Management and conservation of large carnivores in West and Central Africa

To het memory of Jean Paul Kwabong
1952 - April 4th 2007

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Proceedings of an international seminar on the conservation of small and hidden species

CML/CEDC, 15 and 16 November 2006,
Maroua, Cameroon

Editors

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Conservation of large carnivores in West and Central Africa. Proceedings of an International Seminar, CML/CEDC, 15 and 16 November 2006, Maroua, Cameroon

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Editorial note

The conservation of large carnivore populations can only be accomplished successfully if conservationists throughout the continent work closely together and exchange information on all aspects of large carnivore conservation. In order to provide conservationists from West-, Central, Eastern and Southern Africa with exactly such an opportunity, the Institute of Environmental Sciences (CML) of Leiden University in collaboration with the Centre d'Etude de l'Envrionnement et du Développement au Cameroun (CEDC) initiated the organization of a Large Carnivore Seminar in Maroua, Cameroon. The event was organized at the Centre d'Etude de l'Environnement et du Développement au Cameroun (CEDC) under the umbrella of the Regional Network for the Synergy between the CCD and CBD (RNSCC), the Regional Network for Lion Conservation in West and Central Africa (RoCAL) and the African Lion Working Group (ALWG). The CEDC was established as the result of a cooperative agreement between the ex-Ministry of Higher Education, Computer Science and Scientific Research (ex-MESIRES) in Cameroon and the Rector of the University of Leiden in the Netherlands. Financial support for the seminar was received from the Netherlands Committee for IUCN, the Dutch Zoo Conservation Fund, Van Tienhoven Foundation and Prins Bernhard Natuurfonds, a follow-up programme on wild dog conservation is financed by WWF Cameroon and supported by the Painted Dog Conservation Foundation.

Researchers from nine countries (The Netherlands, Benin, Chad, Niger, Equatorial Guinea, Cameroon, Kenya, Zimbabwe and South Africa) were invited to present scientific papers and to discuss various aspects of large carnivore conservation during a 2-day seminar in Maroua. Many participants are members of RoCAL, the network for lion conservation in West en Central Africa. The current proceedings include most contributions.

The subjects addressed during the seminar were diverse, ranging from carnivore-livestock conflicts (considered to be of the highest conservation priority for lions), to large carnivore conservation management and hunting quota. Throughout sub-Saharan Africa, human settlements and associated agriculture and livestock systems are increasingly expanding

into natural savanna regions. Livestock owners may lose part of their stock to carnivores around national parks in the region, although surveys indicate that losses through disease are often more significant. Poaching and poisoning in retaliation to livestock loss has resulted in a significant reduction and fragmentation of large carnivore populations, together with other threats such as a decrease in prey numbers and habitat destruction. The presentations illustrate that large carnivore conservation should not only incorporate aspects of carnivore ecology but should equally involve local communities, especially where improvement of mitigation measures are a necessity to limit livestock predation. In this context, the Lion Conservation Strategy for West and Central Africa was presented to His Excellency, the Governor of the Far North Province in the presence of His Excellency the Ambassador of the Netherlands to Cameroon, and all participants. The aim of the strategy is to assure the sustainable conservation and management of the lion in West and Central Africa. In addition, the Regional Lycaon Initiative for West and Central Africa was launched during this seminar, which aims to establish a regional network focusing on the conservation of the painted dog population in the region.

The editors,

Barbara Croes
Ralph Buij
Hans de Iongh
Hans Bauer

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Welcome speech

Hans de Iongh

His Excellence the Governor of the Northern province,
His Excellence, the Ambassador of The Netherlands in Cameroon,
Mr. Chairman of ROCAL,
Distinguished members of ROCAL,
Distuinguished speakers
Ladies and gentlemen,

It is a great pleasure, on behalf of the director of the Institute of Environmental Sciences of Leiden University, to welcome you at the occasion of the international seminar on Large Carnivores at CEDC in Maroua. This seminar marks a period of about 15 years that the Institute of Environmental Sciences Leiden (CML), jointly with its partner institute the Centre of Environment and Development studies (CEDC) of the University of Dschang, have been involved in research and training on the conservation and management of large carnivores and in West and Central Africa.

This research programme had a main focus on lion conservation and lion-livestock conflicts in the region (partly through the work of dr.Hans Bauer), but also focused attention on interactions with other large carnivores, like hyena and the impact of smaller carnivores on live stock and poultry. Since the signing of a convention between the Minister of Higher Education and Research and the Rector of Leiden university in 1990, the Institute of Environmental Sciences of Leiden university has collaborated with the University of Dschang to develop a joint programme of academic research and education through the CEDC in Maroua. The academic results of this programme are outstanding. Since its establishment this programme has resulted in 12 successful Cameroonian PhD students and some 10 Dutch PhD students, some 250 Dutch Master students and more than 300 UDs Master and B.Sc. students doing research at CEDC on different topics. Some 8 PhD studies are still ongoing. Of these studies, around half has a focus on human-wildlife conflicts. CML also contributed to the development of an environmental science curriculum at UDs. The joint programme has also had a spin off in terms of public services in the region.

CML and CEDC contributed jointly to the establishment of the Regional Network for the Conservation of Lions in West and Central Africa (ROCAL), which has been established in 2001, with financial support of the Netherlands Zoos Nature Conservation Fund and the Van Tienhoven Foundation.

The ROCAL network has been able to translate the results of research on human-lion conflicts into a number of very concrete actions in the field to prevent and mitigate the impact of lion predation on livestock and some of the results of these actions will be presented during the second half of this seminar.

CML and CEDC have also contributed to developing short courses as part of the 'training the trainers programme' for the Garoua Wildlife school, with support of the Netherlands government. In this programme ample attention has been given to large predator conservation and the management of conflicts between large carnivores and livestock. This way, during the past three years, a number of thirty academic trainers have received intensive training, in order to contribute to the curriculum of the Garoua Willdife school.

After the termination of this seminar some of the speakers of this seminar will travel to Garoua to contribute to a one day training course on carnivore conservation and management for students of the Garoua wildlife school.

In addition to specific research and education activities focused on large carnivores our joint programme contributed significantly to the development of other major projects and programmes in the region, such as the Waza Logone project, implemented jointly by the World Conservation Union (IUCN), the Netherlands Development Organisation (SNV) and CML, with financial support (total € 13 mld) from the Netherlands government. CEDC and CML have also obtained a major funding in 2005 for the development of a Regional Network for the Synergy between the CCD and CBD in West and Central Africa from the Netherlands Ministry of Foreign Affairs as part of the so called co-financing programme (total € 2.5 mld). As large predators are at the top of the food chain and thus are indicators of ecosystem health, the results of this seminar will also be highly relevant for this regional network. This programme aims at capacity building and the development of a regional knowledge network.

CML and CEDC intend to contribute with their programmes to sustainable development and environmental conservation in the region of West and Central Africa. The theme of this seminar: 'management and conservation of large carnivores' is an important issue related to the conservation and sustainable use of natural resources in fragile ecosystems such as the dry African savannah belt. It is my sincere wish that this seminar will contribute to developing science-based concepts for improved management and conservation of populations of large carnivores in this region.

I would like to express my special gratitude to the Van Tienhoven Foundation, the Prins Bernhard Natuur Fonds, Dutch Zoo Conservation Fund and the Netherlands Committee for IUCN and the RNSCC network for providing financial support to our joint programme.

I wish you all a very fruitful seminar and a pleasant stay in Maroua.

1 Synthesis of threats, distribution and status of the Lion from the two Lion Conservation Strategies

Hans Bauer

Abstract
In 2005, IUCN and WCS organized a Range Wide Priority Setting exercise for the lion in two workshops which were reported in two lion strategy documents. This paper presents a synthesis of those data, showing a large recent reduction in lion range, with currently between 23.000 and 40.000 lions left of which only 10% in west and Central Africa. There are 86 Lion Conservation Units (LCU); major threats and characteristics for these LCU's are summarized. Most LCU's (52 cases, 73%) have more than half their area under some form of legal protection. Seventeen LCU's are very large areas greater than 50,000 km2 and can be considered strongholds for lions. Indiscriminate killing came out as the most serious threat and presumably most of this killing is retaliatory or pre-emptive killing by pastoralists. Prey depletion is almost equally threatening, followed by small population size and its inherent extinction risks.

Historical distribution and status

Historically, the lion occurred in Africa, Europe, the Middle East and Southwest Asia, in all habitats except very dry deserts and very moist forests. 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).

In West and Central Africa, lions occurred throughout the region, except for the Sahara in the North, the West African coastal rainforest zone and the Congo Basin rainforest zone with a westward extension into southern Nigeria (figure 1.1; based on Nowell & Jackson, 1996). This historical range was confirmed by participants of the Technical Sessions of the regional lion workshops, with one small modification: lions appear to penetrate deeper into the Congo-basin forest than previously assumed.

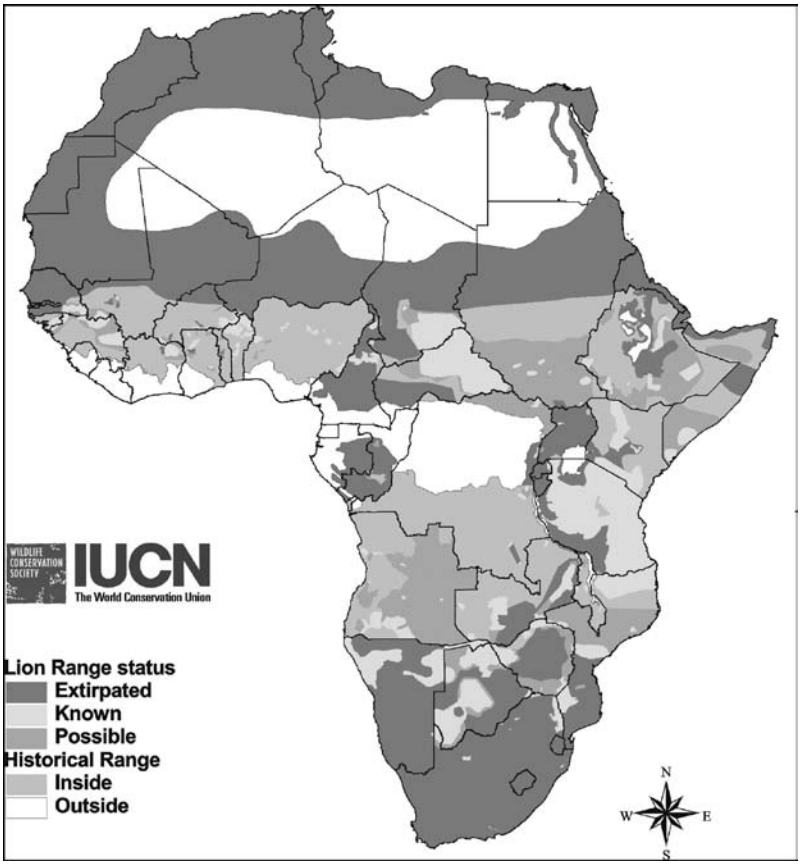

Figure 1.1 Historical and Current Lion Distribution in Africa Source: Hunter et al. (in prep.)

Lions are difficult to count, and any population estimate is essentially imprecise. There is no estimate for lion numbers before 1950, but three sources can be cited for estimates in the recent past:

- Myers (1975) wrote 'Since 1950, their numbers may well have been cut in half, perhaps to as low as 200,000 in all or even less.'
- In the early 1990s, IUCN/SSC Cat Specialist Group members made educated 'guesstimates' of 30,000 to 100,000 for the African lion population (Nowell & Jackson, 1996).
- Ferreras and Cousins (1996) developed a GIS-based model to predict African lion range and numbers; because of the age of their data sources on extent of agriculture and pastoralism they selected 1980 as the base year for their predicted African lion population of 75,800.

Current distribution and status

Three sources are important in describing current distribution: Chardonnet (2002), Bauer & Van Der Merwe (2004) (published in 2004 but data gathered and pre-published in 2002) and the outcome of the Technical Session that was part of the strategy definition workshop (Hunter *et al.*, in prep.). A detailed comparative analysis of the former two publications was prepared by their authors as part of the present strategy definition process (Bauer *et al.*, 2005a, b).

For current lion range, the best available source is undoubtedly the forthcoming report of the Technical Sessions of the regional lion workshops (Hunter *et al.*, in prep.). The report is currently being finalized and may be regularly updated, but we already present some pertinent results here. Figure 1.1 presents a lion range map including all lion populations identified by the other two publications. Table 1.2 compares the extent of historical range with current range. It shows that lions are definitely extant in only 22% of historical range, with a further 38% of historical range unknown.

Table 1.1 Lion Range Categories

Category		Definition
Area of known distribution	Known Range	Known range: areas where it is certain that lions are present Occasional range: areas where lions are present sporadically or are transient
	Probable Range	Areas within the historical range where conditions for lion presence are favorable (habitat, prey, human population density) and where there are no data to indicate that the lions do not exist there
Extirpated		Lions are known not to be present
Survey Areas		Areas which have the potential to contain lions and should be surveyed for their presence
Unknown		Areas within the historical range of the lion unknown to contributing experts

The participants in the technical session identified three categories of factors that limit current lion range, listed here in decreasing order of importance. The first category is a set of factors that can be attributed to human pressure: human density, livestock density, illegal lion killing and insufficient prey were most often indicated as limiting lion range. The second category consists of 'limiting factors not known' and, for

East and Southern Africa exclusively, Problem Animal Control (PAC) and fences. Finally, the category of physical barriers such as habitat transition, water, elevation and other physical barriers, was mentioned as limiting only a small part of lion range.

Table 1.2 Historical and Current Lion Range (known + probable)

	Historical range	Current range (% of historical range)	Unknown range (% of historical range)
West & Central Africa	7,206,817	1,047,231 (15%)	0
East & Southern Africa	13,010,000	3,564,000 (23%)	7,600,000 (58%)
Africa	20,216,817	4,611,231 (22%)	7,600,000 (38%)

For current lion numbers, there is no 'best' source. The RWPS exercise is the most recent, but only provides data for Lion Conservation Units (see next section), not the whole of the lion range. In addition, it gives size classes instead of specific figures for most areas (table 1.5). Still, we can calculate an indicative figure, which yields a total estimate of 32,140 lions with 10% in West and Central Africa and 90% in East and Southern Africa.

The other two sources adopted similar methods in estimating lion numbers: querying resource persons and literature for available knowledge on lion numbers and distribution. The comparative analysis (Bauer *et al.*, 2005a, b) describes in detail that Bauer & Van Der Merwe (2004) obtained a larger proportion of their estimates with more accurate methods, but spatially limited to areas for which information was available, primarily protected areas. Chardonnet (2002) in contrast, had more sources and larger geographical coverage and included some extrapolation or speculation about data deficient areas, which partly explains the difference in figures. Table 1.3 presents the figures giving only the estimates; the sources have different methods of calculating minimum and maximum figures and these intervals are therefore not presented here.

The figures are skewed by the differential treatment of three areas in Tanzania. Bauer & Van Der Merwe (2004) cautioned that the Ruaha and Tarangire ecosystems not assessed by them contain substantial numbers of lions; adding Chardonnet's (2002) figures would bring their estimates to 16,000 for East Africa and to 28,000 for the whole of Africa. In addition, Chardonnet (2002) puts 4,400 lions for the Selous ecosystem in Southern Africa, following ecological borders, but if we define

Table 1.3 Lion population estimates in 2002 by region.

Region	Bauer & Van der Merwe, 2004	Chardonnet, 2002	Ratio of divergence	Corrected ratio of divergence (see text below)
West Africa	850	1 163	X 1,4	X 1,4
Central Africa	950	2 815	X 3	X 3
East Africa	11 000	15 744	X 1,4	X 1,3
Southern Africa	10 000	19 651	X 2	X 1,5
Total	23 000	39 373	X 1,7	X 1,4

regions using national borders they would be in East Africa. Correcting for these three methodological differences only would already reduce the divergence ratios to 1,3 for East Africa, 1,5 for Southern Africa and 1,4 for entire Africa.

Table 1.3 shows that Central Africa is the region with most divergence in figures; it is probably the region for which information is least available and accurate. However, the greatest impact of data paucity on numbers and range is expected in East Africa.

It is noteworthy that while the overall trend is downwards, there have been pockets of natural recolonisation (e.g. Haut Niger area in Guinea) or areas identified as potential recovery areas.

Censusing lions in a particular area is time consuming, labour-intensive, requires specific training, and is therefore expensive. While such survey data should be generated in the future for specific areas of interest, we currently have to rely on various different methods of estimating lion numbers for most range locations. The current level of knowledge of lion status in Eastern and Southern Africa is unprecedented, however, with two independent inventories in 2002 (Chardonnet, 2002; Bauer & Van Der Merwe, 2004), a consensual review of both by their authors (Bauer *et al.*, 2005), and a consensus on current range in 2005 as a result of the technical session of the regional lion workshop (this strategy and Hunter *et al.*, in prep.). Divergence in figures in Tables 1.3 and 1.4 has partly been explained by methodological differences; the authors agreed to disagree on the rest and agreed that both could be shown inaccurate in future.

However, the divergence cannot obscure the convergence in showing similar trends for both regions: considerable reduction in both range

and numbers of lions. The extent of decline in numbers cannot be assessed from a comparison of historical and current information because of major methodological differences. The IUCN Red List classification (IUCN SSC Cat SG, 2004) speculatively proposes a suspected continental decline of 30-50% over two decades; this proposition has not been widely contested and is not contradicted by the present data. Based on this assessment, the lion is classified as Vulnerable on the IUCN Red List. If applied at regional level it qualifies as Regionally Vulnerable in each of the regions except West Africa, where it qualifies as Regionally Endangered (Bauer & Nowell, 2004).

This strategy therefore acknowledges the need for more accurate data, but also states that this may not be a reason to postpone conservation action and postulates that such actions are justified and can be planned and implemented based on the current state of knowledge.

Lion population viability

This section describes the outcome of the technical sessions of the workshops, based on a process that WCS developed and termed Range-Wide Priority Setting (Sanderson *et al.*, 2002). The process identifies ecological units of importance for species conservation (Conservation Units) and aids in priority setting by assessing threats to these areas from a biological perspective. During the strategic planning session the presentation of Lion Conservation Units was welcomed as guidance for delineation of important and viable lion populations, but having no legal basis the term LCU was not adopted by the Lion Conservation Strategy and appears in this section for informational purposes only.

Lion experts participating in the technical sessions identified 20 LCUs in West and Central Africa and 66 LCUs in East and Southern Africa, a total of 86 (figure 1.2). An LCU is defined as an area of known, occasional and/or probable lion range that can be considered an ecological unit of importance for lion conservation. LCU's are not restricted to or required to contain protected areas and were defined analogous to Jaguar Conservation Units (Sanderson *et al.*, 2002). For each LCU, these experts assessed viability, limiting factors and threats; results were helpful for strategy definition because they offer insight into problems and opportunities. Some of the results are presented here, but the complete and final report is currently being prepared by Hunter *et al.* (in prep.).

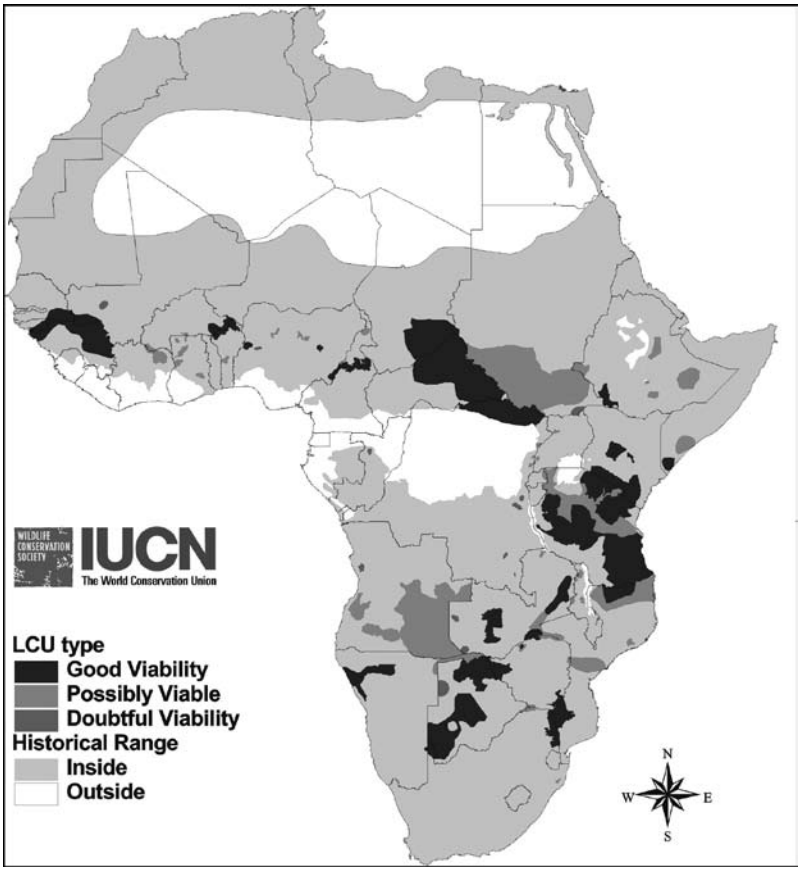

Figure 1.2 Lion Conservation Units in Africa Source: Hunter et al. (in prep.)

LCU's were categorized as viable (class I, 23 cases), potentially viable (class II, 46 cases), or significant but of doubtful viability (class III, 17 cases), based on population size, prey base, level of threats and habitat quality (table 1.5). Note that this is conceptually different from the categories 'small' (<50), 'medium' (>50 and <500) and 'large' (>500) which are introduced in Table 6 for the assessment of threats inherent to small population size (thresholds based on a well known rule of thumb in genetic literature). LCU's were characterized as indicated in table 1.5. Population trends in these LCU's were mostly considered decreasing (36 cases, 42%) or stable (26 cases; 30%), but increasing in 8 cases (9%) and with unknown trend in another 16 cases (19%). Most LCU's (61 cases, 71%) have more than half their area under some form of legal protection. At least 17 LCU's are very large areas greater than 50,000 km^2 and can be considered strongholds for lions.

Table 1.4 LCU classes

LCU	Definition
I	Important ecological unit containing a *viable* lion population
II	Important ecological unit containing *potentially viable* lion population
III	Important ecological unit containing a significant lion population of *doubtful viability*

Experts were asked to assess the most important threats to LCU's; the results are shown in Table 6. For each LCU, experts were also asked to rank these threats by giving at least a 'top 3' (ranks given in superscript in table 1.6; read horizontally). By scoring every threat for the number of times it ranked first (3 points), second (2 points) or third (1 point), we compared threats (table 1.6, read vertically). Indiscriminate killing came out as the most serious threat; presumably most of this killing is retaliatory or pre-emptive killing by pastoralists. Prey depletion is almost equally threatening and well known from extensive literature on bushmeat. These threats are followed by small population size and its inherent extinction risks. These threats are interrelated with habitat and livestock encroachment which were ranked next, before resource extraction, trophy hunting, PAC and disease.

Table 1.5 Characteristics of Lion Conservation Units in Africa (alphabetical order)

Lion Conservation Unit	Area (x 1000 km²)	LCU Type	Percentage Gazetted*	Estimated lion population size	Pop. trend
Albertine North (31)	2.0	II	>50	<50	↓
Albertine South (30)	3.2	II	>50	100-250	↓
Arboweerow-Alafuuto (37)	24.75	II	0	100-250	↓
Awash (28)	15.16	II	25-50	<50	↓
Bale (26)	1.09	II	<50	<50	→
Benoue-Gashaka-Gumti complex (8)	>50	I	>50	200-300	↓
Boma-Gambella (23)	107.1	II	n/a	250-500	?
Boucle Baoule (2)	<25	III	>50	30-50	↓
Bui-White Volta Ecosystem (7)	<25	II	>50	10-20	↓
Bush-Bush (38)	12.4	I	n/a	500-1000	?
Chad-RCA (19)	>50	I	>50	1500	→
Comoe-Leraba (3)	<50	II	>50	< 50	↓
Dar-Biharamulo (71)	164.98	II	<25	900	↓
Digya (10)	<25	II	100	< 50	↓
Etosha-Kunene (64)	55.7	I	>50	315-595	↑
Garamba-Bili Uere (21)	131.64	I	>50	100-250	→

Lion Conservation Unit	Area (x 1000 km²)	LCU Type	Percentage Gazetted*	Estimated lion population size	Pop. trend
Gbele Ecosystem (4)	<25	II	>50	< 50	↓
Gile (62)	2.85	II	>50	<50	?
Gorongosa/Marromeu (63)	42.09	II	>50	100-250	↑
Greater Limpopo (69)	60.99	I	>50	>2000	↑
Greater Niassa (46)	86.47	II	<25	100-250	↓
Hluhluwe-Umfolozi (70)	0.91	II	>50	80	→
Itombwe Massif savanna (41)	2.17	III	<25	<50	↓
Kafue (56)	3.18	I	>50	250-500	→
Kainji Lake (12)	<25	II	100	50	→
Kamuku/Kwiambana (14)	<25	II	100	25-35	↓
Kgalagadi (68)	146.96	I	>50	500-1000	→
Khaudum-Caprivi (65)	24.7	II	25-50	100-200	→
Kidepo Valley-Sudan (24)	7.16	III	>50	<50	↓
Kidepo Valley-Uganda (34)	0.36	II	100	<35	↓
Kundelungu (48)	0.41	III	>50	<50	↓
Laikipia-Samburu (35)	21.89	I	<25	350	→
Lame-Burra/Falgore (15)	<25	II	100	25-35	↓
Liuwa Plains (57)	17.04	III	>50	<50	?
Luama Hunting Reserve (42)	3.34	III	25-50	<50	↓
Maasai Steppe (40)	144.69	I	25-50	>1000	↓
Matusadona (59)	1.43	I	>50	50-100	→
Meru (36)	2.46	I	>50	100-250	→
Mid-Zambezi (54)	20.03	I	>50	250-500	→
Mole (6)	<25	II	>50	< 50	↓
Mt Kouffe/Wari Maro (11)	<25	II	100	< 50	↑
Murchison Falls North (32)	0.57	II	100	100	→
Murchison Falls South (33)	0.89	II	100	<30	↓
MZ South of Labannakass (55)	12.4	II	25-50	50-100	→
Nazinga-Sissili (5)	<25	II	>50	< 50	↑
Niassa Reserve (45)	41.59	I	100	800-900	↑
Niokiolo-Guinee (1)	>50	I	n/a	500-1000	↑
North Luangwa (51)	15.02	I	>50	100-250	→
Nyika (50)	13.42	III	>50	20-30	?
Odzala (20)	<25	III	>50	< 50	↓
Ogaden (29)	35.37	II	<25	50-100	↓
Okavango-Hwange (66)	95.17	I	>50	2300	→
Old Oyo (13)	<25	III	100	< 5	↓
Omay (60)	2.04	II	<25	<50	↓
Oti-Mandouri (8)	<25	III	100	< 50	↓
Petauke Corridor (53)	4.56	III	>50	<50	→
Ruaha-Rungwa (43)	185.54	I	>50	4500	→

Lion Conservation Unit	Area (x 1000 km²)	LCU Type	Percentage Gazetted*	Estimated lion population size	Pop. trend
Selous (44)	190.38	I	>50	5500	→
Serengeti Mara (39)	57.8	I	>50	3500	↑
Shashe-Limpopo (61)	6.46	II	<25	50-100	→
Sioma Ngwezi (58)	0.22	III	>50	<50	?
South Luangwa (52)	1.92	I	>50	250-500	→
South Omo (25)	19.31	I	<25	100-250	↓
Southwestern Sudan (22)	358.15	II	>50	250-500	?
Sumbu (49)	43.77	II	>50	<50	?
Upemba (47)	1.43	III	>50	<50	↓
W-Arly-Pendjari complex (9)	>50	I	100	Disagreement: 250-500 or 100-250	→
Waza (17)	<25	II	100	60	→
Welmel-Genale (27)	6.8	II	<25	50-100	→
Xaixai (67)	13.07	III	>50	50-100	→
Yankari (16)	<25	II	100	50	→
Alto Zambeze ()	Xx	II	0	50-100	?
Bicuar ()	Xx	II	75%	20-40	?
Bocoio-Camucuio	Xx	II	1%	40-70	?
Cameia Lucusse ()	Xx	II	40%	70-130	?
Cuando Cubango ()	Xx	II	<25	750-1400	?
Kasungu ()	xx	II	100	<10	↓
Kissama-Mumbondo ()	Xx	III	<25	<10	?
Liwonde ()	xx	II	100	<10	↓
Luchazes ()	Xx	II	2%	400-700	?
Mangochi()	Xx	III	100	<10	↓
Mupa Cubati ()	Xx	II	>50	50-100	?
Namizimu ()	Xx	III	100	<10	↓
Nkotakota ()	xx	II	100	<10	↓
Nyika – MW ()	Xx	II	100	<10	↓
Vwaza ()	Xx	II	100	<10	↓

*Refers to some form of legal protection, ranging from national park to hunting concession to community conservation area

Trophy hunting is currently practiced in three class I LCU's in West and Central Africa; in East and Southern Africa it is practiced in 15 class I LCU's, 7 class II LCU's and in 3 class III LCU's (and no information for 3 LCU's). Trophy hunting, as it is currently carried out, was considered to have an adverse impact on lion populations in several LCU's. This Strategy emphasizes that lion trophy hunting is an important management tool that can provide benefits to local people and revenues to government conservation authorities, but stipulates that best practices should be implemented in the industry to ensure sustainability.

Table 1.6 Assessment and ranking of threats for LCU's.

Lion Conservation Unit (LCU), alphabetical order	LCU Type	Popula-tion size*	Disease	Indiscrimi-nate killing of lions	PAC	Trophy hunting	Prey deple-tion**	Livestock encroach-ment	Habitat en-croach-ment	Resource extraction
Benoue complex- Gashaka-Gumti	I	Medium	Unknown	Lots[1]	None	Some	Lots[2]	Some[3]	Some	Some
Boucle Baoule	III	Small	Unknown	Some	None	None	Lots	Some	Lots	Some
Bui-White Volta Ecosystem	II	Small[3]	Some	Some	None	None	Lots[2]	Some	Some[4]	Some[1]
Chad-RCA	I	Large	None	Lots (CAR) [1], Some (Chad)	None	Some	Lots (CAR) [2], Lots (Chad)	Some (CAR), Lots (Chad) [1]	None (CAR), Some (Chad) [2]	Some
Comoe-Leraba	II	Small[2]	None	Some[3]	None	None	Lots[1]	None	None	None
Digya	II	Small[3]	None	Some	None	None	Lots[1]	Some	Some[4]	Some[2]
Gbele Ecosystem	II	Small[1]	None	None	None	None	Lots[2]	Some[4]	Some[3]	Some[5]
Kainji Lake	II	Medium[3]	None	None	None	None	Some[2]	Some[1]	None	None
Kamuku/Kwiambana	II	Small[6]	Some[4]	Some[3]	None	None	Lots[1]	Some[2]	Some	Some[5]
Lame-Burra/Falgore	II	Small[6]	Some[3]	Some[4]	None	None	Lots[1]	Some[2]	Some	Some[5]
Mole	II	Small[2]	Some	Some[1]	None	None	Lots[3]	Some[4]	Some[6]	Some[5]
Mt Kouffe/Wari Maro	II	Small[x]	Unknown	Some[x]	None	None	Lots[x]	Lots[x]	Lots[x]	Lots[x]
Nazinga-Sissili	II	Small[1]	Some[3]	None	None	None	Lots[2]	Some[3]	Some[1]	Some[2]
Niokiolo-Guinee	I	Large	Unknown	Some	None	None	Lots[2]	Lots[3]	Lots[1]	Some
Odzala	III	Small[1]	None	Some	None	None	Some	None	None[2]	None
Old Oyo	III	Small[1]	None	Some[3]	None	None	Some[4]	Lots[2]	Some	Some
Oti-Mandouri	III	Small[x]	Unknown	Lots[x]	Some	None	Lots[x]	Lots[x]	Some[x]	Some
W-Arly-Pendjari	I	Medium[x]	Unknown[x]	Some[x]	Some	Some[x]	Some[x]	Some[x]	None	Some
Waza	II	Medium[2]	Some	Some[1]	None	None	Lots	Some[3]	None	Some
Yankari	II	Medium[3]	None	Some[4]	None	None	Some[2]	Some[1]	None	None

Lion Conservation Unit (LCU), alphabetical order	LCU Type	Popula-tion size*	Disease	Indiscrimi-nate killing of lions	PAC	Trophy hunting	Prey deple-tion**	Livestock encroach-ment	Habitat en-croach-ment	Resource extraction
Albertine North (11)	II	Small	None	None[2]	None	None	Medium[3]	None	Some[1]	None
Albertine South (10)	II	Medium[2]	Some[3]	Lots[1]	None	None	Some[1]	Some[4]	Some[2]	Some[4]
Arboweerow-Alafuuto (17)	II	Medium		Lots[1]	None	None	High	Lots[1]	Lots[1]	Lots
Awash (8)	II	Small[3]	None	Some[2]	None	Some[6]	Medium[1]	Lots[5]	Lots[4]	Some
Bale (6)	II	Small[1]	None	Some[3]	None	None	Medium[2]	None	Some[4]	Lots
Boma-Gambella (3)	II	Medium[4]	None	Some[3]	None	None	Unknown[1]	Some[2]	Some[5]	
Bush-Bush (18)	I	Large	Some[2]	Some[1]		None	High	Some[1]	Some	Some[2]
Dar-Biharamulo (51)	II	Large	Some[5]	Lots[1]	Some	None	Low[2]	Lots	Lots[4]	Lots[3]
Etosha-Kunene (44)	I	Large	Some	Some[1]	Some[1]	Some	High[3]	Some[2]	Some	None
Garamba-Bili Uere Complex (1)	I	Medium	None	None[2]	None	None	High[3]	None	Some[1]	None
Gile (42)	II	Small[3]	Some	Some[2]	None	None	Medium[1]	None	None	Some
Gorongosa/Marromeu (43)	II	Medium	None	Some[1]	Some	Some	Low[2]	Some	Some	Some
Greater Limpopo (49)	I	Large	Some[3]	Some[1]	Some	Some	High	Some[2]	Some[4]	None
Greater Niassa (26)	II	Medium	None	Some[1]	None	Some[3]	Medium[2]	None	Some	None
Hluhluwe-Umfolozi (50)	II	Medium[x]	Some	None	Some	None	High	None	None	Some
Itombwe Massif savanna (21)	III	Small[1]	None	None	None	Some[2]	Medium	None	Lots	None
Kafue (36)	I	Medium	None	Some[2]	None	Lots[4]	High[3]	None	Some[1]	None
Kgalagadi (48)	I	Large	None	Some[1]	Some[3]	Some	Medium	Some[2]	None	Some
Khaudum-Caprivi (45)	II	Medium	None	Some[3]	Some[3]	None	Medium[1]	Some[2]	Some	Some[4]
Kidepo Valley-Sudan (4)	III	Small[3]		Some[2]	None	None	Medium[1]	Some	Some	Some[4]
Kidepo Valley-Uganda (14)	II	Small[1]	Lots[3]	None	None	None	Medium[2]	Some[6]	Some[4]	Lots[5]
Kundelungu (28)	III	Small	None	None[2]	None	None	Medium[3]	None	Some[1]	None
Laikipia-Samburu (15)	I	Medium	None	Lots[1]	Lots[3]	None	Medium[4]	Lots[2]	Some	None

Lion Conservation Unit (LCU), alphabetical order	LCU Type	Popula-tion size*	Disease	Indiscrimi-nate killing of lions	PAC	Trophy hunting	Prey deple-tion**	Livestock encroach-ment	Habitat en-croach-ment	Resource extraction
Liuwa Plains (37)	III	Small[1]		Lots[2]	Some[2]	Some[2]	Medium[3]	Some	Some	None
Luama Hunting Reserve (22)	III	Small[1]	None	None	None	Some[2]	Medium	None	Some[1]	None
Maasai Steppe (20)	I	Large	None	Some[1]	Some	Some[5]	Medium[2]	Lots[3]	Some[4]	Some
Matusadona (39)	I	Medium[1]	None	None	None[2]	Some[2]	Low	None	None	None
Meru (16)	I	Medium[4]	None	Some[1]	Some	None	Medium[3]	Some[2]	Some	None
Mid-Zambezi (34)	I	Medium	None	None	Some	Lots[2]	High	None	None	None
MZ South of Labannakass (35)	II	Medium[1]	None	Some[5]	Some[5]	Some[1]	Medium	Some[3]	Some[3]	None
Murchison Falls North (12)	II	Medium[6]	Some[5]	Some[3]	Some[4]	None	High[3]	None	Some[2]	Some[4]
Murchison Falls South (13)	II	Small[1]	Some[3]	Some	Some	None	Medium[2]	None	Lots[2]	Some[4]
Niassa Reserve (25)	I	Large	None	Some[1]	None	Some[3]	Medium[2]	None	Some	None
North Luangwa (31)	I	Medium	None	None	None	Lots[1]	High[2]	None	Some[3]	None
Nyika – ZM (30)	III	Small[1]							Some[2]	
Ogaden (9)	II	Medium[5]	None	Some[2]	None	None	Medium[1]	Lots[3]	Some[4]	
Okavango-Hwange (46)	I	Large	None	Some[1]	Some[3]	Some	High	None[2]	None	Some
Omay (40)	II	Small[3]	None	Some[2]	Lots[1]	Lots[1]	Medium[2]	Some[2]	Some[2]	
Petauke Corridor (33)	III	Small	None	None	None	Some[2]	Medium[1]	None	Some	None
Ruaha-Rungwa (23)	I	Large	Some[4]	Some[1]	Some	Lots[3]	High[2]	Some[5]	Some	None
Selous (24)	I	Large	Some[3]	None[2]	Some	Some[4]	High[1]	None	None	None
Serengeti Mara (19)	I	Large[6***]	Some[2]	Some[4]	None	Some[7]	High[1]	Some[5]	None[3]	None
Shashe-Limpopo (41)	II	Medium[1]		Some[2]	Some[4]	Some[4]	Medium	Some[3]	Some	None
Sioma Ngwezi (38)	III	Small[2]					Unknown[3]		Lots[1]	
South Luangwa (32)	I	Medium	None	Some	Some	Lots[1]	High[3]	None	Some[2]	None
South Omo (5)	I	Medium	None	Some[1]	None	Some[4]	Medium[2]	Some	Some[3]	None
Southwestern Sudan (2)	II	Medium[4]	None	Some[2]	None	None	High[1]	Some[5]	Lots[3]	Lots

Lion Conservation Unit (LCU), alphabetical order	LCU Type	Popula-tion size*	Disease	Indiscrimi-nate killing of lions	PAC	Trophy hunting	Prey deple-tion**	Livestock encroach-ment	Habitat en-croach-ment	Resource extraction
Sumbu (29)	II	Small[2]								Lots[1]
Upemba (27)	III	Small	None	None[2]	None	None	Medium[3]	None	Some[1]	None
Welmel-Genale (7)	II	Medium	None	Some[2]	None	None	Medium[1]	Some[3]	Some	None
Xaixai (47)	III	Medium[3]	Some	Some[1]	Some[2]	Some	Medium	Some	None	Some
Alto Zambeze ()	II	Medium[3]		Some[1]	None	None	Unknown[2]		Some	Some[4]
Bicuar ()	II	Small[2]		Some[1]	None	None	Unknown[3]	Some[4]	Some[5]	Some
Bocoio-Camucuio	II	Small[3]		Some[1]	None	None	Unknown[2]	Some[4]	Some[5]	Some[6]
Cameia Lucusse ()	II	Medium[3]		Some[1]	None	None	Unknown[2]		Some	
Cuando Cubango ()	II	Large		Some[1]	None	None	Unknown[2]		Some	
Kasungu ()	II	Small[3]		Lots[5]		None	Medium[4]	None	Lots[1]	Lots[2]
Kissama-Mumbondo ()	III	Small[1]		Some[2]	None	None	Unknown[3]		Some[4]	Some
Liwonde ()	II	Small[3]		Lots[5]		None	Medium[4]	None	Lots[1]	Lots[2]
Luchazes ()	II	Large		Some[1]	None	None			Some	Some
Mangochi()	III	Small[3]		Lots[5]		None	Medium[4]	None	Lots[1]	Lots[2]
Mupa Cubati ()	II	Medium		Some[1]	None	None	Unknown[2]	Some[3]	Some[4]	Some[5]
Namizimu ()	III	Small[3]		Lots[5]			Medium[4]	None	Lots[1]	Lots[2]
Nkotakota ()	II	Small[3]		Lots[5]	None	None	Medium[4]	None	Lots[1]	Lots[2]
Nyika – MW ()	II	Small[3]		Lots[5]		None	Medium[4]	None	Lots[1]	Lots[2]
Vwaza ()	II	Small[3]		Lots[5]		None	Medium[4]	None	Lots[1]	Lots[2]
Threat ranking points*		95	11	146	16	25	126	50	64	41

x Numbers in superscript indicate the rank of this threat compared to the others, x indicates ex-equo ranking.
*See text for more explanation
**Threat ranking is for human hunting of lion prey
***This threat ranking refers only to Ngorongoro Crater, a small part of the LCU

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2 Livestock-carnivore conflicts: results of an inventory around Bénoué National Park, Cameroon

Barbara Croes, Ralph Buij, Jasper van Dalen & Hans de Iongh

Abstract

The proximity of lion home ranges to populated areas along the borders of the Bénoué National Park, illustrated recently by GPS data of two of four GPS_GSM collared lions, suggests that occasional livestock predation by lions is likely. To investigate the status of the carnivore-livestock problem around the Park, structured interviews were conducted of 109 household heads in 19 villages along the western border of the park. These revealed that livestock depredation is a relatively unimportant cause of livestock loss, especially compared to disease. Carnivores were generally perceived as relatively low-nuisance wildlife when compared to olive baboon, patas monkey and elephant. Most carnivore attacks on livestock took place during the wet season, mainly by smaller carnivores, particularly 'wild cats', and to a lesser extent by spotted hyena. The wild cat group probably includes genuine African wild cats and African civet, but may be dominated by feral housecats. These small carnivores most frequently target poultry. Spotted hyenas cause significantly less financial damage than wild cats through predation of goats, sheep and chickens usually by entering enclosures; however, spotted hyenas were perceived equally damaging as wild cats. Larger carnivores, such as lion and leopard, rarely take cattle and small ruminants, lions mostly during the dry season when livestock grazes away from villages without protection. However it should be mentioned that only resident farmers were interviewed, work with nomadic herdsmen is stille ongoing. Despite the small financial impact of livestock losses through carnivores, poaching and poisoning to deliberately kill carnivores were mentioned on several occasions, and probably occurs on a more regular basis. An observed decrease of lion, leopard, wild dog and spotted hyena by locals in the area over the past decade is a likely result of such practices.

Introduction

In sub-Saharan Africa, loss of natural habitat and associated declines in herbivore populations have resulted in a significant reduction and fragmentation of large carnivore populations (Nowell & Jackson 1996; Fanshawe *et al.* 1997; Mills & Hofer 1998). The increased frequency of conflicts between large carnivores and a growing human population over loss of livestock through depredation (Treves & Karanth 2003), often leading to poaching of carnivores (Woodroffe & Ginsberg 1998), has further impacted carnivore numbers. As a result, many carnivores have become locally extinct (Nowell & Jackson 1996; Woodroffe & Ginsberg 1998; Woodroffe 2001; Di Silvestre 2002). In the West African region, Cameroon still supports an important large carnivore community (Nowell & Jackson 1996; Fanshawe *et al.* 1997; Mills and Hofer 1998), although scarce population survey data reveal that carnivore numbers have declined drastically (Bauer & Van der Merwe 2004). In the Extreme North Province of Cameroon, livestock predation by lions and other large carnivores is a particularly well-described phenomenon around the Waza National Park (De Iongh *et al.* 2005). Livestock owners in this area loose a significant percentage of stock to carnivores on an annual basis and retaliate by killing carnivores (de Iongh *et al.* 2005). Knowledge on the occurrence of such conflicts may help conservation action through adoption of mitigation measures (Nowell & Jackson 1996; Fanshawe *et al.* 1997; Mills & Hofer 1998, Bauer *et al.* 2003), eventually reducing retaliatory killing of carnivores.

In contrast to Waza, detailed knowledge on the status of carnivore-human conflicts around the Faro, Bouba-Ndjidda and Bénoué National Park (BNP) complex in the North Province is lacking, although this complex supports the largest contiguous habitat for large carnivores in Cameroon and is therefore of great importance to carnivore conservation (Mayaka 2002). Recently acquired data from three GPS/GSM collared lions in the Benoue N.P. in the North Province do show, however, that populated areas around the Park are visited by lions (De Iongh *et al.*, in prep.), indicating a potential for human-lion conflicts. The aim of this study is to investigate the status of conflicts between resident communities west of Benoue N.P., and carnivores. Major objectives are to assess the frequency of carnivore attacks on livestock and economic losses in the area, especially in comparison to losses through disease and theft; the carnivore species responsible for attacks; the timing and seasonality of attacks; and finally, measures taken by villagers to prevent livestock predation.

Study area

The Benoue N.P. (1,800 km²) is part of a larger ecosystem (23,500 km²) comprising three national parks, 28 hunting zones as well as pastoral areas. Lion numbers are estimated at 200 for the entire ecosystem (Bauer & Van der Merwe 2004), while spotted hyena and leopard occur in unknown numbers. Wild dog and cheetah are rare or extinct in a large part of their former range. The present study focuses on communities living near the western border of the park, between the villages of Guidjiba in the north and Koti Manga in the south, along a 50 km stretch of road bordering either the park or a hunting zone, or both (figure 2.1). The total human population size in this region is estimated at approximately 6000. Protection from carnivore attacks in these villages is through thatch or otherwise fenced enclosures for goats and sheep (figure 2.2), or simpler structures to protect poultry (figure 2.3).

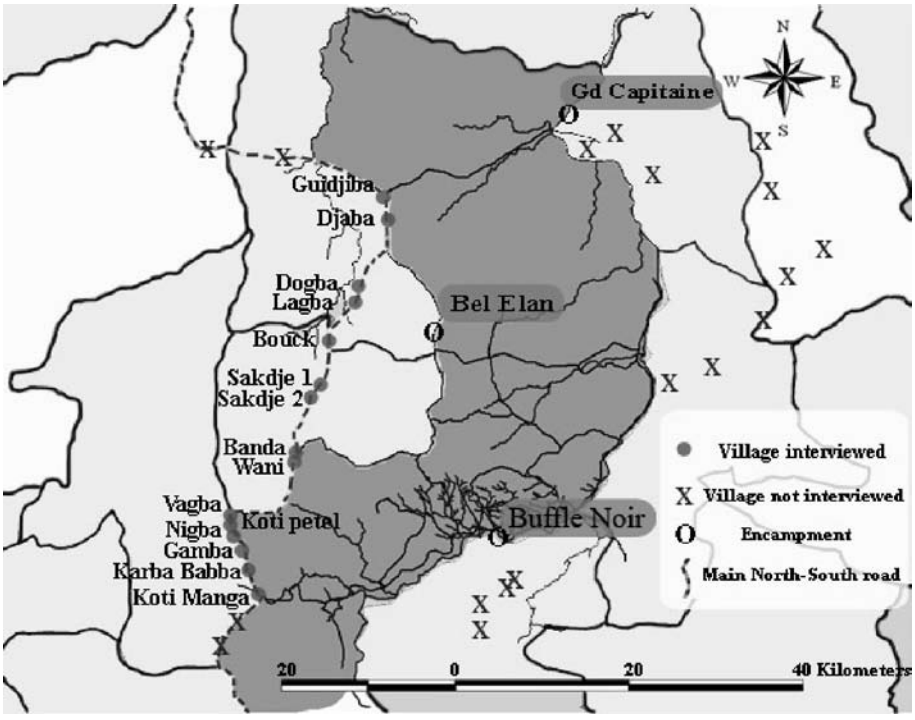

Figure 2.1 The study area includes villages west of BNP and surrounding hunting zones

Figure 2.2 Goats and sheep are often kept inside enclosures such as this one

Methods

Interviews with villagers were conducted between 15 August and 5 October 2006. In total, 109 family heads were interviewed in 19 villages west of the Park. Livestock owned by the interviewed included cattle (total of 84 for 109 family heads at the time of the interviews), sheep (52/109), goats (365/109), chickens (684/109) and unknown numbers of dogs, and ducks, although we shall not consider the latter two here. To acquire a representative sample of people in the area, population numbers for each village were obtained prior to the study and the number of interviews in each village was held directly proportional to the total number of its residents. The village chief was always first approached for permission to interview his villagers, after which the research team randomly assigned family heads for interviewing. To determine people's

Figure 2.3 A characteristic construction to protect poultry at night. A stone is put in front of the entrance to keep chickens inside

knowledge of carnivores, people were first asked to identify 10 carnivore species occurring in the area on the basis of pictures and to provide basic knowledge on their behaviour and ecology. Only information provided on identified carnivore species was included in the analyses. The number of livestock lost by the interviewed person was determined between 2004 and 2006, as people accounts before this period were not expected to be sufficiently accurate. General information was gathered on attacks beyond this period, including the season, timing, and location of attacks; and what measures were taken to avoid livestock losses.

Results

All 109 family heads were asked to provide the number of livestock and poultry lost to specific carnivore species between 2004 and 2006 (table 2.1), and to describe evidence that identified the carnivore. Lion and leopard killed a negligible number of livestock, while spotted hyenas took on average approximately nine goats and three sheep per year. Golden jackal and African civet took a limited number of poultry, in particular when compared to the 'wild cat' group. This mixed group of domestic cats, wild cats, and their hybrids takes a relatively large number of chickens. Wild dog, cheetah, and caracal were not identified as livestock raiders during the three year period.

Table 2.1 Number of livestock lost to carnivores between 2004-2006 west of Bénoué National Park (109 family heads)

Carnivore	Cattle (N)	Sheep (N)	Goat (N)	Chicken (N)
Lion	1	1	0	0
Leopard	0	0	0	2
Spotted hyena	0	8	28	8
'Wild cat'	0	0	0	1717
Jackal	0	0	0	1
Civet	0	0	0	13
Total	**1**	**9**	**28**	**1741**

To assess how and when carnivores attacked, people were asked to specify accounts of attacks from their own life experience, either through first hand encounters or information received from other villagers. Results indicate that wild cat and spotted hyena most often enter

enclosures to capture livestock, either through an existing small hole in an enclosure (wild cat) or by forcing their way through a – often thatch -enclosure (spotted hyena). Lion, and to a lesser extent leopard, usually catch livestock walking around outside the village where protection is absent (figure 2.4). People indicate that this is often the case at the end of the dry season when cattle, goats and sheep are allowed to wander off into the bush in search for water and forage. Lions indeed attack livestock more frequently during the dry season. In comparison, spotted hyenas and the small carnivores show a significant preference for wet season predation (Pearson Chi-square test, $p < 0.05$; figure 2.5).

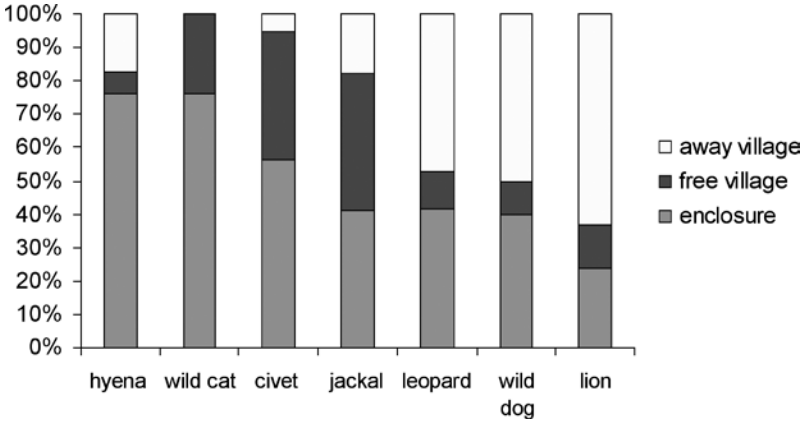

Figure 2.4 Location of attacks on livestock for 7 carnivores, expressed as percentage of total attacks. Attacks in the village occurred either on free-roaming animals ('free village'), or when these were contained in enclosures.

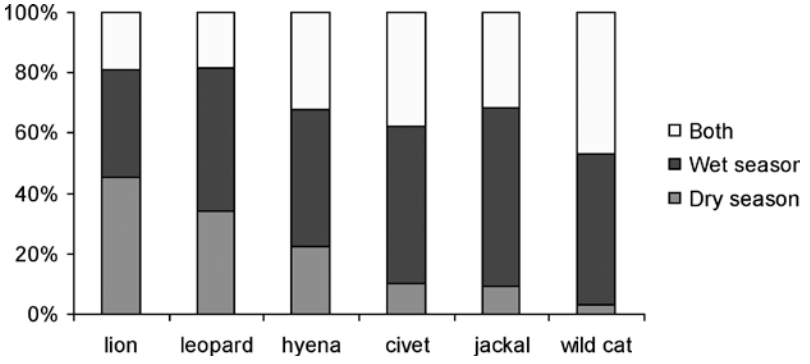

Figure 2.5 Timing of attacks on livestock for 7 carnivores, expressed as percentage of total attacks.

When livestock losses are expressed as financial losses it appears that predation by wild cat can be considered by far the most important economic problem, in comparison to predation by other carnivores. On average 18 Euro per household per year is lost to predation by wild cats. If results are extrapolated for the entire human population (n= 5962) in the study area, the wild cat group results in losses of > 15,000 Euros per year, while spotted hyenas cause considerably less economic damage (figure 2.6). However, when people were asked to label a 'most problematic predator', spotted hyenas were pointed out as often as wild cats. Regional losses as a result of lion predation are just over 2,000 Euros.

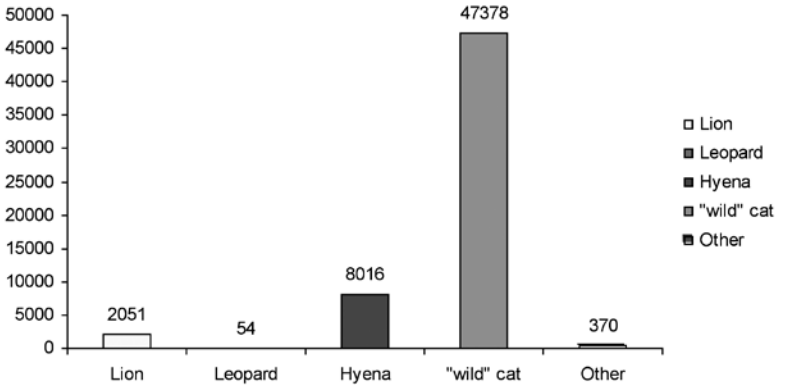

Figure 2.6 Total extrapolated regional financial losses per predator over 2004-2006 (expressed in Euro)

To put economic losses through predation into perspective, losses to disease and theft were also calculated (figure 2.7). Although financial losses incurred by the 'wild cat' group are considerable, these losses

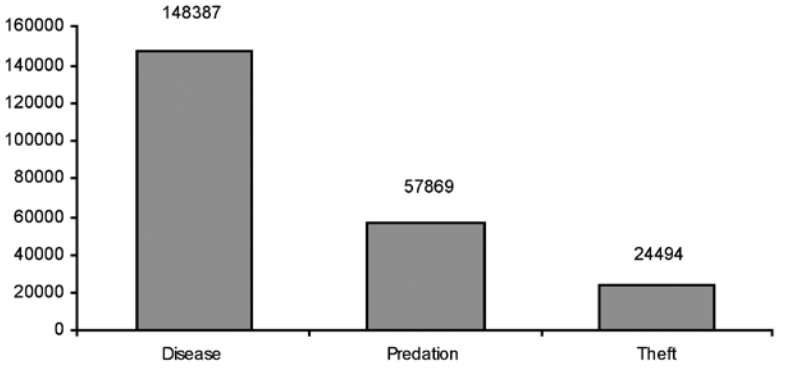

Figure 2.7 Total estimated financial losses to disease, predation, and theft at the regional level between 2004-2006 (expressed in Euro)

are minor compared to damage done through disease. A similar picture emerges through a comparison with other wildlife-related problems. When people were asked to list a top 4 of problem animals, and scores were assigned accordingly, only wild cat and spotted hyena played a role of significance. They are relatively unimportant, however, when compared to baboons, patas monkeys and elephants (figure 2.8). It is important to note that lions were listed only once as a top 4 problem animal, and leopards three times.

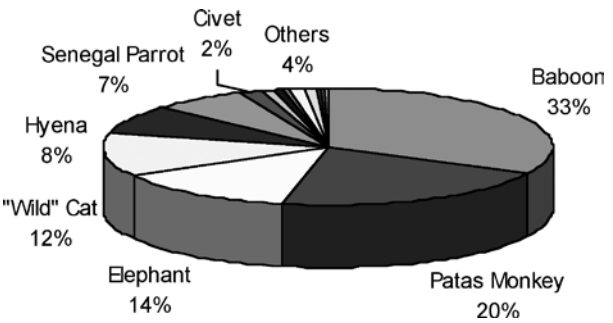

Figure 2.8 Most problematic animals (people's perception)

When people were asked for measures to prevent predation, the use of enclosures was indicated most frequently to protect livestock and poultry, and to prevent stock loss (figure 2.9). Two men admitted using poison to kill carnivores near the village; the use of poison away from the village was admitted by two others. The pesticide Landrin was mentioned as an effective poison against carnivores on three occasions. People also put forward their strong conviction that the M'bororo no-

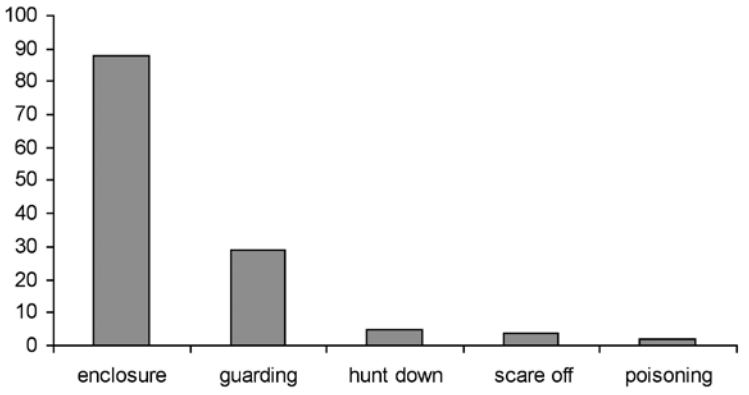

Figure 2.9 Methods used by interviewed people to prevent predation

mads, which seasonally migrate through the area with their cattle, frequently use poison on carcasses to kill carnivores.

The use of poison is likely to have had a significant impact on the carnivore population in the area. While on occasion an apparent increase in lion and spotted hyena numbers was noted in the area, over 40% of people noted a decline for both species compared to the past (figure 2.10). When asked to indicate when this decline set in, respondents indicated on average 8 to 9 years ago for lion and spotted hyena, respectively. A similar trend was found for leopard and wild dog, which were more commonly seen > 9-10 years ago.

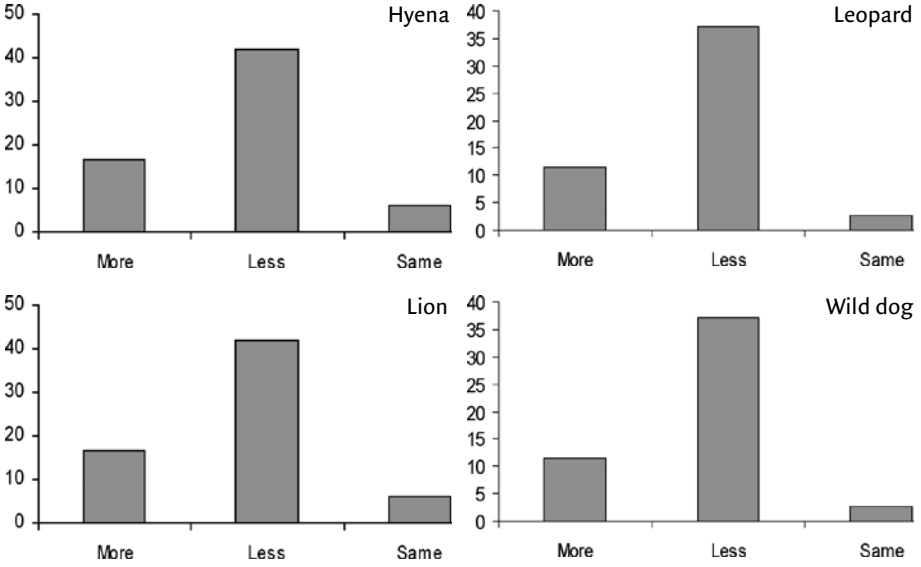

Figure 2.10 Increase and decrease of observations on spotted hyena, lion, leopard and wild dog (people's perception)

Discussion

The largest predation problem by carnivores west of Benoue N.P. is evidently posed by the 'wild cat' group, which causes heavy losses especially to poultry owners in the area. These wild cats, as they were referred to in interviews, are most probably predominantly stray feral cats, although the occasional African wild cat and hybrids cannot be excluded. During the course of the study, feral cats were often seen crossing the roads in the area, especially at night and on occasion several km away from the nearest habitation. People often pointed out the illustration

of a wild cat as it was shown to them, then adding that the colouration of the resident cats was different. They usually described a pattern of white and dark patches typical of domesticated cats. Apart from these wild cats, other small carnivores are likely to prey on chickens, including jackal and civet. In other parts of Africa similar problems have been reported regarding African wild cats, hybrids or mistakenly identified small carnivore species predating on small livestock (e.g. South Africa: Funston, personal communication). Weladji (1998) found that civet predation on chicken posed an important problem in the Bénoué region region. Although this conclusion cannot be supported from the results of this study, civet predation may have been underestimated due to its more secretive behaviour and resemblance to feral cats. On some occasions, people clearly had problems separating cats and civet, or they pointed out that civet was similar to a cat – in the latter case, data were not incorporated into the analyses. An identification bias may have been enhanced, however, by difficulties to identify the culprit when it had not actually been seen. Specific questions were asked related to the identification of the carnivore when it had not been seen, the only possibility of identification often being available through the shape of holes in an enclosure, or tracks. These usually allow distinction between small and large carnivores and between large carnivores, but less often between small carnivores; knowledge on tracks of large carnivores was generally good and signs left by a large carnivore, such as a hole in an enclosure by a hyena, are usually much more evident than those of a cat or a civet. Despite the inclusion of some identification errors of small carnivores, however, we feel that the data reflect the actual situation well; and even if chicken predation by civet is biased by several factors, it remains negligible when compared to losses through feral cats.

The rainy season is the problem season for livestock predation except by lion. Data from collared lions in Benoue N.P. indicate that ranges overlap areas with human habitation in the dry season, which increases their chance of encountering livestock that wander off into the bush in search for water and grazing. For spotted hyena, rainy season predation is perhaps a result of general dispersion of prey species at the start of the rainy season away from the riverine area of the Park where most herbivores concentrate during the dry season. Wider ranging of hyenas in response to their prey species' distribution may result in increased contact with livestock at the edge of the Park during the wet season. For hyenas and other carnivores, the wet season probably also offers increased cover and therefore better opportunities to more readily approach livestock and poultry close to villages.

Despite the heavy toll on chickens as a result of feral cat predation, our data illustrate that financial damage through predation is a relatively small problem west of BNP, both in absolute terms and when compared to losses through disease and theft. This can be explained as follows. First, people in the area own relatively low numbers of livestock, especially when compared to the area around Waza National Park in the north where the livestock-carnivore conflict is much larger (de Iongh *et al.* 2005). Second, measures to protect livestock from predation appear effective and are commonly used. Most damage is done through 'wild cat' predation on chickens, which may be most vulnerable due to flimsy enclosures and an abundance of small carnivores. Finally, and perhaps most obviously, attacks by large carnivores in particular are rare because of the rarity of the carnivores themselves. Although large carnivores generally occur in low densities, most villagers noted a decline in large carnivore numbers 8-10 years ago likely as a result of widespread poisoning of carnivores, and a simultaneous decline in herbivore numbers. As a consequence, species such as wild dog and cheetah are now only rarely seen in the area, while observations of lions, leopards and hyenas are infrequent.

The use of pesticides to kill carnivores may have been initiated from the large-scale introduction of cheap pesticides in West Africa 15-20 years ago. Villagers admit to using pesticides to kill carnivores even though carnivores are perceived as low nuisance when compared to other wildlife. Spotted hyenas are an exception, and regarded as an equally important nuisance to wild cats, despite their much lower factual contribution to financial losses. The preference of hyenas for small ruminants may have resulted in a bad reputation as attacks have a larger economic impact for the individual farmer compared to loss of poultry. To stop hyena predation, people resort to using a widely available and cheap pesticide such as Landrin, which is put out on bait (e.g. skin of a goat) at night, rather than improving existing protective measures such as enclosures. Although only a few people admitted the use of poison to kill hyenas, the number of people actually using poison to kill carnivores is probably much higher as people are often reluctant to share such sensitive information. Nomads moving through the area in predefined corridors west and east of the Benoue N.P. are also said to use poison to kill large carnivores such as spotted hyenas, which are said to often follow the migrating cattle herds. When not restricted, the practice of carnivore poisoning is likely to further impact spotted hyena numbers and – perhaps to a lesser degree – lion, jackal, and leopard populations.

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3 Review of more than ten years research on lion ecology and lion livestock conflicts in the Waza Logone region, North Cameroon

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Abstract
The African Lion Working Group (ALWG) has concluded that there is a lack of research data on lion populations in Central and West Africa. The present review intends to contribute to a better knowledge of lion populations in this region with special reference to lion-livestock conflicts in the Waza Logone area, North Cameroon. Research on the lion population of Waza National Park (1700 sq. km) in North Cameroon was initiated in 1995 focusing on livestock depredation, pride structure and movements and home ranges. The main focus of research was on lions in the woodland zone of the Park and on lion-livestock conflicts South of the Park. Our research review indicates very large wet season home ranges of pride members and seasonal movements of individual lions outside the park during the wet season. We also identified the presence of male problem animals. Population estimates range between 30-60 animals in the Park and bufferzone.

Prey populations and lion population size have steadily declined since a census of 1962. Wild prey biomass per kg of predator is lowest, when compared with national parks in East and South Africa. In addition lion density in Waza is low (2 animals per 100 km^2), much lower than in East and South African National Parks. Our review covers lion-livestock conflicts in and around Waza N.P. Livestock losses range between 2.1% (cattle) and 20% (goats) of total stock per annum. Finally an analysis is made of factors contributing to lion-livestock conflicts in the Waza Lagone region.

Introduction

The present review covers more than 10 years of research on a lion (*Panthera leo leo*) population in Waza National park, North Cameroon (figure 3.1). It was carried out within the framework of a cooperation between the Institute of Environmental Sciences (CML) of Leiden University, the Netherlands, and the Centre for Environment and Development Studies

in Cameroon (CEDC). These institutions have been the driving forces behind a major collaborative research programme on wildlife ecology and management, wildlife conflicts and the participation of local communities since 1990 (Loth 2004; De Iongh *et al.* 2005).

Study area

The Waza-Logone region is situated in the extreme north of Cameroon and is defined here as the region extending from the divisions of Mayo Kani (Kaélé) and Mayo-Danai (Yagoua) in the south to the Lake Chad in the north (figure 3.1). It covers an area of approximately 29,800 km^2 and lies between 10°025' and 12°0 50' north, and 14°0 05' and 15°0 15' east. The area includes two national parks: Waza N.P. (1,600 km^2) and Kalamaloué N.P. (27 km^2).

The climate varies from soudano-sahelian in the south to sahelian in the north. The dry season lasts for 6 to 8 months, and the rainfall varies from about 1,000 mm per year in the south to less than 350 mm in the north. The region includes three distinct vegetational communities: periodically flooded grasslands of the Logone and Chari, and Lake Chad floodplains with *Echinochloa pyramidalis, hyparrhenia rufa, Oryza longistaminata and Pennisetum ramosum*; thorny shrub savanna with *Acacia spp., Balanites aegyptiaca, Piliostigma reticulatum, Calotropis procera and Ziziphus spp.*; and woodland savanna with *Combretum spp., Feretia apodenthera, Acacia dudgeoni* and *Anogeissus leiocarpus*. The main land-uses in the area are small scale agriculture, pastoralism, fisheries and the establishment of protected areas to conserve wildlife.

Waza N.P. is one of the most well-known parks of Central and West Africa. Waza is also the major touristic attraction in northern Cameroon. Its diverse wildlife populations include elephant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), lion (*Panthera leo*), ostriches (*Struthio camelus)* and various species of antelopes such as the Buffon's kob (*Kobus kob kob*), red-fronted gazelle (*Gazella rufifrons*), roan antelope (*Hippotragus equinus*) and korrigum (*Damaliscus korrigum*). In addition, Waza N.P. is rich in birds with 379 species counted, among them large numbers of Ethiopian and European migratory birds such as the white faced whistling Duck (*Dendrocygna viduata*).

Human exploitation of natural resources, increased elephant numbers and the decrease in rainfall have seriously depleted the Kalamaloué National Park's natural resources, situated about 50 km north of Waza N.P. (figure 3.1).

A large part of the study area is in the Waza-Logone floodplain. Originally, 60% of the area was inundated for 6 to 8 months a year (between August and March) because of flooding of the Logone river. The construction of a large dam for the SEMRY II rice project at Maga has caused, in combination with a decreased rainfall, a disruption of the annual hydrological regime. Inundations have been disrupted and the flooded area has been reduced considerably, leading to a desiccation of the floodplain and a reduction of forage for wildlife and cattle. In addition, smaller irrigation schemes in the Mandara mountains southeast of the floodplain may have had a negative impact on the depth of the water table in the floodplain area, which has dropped markedly in recent years. This reduction in availability of water affects the entire floodplain, locally called 'yaérés', downstream of the Maga dam, including almost the entire eastern part of Waza N.P. People in the floodplain have been forced to change their resource use systems. Traditional fishermen have adopted the cultivation of mouskouari (dry season millet) and some nomads have sedentarized in order to cut and sell firewood. These activities coupled with human population growth have led to the fragmentation and loss of suitable habitat for a range of herbivore species.

In 1993 The World Conservation Union (IUCN) started the Waza-Logone Project in this area. The objective of this project was the restoration of the floods which will, at least in part, contribute to the provision of increased amounts of water in the southern half of Waza N.P. and the adjacent floodplain. In 1994 an opening was made in the embankment at Tékélé, resulting in 50% restoration of the original flooding. Increased water availability may improve forage quantity and quality, and consequently influence the pattern of animal movements and habitat utilization, with special reference to the migration of the elephants (Tchamba 1996; De Iongh *et al.* 2004).

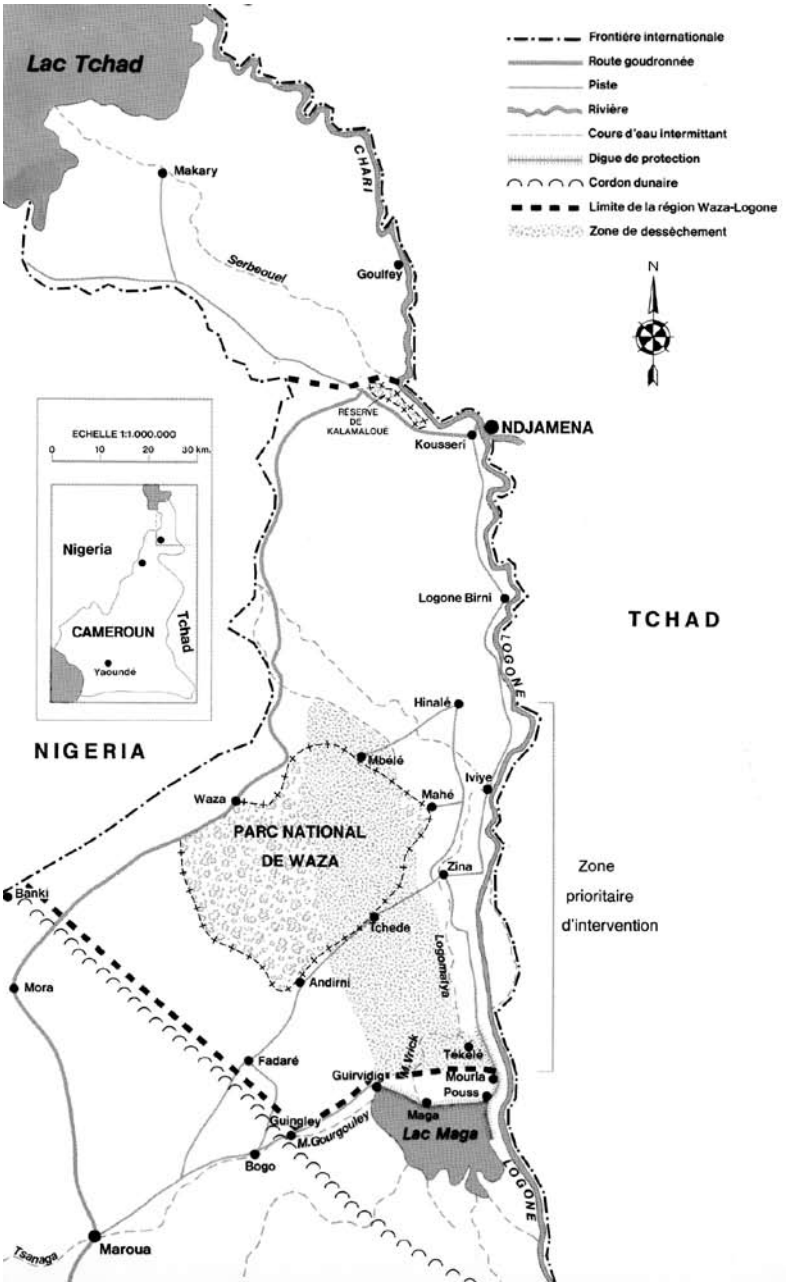

Figure 3.1 Map of the Waza Logone area in North Cameroon

Review recent research

Research on the impact of the pilot reflooding on antelope assemblages and elephants in Waza National Park has been summarized by De Iongh *et al*. (1999), De Iongh & Prins (2000), Loth (2004) and De Iongh *et al.* (2005).

Recent research on the lion population and lion livestock conflicts in the Waza Logone area has been covered by De Iongh *et al.* (2003), Bauer (1995, 1999, 2003), Bauer *et al.* (2003a, 2003b), Nieuwenboer & Wiegman (1999), Kranendonk & Kroese (2000), Schultz & Turk (2002), Hamling (2002), Bij de Vaate & Van Bommel (2003), Vlieger & Van den Pol (2004), De Iongh et al. (2005) and Van Bommel *et al.* (2007). The main findings of this research are summarized below.

Individual size and age

Based on a sample size of n = 3 females and n = 4 males, Waza lions appear to be considerably smaller than their East and South African counterparts (Bauer 1999). Male lions from Waza N.P. have an average weight of 145 kg, while East and South African male lions can weigh up to 230 kg. A lioness from Waza N.P. may attain an average of 93 kg, compared to around 160 kg in East and South Africa. Waza lions also seem similar in size or even smaller than the Asiatic lion, with males between 150-250 kg and females between 120-180 kg (Asiatic Lion Information Centre). However, our sample size is too small to draw definitive conclusions on the differences in size.

A lion will normally live up to 15 years but have been known to live up to 30 years in captivity. The oldest lion recorded in Waza is now about 14 years old, age determination was based on mane development, dentition and other characteristics (Bauer 2003). He has survived a shooting injury. Another pride male was about 8 years old when he was killed in 2002 for livestock raiding.

Pride size

In East and South Africa prides of up to 30 lions have been recorded but with prides commonly of 6 to 10 individuals. A typical pride would include one or more dominant male(s), juvenile males, two to three lionesses and various young lions. Most lions are observed in the woodland zone, solitary, or in pairs of mother and offspring (Bauer 2003). Lions in Waza have only been reported in prides of up to seven individuals including cubs. Kranendonk & Kroese (2000) found a pride consisting of 5 animals (one male and four females) in the woodland zone of Waza

N.P. Bauer (2003) reported an average group size of 1.5 and a male-female ratio of 1:3.5 in Waza N.P., based on 67 observations. The pride male 'Hamidou' was killed by cattle nomads in 2001. Tracks found during January 2002 in the woodland zone by a tracker and identified by researchers suggest that a new large male had entered the woodland zone, accompanied by a smaller male, five females and a 'cub' (Schultz & Turk 2002). This suggests the presence of a single pride living mostly solitary lives with overlapping ranges. The death of Hamidou left a 'gap' in the woodland pride which appeared to have been filled by a new dominant male. Bauer (2003) also concluded that the combination of fragmentation and low density is typical of the region and different from most areas where lions have been intensively studied. By analyzing group size in three different West and Central African populations he suggested that lion group size in West and Central Africa is much lower than in other regions, possibly affecting pride structure (Bauer *et al.* 2003a).

Population size

Initial population estimates during 2000 by Bauer (2003) of the lion population in Waza N.P. provided a range of 30-60 lions. Calling station surveys in 2001 provided a more accurate estimate of about 60 lions (Schultz & Turk 2002). Populations of main prey species (roan antelope, korrigum and Buffon's kob antelopes) have been monitored since 1962 (De Iongh *et al.* 2007). The general trend of prey populations is a strong decline since 1962 and a stable situation during 1994-1997, possibly with an increasing trend for Buffon's kob populations since 1998 and a recent drop since 2005. When extrapolating lion populations (reference year 1998), based on the declining trends in prey species and the predator prey ratio defined by Carbone *et al.* (1999) the trend of the Waza lion population can be projected since 1962, showing a decline from a population of 250 lions in 1962 to 50 lions in 2005 .

Declining trends in antelope assemblages in Waza N.P. can be explained by the cumulated effects of the construction of the Maga dam in 1979, declining rainfalls figures after 1980 and the impact of rinder pest during 1980-1990. In addition there has been an impact of the reduced management intensity of Waza N.P. as expressed in the number of game guards (the latter declining from 30 in 1980 to 5 in 2005).

Density and home ranges

Density of the Waza population is estimated at 2 individuals per 100 km^2, which is very low compared with Kruger N.P. and Masai Mara (De Iongh *et al.* 2005). Surveys in the Kruger National Park recorded a den-

sity of approximately 13 lions per 100 km². In the Masai Mara there are about 35 lions per 100 km².

Dry season home ranges (MCP) of two females and two males followed in Waza N.P. partly overlapped and showed mean ranges of 604 km² (482-1054, n=4) (Bauer 2003). This is much smaller than recently discovered home ranges in Bénoué N.P., which show a mean of 156 km² (42-307, n=4) (De Iongh *et al.*, in prep.). During the wet season lions spent more time outside Waza N.P. than during the dry season (Kranendonk & Kroese 2000). During 2003 three lions were radio tagged in the floodplain. These lions were tracked down near the same location in the floodplain during February-March 2004, although they moved between different waterholes (Vlieger & Van den Pol 2004). It was not clear if these particular lions had left the Park during the wet season for livestock raiding. Bauer (2003) concluded, with regard to the problem of predation on domestic animals, that a differentiation between individuals was apparent. Male lion Hamidou 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 male lion Paul was peculiar. He occasionally left Waza N.P. when healthy, but permanently when wounded. This suggests that stock raiding can be reversibly induced by adverse circumstances. These results confirm the existence of habitual problem animals and lions feeding exclusively on wildlife, as described in Etosha N.P. by Stander (1990).

Prey availability

The prey base of lions in Waza NP is probably largely limited to Buffon's kob (*Kobus kob kob*), red-fronted gazelle (*Gazella rufifrons*), roan antelope (*Hippotragus equinus*), korrigum (*Damaliscus korrigum*) and warthog (*Phacochoerus africanus*). Wanzie (1986) documented predation of lions on Buffon's kob. Of 387 dead kobs found in Waza NP from 1976 to 1979, 42.1% were victim of predation by lions. Kranendonk & Kroese (2000) reported finding radio-collared lions in Waza NP with carcasses of warthog, roan antelope, Buffon's kob, civet (*Viverra civetta*), marabou (*Leptoptilos crumeniferus*) and cuckoo (*Chrysococcyx sp.*). Whether lions had actually killed these themselves or scavenged them is not explicitly stated. In a study to determine diet choice of lions in Faro N.P., Cameroon, 119 faecal samples of lions were collected (Breuer 2005). Buffon's kob was identified in 51.3% of the samples. Next to traces of several large ungulates like buffalo, bushbuck (*Tragelaphus scriptus*), and roan antelope, and smaller ungulates like oribi (*Ourebia ourebi*) and Grimm's duiker (*Sylvicapra grimmia*) traces of porcupine, red river hog (*Potamo-*

choerus porcus) and several primates like olive baboon (*Papio cynocephalus anubis*) and guereza colobus (*Colobus guereza*) were found as well.

Fauna trends over the period 1962-2002 have been analysed by De Iongh *et al.* (2005). Over the years, different counting methods have been used. In 1977 there was a rinder pest outbreak and animal numbers dropped drastically. The last years the Buffon's kob, korrigum and roan antelope recovered and showed an increase in number. For the calculation of predator-prey ratio the census results of 1998 were used (Bauer 2003). De Iongh *et al.* (2005) also compared prey biomass and predator biomass between Waza N.P. and five national parks in East and South Africa. The main predators in Waza are lions and hyenas. In the other mentioned parks also leopards, cheetah and wild dogs were present. The prey and predator numbers were based on those quoted by Schaller (1972). Compared to the other national parks, Waza N.P. had the lowest biomass both for lions, total predators and prey per km^2. The amount of prey meat available per predator with 76 kg per kg of predator/km^2 was also the lowest compared with (in climbing sequence) Nairobi N.P., Kruger N.P., Ngorongoro crater, Manayara N.P. and the Serengeti ecosystem. This low availability of prey may be an explanation for the relatively high incidence of livestock conflicts around Waza N.P.

Lion- livestock conflicts

Bauer (2003) studied local perceptions of villagers in 25 villages around Waza N.P, in which he interviewed 10% of the villagers (total of 236 respondents). His study suggested that local people perceived livestock losses by lions as 2.1% (cattle), 15% (sheep) and 20% (goat) of total stock. Livestock losses by predation were higher compared to livestock losses by disease and theft.

To investigate the lion-livestock conflicts in the area south-west of Waza N.P. 122 interviews were carried out in six villages 0 to 38 km from the Park (Van Bommel *et al.* 2007; Bij de Vaate & Van Bommel 2003). The damage of livestock raiding was estimated at US 100,000 per year in the six villages. Livestock losses (cattle, sheep and/or goats) caused by lions differed between villages per year, ranging from 8 to 232 animals per village per year or 37 to 1115 US$ per livestock owner. At the individual level, predation increased with the combined ownership of cattle and sheep and/or goats. Van Bommel *et al.* (2007) found three factors to be important in relation to the intensity of predation on livestock by lions. The further the village is situated from the park, the lower the percentage of people whose animals have been raided by lions. Also, closer to the Park lions were found to predate livestock during the whole year, further away from the Park, lions only cause livestock losses in the rainy season. The more people there are in the

village who possess livestock, the higher the percentage of people who loose livestock. In general local communities do not seem to do much effort to mitigate the lion-livestock conflict. Herding methods could be changed to decrease livestock predation, for example herding livestock with more than one herder, or building bomas for cattle at night.

In summary; the people – predator conflict is serious in the areas around Waza N.P., especially on the southern border. During problem ranking and restitution, predation was confirmed to be a priority problem in these areas (Bauer 2003). 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. The available studies in Waza NP until now have mainly focussed on the woodland prides and virtually nothing is known of the floodplain prides. It is therefore recommended to study the movements and home ranges of the floodplain prides in the near future.

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4 Report of the DAS/ROCAL pilot project in Zakouma National Park, Chad

Nathalie Vanherle

Abstract
Eleven villages and six nomad camps were covered by the Zakouma Lion Study to survey the predation of domestic cattle by wild carnivores around Zakouma National Park in Chad in 2006. Results show that of the 11 villages surveyed only 3 were affected by regular predation by lions. Lions generally attack at the pasture during the day and more rarely at night before cattle return to the village. The majority of the livestock guards are children, who are generally incapable of protecting livestock from lion attacks. Predation by spotted hyenas generally occurs at night during the rainy season when the cattle is locked up in enclosures. In nomad camps, lion predation on cattle is a regular problem in 5 of 6 nomad camps. Lions attack livestock either during the day on the pastures, or at night in the camps. Attacks by hyenas occur especially at night in the camp or at pastures before animals returned to camp. Surveys show that the means of defense set up in the villages in order to protect cattle against attacks by predators are often inappropriate. Overall the losses due to the predation remain insignificant in comparison to losses due to disease.

Introduction

To collect socio-economic data and information on human-predator conflicts, surveys were carried out under project CURESS[1] near the peripheral zone of the National park of Zakouma (PNZ) in 2005. In order to supplement the information gathered during 2005, a second survey was carried out by the Zakouma Lion Study[2] during the year 2006. This survey was more specifically centered on the predation of domestic cattle by wild carnivores; inhabitants interviewed were livestock owners

1 Conservation and sustainable utilization of Soudano-Sahelian Ecosystems – projects financed by the European Union with as major objective sustainable resource management of Zakouma National Park and its periphery.
2 The interviews were performed with the help of volunteers from the Volet Eco-development of the project CURESS which has assured the translation French-Arabic between nomads, interviewers and other parties involved.

of various villages and nomadic camps located around the peripheral zone of the park. Eleven villages (figure 4.1) and six nomad camps (or groups of several camps) were covered during this second investigation (see appendices for details).

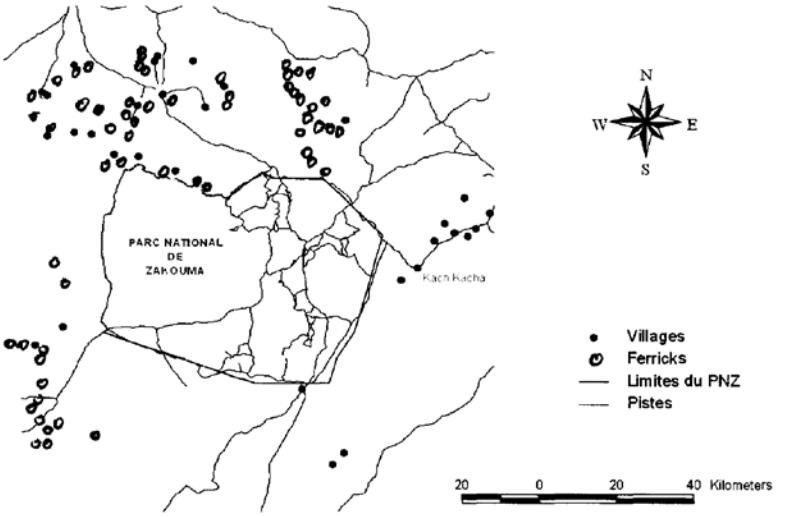

Figure 4.1 Distribution of villages implicated in the 2006 survey on predator-livestock conflicts around Zakouma National Park, Chad

Intensity of predation on livestock

Villages

Among the 11 villages surveyed during the investigation, only 3 were affected by regular predation by lions (at least 1 attack/year). The village of Ambaradje, located near the limits of the PNZ, was particularly affected. Due to the presence of a permanent water point, the zone attracts important livestock concentrations (approximately 15,000 heads of cattle gather in the area during the dry season), which partly explains the frequency of predator attacks. The village and its surroundings are also prone to the attacks of the predators as a result of the proximity of the park. Local livestock owners state that the lions which attack their cattle often originate from the park and return as soon as they have finished a meal. Among the 8 other villages surveyed, people from two villages from time to time undergo lion attacks (less than 1 attack/year) while in six other villages cattle were never attacked by lions. In contrast to lion predation, hyena predation is a regular problem in 10 of 11 villages that were surveyed. Table 4.1 summarizes the information

collected in the villages concerning predation intensity on cattle of sedentary livestock owners.

Table 4.1 Lion and spotted hyena predation intensity in 11 villages around Zakouma National Park, in 2006

Villages	Lion predation intensity	Lion predation period	Spotted hyena predation intensity	Spotted hyena predation period	Most important predator
A Chigaf	2	Rainy season	2	Rainy season	Spotted hyena
Ambaradje	2-3	Entire year	2	Rainy season	Lion
Am Choka	1	Rainy season	2-3	Entire year	Spotted hyena
Déléba zones 1 and 2	0	-	2-3	Entire year	Spotted hyena
Déléba zone 3	2	Entire year	3	Entire year	Spotted hyena
Kach Kacha	0	-	3	Entire year	Spotted hyena
Kièké	1	Rainy season	2	Rainy season	Spotted hyena
Tiolé	0	-	2	Rainy season	Spotted hyena
Bone	0	-	2	Rainy season	Baboon
Mouray	0	-	1-3	Rainy season	Spotted hyena
Ibir	0	-	1	Entire year	Spotted hyena
Zan	0	-	1-2	Rainy season	Spotted hyena

Intensity: 0 = no attacks, 1 = less than 1 attack/year, 2 = at least 1 attack/year, 3 = frequent attacks.

Despite the locally frequent attacks, predation is generally considered of minor importance for loss of livestock compared to disease. Diseases transmitted by insects (e.g. trypanosomiasis) and foot-and-mouth disease are the principal diseases indicated by local livestock owners.

Nomad camps

Lion predation on cattle is a regular problem in 5 of 6 nomad camps (or groups of camps) surveyed. The zones around Ambaradje and of Zan, where the wandering livestock owners gather in high densities during the dry season, are most heavily affected. The 6th camp consulted only seldomly undergoes attacks of lions on cattle (less than 1 attack/year). Predation by hyena on cattle is also a very widespread problem, occurring in almost all camps except the camp located in the zone of Zan. Table 4.2 summarizes the information collected in nomadic camps

concerning the intensity of livestock raiding by lions and spotted hyenas.

Table 4.2 Lion and spotted hyena predation intensity in 6 nomadic camps around Zakouma National Park, in 2006

Zone	Predation intensity lion	Predation intensity spotted hyena	Most important predator
Ambaradje	3	3	Lion/spotted hyena
Tiolé 1	1	2	Spotted hyena
Tiolé 2	2	3	Spotted hyena
Mouray	2	3	Spotted hyena
Ibir	2	3	Spotted hyena
Zan	3	0	Lion

Intensity: 0 = no attacks, 1 = less than 1 attack/year, 2 = at least 1 attack/year, 3 = frequent attacks.

Again, although carnivores may cause heavy losses among livestock, local livestock owners consider disease as being the principal cause of loss of cattle.

Means of defense

Villages

During the dry season, which is also the agricultural work period, cattle graze without protection in the periphery of the village during daytime. The cattle generally return to the village in the evening; houses making up the villages are laid out in a circle and the cattle are gathered in the center to spend the night. Sheep and goats – in contrast – regularly do not return to the village at night. In the village of Ibir, for example, goats often climb the hilltops top surrounding the village at the end of the afternoon to remain there until the early morning. With Am Choka, sheep and goats are often left outside the village as well in the course of the day as for the night. Watchdogs (figure 4.2) are largely used in the consulted villages, except in Bone where livestock owners state that they are ineffective because they are frequently killed by hyenas.

Figure 4.2 Watchdogs used to protect livestock in villages (left) and a young guard protecting cattle

During the wet season, cattle are entrusted to the nomads in some villages, such as Ambaradje. The few cows that remain in villages for the production of milk graze during the day while being monitored by young guards (the majority of them being children; figure 4.2). During the night, cattle are locked up in enclosures especially designed for this purpose. The majority of the enclosures are built of thatch in the peripheral zone of PNZ (figure 4.3a). Fire is normally lit in their center at night in order to chase off mosquitoes which are abundant in this area.

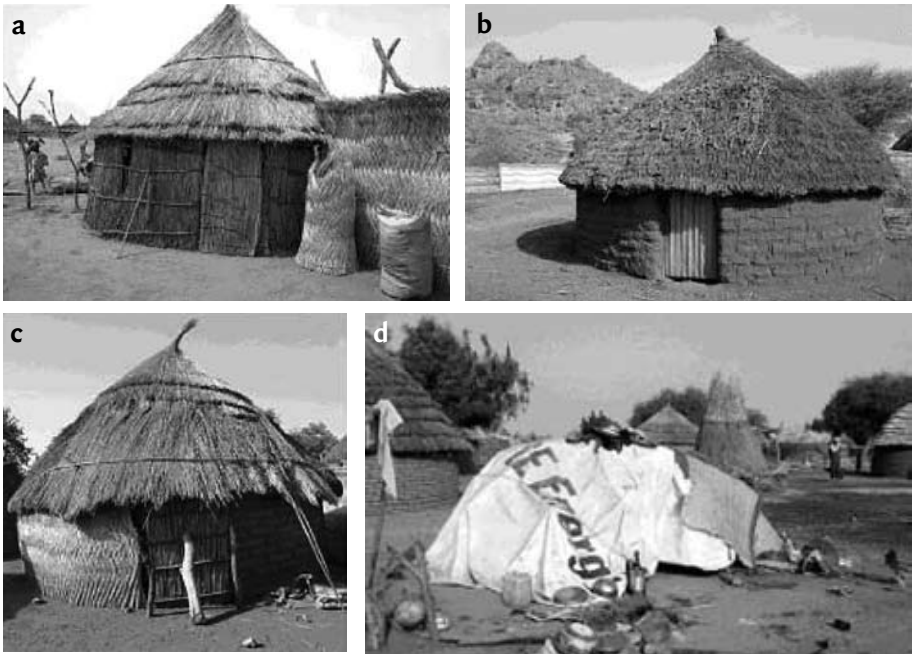

Figure 4.3 Enclosures built to confine cattle at night during the wet season (a: enclosure built of poles and thatch, b: enclosure built of earth bricks with a tin plate door, c: bricks with a stick door, d: enclosure for small ruminants in Am Choka)

Elsewhere, enclosures are generally built out of earth bricks. The doors of these enclosures are of variable quality. Certain villagers use metal doors (figure 4.3b) but their costs are high and they have limited use. Other livestock owners use traditional doors, built by means of wooden logs and held in place by two logs at each side of the door. The majority of the doors are, however, made of thatch, sometimes supported by logs (figure 4.3c). Some constructions are very simple such as those seen for smaller livestock in the village of Am Chokaoù; small ruminants are kept during the night under a simple plastic cover (figure 4.3d). Watchdogs are used in addition but such protection is not very effective when it rains.

Nomad camps

Cattle are supervised 24 hours a day by adult guards helped by watchdogs, on grazing grounds during the day and in the camp at night. In the camps, tents are laid out in circle and cattle are gathered in its center during the night. Goats, sheep and calves are more generally locked up by fences made of thorn-bush (figure 4.4a) while the very young animals are attached using a cord to a stake or to the tents (figure 4.4b).

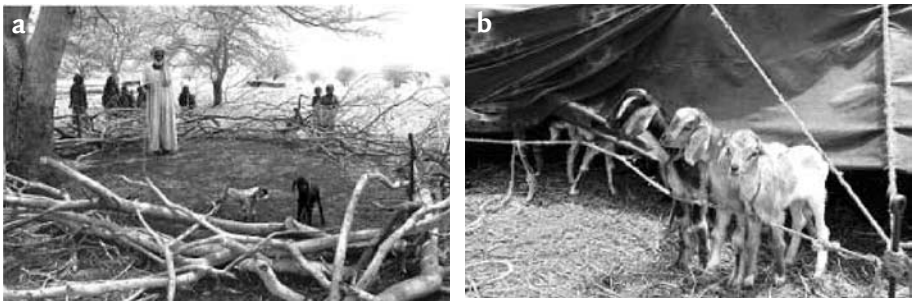

Figure 4.4 Enclosure of spiny thorn bushes used to protect small ruminants at night (left) and cords attached to a tent used to prevent small ruminants straying off

Circumstances of predation

Villages

Lions generally attack at the pasture during the day and more rarely during night before cattle return to the village (figure 4.5). The majority of the guards are children, who are generally incapable of driving out a large predator such as a lion preying on livestock. Predation by spotted hyenas generally occurs at night during the rainy season when the cattle is locked up in (thorn-bush) enclosures.

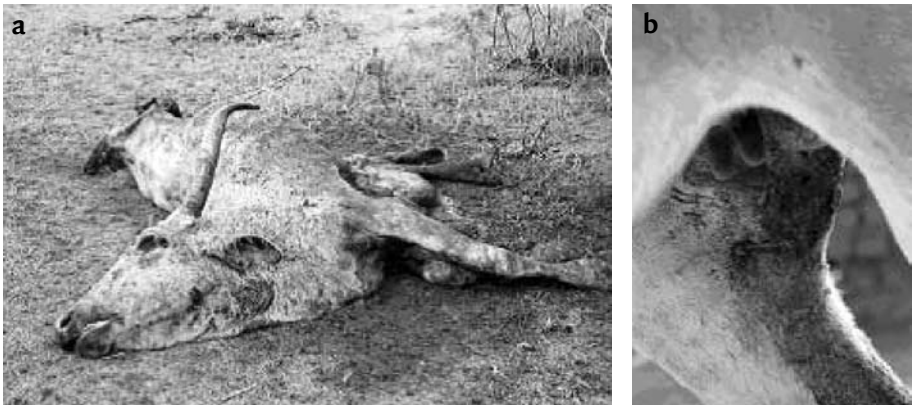

Figure 4.5 Cow killed by a lion when grazing without protection near the village of Goz Djerat (a) and wounds sustained by a donkey attacked by a lion in a nomad camp

Thatch and thorn-bushes do not constitute an effective barrier against spotted hyenas. They often manage to penetrate through thatch doors even when those are reinforced by logs. If the door resists, they sometimes dig a hole under the door to enter the enclosure.

Nomad camps

Lions attack livestock either during the day on the pastures, or at night in the camps. Attacks by hyenas occur especially at night in the camp or at pastures before animals returned to camp.

Conclusion

Villages

The means of defense set up in the villages in order to protect cattle against attacks by predators are often inappropriate (little or no guarding, fragile shelters). The majority of the consulted livestock owners recognize that their means of defense against predators could be improved but also affirm that they will not do so unless they are financially supported. For these reasons, and because of the relatively small loss of cattle through predation compared to disease, we believe that predation is not at this point a real problem in the villages of the peripheral zone of the PNZ.

Nomad camps

The means of defense set up by the nomads to protect their cattle from predatory attacks can only be improved with difficulty. Predation is a real problem in at least 2 of the 6 camps (or groups of camps) con-

sulted. However the losses due to the predation (which are generally lower than 5 % and never more than 10 %) remain insignificant in comparison to losses due to disease (which in case of epidemics affect up to 100 % of livestock).

Annex 1: Results of interviews on predator-livestock conflicts around Zakouma N.P. in 2006

List of abbreviations used: CA = cattle, HO = horses, SR = small ruminants

Table Zone Am Choka

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
Am Choka	SR – (600) CA HO Donkeys	– –	+/– day on grazing ground	+ on grazing ground	++ at night in shelter		• Spotted hyena: 20–30 SR/year • Lion <1 cattle/year	• Guards • Thatch enclosures (at night/rainy season) • Watchdogs	• Guarding ineffective according to livestock holders • SR are alone during the night and day during the dry season
Déléba zone 1 and 2	SR CA HO Donkeys	– –	– –	+ on grazing ground	++ at night in shelter			• Guards • Thatch enclosures (at night/rainy season) • Watchdogs	• Guards : children
Déléba zone 3	PR BV CV Donkeys	+ day and night on grazing ground	+ night in shelter	++ at night	++ at night in shelter			• Guards • Thatch enclosures (at night/rainy season) • Watchdogs	• Guards : children
Kach Kacha	PR BV CV Donkeys	– –	– –	– –	++ at night in shelter		• Spotted hyena : 10 SR/ previous rainy season	• Guards • Thatch enclosures (at night/rainy season) • Watchdogs	• Guards : children

General comment

During the rainy season, cattle are locked up in thatch enclosures for the night. Fire is lit in the center of the enclosure and is maintained all night to chase off mosquitoes and flies (vectors of fatal diseases for cattle). More firm brick enclosures would constitute a better shelter against predators but would contain the heat of the fire making the enclosure to warm for cattle.

Conclusion

Lions do not attack the cattle during the dry season (except in Déléba) and their attacks are rare during the rainy season. Spotted hyenas are the most important predators of the zone. They cause losses throughout the year but are mainly active during the rainy season. There are few efforts undertaken by livestock owners in this zone to offer real protection to cattle against predators. Small ruminants frequently wander during the dry season and cattle are enclosed for the night in simple thatch enclosures during the rainy season (these enclosures help to protect the cattle against mosquitoes but are inefficient against hyenas). The diseases transmitted by the mosquitoes and flies represent apparently a much greater risk of loss of cattle for the local livestock owners than those caused by predators.

Table 4.2 Restult of interviews; Zone A Chigaf

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
A Chigaf	SR CA HO Donkeys	–	+ day on grazing ground	–	+ at night in shelter			• Guards (grazing ground) • Thatch enclosures with thorn bush (night/rainy season) • Watchdogs	• Guards: children
Ambaradje (village)	SR CA HO Donkeys	+ day on grazing ground	++ day on grazing ground	+/–	+ at night in shelter		• Lion: 20 CA, 50 SR and 7 donkeys/12 last month • Spotted hyena: 30 SR/rainy season	• Guards (grazing ground) • Thatch enclosures with thorn bush (night/rainy season) • Watchdogs	• Ambaradje is a zone of concentration of livestock during the dry season • Guards: children
Ambaradje (nomad cattle breeders)	SR CA HO Donkeys	++ at nights in camps and during day on grazing ground	–	++ at night on grazing ground (if the cattle are not in) or sometimes in the camp			Since the be ginning of the season: • Spotted hyena: 300 SR • Lion: 60 CA	Watchdogs 24 h at night : • Tents in circle (CA in the center) • Thorn enclosures (SR) • Calves attached to a spike	• Guards : adults • Problems with agents of the Ministry of Water and Forest when they construct spine enclosures

General comment

About 70% of the village cattle of this area are entrusted to nomads during the rainy season. The cattle that remain on the spot (kept for milk production) are kept in thatch enclosures for the night. A fire is lit in their center in order to chase off mosquitoes and flies (vectors of fatal diseases for cattle). More firm brick enclosures would constitute a better shelter against predators but would contain the heat of the fire making the enclosure to warm for cattle.

Conclusion

Ambaradje (located near the boundaries of PNZ) offers permanent access to water. It is a zone of high cattle concentration during the dry season. The nomads in this area are confronted with a real predation problem – by hyenas as well as lions (losses generally less than 5% total stock). During the rainy season, lion attacks are common in the villages of the zone but few efforts are undertaken to protect livestock against such attacks. Diseases transmitted by mosquitoes and flies apparently represent a much greater risk than predation.

Table 4.3 Restult of interviews; Zone of Bone

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
Bone Daoud	Goats HO Donkeys	–	–	–	+ at night in shelter (some attacks at night on grazing ground)	• Principle predator is baboon. Attacked during the day near rocky outcrops or sometimes in the village • Wild dogs sometimes attack in the wet season (day)		• Guards (rainy season) • Earth enclosures, with wooden or thatch door (night/rainy season) • Watchdogs	• Guards : children • Hyenas enter enclosures by digging a hole under the wall/door
Bone Fakara Zone 1	Goats (+/- 300) HO Donkeys	–	–	–	+ at night in shelter (some attacks at night on grazing ground)	• Principle predator is baboon. Attacked during the day near rocky outcrops or sometimes in the village • Wild dogs sometimes attack in the wet season (day; 10-15 goats at once)	• Spotted hyena: 30 goats/rainy season	• Guards (rainy season) • Earth enclosures, with wooden or thatch door (night/rainy season) • Watchdogs	• Guards : children • Hyenas enter enclosures by digging a hole under the wall/door • Few watchdogs
Bone Fakara Zone 2	Goats HO Donkeys	–	–	–	+ at night in shelter	• Principle predator is baboon. Principle predator is baboon. Attacked during the day near rocky outcrops (20 goats since the start of the dry season)	• Spotted hyena: 15 goats/rainy season	• Guards (rainy season) • Earth enclosures (night/rainy season)	• Hyenas enter enclosures by digging a hole under the wall/door • They also enter through the thatch roof if the wall is too low. • No watchdogs that are said to be attacked by hyenas.

General comment

Cattle are locked up for the night in earth enclosures during the rainy season. Their doors are often too fragile due to a lack of financial means and the walls are often too low (the roof is sometimes so low that the hyenas manage to penetrate in the enclosure by pulling off the thatch on the roof).

Conclusion

There were no attacks by lions on cattle in the area. Predation by hyenas occurs only during the rainy season and causes few losses. Baboons are the principal predators.

Table 4.4 Review of interviews; Zone of Mouray

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
Mouray	SR (+/– 500) 2 -3 calfs HO Donkeys	–	--	+/–	++ at night in shelter sometimes during the day on grazing grounds	Leopards attack during the rainy season but cause few losses (1 animal at a time)	• Spotted hyena: 35 SR during the previous rainy season	• Guards (day/rainy season) • Earth enclosures with thatch door • Watchdogs	• Guards : children • Hyenas penetrate enclosures through their thatch doors
Camp close to Mouray	SR CA HO Donkeys	+ day on grazing ground and at night in camp	–	++ at night in the camp or during day on grazing ground (if cattle not yet in)	–	Leopards sometimes attack on grazing grounds (rare)	Since the start of the dry season • Spotted hyena : 20 SR • Lion : 1 CA, 1 calf and 1 HO	• During the night : • Tents in a circle (CA in the center) • Spine enclosures (SR) • Calves attached to sticks	–

General comment

The nomads frequently complain about their bad relations with the agents of the National Forestry Commission concerning construction of thornbush enclosures.

Conclusion

There were no attacks by lions on the cattle in the villages of the area. Stray cattle are sometimes attacked but the losses are minor. Spotted hyena is the principal predator in the villages and camps of the zone (losses = 5-10%). Leopard attacks sometimes occur on cattle but losses are few.

Table 4.5 Review of interviews; Zone of Ibir

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
Ibir (village)	Goats (800 – 900) Horses Donkeys	–	–	+/– at night	+ At night in the thorn enclosures (when villagers are in the camp with their cattle)	Wild dogs sometimes attack small ruminants at the end of the dry season. The attacks occur early in the morning when the goats descend from the rocks and cause sometimes heavy losses		• Goats climb to top of rocky outcrops at night (dry season) • Guards (day/rainy season) • Spiny enclosures (night/rainy season) • Watchdogs	–
Ibir (nomad cattle breeders)	SR Cattle (>1000) HO Donkeys	+ at night	–	++ at night on grazing ground or in the camp	–	Leopards sometimes attack during the day on the grazing grounds but cause small losses (15 goats/dry season)	Start of the dry season: • Lion: 10 CA • Spotted hyena: 75 SR et 4 CA	During the night : • Tents in a circle (CA in the center) • Double spiny enclosures (SR) • Calves attached to sticks	–

Zan	Goats (+/– 1000) HO Donkeys	–	—	+/– at night	+ At night in thorn enclosures (when villagers are in the camp with their cattle)	• Baboons attack goats born in the dry season (35 -40 goats/year). Attacks occur during the day near rocks • Leopards sometimes attack goats near rocky outcrops (5-10 attacks/year) • Caracal attacks goats on the summit of rocky outcrops in Ibir et Zan (3-5 cases/year)	• Spotted hyena: 80 goats/year	• Guards (rainy season) • Earth enclosures with thatch doors (sometimes reinforced with wood) • Watchdogs	• Guards – children • Hyenas enter through holes dug under walls/door of the enclosures, sometimes removing wooden support structure • Few watchdogs
Camp (between Ibir and Zan)	CA (800) SR (100)	++ day and night	–	–	–	–	2 cattle /month	• Guards with dogs 24 h During the night: • Tents in a circle (CA in the center) • Double thorn enclosures • Calves attached to poles	

General comment

The consulted nomads in Ibir noted an increase in the number of hyenas in the zone.

Conclusion

There were no attacks of lions on cattle in the villages. Attacks by spotted hyenas are rare in Ibir but occur each year in Zan during the rainy season when the villagers move through the fields with their cattle. The relatively frequent predation by the lions and hyenas in nomad camps in the zone (losses = 5-10%) causes less loss overall that disease.

Table 4.6 Review of interviews; Zone of Kièké

		Predation by lion		Predation by spotted hyena					
Place	**Cattle (numbers)**	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**Other predators**	**Losses declared**	**Means of defense**	**Comments**
Kiéké	SR CA HO Donkeys	–	+/– day on grazing ground	-	+ at night when it rains			• Guards on grazing grounds • Earth enclosures • Watchdogs	• Hyenas enter through holes dug under walls/door of the enclosures
Camp N°1 (Abou Rachida)	SR CA HO Donkeys	+/– day on grazing ground	–	+ at night in camp	–			• Guards and watchdogs 24 h At night : • Tents in a circle (CA in the center) • Spiny enclosures (SR) • Calves attached to poles	
Tiolé	SR HO Donkeys	–	–	–	+ at night in shelter			• Guards (day/rainy season) • Earth enclosure with thatch door or entirely thatch enclosure	• Guards : children • Thatch is not an effective barrier for hyenas
Camp N°2 (Rachid)	SR CA HO Donkeys	+ day on grazing ground	–	++ at night in the camp	–			• Guards and watchdogs 24 h At night : • Tents in a circle (CA in the center) • Spiny enclosures (SR) • Calves attached to poles	• No spiny enclosures due to problems with agents of Ministry of Water and Forest

General comment

The livestock owners of this zone noted a significant reduction in the number of lions and hyenas. The lions are more frequent during the rainy season but would target mainly wild prey (warthogs in particular).

Conclusion

There is no predation by lions on cattle during the dry season and predation is rare during the rainy season. Spotted hyenas do not attack cattle of the villager during the rainy season and generally cause few losses. The hyena is the principal predator in the nomad camps of the zone where it sometimes causes major losses (up to 50 heads of cattle at the same time). Lion attacks are rare.

5 Research on lions in Benin: Review and Perspectives

Etotépé A. Sogbohossou

Abstract
In contrast to other parts of the world, especially Africa, wildlife is relatively understudied in West Africa and in Benin in particular. One of the species in the region not having received much research attention is the lion. Since 2001, after the first workshop on the West and Central African lion in Limbe, lions started to become the focus of wildlife research in Benin. Different aspects have been studied so far: the status and the demography of lion populations in protected areas, human-carnivore conflicts and the socio-economic importance of lions. In addition, the genetic structure of the lion population in the region has recently been studied. These different studies showed that lion densities in Benin are relatively low. Threats include the use of lion parts in traditional medicine: lions are among the most frequently used species for this purpose. Human-lion conflicts constitute another real threat to lion populations in Benin and West Africa. Due to limited funds, studies focusing on lion conservation are conducted at a limited scale and some aspects like the long-term demography, ethology and ecology of Benin lions are still to be investigated.

Introduction

Lions, like other carnivores, have played an important role in the habits and customs of local tribes since ancient times. The lion is perceived to be the most powerful and symbolic carnivore and its mystic role is unquestionable. As part of the 'big five' or the five species which are considered of most importance for the African hunting industry and as a principal target for ecotourism, the lion contributes a great deal to the income generated through tourism in Africa. Apart from its cultural and economical role, the lion plays a key role in the savanna ecosystem it inhabits. Through its status of carnivore it is placed at the top of the food chain, consequently the lion influences the other species within the same ecosystem (Gittleman *et al.* 2001). In other words, the lion can be seen as an indicator species of the ecosystem, and therefore deserves special conservation attention. Unfortunately, however, in the West Af-

rican region where the species is considered to be the most threatened in Africa, very little studies on lions have been conducted. The first time that the attention was drawn towards the status and needs for lion conservation in the West and Central African region, was during a workshop in Limbe, Cameroon (Bauer *et al.* 2003a). A subsequent workshop in Douala in October 2005 (IUCN/SSC), had researchers and decision makers gather from all countries of importance for the management of lions in the sub-region. Before specifying research on the ecology and conservation of the species, it is important to describe what has been done so far as to better orient further action. This applies especially to the West African region, where recent survey results have led to the classification of the lion as Regionally Endangered instead of Vulnerable on the international scale (Bauer & Nowell 2004).

The main aim of the present study is to contribute to the general knowledge on lions in Benin. The specific objectives are to create an overview of the studies which have been conducted and to formulate the most important research needs from the results of these studies to allow efficient future conservation of the species.

Study location

Benin is a small country in West Africa covering 112,600 km² and bordering Nigeria to the East, Togo to the West, Niger, Burkina Faso to the North and the Atlantic Ocean to the South. Studies conducted on lions are particularly located in the two national parks of Benin and their surrounding zones (figure 5.1): the Pendjari and W National Parks in the north of the country. These two protected areas range between 10°3 and 11°6 North and 0°5 and 3°5 East, and represent the main habitats of lion in Benin. The Biosphere Reserve of Pendjari, which has a surface of 4,711 km², incorporates the Pendjari National Park and the hunting zones of Pendjari and Konkombri. The transfrontier Biosphere Reserve W in Benin, with a surface of 5,723 km², is made up of the W National Park and the hunting zones of Djona and Mékrou. Lions have been observed to occasionally visit the forests of Mounts Kouffé-Wari Maro, the Three Rivers and Gongoun Sota. This lions habitat located in the sudanian zone of Benin is characterized yearly by one rainy season and one dry season. Average annual precipitation varies from 600 mm with 1,100 mm from the north to the south. The annual average temperature is 18°C during the cold dry period (December at February) and 37°C during the hot period. The vegetation, degraded at certain locations, is composed of a mosaic of savanna with a prevalence of shrubby savan-

nas. The wildlife is diversified; almost all the species characteristic of West African savannas are present albeit in relative low densities in W National Park. Species frequently encountered include elephants, various antelopes, West African buffalo, hippopotamus as well as a variety of birds, reptiles, insects and fish. Most carnivore species are rare.

Various ethnic groups live around de Pendjari and W National Parks. These populations commonly practice agricultural activities and livestock keeping, especially cattle.

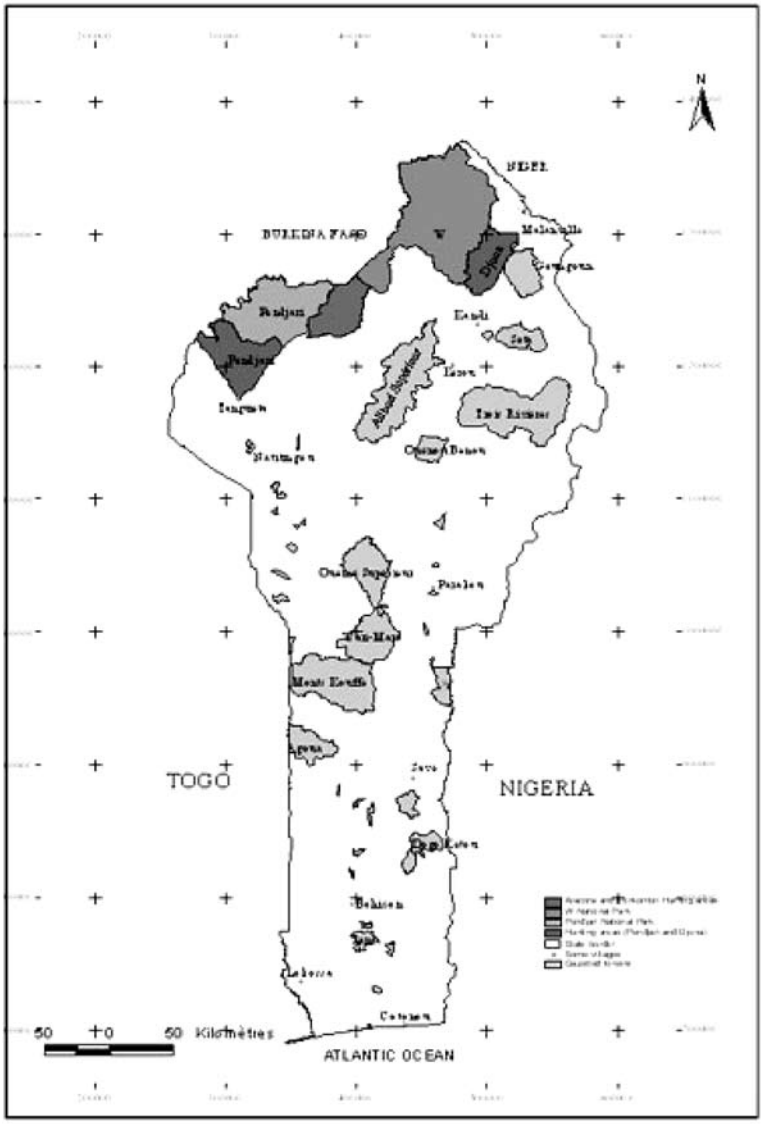

Figure 5.1 Location of protected areas in Benin

Methodology

Till recently, lion densities have not specifically been studied in Benin. Wildlife counts through linear transects on foot or aerial counts (Sinsin 1996; Sinsin *et al.* 2000; 2001a; 2001b; 2002) only provided an indication of the presence of the species. Counting frequencies are often insufficient to evaluate the abundance and the density of species. However, by using several different methods, recent studies on lions succeeded in identifying population parameters, particularly in the two protected areas in the northern part of the country. The most important methods used in these studies are the so-called calling station method, which has proven to be an effective method for estimating lion density in other regions of Africa (Ogutu & Dublin 2002; Bauer 2003) and questionnaires. Questionnaires were addressed to tourists, wildlife rangers and hunting guides as well as to local people.

Results

Lion abundance in Benin

As early as the 1970's, Sayer and Green (1984) estimated the population of lions in Pendjari N.P. at approximately 80 individuals or 3 lions per km². Over the past few years, the Pendjari population was again studied using calling station and associated methods and estimated at 30-50 individuals or 1 lion per km² (Di Silvestre 2002; Sogbohossou 2004). The Pendjari population lives in 9 to 10 prides with 2-10 individuals per pride. In the W National Park, the density is much lower although population size is very difficult to estimate due to the large size of the park and difficulties in accessing the park. Nevertheless, recent surveys indicate the existence of at least two families consisting each of at least 2 to 3 adults and sub-adults (Di Silvestre *et al.*, 2003). While lion density in W National Park is low, the Pendjari density is similar to the one of many other African Parks such as Etosha in Namibia (Stander 1991), or the Kalahari in South Africa (Mills *et al.* 1978). However, group size in Pendjari and W National Parks are generally smaller than groups in Eastern and Southern Africa (Bauer *et al.*, 2003a). The results of the surveys conducted in Benin resulted in the classification of the lion as a Vulnerable species for the country (Di Silvestre *et al.*, 2003). Until more accurate estimates on lion numbers are available, annual hunting quotas for lions are now set at 2 lions every two years per hunting zone, instead of 2 lions per year per hunting zone. Although no studies on lion have been conducted in other parts of the country, informal interviews with managers of other protected areas in the country have revealed

that lions inhabit, or at least occasionally visit the classified forests of Goungoun Sota and Mounts Kouffé-Wari Maro. Local people reported occasional observations of single individuals in these forests.

Human-lion conflicts

Human-lion conflicts are considered to contribute significantly to problems related to the conservation of lions. Such conflicts have largely been ignored in Benin to date, despite their occurrence. Around the two national parks in the north of Benin, conflicts mostly involve lion, cheetah, leopard, spotted hyena and wild dog. In general, large carnivores are reported to prey on livestock such as cattle, small ruminants, pigs, poultry, and sometimes dogs. Attacks take place during the night, inside villages (mostly lion, hyena, wild dog) or away from the settlements (mostly lion, leopard, and cheetah).

Attacks by spotted hyena inside settlements occur most frequently. Attacks by lions are less common, although losses incurred by lions are higher in an economic perspective as compared to losses incurred by hyenas. This can be explained by the fact that lions usually target bovines which have a higher economic value, whereas hyenas mostly prey on smaller ruminants, pigs and dogs which have a much lower economical value. The average annual loss due to large carnivores of a Fulani livestock owner has been estimated to 175,240 FCFA ($ 365) while it has been estimated to 98,000 F CFA ($ 204) for a farmer that has small livestock to predation (Sogbohossou 2004). Predation by carnivores on livestock appears to vary according to the period in the year. Most attacks take place during the rainy season especially in villages surrounding protected areas. During the dry season, the attacks are more likely to occur inside the reserve and not within the settlements. In Pendjari, during 2003-2004, 74.5% of the attacks by large carnivores took place during the rainy season. In contrast, the situation around W National Park is somewhat different. The Fulani camps are located at some distance from the villages and usually very close to the park. As a result, conflicts with wild carnivores are more likely to occur and independently to the season. We should notice that it is around this W park that lion poisoning by herders has been reported.

Economic and socio-cultural importance of lions

In many societies, modern as well as traditional, lions are considered a species of particular importance. In Benin, especially within villages bordering the protected areas, hunting was always a common and traditional activity. There were established rules for traditional hunting which were respected by the hunters, although anybody could participate in hunting activities. Some species, such as lion, could

only be hunted by a certain class of hunters. As a result, lion was seldomly killed and usually only in case of conflicts with humans; lion populations profited from people's worship. In addition, only traditional, non-destructive weapons were used for hunting. Unfortunately, with modernization, more sophisticated weapons are used to hunt wildlife. Foreign hunters using these weapons first killed wildlife on a large scale, and species like lion, leopard, and elephant were a major target due to their high commercial value. Initially, these hunters were assisted by local hunters. Gradually large scale and high-impact commercial hunting completely replaced the conservative traditional hunting methods. Traditional hunting with the respect for local laws progressively disappeared with the implementation of new and less conservative hunting regulations (Chardonnet *et al.* 1995). While traditional hunting activities became less important, traditional practices related to the use of wildlife products in a 'medical-magic' context remained common. Among carnivores, lions are most often used for medicinal recipes and magical practices: lion is most often quoted for medicinal receipts and magic. Almost all body parts are used, including bones, skin, the heart, eyes, fat, secretions and urine. The diseases which are treated through these parts are variable, and include among others rheumatism, wounds, and vision problems. Lion products are even more often used for magical purposes, e.g. to enhance certain capacities such as physical strength. Large carnivore products and particularly those of lions, are found on markets throughout Benin, most often around protected areas and in the larger cities (Di Silvestre *et al.* 2003; Sogbohossou 2006). In the north of Benin, salesmen often enter from nearby Niger or Nigeria. In the south, the *Fons* ethnic group has monopolized this trade of carnivore parts by moving through neighbouring countries and often buying parts from local Haoussa. As a result, products sold in Benin often originate from other countries, such as Nigeria (the majority of products), Niger, Chad and even Cameroon. Very few products originate from regions where National Parks are located. This suggests that the trade in animal parts does not pose a real threat to our protected areas in Benin. However, the fact that some well-known poachers around our protected areas sell animal products indicates that the trade does represent a problem. Furthermore, some protected areas share common borders (as it is the case with the WAPO complex), so not well-established hunting regulations in one park may invariably affect adjoining protected areas.

Conclusion and perspectives

Research on lions in Benin has seen a relatively rapid development since 2004, when research projects started with a focus on lion abundance (calling station methods), human-carnivore conflict surveys, and the socio-economic and cultural importance of lions. Nevertheless, there is still an urgent need to expand and improve current research on lions in the region. Demographic aspects have not yet been studied and more information is required on population structure and ecology. Knowledge on lion ethology and interactions with other carnivores is equally needed. It would also be interesting to characterize morphological and genetic differences of the Benin lion population and the larger West African lion population in general. Finally, the field of epidemiology is often neglected although it is of the utmost importance for investigating how disease has affected population numbers in the past and what diseases are potentially threatening to current lion populations in the region.

Acknowledgements

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6 Lions, Conflict and Conservation

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Abstract
Most conflict between people and large carnivores in Africa is due to depredation on livestock, although man-eating does still occur in some areas. In both Laikipia and Kajiado Districts of Kenya, we have found that properly applied age-old livestock husbandry techniques significantly reduce livestock depredation. These include keeping livestock in sturdy bomas (cattle enclosures) with solid gates and impenetrable thorn bush walls at night; deployment of guard-dogs both at night and while herding during the day to warn of carnivores' presence; and vigilant herding of the livestock during the day to ensure that none stray. We have built over 100 'demonstration bomas' in communal areas, and many people have adopted the modest changes recommended to better protect their livestock. In Kajiado, many livestock are lost to predators when they are left outside of bomas overnight. Improving poor herding practices would dramatically reduce conflict between livestock farmers and large carnivores at little cost. Experiments involving the deployment of capable and suitably motivated herders are due to be carried out in the first quarter of 2007. In both of the study sites, there are intractable difficulties in effecting carnivore conservation because of the minimal wildlife-related economic benefits in Kenya for its citizens. Poison is so readily available in Kenya today that people must realize and perceive economic benefits from carnivores if they are to have the motivation to improve husbandry rather than simply getting rid of large predators. Our work in Kenya shows that any other solutions are either temporary, or palliative, or both.

Introduction

Although we have no reliable data on Africa-wide lion populations prior to the late 20th century, there is wide agreement that numbers have been in steady decline, and are no doubt at an all-time low; estimates based on local experts' best guesses and estimates range between 16,500 and 47,000 (Chardonnet 2002; Bauer & Van der Merwe,

2004). Lions have been totally eliminated in North Africa, and only relict populations remain in West and Central Africa (ibid). Half of the remaining population is in one country, Tanzania, and smaller viable populations remain in Kenya, South Africa, Mozambique, Botswana, Zimbabwe, Zambia and Namibia.

As with the world's other large carnivores, the reduction in lion populations has been largely due to conflict with humans over livestock. Large carnivores kill livestock and are in turn killed by livestock owners or herders. Lions also attack people, and even in the 21st Century maneating is a serious problem in Ethiopia, Tanzania and Mozambique. Reports in the popular press have implicated Feline Immunodeficiency Virus (FIV) and sport hunting as playing roles in the decline but there is little supporting data; FIV is notable for its apparent lack of clinical effects on individuals, and there is no credible evidence that it poses any threat to wild populations (Packer *et al.* 1999, Troyer *et al.* 2005). One report has blamed a local population decline on poorly regulated trophy hunting (Loveridge & Macdonald 2003), but this problem appears to be restricted to Zimbabwe (see Packer *et al.*, 2006) and extensive retaliatory killing, snaring and habitat loss in the surrounding area are likely to be the major conservation risks to lions. Our opinion is that retaliatory and pre-emptive killing of lions by rural people, particularly livestock owners is the single greatest threat to lion populations.

European settlement of Africa had a major impact on wildlife generally and predators in particular. Because they readily prey on livestock, large carnivores were considered vermin (they are still legally classified as such in some countries), and settlers made great efforts to exterminate them in farming and ranching areas. These killings were exacerbated by a burgeoning demand for exotic wildlife products such as skins and ivory. Lion and other wildlife populations were viewed as inexhaustible and exploited as rapidly as they were encountered. As an example of the zeal with which lions were shot,, safaris to the Serengeti area in the early part of the last century sometimes shot over 100 lions (Turner 1987), clients of just one safari company killed 700-800 lions in 1911 (Herne 1999) and in 1908, over 150 lions were killed 'on license' in Laikipia District, Kenya, alone (Playne 1909). This scale of slaughter was not exclusive to the early twentieth century: in Southern Africa the large scale slaughter of wildlife kicked off in the early 1800's and between 1946-1952, one Laikipia game warden shot 434 lions 'on control' (Herne 1999), and several individuals killed over 300 lions apiece in the course of ranching in Kenya in the 1970's and 80's (Anonymous, pers.

comm.). By the 1960s, lions in South Africa were restricted to just two National Parks: Kruger and the Kalahari.

Much of this killing no doubt took the form of 'sport', but was motivated primarily by the perceived need to protect domestic animals. Although ranchers in East Africa used traditional African cattle husbandry methods which effectively minimized losses (below), western practice was to eliminate predators rather than try to live with them. Poison (strychnine and organophosphate cattle dips) was used very widely on East African ranches, continuing well into the latter half of the twentieth century (Denney 1972) and is still reportedly used by a small minority of commercial ranchers. At least until very recently, the Kenya Wildlife Service and the Kenya Veterinary Department poisoned hyenas on a wide scale, no doubt affecting lions and other scavengers as well. A very worrying development has been the increasing use of the soil dressing Furadan (carbofuran), to kill predators in some traditional pastoralist areas of Kenya (Frank, unpub. data). Although shooting can target specific problem animals, poison is indiscriminate and often removes whole prides at once, as well as large numbers of other predators and scavengers (Jenkins 2001). The Kenya Veterinary Department appears to be restricting availability of strychnine, but Furadan is widely available, cheap, and thought to be the poison of choice for eliminating predators. During a recent ban on lion killing in Botswana, several reports of poisoning appeared in the popular press and one was recorded and reported by GH (Hemson 2003). Subsequent observations and conversations with wildlife officials made it apparent how difficult it was to identify and prosecute poisoners (it being illegal in Botswana).

Spearing and poisoning in retaliation for livestock depredation appears to be decimating lion numbers in southern Kenya. Masailand comprises about 93,000 km^2 of grassland, including Serengeti National Park and the Ngorongoro Conservation Area in northern Tanzania, the Masai Mara National Reserve and Amboseli National Park in southern Kenya, and vast tracts of unprotected country in between. This region is inhabited by traditional Masai pastoralists with their large herds of cattle. Because of the large amount of wildlife and these world famous protected areas, it is one of the most important remaining semi-natural ecosystems in East Africa. It has also been home to what is probably the single biggest contiguous lion population in Africa. We have no good numbers on the lion population outside of protected areas, but several well-documented local situations suggest that lions are now under very severe human pressure, and that we may be in imminent danger of losing them outside parks in this entire region. The lions of Nai-

robi National Park and the adjacent Kitengela Plains were decimated by a rash of spearing by Masai morans (warriors) that killed at least 87 lions since 1998 (Ogutu 2005) allegedly in retaliation for attacks on livestock. Due to the lack of land-use planning around the Park, development and fencing have severely reduced natural prey in the region. A recent study by *Ogutu et al.* (2005) found that the lion density to the north of the Masai Mara National Reserve was only 12% that of the reserve itself; until recently, lions were abundant throughout the rangelands adjacent to the Reserve (LGF, unpub. data). Richard Bonham has documented a minimum of 76 lion killings (using poison or spears) since early 2001 and a drastic decline in lion sightings on and around Mbirikani Group Ranch in southeast Kenya, between Amboseli and Tsavo National Parks. In Tanzania, Bernard Kissui (in preparation) has documented over 125 lion killings between 2000-2005 in the greater Tarangire-Manyara ecosystem, and Dennis Ikanda (2005) reported 35 lions killed in the Ngorongoro Conservation Area between 1998-2004. Thus, the same pattern is occurring in a wide range of areas; elsewhere in Masailand, no one has been counting.

The reasons behind this apparent increased intolerance of predators are not entirely clear but are currently under study (Lamprey & Reid 2003; L. Hazzah, unpub. data; S. Rodriguez, unpub. data). Masai socioeconomics are rapidly changing under the interrelated influences of land subdivision, ever-growing populations, developing participation in a cash economy, the influence of missionaries, and increased politicization. Suppression of cattle raiding has deprived morans of their traditional youthful pursuits, leaving lion killing as the sole remaining way to test their bravery. In Kenya, the problem may be compounded by the fact that, in the absence of trophy hunting, wildlife outside of parks has no financial value.

While this is an extreme example of lion intolerance, killing of lions for livestock losses and threat to human life is near ubiquitous in Sub-Saharan Africa. In Mozambique lion-human conflict is a source of livestock and lion mortality in all four provinces (Anderson and Pariela, 2005 and below) and popular press reports from Zambia indicate the problem occurs widely (The Times of Zambia, November 2005). In Namibia human lion livestock is restricted to areas surrounding Etosha, Kaudom, Caprivi and the Southern Kalahari with a small population occasionally problematic in the Skeleton Coast (Stander & Hanssen 2003). In Botswana, reprisal killings of lions in response to lion depredation on livestock led to a total ban on lion hunting in 2000. Indeed it is reasonable to conclude that lions and other predators are being

killed in all major range states in response to their depredations on livestock.

In some areas such as the Okavango Delta, large source populations and low human densities might sometimes mean that the human threat to lion population integrity is limited. However, long-term viability of the lion population may not be sustainable in areas of high human and low lion density, e.g. Makgadikgadi, the Southern Kalahari, and Masailand. Even populations as large as 500 animals may become unsustainable in the face of stochastic environmental variation if persecuted by people and completely isolated from more robust sources (>1000 animals). There appear to be only five or six populations that large in all of Africa (Kruger, Okavango, Serengeti, Selous, Moyowosi/Rungwa, and possibly Tsavo). It is reasonable to conclude that direct killing threatens lion populations in smaller reserves and outside large protected areas today, and in the long term threatens almost all lions as metapopulation connections are broken down.

Costs

In spite of its overwhelming importance in lion conservation, there has been remarkably little research on lion-human conflict. Laikipia District, Kenya, is a conservation success, with abundant wildlife, including predators, living on commercial livestock ranches. Both commercial ranchers and Mukogodo-Masai pastoralists use traditional African livestock husbandry techniques: cattle, sheep, goats and camels are closely herded by men and dogs as they graze by day, and at dusk are brought back into thornbush bomas (kraals) with people living in huts around them. On the commercial ranches, Frank (1998) found that lions took 0.51% of cattle and 0.27% of sheep annually. In 1996, it cost $300-$400 in lost livestock to support a lion on the commercial ranches of Laikipia; improved husbandry in recent years has decreased losses on most ranches. Data from one Laikipia group ranch and one settlement scheme (both communally owned by Mukogodo Masai pastoralists) showed losses of 0.69 % of their cattle and 1.40% of sheep and goats annually to predators, largely spotted hyenas. This may be compared to figures calculated from Butler (2000) for communal lands in Zimbabwe, in which 1.2% of cattle and 3.4% of shoats were taken by predators. By contrast, lions on Mbirikani Group Ranch in Masailand of southern Kenya take less than 0.01% of cattle; we do not know if this is representative of 'normal' conditions, because that lion population has been reduced by an estimated 60-80% through massive persecution in the last four years (Maclennan & Franks, unpub. data).

While losses of livestock may be similarly low in many areas, means do not tell the entire story. In the Makgadikgadi of Botswana, livestock losses were not spread homogenously through the population. Rather people living nearer the protected area (and the main lion population) lost more livestock than those further away (Hemson 2003). While this cost was unevenly distributed, revenues from tourism were spread throughout the community, leaving an imbalance and creating ill feeling among those people living closest to the threat. To the community and to many farmers, attacks on livestock killings are unpredictable events of variable impact; occasionally lions destroy a family's livelihood in one night. In one example, a pair of resident adult males killed 43 goats at once, creating one irate farmer whose attitudes fell well outside the mean for his population. In these situations, the availability of nonspecific and highly effective poisons and traps creates the likelihood of collateral damage to all local carnivores. Indeed, it may be significant to note that while spotted hyaenas were seen at the beginning of the Makgadikgadi study they were not encountered at all in the last year (Hemson & Maclennan, pers. obs.).

In this same study, only people actually employed in tourism were significantly less likely to want to remove lions and more open to co-existing with them. Here, tourism created opportunities and wealth but when divided amongst the community at large did not create enough positive association to engender any community-wide protective sentiment towards predators. While the situation may be different in areas of extremely high aesthetic value and low human populations such as the Okavango, similar or worse situations may exist in many areas in which lions are most threatened, (Harcourt, Parks & Woodroffe 2001).

Depredation circumstances

In Kenya and Botswana, the great majority of lion depredation occurs at night (Frank 1998; Ogada *et al.*, 2003; Hemson 2003). In Kenya, lions most frequently approach a boma, causing the cattle inside to panic. If the boma is not sufficiently strong, or if it has weak points (most often the 'gate' which may be just a bush pulled into the opening), the cattle stampede, burst out of the boma, and flee into the bush where they might be taken by the lions or by hyenas; rounding them up often takes several men and vehicles most of the next day. Aside from the actual loss of cattle killed, ranchers complain that the stress causes loss of weight, and hence, profit. Depending on the structure of the boma

(below) some lions may learn to leap over the wall, particularly when taking small stock.

In Botswana, livestock are frequently not herded and are often left to wander outside enclosures at night. As a result, while people did complain that lions raided their enclosures, the majority of kills recorded were away from the enclosures. Indeed data from GPS collared cattle and interviews suggested that between 13-20% of livestock were wandering around untended at night, making depredation almost inevitable. Reports from the Southern Kalahari, Okavango and Khutse suggest similar patterns. In this situation, it is unsurprising to learn that enclosure structure had no significant influence over stock losses (Hemson 2003).

Less commonly, lions take stock by day. This seems to be more opportunistic than taking them from bomas at night, and probably occurs when a herd inadvertently wanders into lions sleeping in the bush. Most ranchers consider this to be simply bad luck, and do not hunt down the responsible lions. On one ranch which halted all lion shooting, however, lions learned that they could take stock by day with impunity, and losses rose to 79 cattle in one year.

Data from Laikipia (Woodroffe & Frank 2005) and from the Tsavo region (Patterson *et al.* 2004) support ranchers' and pastoralists' reports that livestock losses are higher during rainy periods. We saw few losses to predators during a severe multi-year drought, but losses skyrocketed when the rains finally came and many lions were shot in response. We speculate that listless wild prey and ready availability of carcasses during dry periods provide easy meals, but that lions are likely to turn to livestock when abundant grass makes wildlife harder to catch. In the Makgadikgadi and Ngorongoro Conservation Area, clear seasonal trends in livestock predation were recorded. These were related to wild prey availability and stock raiding decreased when migratory wild prey was present in large numbers despite local increases in lion populations. As migrant zebra and wildebeest moved to other areas local livestock predation increased despite a local decline in lion density (Hemson 2003; Ikanda 2005). In this case some lions remained resident in areas in which they could kill wild prey when it was abundant and livestock when migrants were scarce. Another subset of the population tracked the wild migratory prey throughout the year and rarely encountered livestock.

During a prolonged drought in Makgadikgadi, livestock were left to wander untended for days and weeks to allow them to find fodder. The more mobile lions began to encounter livestock throughout the park and evidence from the very end of the project suggested that these newly acclimated lions subsequently became resident livestock killers.

Although Stander and Anderson (1981) suggested that subadult males are most likely to become livestock killers, it was apparent in all our study areas, that all lions are potential livestock killers. While subadults can be a major source of livestock loss in some areas, these situations tend to occur some distance away from protected areas or on the boundaries of protected areas with very hard edges such as fences. Closer to soft-edged protected areas, in multi-use landscapes and in unprotected areas with viable lion populations (as opposed to scattered sub-adults) all age-sex classes are known to kill livestock. Although sub-adult males may be more likely to become livestock killers, these animals may be important to maintaining the genetic integrity of otherwise isolated regions of a metapopulation (e.g. Sweanor, Logan & Hornocker 2000). One sub-adult male in Botswana moved approximately 400km after collaring (Hemson 2003).

Lethal control

Although Laikipia ranchers are remarkably tolerant of predators and willing to absorb a certain amount of loss, they do shoot persistent stock raiders, usually by tracking lions from a kill or by 'sitting up', waiting for them to return to the carcass of a cow killed the night before. This is highly selective; 'innocent' lions are rarely shot. Between 1998 and 2002, an average of 19.4% of the adult population was shot annually, amounting to 30-40 lions per year, equally divided among males and females (Frank 1998; Woodroffe & Frank 2004). Although this seems very high, the population appears to be stable at a density of 6-7 lions/100 km^2 (unpub data): cub survival is high and the only emaciated lions we have seen have been very old solitary individuals. Laikipia has abundant wild prey throughout the year which form the bulk of the lions' diet, even though wild ungulates are outnumbered ten to one by livestock (Georgiadis, Olwero & Ojwang' 2003).

Importantly, lions originally collared in association with livestock kills were nearly four times more likely to be shot in response to subsequent livestock damage than were lions collared on wildlife kills (12.9% vs. 49.0%), strongly supporting ranchers' contention that certain individ-

uals or prides are chronic livestock killers while others are not. More generally, ranches with good livestock husbandry rarely lose stock and rarely shoot lions, while both livestock and lions are killed at higher rates on ranches with poor practices. Given that most lions move over several ranches (which average 132 km^2 in size), Woodroffe and Frank demonstrated that a single ranch which kills many lions serves as a local sink, draining lions from a much larger area. Thus, if a community of landowners wants to support predators, all members must practice similar levels of husbandry.

Due to the high mortality rate of stock-killing females, those not known to take livestock had four times higher cub production (0.981 cub/female/year vs. 0.231 cub/female/year) and 2.7 times higher cub survival than did stock killers. Moreover, this population is producing a skewed cub sex ratio, 69:31 favoring males. It is not known whether this is an effect of high mortality or other ecological factors.

Solutions

Ogada *et al.* (2003) assessed the efficacy of traditional African methods of livestock husbandry in protecting livestock from predators on commercial ranches. These practices evolved in response to the twin threats of both predators and livestock-stealing humans, and are thought to have remained relatively unchanged for thousands of years (Marshall 1990). Not surprisingly, Ogada *et al.* (2003) found that ranchers kill significantly more predators on ranches where predators kill more livestock. Thus, implementation of any practice that reduces the vulnerability of livestock is critically important for reducing retaliatory killing of predators. Seventy-five percent of depredation on cattle, sheep and goats took place at night, and lions were responsible for over 75% of the total; predation in East African ranches occurs largely at the boma. Well-built bomas effectively constrain cattle and keep predators out. Bomas in Laikipia are made from native thornbush, stone walls, wooden posts or wire mesh (which is used for merino sheep); of these, thick strong thornbush was most effective at keeping lions out and panicked cattle in. Stone is an excellent building material if there is a fence on top to prevent lions from leaping onto the wall and into the boma. Although most expensive to build, stone bomas last essentially forever and need no maintenance. Wire mesh is a very poor barrier if not well-supported, but one Laikipia ranch has developed a modular, moveable fence made of 8 x 4 x 4 foot panels of mesh welded into interconnecting angle iron frames that is highly resistant to predators and easily transported.

Thornbush bomas are most effective if divided into inner 'rooms' that make it harder for cattle to reach the main gate, and the gate must be very strong, preferably made from lumber. The normal practice of using a tree or bush as a gate is ineffective, as it does not contain panicked cattle and allows hyenas to enter.

We found that lions are reluctant to approach bomas that are located in close proximity to large numbers of people. However, for security and environmental reasons, some ranches do not allow herders to have their families at the bomas. Of course, in traditional societies bomas usually have large numbers of people and dogs. Dogs are also highly effective deterrents; they do not chase predators, but warn of their approach, waking the herders who then chase the lions. Again, however, some ranches do not allow dogs, as herders will use them for hunting wild game. Dogs can carry lethal carnivore diseases, but they are such an effective deterrent that vaccinated dogs are an essential component of livestock husbandry. A bright light or noise-making device like a shotgun or thunderflash is also very helpful at discouraging loitering lions.

Different techniques must be employed in areas where livestock are often left out at night. While 88% of livestock owners In the Makgadikgadi thought they were responsible for their livestock, only 15% thought they were responsible for their losses to lions and 80% thought that the government was responsible for livestock losses. We suspect that a poorly conceived compensation system may have played a role in this situation in Botswana: farmers were essentially free to remove predators at will and received a payment for lost livestock without any husbandry conditions being met. Consequently, the most economically effective way to limit financial losses was to remove predators, accept any compensation offered, and, if the owner could afford it, pay someone the bare minimum to look after livestock while the owner worked for cash elsewhere. An analogous situation was highlighted by Swenson and Andren (2005) in Norway. Here the government pays compensation regardless of the efforts taken to protect livestock and pays slightly under market value. Neighboring Sweden pays over the market value but insists farmers adopt state sanctioned methods for preventing livestock losses. Despite paying more per predation, Swedish farmers lose much less livestock per carnivore and Sweden has much healthier carnivore populations. The Swedish approach encourages and rewards better livestock care whereas the Norwegian and Botswana style lacks any such incentive.

One general trend emerging from studies of carnivore human conflict is that livestock killing seems most frequent in areas of extremely scarce wild prey. In some cases it is seems possible that wild prey may be scarce because people are hunting it and that the link between this hunting and livestock predation needs to be made clear. If communities were aware of this correlation, farmers might exert pressure on local hunters directly through community.

Problem animal control

In the absence of totally reliable methods for protecting livestock from lions, some amount of depredation is inevitable and some lions will form the habit of killing livestock. There is as yet no alternative to lethal removal of chronic offenders through Problem Animal Control; we strongly recommend against the common practice of 'translocating' problem predators to parks, as translocated predators often sustain damage in the trap, rarely stay where they are released, and usually end up being killed after causing further problems as they try to find their way home (Jenkins 1997; LGF, unpub. data). Most commercial ranchers are able to deal with problem lions but small scale rural farmers and pastoralists usually do not have the means. In Kenya, rural people consistently complain that wildlife authorities do not react effectively when people report chronic stock raiders, leading to resentment not only against government but also against wildlife, conservation, and tourism. A well-trained and reliable PAC team, able to respond efficiently, effectively and rapidly, is an essential element of large carnivore management in livestock areas, but few countries have them. In their absence, rural people have little alternative besides such indiscriminate methods as poisoning, which probably poses the most serious threat to predator populations. PAC teams should be trained not only in humane removal, but also in the reliable identification of problem animals and especially in educating rural people in livestock husbandry techniques that better protect stock.

Conflict resolution

Conflict with humans over livestock depredation is the single most important factor causing the decline in African lion populations. With growing numbers of people and livestock throughout the continent, lions will become entirely restricted to very large or well-managed protected areas if conflict mitigation cannot be implemented on a wide

scale. Ancient methods of livestock husbandry are remarkably effective at minimizing conflict, but these are rapidly being lost to modernization. Building good bomas and conscientiously tending livestock require time and effort at a time when poison is readily available and spearing lions is the only traditional test of manhood left for young warriors. As a cash economy has become increasingly relevant to rural Africans, they have lost their tolerance of predators and are likely to continue eliminating lions unless they bring in financial benefits that outweigh costs.

In many areas, tourism ventures are encouraged with unrealistic promises of wealth creation and/or employment in areas where tourism is unlikely to be sustainable or without sufficient investment in local skills development (Walpole & Thouless 2005; Hemson 2003). In these circumstances (which might easily be extended to hunting) the potential for wealth generation should not be overstated when setting up a new venture. Having encouraged a community to view lions and wildlife as their own private economic resource, conserving the local lion population might no longer make sense should the economy change (e.g. Zimbabwe) or the venture fail to live up to economic expectations of a growing population. That's not to say that encouraging sport hunting and tourism is bad, but an enormous amount of work remains to identify the components of a successful venture.

Lion attacks on humans

Although depredation of livestock may be the most widespread form of human-lion conflict in Africa, lion attacks on humans are not uncommon. This form of conflict poses unique challenges for lion conservation that must balance the needs of local people and the long-term viability of lion populations. Historic man-eating lion outbreaks like the 'Man Eaters of Tsavo' have become modern-day legends and such cases of sustained localized outbreaks have occurred throughout Africa for millennia. One of the worst recorded cases occurred in the Njombe district of southern Tanzania in the 1930s, when lions killed about 1,500 people in a 150 square mile area over a 15 yr period (Peterhans & Gnoske 2001). Perhaps equally shocking is the level of attacks currently occurring in southeastern Tanzania. Since 1990, lions have killed close to 600 people and injured at least another 300. This number represents a four-fold increase in attacks in the last 15 years (Packer *et al.* 2005). These attacks are not one large outbreak attributed to a single lion or lion pride but are due to multiple isolated outbreaks geographi-

cally dispersed throughout the country and attributed to dozens (if not hundreds) of lions.

A number of factors are believed to contribute to man-eating outbreaks by lions, including passive provisioning with human remains, attraction to livestock, lion social traditions and behavior, poor health or injury, vegetation and habitat characteristics, climate and seasonality, and prey depletion (Peterhans & Gnoske 2001). It is likely that for both historic and current outbreaks a number of these factors are working simultaneously. Passive provisioning of lions with human remains may have played an important role in historic man-eating outbreaks. Human remains are likely to have been left unburied as part of the brutal history of the slave- and caravan-trading routes, as well as from disease epidemics and human warfare. Provided with this easy source of food, lions may have developed a taste for human flesh, potentially leading them to seek live human prey. Lions may also be attracted to humans due to their possession of livestock. If a lion kills a person while raiding livestock, it might subsequently begin preying on people (Peterhans & Gnoske 2001).

Lions may pass on the behavior of attacking people to their offspring. This is especially likely during long outbreak periods where multiple generations of lions are involved. In addition to learned behavior, lion attacks on humans may be spurred by competition between prides and by expulsion of juveniles from their natal prides. The stress suffered by a small pride living next to a large pride was implicated in a 1991 outbreak of man-eating in Zambia (Yamazaki & Bwalya 1999). Data collected outside Tsavo National Park in Kenya indicates that most problem lions were less than five years old and had most likely left the park because they were unable to establish themselves in existing territories. By leaving the park, these lions were more likely to encounter people and attack livestock or humans (Patterson *et al.* 2003).

It is possible that some outbreaks of man-eating started because lions tend to attack prey that is either ill or behaving abnormally. In some cases, inebriated men became targets due to their abnormal behavior after leaving a bar late at night (Schaller 1972); this was also the circumstance of Kenya's only recorded case of human predation in recent years. Another important factor may be the health and age of the lions themselves. Malnourished, wounded, or aged lions that have difficulty catching their normal prey may start capturing humans. Historic man-eating incidents have been attributed to lions with tooth ailments, dam-

aged limbs, and porcupine quills embedded in their paws (Peterhans & Gnoske 2001, Patterson *et al.* 2003).

Environmental factors such as vegetation, habitat, climate, seasonality, and prey availability may all affect the likelihood of lions attacking people. Vegetation cover and habitat can have an impact on a lion's ability to capture prey. In some cases, a certain amount of cover is crucial for hunting success, but in others, cover type may actually hinder hunting abilities. Dense cover near human settlement may provide areas for lions to hide undetected and stalk people from close distances without being noticed. But in tall grasses that rustle easily, lions may sometimes find it harder to catch their natural prey, making them more likely to turn to humans as food (Peterhans & Gnoske 2001). Floods may create barriers to movement and separate lions from their natural prey. Prey depletion due to disease, drought, habitat degradation, and over-hunting have all been implicated in man-eating outbreaks. In Njombe, where as many as 1,500 people were killed over a 15 year period, the outbreak was attributed to the establishment of a large game-free zone by the British to prevent the spread of rinderpest to livestock (Peterhans & Gnoske 2001).

Environmental and behavioral factors are likely to interact to create man-eating outbreaks and to vary across man-eating incidents and geographical locations. In southeastern Tanzania, prey availability, habitat type, seasonality, and human activities all contribute to chronic man-eating outbreaks. Attacks are highest in districts with the lowest abundance of natural prey and the highest abundance of bush pigs (Packer *et al.* 2005). Subsistence hunting and habitat degradation due to fire and agriculture may have depleted the mid-sized antelopes in these areas. Bush pigs, unlike other mid-sized prey, flourish in human dominated agricultural areas, as they are such adept crop raiders. In addition, because southeastern Tanzania is predominantly Muslim, bush pigs are not common targets of subsistence hunting. The most common context of attacks is when people are tending crops (27% of all cases), and almost 40% of attacks occur during harvest time (March-May), which coincides with the wet season (Packer *et al.* 2005). During this time, people sleep in their fields in makeshift huts to protect their crops from bush pigs. The compounding factors of prey dispersal during the wet season, bush pig attraction to human-dominated areas, and people being especially vulnerable in makeshift huts, makes tending and protecting crops the most common context for lion attacks. Other activities associated with a high risk of attack are walking alone in the early morning and evening hours when lions are active, going to the

outhouse at night, and participating in retaliatory lion hunts (Packer *et al.* 2005).

Aside from being a major threat to people, man-eating outbreaks also cause a major threat to long-term lion population viability. People who fear for their lives and safety are, at best, unlikely to support conservation effort and, at worst, likely to retaliate by killing any lions found near human settlements. Poisoning of bush pig carcasses is not uncommon and in one case, the body of a human victim was dosed with poison to kill the offending lions. District game officers in Tanzania kill numerous lions each year in retaliation for attacks. Since 1980, game officers in Tunduru district killed 83 lions; almost half of these were killed after a major man-eating outbreak in the late 1980s. In Rufiji district, 94 lions were killed by game officers and another 34 were injured between 1980 and 1990 alone. Although no one would question the killing of lions that put people's lives in danger, it is evident that retaliatory killing of lions poses a substantial threat to lion populations in southeastern Tanzania.

Solutions

Solutions to the current man-eating lion problem in southeastern Tanzania must balance the needs and safety of local communities with lion conservation efforts. The most promising solutions to such conflict may involve assisting local residents in making their day-to-day activities safer. In areas where bush pigs are a major problem, bush pig control would reduce the need for people to sleep in agricultural fields and limit contact between lions and humans. Additional measures would include encouraging people to avoid walking long distances during high-risk times of day and building visual barriers to surround their homes, outdoor toilets, and cooking areas. People are also drawn to wildlife areas to collect water and firewood, so providing water sources in the village center and developing alternatives to firewood collection on foot would also limit human contact with lions. In addition, improving the speed and thoroughness of the responses by district game officers would greatly reduce the likelihood that the same lion or lions would kill numerous people before being caught and killed. Lastly, in order to maintain viable lion populations that do not pose a constant threat to neighboring villages, efforts to conserve habitat and increase mid-sized lion prey are critical. Unless lions have alternative sources of food, they will continue to turn towards humans as an easy source of prey. It is only with a combined effort that takes into account improving

human safety, rapid response to attacks, and habitat health that man-eating outbreaks in southeastern Tanzania will be prevented. Without such effort, there is a risk of complete extermination of lions from these areas. In Njombe, home to the most deadly man-eating outbreak in history, lion attacks no longer occur because lions have been eradicated from the area. With Tanzania hosting almost 50% of Africa's lion population, man-eating outbreaks threaten not only human lives and livelihoods, but also threaten lion survival throughout Africa.

Conclusions

Large carnivores are among the most problematical animals to conserve because their feeding habits inevitably bring them into conflict with humans. At the same time, their wide ranging movements and need for substantial prey populations require very large areas, and thus only the biggest protected or well-managed landscapes currently provide relative long term security for viable populations; only six such areas currently exist in Africa. Elsewhere, we will either learn to live with lions or we will lose them. We have shown that ancient livestock husbandry methods effectively protect livestock from lions, and data on the socioeconomic and ecological circumstances that lead to man-eating gives us confidence that proper management can minimize attacks on people. However, spears, bullets and poison are always cheaper and easier solutions than managing livestock, lions or growing rural human populations. Thus, rural people must perceive lions and other wildlife as valuable commodities if they are to accept the burden of living with animals: the benefits of wildlife must outweigh the costs. Effective lion conservation must combine effective management of risks with development of viable wildlife-based economies that improve the lives of rural Africans. Traditional peoples and wildlife managers already have most of the techniques necessary to manage depredation, but the greater challenge of managing ecologically sustainable rural development lies in the realm of policy, social science and politics.

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7 Status, trends and threats for lion populations in the Republic of Guinea

Aboubacar Oulare

Abstract
Although the national legislation in Guinea classifies the lion as a protected species, the lion is still facing a variety of threats. The lions are all confined to marginal regions in the country, which can be divided into four main sectors. The reduction in lion numbers is primarily related to a reduction of habitat but also caused by a decrease in prey numbers and the occurrence of conflicts between people and lions. Calling stations appeared to be ineffective for the purpose of counting lions, since not a single individual responded to a calling station, for unknown reasons. However, the authors are convinced of their existence and the total population is estimated at 350 individuals. The implementation of the micro-project ROCAL enabled for the first time lion conservation action in the country. The innovative character of the activities described in the ROCAL plan created possibilities and initiated i) awareness amongst human populations in and around the National Park by using statements of the Holy Koran; ii) the implementation of an operation trying to limit problems associated with lions moving outside park boundaries in cooperation with hunters from villages; iii) to sensitize inhabitants of villages bordering parks and explain the importance of conservation.

Introduction

With a surface area of 245,857 km² and average human density of 28 inhabitants per km², Guinea's landscape is characterized by various ecosystems, including tropical humid and dry forests, Soudanian savanna and Guinea savanna. In the past, lions were distributed throughout the savanna areas, being only absent from humid forests in the south. Since the 1950s, lion numbers have markedly declined. This observation of decreasing lion populations corresponded with a reduction in natural habitat of approximately 50-60%. Lion populations are now centered on four principle regions, where human population density is estimated at approximately 5 inhabitants per km². Three of these four areas are on the border with neighboring countries:

- Centre: Biosphere Reserve of Upper Niger in Guinea;
- East : Faunal Reserve of Kankan bordering Mali and Ivory Coast;
- North: transfrontier protected area with Mali covering 26,600 km² and transfrontier complex of Nioko-Badiar with Senegal with 20,000 km² in Guinea;
- North-West: protected transfrontier area of Cogon-Korubal and Nunez between Guinea and Guinea-Bissau of 17,000 km².

Despite the official protection of lions and their classification as 'Integrally protected' by the Guinean law (protection code for wildlife and hunting regulation/ 1997 law), current conservation efforts for large carnivores in Guinea have not had their desired effect. Major factors affecting lion populations in the country include loss of habitat and prey due to conversion for agriculture, cotton in particular; exploitation of lion parts; poaching; frequent bush fires; industrial exploitation of gold and diamants; and a negative public image of the lion, which is perceived as a danger and its conservation as a useless luxury.

The attention for lions in Guinea has recently increased as a result of both increased awareness that lion population numbers and its habitat are rapidly decreasing, and the evolution of legal frameworks on the protection of habitats and wildlife. Although lion numbers are not particularly high in Guinea, the remaining populations are of extreme importance especially in terms of the exchange of genetic material across boundaries.

Recent lion surveys in Guinea

The implementation of the micro-project ROCAL enabled for the first time lion conservation and survey action in the country. The innovative character of the ROCAL plan created possibilities and initiated i) awareness amongst human populations in and around the National Park by using statements of the Holy Koran; ii) the implementation of an operation trying to limit problems associated with lions moving outside park boundaries in cooperation with hunters from villages; iii) sensitization of inhabitants of villages bordering parks of the importance of habitat and lion conservation. Scientifically based estimates of lion population numbers are lacking for the country, although estimates based on interviews with villagers indicate that approximately 20 individuals should still be present in the Central section, 100 individuals inhabit the Eastern section, 200 in the Northern section and 50 in the North-eastern section. Efforts to acquire data on population numbers

using a series of calling stations in the 'Higher Niger Biosphere' and the 'Badiar reserve' failed since no lions responded.

Conclusions

Taking into consideration the dramatic decline in natural habitat for lions it is proposed to prepare inventories of lion populations, within the four centres of distribution which should create an accurate lion survey database. From these results, a micro-project could then be implemented within the national lion conservation strategy. The formulated national conservation strategy will eventually be integrated in the long-term 2006-2015 program.

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8 Hunting of large carnivore in Cameroon over the past 20 years

Jean Paul Kwabong

Abstract
This paper briefly summarizes large carnivore off-take through hunting in Cameroon between 1986 and 2006. Total numbers of mammal species legally hunted in northern Cameroon are presented, in addition to local hunting fees.

Introduction

Figures on hunting off-take are available for longer periods of time for some areas in Cameroon, while in other cases only a few years' data are available (e.g. for the forest zone). Decent statistical information on hunting for the whole of Cameroon is generally lacking; several official government bodies charged with the responsibility do not hold records and the same is true for other national or international organizations present in Cameroon. Apart from the lack of statistics on off-take, other factors such as poaching by M'Bororo livestock herders, who blame the carnivores for taking their livestock and consequently kill them, affect total off-take to an unknown extent. All these factors influence the data which will be presented later. Despite these problems, each year at the start of the hunting season, hunting quota are announced to each hunting guide for his particular hunting zone. Below, the annually generated income through large carnivore hunting over the past twenty years (1986-2006) will be discussed.

Techniques and methods
Hunting can be defined as the extraction of faunal products from their natural habitat, e.g. animals, their trophies, photographs, skin. It can be conducted legally ('hunting'), or illegally ('poaching'). The legal exploitation of wildlife is subject to the implemented regulations. It is defined in article 36, subparagraph 3 of the decree N° 95-466-PM. from July 20, 1995. The act of hunting includes all actions towards:

- The pursuit, kill or capture of a wild animal, or guiding with this purpose
- Photographing or filming wild animals for commercial purposes

Hunting may be subdivided in three categories (small-medium-high), including sports hunting within well-defined criteria. Regarding the hunt of large carnivores, this is performed in the two top categories and particularly concerns the savannah zone in the North Province of Cameroon where the larger part of hunting activities are carried out. The North Province holds three national parks covering an area of 7,300 km^2 and 25 hunting zones (19,466 km^2), altogether occupying 44% of the Province.[1] In total, 23 professional hunting guides and 20 assistant hunting guides are based in the North Province, all working under the strict supervision of MINFOF.[2]

Of the carnivores inhabiting the savanna region of Cameroon: the lion (*Panthera leo*), the spotted hyena (*Crocuta crocuta*), the African wild dog (*Lycaon pictus*), the common jackal (*Canis aureus*), the leopard (*Panthera pardus*), the African civet (*Civettictis civetta*), génette sp (*Genetta genetta*), serval (*Felis serval*), cheetah (*Acinonyx jubatus*); only the lion, spotted hyena, jackal, African civet and serval are officially hunted. The African wild dog, the cheetah and the leopard are integrally protected and can only be hunted with a special authorization. A total of 2076 hunters, originating from 34 countries representing in order of importance French, Spanish, Italian, German, the Austrians, Russian, English, some Turkish, American, Mexicans and African, Asian, and Australian hunters visited the hunting zones in the far Northern Province of Cameroon over the past twenty years.[3] These legally hunted a total of > 11,000 animals, among others 191 lions, 59 civets, 15 leopards, 6 wild dogs and 42 spotted hyenas (Table 1). A total of 327 carnivores were hunted, or almost 3% of the total number of mammals taken. Lions make up almost 60% of the total carnivore number hunted over this 20-year period. It is surprising considering the general decrease in numbers that the total number of carnivores that were hunted has increased the past few years.

1 Waga Béskérou, Chef of Wildlife Services at the Provincial Delegation of MINEF/north.

2 Ministry responsible for the conservation and sustainable use of wildlife in Cameroon.

3 From the results presented by Mr Kirda; report on hunting activities in the Northern Province.

Revenues

Revenues from tourism in national parks and hunting in hunting zones accumulate to a total of >80 million FCFA or >1.2 million Euro per year.[4] Regarding the hunting tourism, the revenues are generated from: license hunting guide, hunting permit, weapon tax, costs for examination permits, hunting zone rights; for those who want to expand freelance activities in other interesting areas or co-managed hunting areas, a sportive hunting permit has to be acquired in addition to other licenses, such as those needed for capture (Table 2 for examples). On top of these come costs for exploitation of fauna and hunting rights. If the hunter has submitted a demand to export a trophy with MINFOF, these can be extended including a certificate of origin. This certificate carries the following details: scientific name, CITES classification, country of origin, hunting permit number, weight, serial number, reference numbers of hunting right.

Table 2 Fixed costs for hunting permits in the North Province, in Euro (since 1996)

A – Permit for medium sportive hunting

Solliciters	Permit	Admin fees	Add fees
Nationals	76	8	22
Residents	183	8	52
Tourists	244	8	335

B – Permit for high sportive hunting

Solliciters	Permit	Admin fees	Add fees
Nationals	153	15	37
Residents	229	46	159
Tourists	382	76	655

C – Hunting guide

Solliciters	Permit	Admin fees	Add fees
Nationals	611	153	76
Residents	1,985	153	229

4 Waga Béskérou, Chef of Wildlife Services at the Provincial Delegation of MINEF/north.

D – Assistant hunting guide

Solliciters	Permit	Admin fees	Add fees
Nationals	305	76	76
Residents	916	153	153

Conclusions

The medium and high level hunt on carnivores in Cameroon has for the past 20 years its limitations at several levels, especially in the wildlife areas of the North Province. It is necessary that experiences from elsewhere are discussed and incorporated. The preparation of the hunting quota which is performed by the Chef of Wildlife Services, and validated in a meeting consisting of the Governor of North Province, a ministerial delegation, the representative of MINFOF/north, the Chef of Provincial Wildlife Services, the park wardens and hunting guides, is not supported by a valid scientific argumentation at this point. Instead of a fixed off-take system, adaptive hunting quota set on the basis of regular wildlife monitoring would be more sustainable and advisable. Regarding the relative rarity of carnivores and the fact that they are increasingly popular hunting targets, a re-evaluation of the current system on the basis of scientific data is now needed more than ever.

Table 1 Mammals hunted between 1986-2006 in the North Province of Cameroon

Species/year	86	87	88	89	90	91	92	93	94	95	96	97	00	01	02	03	04	05	06	Tot
Buffon's Kob	44	43	63	68	89	79	68	41	70	69	58	57	44	97	103	93	105	100	106	1,397
Hartebeest	49	34	42	55	79	70	68	56	68	73	56	45	44	76	73	76	81	83	80	1,208
Buffalo	21	23	12	32	36	38	52	40	52	45	46	46	41	62	45	66	69	79	77	882
Roan antelope	43	22	13	37	44	43	44	42	56	41	38	41	32	56	59	60	59	61	53	844
Reedbuck	30	18	26	38	60	42	32	44	47	56	46	42	50	72	67	58	64	58	49	899
Bushbuck	29	24	18	36	41	42	35	36	57	33	50	41	43	68	76	73	84	89	79	954
Waterbuck	42	21	24	37	32	40	28	24	45	32	42	32	29	71	52	62	58	63	53	787
Oribi	32	19	18	37	54	44	42	30	54	43	44	27	28	61	53	45	48	47	45	771
Derby's eland	11	12	13	16	28	38	33	24	34	41	33	36	31	52	46	54	71	61	61	695
Warthog	16	9	20	19	22	24	20	19	33	37	33	23	23	33	38	28	31	27	21	476
Elephant	18	18	29	21	32	16	22	11	32	18	15	3	15	40	24	28	24	18	18	402
Grey Duiker	8	9	6	31	32	24	15	16	28	42	35	29	26	47	46	36	46	51	40	567
Red-fl. Duiker	9	5	9	2	15	16	12	11	17	22	27	24	22	43	49	32	35	50	46	446
Baboon	4	5	6	3	13	9	7	9	10	28	11	20	14	21	32	21	30	28	22	293
Lion	4	6	8	8	15	12	18	9	12	7	8	11	12	13	8	8	6	13	13	191
Hippopotamus	1	0	5	7	9	8	8	3	9	3	7	0	2	10	12	10	7	9	6	116
Civet	1	0	1	0	0	1	3	2	2	7	5	7	0	5	7	3	6	7	2	59
Leopard	4	3	0	4	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	15
Patas monkey	1	0	1	1	0	0	1	2	0	1	2	0	0	0	1	1	0	2	0	13
Spotted hyena	0	0	0	0	0	1	2	0	0	5	1	1	2	8	8	4	1	5	4	42
Jackal sp.	0	0	0	0	0	0	0	0	0	0	5	3	1	1	1	0	1	5	1	18
Vervet monkey	1	0	0	0	0	0	0	1	0	1	2	1	0	1	2	0	0	0	0	9
Wild dog	0	0	0	2	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	6
Porquipine	0	0	0	0	0	0	0	1	0	0	1	1	0	7	2	6	2	0	1	21
Serval	0	0	0	0	0	0	0	1	0	1	0	1	0	0	2	2	0	1	2	10
Genet sp.	-	-	-	-	-	-	-	-	-	0	0	2	0	2	0	1	1	1	0	7
Red-fronted gazelle	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	1	1	1	0	7
Total	368	271	315	455	603	549	510	422	626	608	566	493	459	846	806	768	830	808	779	11,135

From 1986-1997: results of Philippe Kirda; 2000-2006: results of Derric TABI.

9 Conservation and management of lions in Southern Africa: Status, threats, utilization and the restoration option

Paul J. Funston

Abstract

The declines in lion numbers and distribution recorded throughout its range are typical also of the situation in southern Africa, with the largest reduction having occurred in South Africa. There are also fundamental differences in South Africa, as compared with other countries in the sub-region, with lions being restricted to fenced reserves. However, the presence of these fences, along with a substantial increase in wildlife related tourism in the country, has resulted in 25 new lion populations having been established in the last 15 years. Collectively these reserves cover an area of 5702 km² incorporating about 460 lions. The management of lions in these small fenced reserves is complicated primarily by the small size of each subpopulation, and the predation impact on the ungulate populations in each reserve. This has lead to the development of micro-management strategies that are questionable in terms of their desirability, effectiveness, and financial sustainability. These restored populations nevertheless offer the potential for metapopulation management and meaningful conservation benefit. However, as most of these populations are not managed according to metapopulation guidelines, tending rather to be managed as single or isolated populations, it remains doubtful that they individually can make a meaningful contribution to lion conservation. While lion populations in other southern African countries suffer from the negative effects of habitat and prey loss, as well as excessive human conflict and in places trophy hunting mortality, there is evidence that in large conservancies being established in Botswana, Namibia and Zimbabwe, that lion populations are being restored in areas where they were previously extirpated. Some countries in southern Africa clearly also set lion hunting quotas that are not biologically sustainable, and threaten at least four of the seven important populations in the region. There are, however, initiatives underway to bring these levels of utilization in line with guidelines that will ensure a sustainable harvest. The impact of particularly photo-tourism on lions conservation in southern Africa is substantial and is a key to there survival and restoration in many areas.

Introduction

Due mainly to increasing human pressures, and ongoing fragmentation of potential wildlife land, there have been substantial reductions in mammalian large carnivores across all landscapes. Perhaps in Africa these declines have taken longer to manifest than elsewhere. Nevertheless it is clear that large carnivores that either prey directly on man (e.g. lions, *Panthera leo*, Yamazaki & Bwalya 1999, Baldus 2004, Packer *et al.* 2005), or more often on his livestock (e.g. lions, Ogada *et al.* 2003; Ogutu, Bhola & Reid 2005; spotted hyaena, *Crocuta crocuta*, and wild dogs, *Lycaon pictus*, Woodroffe *et al.* 2005) are in peril. This is primarily because of loss of habitat and prey, but of concern also is that the levels of conflict are as intense today as ever before, and possibly increasing.

While it is clear that there have been vast reductions in the number of lions in Africa, the extent, and perhaps more importantly the current trend, have not necessarily been all that well quantified. The only range wide estimate provided for lions in recent times was that of Nowell & Jackson (1996) suggesting that were between 30,000 and 100,000 lions in Africa at that time. This estimate was, however, predominantly based on guess work. Thus when figures of between 16,500 and 30,000 were published more recently (Bauer & van der Merwe 2004), along with a suggestion to upgrade the IUCN status from 'Vulnerable' to 'Endangered' in certain regions (specifically West Africa, Bauer *et al.* 2001), much interest in the conservation status of lions has arisen. It must be noted, however, that the recent lower estimates do not necessarily imply the trend in decline suggested with the two estimates having being derived differently.

This paper mainly looks at the lion in southern Africa, its objectives being to highlight status, identify some of the key problem areas, as well as some of the measures that are being implemented or proposed to mitigate the key source of decline: competition with man for resources and loss of habitat. It will also focus closely on the role of restoration projects to reverse the trends of the last century.

Population estimates and status

Southern Africa still has a fairly large lion population with average estimates ranging from about 10,000 (Bauer & Van der Merwe 2004) to 15,000 (Chardonnet 2002) (table 9.1). For the purposes of this discussion the countries listed in Table 1 are regarded here as southern Africa.

Table 9.1 Southern African countries and comparative population estimates from Bauer & Van der Merwe (2002) and Chardonnet (2004)

Country	Chardonnet (2002)	Bauer & van der Merwe (2004)
Angola	749	450
Botswana	3,207	2,918
Lesotho	None	None
Malawi	25	Not
Mozambique	955	400
Namibia	691	910
South Africa	3,852	2,716
Swaziland	27	15
Zambia	3,199	1,500
Zimbabwe	1,686	1,037
Total	14,391	9,946

The most important lion populations in southern Africa currently exist in northern Botswana and eastern Zimbabwe (Chobe-Moremi-Okavango-Hwange system), central (Kafue) and eastern Zambia (Luangwa), and north-eastern South Africa (Kruger system). Other notable populations occur in the Kgalagadi Transfrontier Park straddling South Africa and southern Botswana, in the Zambezi valley of Zimbabwe and Zambia, and in the Etosha National Park in Namibia. Each of these seven systems was classified as a Category 1 Lion Conservation Units (LCU) at a workshop for southern and east Africa range states (Nowell & Bauer 2006). Category 1 LCU's are regarded as being key areas to protect for the long-term conservation of lions. In other areas of southern Africa there are smaller protected areas than were given lower priority, most notable of which are perhaps the large number of small reserves in South Africa, where lions have been restored.

Looking at their status in southern Africa more closely two clearly sustainable populations of lion in South Africa occur in the former Kalahari-Gemsbok National Park where 92-125 lions survive (Castley *et al.* 2002) but are contiguous with the entire Kgalagadi ecosystem, where 452 exist (Funston 2001), and Kruger National Park and adjoining reserves where about 2000 exist (Bauer and Van der Merwe 2004). The lions in the Kgalagadi Transfrontier Park are possibly still contiguous with a population of about 400 lions in the Central Kalahari Game Reserve. The largest proportion of Botswana's lions (about 2000, Bauer & Van der Merwe 2004), however, occur in the north of the country being contiguous with a population of about 300 lions in the Hwange

area in Zimbabwe. Other important populations in Zimbabwe exist on game ranches and reserves in the south-east (possibly connected with Kruger), and the Zambezi Valley population connected with Zambia. Elsewhere in Zambia reasonable numbers of lions (about 1500) occur in the Kafue and Luangwa systems.

While lions do occur in northern Mozambique in the Naissa system this area is out of the scope of this report. Lions do, however, occur sporadically in central Mozambique from the Zambezi delta south and west wards right up to the borders with South Africa and Zimbabwe. This population is speculatively estimated at 200 (Bauer & Van der Merwe 2004), but reports suggest that the population in Gorongosa National Park is recovering well (R. Beilfuss *pers comm.*)

Human-lion conflict

In a recent analysis Woodroffe (2000) found a positive relationship between historical patterns of large carnivore extinction probability and human population density. However, much of the data in this analysis came from a period when carnivore extermination was a management objective. However, a recent analysis (Linnell *et al.* 2001) found in Europe and North America that large carnivore populations have increased after favourable legislation was introduced, despite further increases in human population density. Thus it is believed that the existence of effective wildlife management structures is more important than human density *per se* (Linnell *et al.* 2001).

Nevertheless, conflict between people and wildlife is a major issue in both wildlife conservation and rural development, especially in Africa (Ogada *et al.* 2003; Woodroffe *et al.* 2006). Retributive killing of large carnivores, especially lions, is seemingly disproportionate in many areas (Ogada *et al.* 2003; Woodroffe & Frank 2005). Such conflict has led to the extirpation of these species from many areas (Woodroffe & Ginsberg 1998), and also impacts the livelihoods of local livestock farmers. The extent and response to problem of lions predating on livestock, however, varies from place to place, ranging from complete intolerance to recognition of the value of wildlife and a tolerance of the presence of lions. Generally it is probably wise to take a fairly pragmatic approach to the management of lions, or lion-conflict, occurring outside national and other formally protected areas. Not all people will tolerate the presence of lions in the area where they live, this seemingly being exacerbated by their inherent fear of lions as a real threat to human life.

This is well illustrated by a study conducted by Hermann & Funston (2001) in the southern Kalahari where farmers responded lethally in 85% of cases where lions were responsible, but only responded with lethal persecution to 55% of cases where other large carnivores were responsible.

To investigate the possibilities for coexistence of people, livestock, and large predators in community rangelands, Woodroffe *et al*. (2006) measured the effectiveness of traditional livestock husbandry in reducing depredation by wild large carnivores. Overall it was found that the risk of predator attack by day was lowest for small herds, accompanied by herd dogs as well as human herders, grazing in open habitat. By night, the risk of attack was lowest for herds held in enclosures ('bomas') with dense walls, pierced by few gates, where both men and domestic dogs were present. These findings suggest that improvements to livestock husbandry can contribute to the conservation and recovery of large carnivores in community rangelands, although other measures such as prey conservation and control of domestic dog diseases are also likely to be necessary for some species (Ogada *et al*. 2003; Woodroffe *et al*. 2006).

As many protected areas that have lions in southern Africa are fenced, or because in many areas lions are only expected to live within the boundary of a park (even if unfenced), the problem of what to do with lions that kill livestock outside the boundaries of these protected areas often arises. In these areas the probability of lion conflict would seem to be sufficiently low such that pastoralists barely, if at all, apply husbandry practices to minimize conflict. This is a large problem for as mentioned earlier the extent of retribution often outweighs the apparent impact. Thus while attempts to improve husbandry practise should be encouraged; in the absence, or partial compliance, of these other measures may be required. Both Stander (1990) and Herrmann & Funston (2001) found that the often advocated translocation of offending lions back into the protected areas was only effective for 'occasional' stock raiders, but that 'habitual' stock raiders should rather be destroyed in the absence of other forms of mitigation. Thus while improved animal husbandry and responsibility is definitely key to sustainable coexistence of lions and people, lethal control may play an important role in avoiding the spread of such behaviours through the population (Woodroffe & Frank 2005).

Trophy hunting

Wildlife based tourism is a management practice that is supposed to encourage coexistence of lions and people through the augmentation of livelihoods via the utilization of lions. However, coexistence is seldom possible in areas with intensive livestock husbandry in communal land. Income generation can be both consumptive (trophy hunting) and non-consumptive (photographic tourism), but photographic tourism is also seldom compatible with communal land due to tourist requirements for wild areas without resident people. If properly managed hunting has the potential to provide large amounts of money for conservation and community empowerment. The lion seems ideally suited to high income generation, because due to the fact that relatively few lions are generally available in an area for hunting, allowing the implementation of substantially higher trophy fees. Furthermore in areas where it might be desirable to reduce lion densities, such as buffer zones and WMA's, hunting can be a useful management tool. However, in some areas concern has been expressed that unsustainable hunting of lions has extensive effects on populations supposedly protected by reserves (Loveridge 2005). This is because their large home ranges make lions originating in protected areas vulnerable to peripheral over hunting (Woodroffe & Ginsberg 1998).

Lions are trophy hunted in most southern African countries with Botswana, Zambia and Zimbabwe the key trophy hunting destinations in the region. The extent of hunting varies substantially between countries, with Botswana being renowned for setting very conservative quotas (e.g. typical quota of 30 lions from the northern population of about 1600 lions, i.e. estimated quota of about 2%). In Zimbabwe and Zambia, however, it has become clear that very high quotas are set in hunting zones adjacent national parks, which have far reaching effects on the populations inside the parks (Yamazaki 1996; Loveridge 2005). In Hwange National Park a very high proportion (75%) of male lions radio-tagged within the park were shot outside the parks boundary, directly affecting home range behaviour of remaining males and the cub survival and persistence of prides near the boundary. Thus while trophy hunting is generally perceived to result in the removal of small numbers of biologically surplus animals, it is clear that in some areas in southern Africa, such as Hwange, Luangwa and Tuli Circle, that quotas and off-take are to high and are negatively affecting those lion populations.

While it is clear that lions can be negatively affected by excessive hunting, it is also evident that they have tremendous potential to persist un-

der, and recover from excessive utilization (Smuts 1978). This is well illustrated in the example from the Kunene in Namibia above (Stander & Hanssen 2005), and in Kruger National Park were lions had almost recovered to former densities within two years of an extensive culling operation. However, excessive and sustained removal of lions from small populations may have wide-reaching effects on population biology and demography as shown in Hwange (Loveridge 2005). Specific effects of over-utilization in lions are likely to include, a) reduced male tenure resulting in lower cub survival, b) increased take-over rates resulting in lower cub survival, c) distorted sex ratios resulting in declining pregnancy rates and reproductive collapse, and d) reduced genetic diversity. As with genetic impacts, altered sex ratios and cub survival rates may have as yet undetected negative consequences. Thus because of these potential impacts, monitoring of trophy quality and age, hunter effort and populations size and demography will be crucial to a sustainable and well-regulated harvest (Treves & Karanth 2003).

Culling has been applied at various times and reserves in South Africa, and while culling did not really make a significant impact when applied in one area of the Kruger National Park in the 1970's (Smuts 1978) it very effectively slowed down the recovery of the lion population when the park was first proclaimed (Stevenson-Hamilton 1903-1945). Elsewhere in parks such as Hluhluwe-Umfolozi Game Reserve culling, mainly to reduce human-lion conflict on the edge of the reserve, effectively reduced the lion population to very low levels (Anderson 1981).

Lion restoration program in South Africa

With increased human population pressures and continued fragmentation of the landscape, the remaining habitat of wide-ranging carnivores has become more and more critical. Biologists and managers are increasingly forced to adopt interventionist approaches to carnivore conservation, among them, species reintroduction. Large carnivores are frequent subjects for such projects. Their ecological demands and potential for conflict with humans make them among the first species to disappear from an area. However, ironically, large carnivores frequently symbolize wilderness to the general public who express great interest in their reintroduction. Despite this high profile with the public, high cost and logistical complexity of such projects, many efforts involving large carnivores have received little post-release monitoring and those that have record limited success (Linnell *et al.* 1997).

In 30 large carnivore reintroductions reported from Africa where the final outcome was known, only nine were considered successful (Breitenmoser *et al.* 2001). Yet many more translocations of large predators have occurred in Africa and this lack of published information has not resulted from a lack of translocations, but rather conservation managers have been busy implementing translocations rather than writing about them. Given the global problem of large carnivore decline (Weber & Rabinowitz 1996), documenting the results of such attempts is crucial to future conservation management efforts and overall conservation success.

In South Africa, recent dramatic political changes have given rise to an extensive reassessment of the historical use of land (Wells 1996). Revenue from increased eco-tourism to South Africa is viewed as a potentially lucrative alternative to subsistence and intensive farming practices which are usually at odds with wildlife. As a result, government, private land owners and local rural communities are all attempting wildlife reintroduction projects on a scale that is not occurring anywhere else in Africa. For most such projects the ultimate objective is to re-establish the large carnivores, in particular the lion, as the single most sought-after species for tourists visiting reserves.

As they have such a high profile with the general public, the information collected from these efforts may be applied to other carnivore restoration projects in different parts of the world (Hunter 1998). Furthermore, as the human population continues to grow in Africa and place enormous pressure on wildlife populations, the opportunity for these exercises on such an extensive scale may not present itself again. As a result there are several research programs housed at South African universities studying the restoration of lions and other large carnivores.

In South Africa since 1992, lions have been reintroduced into at least 27 privately and publicly owned reserves covering a combined land area of 6002 km^2. This is potentially a significant increase in lion real estate, and currently supports a population of about 460 lions, growing at an average rate of about 30% $year^{-1}$ (table 9.2). While it will be made clear later that these populations are not necessarily easily managed, however, with sufficient will these various populations could be effectively managed as a meta-population of some significance. While a registry of the dates of births and genealogy of the lions in many of these reserves is being kept it still remains an open question to see if these lions will meaningfully contribute to biodiversity conservation (Hunter *et al. in press*).

Table 9.2 Private and provincial protected areas where lions have been introduced since 1992

Reserve	Size (km^2)	Date lions introduced	Number of founders	Growth rate	Estimated current population size in 2006
Addo National Park	134	2003	6	1.51	12
Entabeni Game Reserve	25	1999	4	1.59	8
*Hluhluwe-Umfolozi Game Reserve	890	1958	7	1.22	80
Kapama Game Reserve	100	1995	6	1.28	12
Karongwe Game Reserve	85	1999	4	1.41	11
Kariega Game Reserve	50	2004	4	1.25	6
Kwandwe Game Reserve	200	2001	4	1.62	12
Lalibela Game Reserve	75	2003	3	1.25	4
Ligwalagwala Game Reserve	140	1998	13	1.37	15
Lowhills Game Reserve	40	1999	4	1.23	8
Makalali Game Reserve	150	1994	5	1.29	18
Madikwe Game Reserve	650	1995	12	1.28	60
Madjuma Game Reserve	15	1992	6	1.25	10
Marakele National Park	650	2004	3	1.00	4
Mapungubwe	300	2005	10		10
Methethomusha Game Reserve	80	1996	4	1.37	10
Phinda Resource Reserve	170	1992	13	1.18	23
Pilanesberg National Park	550	1993	19	1.22	40
Pumba Game Reserve	65	2004	3	1.25	6
Scotia Game Reserve	16	1996	6	1.25	6
Selati Game Reserve	250	2003	6	1.34	12
Shambala Game Reserve	110	2000	4	1.25	8
Shamwari Game Reserve	187	2000	6	1.41	15
Thembe Game Reserve	300	1998	4	1.37	12
Thorny Bush Game Reserve	110	1995	6	1.27	22
Venetia-Limpopo Nature Reserve	330	1992	9	1.34	22
Welgevonden Game Reserve	330	1997	5	1.17	20
Total	5,702		166	1.30 + 0.03	457

*The Hluhluwe-Umfolozi lion population has been supplemented recently due to genetic concerns

During the process of a lion reintroduction management invariably has to accept that each area and population will respond uniquely to an introduction, and adaptive management techniques and skills are essential (Van Dyk 1997). The main aspects that need to be addressed by management include population growth, genetic integrity, and predator-prey relationships. Re-established lion populations have been found to increase rapidly under conditions of plenty (Druce *et al.* 2004; Kilian & Bothma 2003), and thus are generally managed to regulate population growth (Peel & Montagu 1999). Population regulation, and to a lesser extent maintaining genetic integrity of lion populations, appears to govern most current management strategies for reintroduced lion populations (Van Dyk 1997, Kilian & Bothma 2003).

When discussing lion management, specifically in South Africa, it is useful to classify reserves according to size, with the intensity of management seemingly increasing as reserves get smaller. Large reserves (>1000 km²) like Kruger National Park opt for extensive management where management have accepted a 'hands off' approach. Population regulation, avoidance of inbreeding, and predator-prey dynamics (Mills & Shenk 1992) are all self regulatory. Management of lions is thus concentrated mainly on problem animals and situations of conflict, where for example, lions exit the park and come into contact with humans.

All 27 reintroduced lion populations in South Africa occur in small- (<100 km²) and medium-sized (100-1000 km²) reserves. In medium-sized reserves some natural functions are allowed to take their natural course, while other aspects tend to require semi-intensive management (Bothma 2002). Small reserves seem to necessitate intensive management, and in most the possibility for natural ecological dynamics of both predator and prey populations is questionable (Power 2003). Reserves with reintroduced lion populations are all fenced with predator-proof, electrified fencing ensuring minimum risk of conflict and that they can be managed as distinct ecological units. Each also has electrified bomas enabling a pre-release captivity period (soft-release), and here there has been considerable development of the technical know-how and guidelines from soft-release to post-release management and monitoring (Van Dyk 1997; Van Dyk & Slotow 2002, 2003; Hunter *et al.* *in press*)

The earliest document lion reintroduction occurred in Umfolozi Game Reserve in kwaZulu-Natal in 1958, when lions apparently self-reintroduced after a twenty year absence (Steele 1970). The current population of about 80 individuals stems from one of these recolonisers, plus six

that were reintroduced from reserves adjacent to Kruger in 1965 (Rowe-Rowe 1992). In 1999 new genes were supplemented into the population, with the introduction of 3 male and 3 female lions into the northern section of Hluhluwe. In 2000 four lionesses where introduced into Umfolozi, with an additional six lionesses being introduced in 2002. Almost immediate inter-breeding between the existing and introduced lions was interpreted as an early success of the project (Reid 2002).

In the North-West province Pilanesberg National Park and Madikwe Game Reserve had vast wildlife reintroduction programmes during their creation. Lions were reintroduced to Pilanesberg in 1993, and by 2001 a population of 60 was present (Van Dyk & Slotow 2003). The population is currently held at about 40 individuals; a management response to excessive impact on both rare (Rymer & Du Toit *in press*) and common (Tambling & Du Toit 2005) ungulate species. Madikwe's Operation Phoenix involved the largest translocation of wildlife in the world with 8,200 individuals of 27 species reintroduced during the mid-1990s (Hofmeyr *et al.* 2003). Twelve lion were reintroduced to Madikwe from Pilanesberg and Etosha (Hofmeyr *et al.* 2003). By 2001, this founder population had increased to 53, along with 20 that were removed to stock other reserves (Hofmeyr *et al.* 2003). The population is currently regulated at about 60 individuals.

In the Limpopo province five lions (three from Pilanesberg National Park and two from Madikwe Game Reserve), of varying degrees of relatedness were reintroduced to Welgevonden Game Reserve in 1998 (Killian & Bothma 2003). A lioness and her four cubs were reintroduced to Makalali Game Reserve in 1994 and by 1999, when two unrelated males were introduced, 35 offspring had been produced (Druce *et al.* 2004). Both populations increased very quickly with small founder populations being introduced to relatively large reserves. Lions recolonised Venetia-Limpopo Nature Reserve as the reserve was consolidated in 1992. The lions probably originated from the nearby Northern Tuli Game Reserve in Botswana, and had increased to 25 individuals by 2000 from an estimated original nine. Subsequently through indiscriminate trophy hunting the lion population had declined to eight individuals by the end of 2004, with the population currently having recovered to 22.

The lion disappeared from the western half of the Eastern Cape in the 1850s, but ten conservation areas in the Eastern Cape have reintroduced large predators since 1996. Lion have clearly been the most successful species reintroduced to the Eastern Cape. The 2005 population of lions stood at 56 individuals after 35 were reintroduced and 49 cubs are

known to have been born. In Phinda, 7.2 lion cubs were born per year for the first six years following reintroduction (Hunter 1998), while in the Eastern Cape lions produced either 4.7 or 7.3 cubs per year after release.

Thus it appears that lions rapidly become overabundant in most small reserves where they are introduced, and it has thus been found that competitively dominant carnivores like lions are more resilient to the reintroduction process than more threatened species because they are free from competitive persecution. Despite the success none of the reintroduced lion populations in South Africa have more than the 50 breeding individuals considered necessary to protect from genetic problems (Frankham 2005), with only sites as large as the 20000 km² Kruger and 36000 km² Kgalagadi Transfrontier National Parks being considered large enough to support genetically viable populations. Consequently continued supplementation and mixing of new genes will be fundamental to the long-term conservation of lions in these reserves

However, once the reintroduction process is complete, management tend to find that a need soon arises to manage several other aspects of the lion and prey populations. One of the initial problems faced by management is the impact of these large carnivores on their ungulate prey base (Peel & Montagu 1999). However, managers need to recognize that declines in prey numbers are affected by many factors, predation being only one of these, and that ungulate populations should be allowed to vary within established lower and upper limits. Thus managers should be aware that the dynamics of specific animal populations cannot be separated from those of associated populations or from the environment as a whole (Smuts 1978).

Due to the high population growth rates of reintroduced lions the genetic integrity or health of the population soon comes into question, with related individuals mating more frequently than would be expected in normal lion populations. As no medium-sized reserve in South Africa has genetically viable populations this will inevitably lead to these populations becoming genetically compromised in much shorter periods of time than would normally be expected and thus forcing management intervention at a very early stage of the reintroduction process.

There is little evidence as to whether the effect of inbreeding poses a threat to the future of lions as a whole, but there is concern as to the long-term viability of smaller, isolated populations (Kissui & Packer 2004). Lowered genetic variation within populations reduces the op-

portunity for adaptation, resilience to disease outbreaks, and may result in reduced reproduction or survival, thereby reducing the viability of the population (Madsen, Stille & Shine 1996).

The management of lions in small- and medium-sized reserves has thus been shown to be complex, and a variety of management aspects need to be successfully addressed to conserve these populations. The question really is, should these reserves be allowed to manage their lion populations purely for tourism and financial gain, or should they be held accountable for also improving the conservation status of the species?

Jolley (2005) showed that managers can predict when new male lions need to be introduced into small restored population so as to prevent inbreeding in a population (figure 1). It would be necessary to combine this with strategic removal of individuals that have already contributed to the population, trophy hunting being a logical option that offsets some of the management costs. The time parameters established by Jolley (2005) is surprisingly similar to that of Beier (1993) who found that as few as between one and four animals per decade could significantly decrease the risk of inbreeding depression in small isolated populations of cougars. I thus argue that much of the artificial manipulation of pride and coalition structure in current management strategies is excessively intensive and approaches micro-management.

Depending on the objectives of the reserve, and the relative conservation value of each reintroduced lion population, their management could possibly be divided into two separate management strategies, namely a metapopulation or a single population management approach. While some reserves in South Africa manage their lion populations according to a metapopulation approach, as many are merely managing each population as a single entity. Reserves managers, perhaps in conjunction with species conservation consultants, need to decide which of the two different management approaches should be applied.

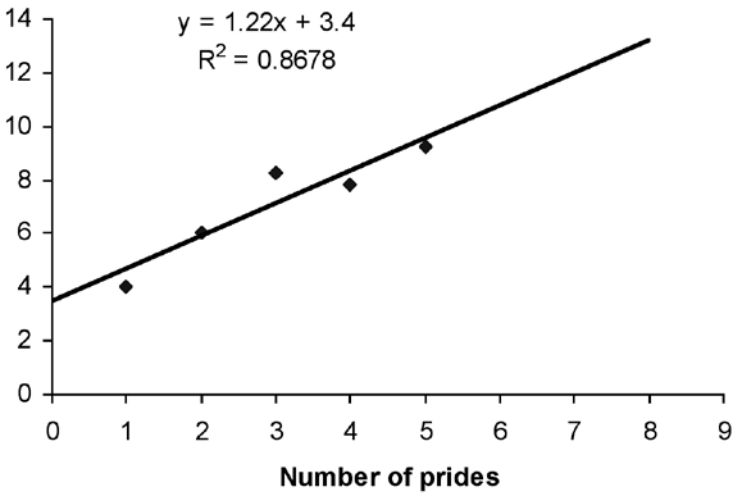

Figure 9.1 The time frame depicting when the first inbreeding events would probably occur and thus when new genetic material should thus be introduced (from Jolley 2005)

Metapopulation management approach

Metapopulation theory implies that populations with independent dynamics are spatially structured into assemblages of local breeding populations with small amounts of immigration taking place (Hanski & Simberloff 1997). The predictions of metapopulation models have been supported by studies of real metapopulations, reinforcing the assumptions that genetic diversity within and among local population subunits is strongly influenced by characteristics and methods of dispersal (Hanski & Simberloff 1997). Artificial dispersal opportunities created by management facilitate immigration and emigration, with even modest rates of immigration being able to counter the effects of inbreeding depression, loss of diversity by drift, and demographic and environmental stochasticity (Simberloff 1988; Schaffer 1987). This approach thus seems a sensible and a viable management option available to maintain healthy lion sub-populations. This approach does, however, require a detailed and up-to-date stud book of all populations through continual monitoring thereof, as well as frequent immobilization, veterinary involvement, and logistical co-ordination for successful genetic exchange. The establishment of a management liaison committee would be required in order to facilitate the movement of individuals to and from reserves.

Metapopulation management has been applied in the management of wild dog populations in medium-sized reserves in South Africa, resulting in an increase from 19 individuals in 3 packs in 1997, to 54 individuals in 10 packs prior to denning in 2002 (Lindsey 2003). The target population size for the wild dog metapopulation was achieved in just over half the time that was expected (Mills *et al.* 1998). However, recent further growth in the wild dog metapopulation in South Africa has resulted in substantial difficulties in both maintaining the metapopulation management approach and more importantly deposing of dogs assumed to be in excess (M.G. L. Mills *pers. comm.*). Due to current management views and approaches lions face the same challenges with culling being a very real consideration that has recently been employed in Pilanesberg National Park (S. Dell *pers. comm.*)

Single or isolated population management approach

The concept of this management approach is that each reserve is considered a separate units, with each lion population being managed as an 'island' population, the genetic integrity of the population should ideally be carefully managed in order to avoid inevitable inbreeding.

The same principles could be employed to minimise inbreeding, but importantly here various source populations of genetically diverse lions would be required to supplement each reintroduced population. This form of management would probably not require very extensive communication between other reserve bodies.

This form of management may yet prove to best suit reserve managers, and may be a more financially viable method of lion management in medium-sized reserves. This approach importantly demonstrates that lion populations in medium-sized reserves, where the primary goal and objective is that of tourism, can be maintained using a less intensive management approach.

Lion restoration in other southern African countries

Lion populations are currently not only being restored in South Africa. In Zimbabwe there are several large conservancies where lions until recently were extirpated, but are starting to re-establish. A population of about 45 lions is present on the 400 km² Malilangwe Estate in south-eastern Zimbabwe, which was established in the early 1990's

(Lunt 2005). This reserve shares its southern boundary with Gonarezhou National Park, where a population of unknown size is present. Another population of lions is currently establishing itself in the Save Valley Conservancy (± 3000 km²), which also adjoins Gonarezhou (P. Lindsey *pers. comm.*). There are currently about 60 lions in this population, but the expectation is that the population will grow to at least 200 lions in the next few years. In south-western Zimbabwe, Sentinel Ranch and Nottingham Estate form part of the Shashe-Limpopo Transfrontier Conservation Area (TFCA), and will potentially be recolonised by lions soon, as has the Mapungubwe National Park south of the Limpopo River in South Africa. To the north-east of Sentinel, another introduced population of lions occurs in the Bubye Conservancy (these were brought in from Namibia), but there is no data available as to whether these lions move into the proposed TFCA; the conservancy was until recently completely fenced (Purchase & Wilson 2005). For tourism purposes female lions were also introduced to the Bumi Hills Estate (50 km²) west of Matusadona National Park, which attracted immigrant sub-adult males to form a new resident pride (Hoare & Williamson 2001).

Similarly in Botswana the increase in the number of game farm operations in the vicinity of the Northern Tuli Game Reserve (south-east), and the Ghanzi (north-west) and Kalahari (central-north) districts, all offer tremendous potential for lion populations to expand into. It would seem likely that similar expansion is possible in Namibia, with lions already having been introduced into the large game farms adjacent to the Kgalagadi Transfrontier National Park. A common management theme that will inevitably have to be addressed in all these new populations is concerns by largely private land owners about the predation impact of lions on prey populations. This aspect needs urgent research attention, and perhaps more importantly extensive education.

Elsewhere in Namibia the desert adapted and coastal roaming lion population that exists in the Skeleton Coast Park, and surrounding communal conservancies, was thought to have disappeared completely in 1988 after skirmishes with pastoralists (Stander & Hanssen 2005). However, recent surveys indicate that about 100 lions currently occur in this population, illustrating the resilience and speed of recovery of lion populations.

Captive Breeding and 'canned' hunting

An aspect of concern is that particularly in South Africa it is estimated that about 3000 lions occur in captive breeding facilities. The vast majority of these are bred for sale to newly established breeding facilities, and ultimately many of these are killed by tourist hunters as part of what is termed 'canned lion hunting'. Generally these lions are released into roughly 1000 ha sized camps a few days before the hunt is to take place. An effort is, however, being undertaken by the South African government to curtail the growth in this industry, and possibly to stop it via the imposition of operational restrictions. However, if breeders can comply with the regulations it will still be possible for lions to be ranched specifically for hunting. However, it will be required that they are wild in the sense that they live in large enough areas to sustain themselves by hunting themselves, and are expected to function in normal social units.

There is also substantial interest in Botswana, Namibia, and Zimbabwe in ranching lions, but it seems as if the holding of lions in small camps for release into hunting camps is unlikely to be allowed in these countries. Lions will, however, probably be able to be stocked into game ranches that are large enough for the lions to be classified as wild. In Zimbabwe already a new tourism activity, 'walking with lions' has been developed. Here tamed sub-adult lions accompany tourists on bush walks. The potential problem here lies primarily in the need for these lions to be sub-adults, and what will become of them once fully mature. There are fears that these lions may also be hunted. Thus it seems that all captive breeding and tourism related activities need to be strongly governed by well thought out regulations, and that these activities should not be entered into if these regulations will not be strictly adhered to.

Conclusions

While it is clear that conflict with man for resources has lead to the demise of large carnivore populations generally, southern Africa represents an interesting case study with respect to lions. The typical threats associated with both livestock and human mortality occur throughout, along with areas where trophy hunting impact is clearly excessive. But also importantly there are examples in several southern African countries of how lion populations can be restored when: 1) the levels of persecution are reduced, 2) when habitat and prey populations are

adequately protected, and 3) perhaps most importantly when wildlife tourism initiatives identify the need for lions to be present.

Because conflict between humans and lions is inevitable it is essential that conservation managers seriously investigate and implement measures and policies to minimize conflict between lions and people, both on park boundaries and other areas outside of protected areas where lions occur. Treves & Karanth (2003) advocate a mixture of situation-specific strategies driven by scientific data, including non-lethal control, separation of carnivores and people, regulated harvest and lethal control of problem animals as providing the best conservation strategy for large carnivores. Many simple and effective animal husbandry techniques have been practised by African pastoralists in the past and if reinstated could make an important contribution to the conservation of large carnivores (Ogada *et al.* 2003).

Where reviews a decade ago concluded that reintroductions of large predators were not viable (Wemmer & Sunquist 1988, Mills 1991), an increase in knowledge and technical expertise has now made this common practice. Certainly lions can be reintroduced and translocated with a high success rate. Ultimately all reintroduction programmes aim for population persistence without intervention, however, this is a state, rather than a result and it is assessable only in the long-term via continued monitoring (Seddon 1999). Consequently, management seems increasingly likely to become a permanent requirement for the conservation of most large terrestrial predators whether they are enclosed by electric fences, as in southern Africa, or by uninhabitable land as elsewhere.

Whether or not restored lion populations will be managed according to metapopulation guidelines remains to be seen, but thus far reserves have tended to opt for the option of managing each population in relative isolation. The metapopulation approach, while somewhat more expensive than the single or isolated population management approach, aims at the conservation of the species as a whole. This management approach could be applied in all reserves provided there was sufficient funding and commitment. However, the isolated population approach currently makes greater financial sense, and in many respects is the approach being most closely followed in most reserves in South Africa. This, however, could seriously question the conservation value of these restored lion populations unless they are properly managed.

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10 Conflicts between large carnivores and domestic livestock in the peripheral zone of the W transboundary Park in Niger

Hamissou H. Malam Garba & Ilaria Di Silvestre

Abstract

This study contributes to the conservation of large carnivores populations of the W Transboundary Park (WTP) in Niger and its pheriphery by analysing the causes of conflicts between carnivores and the rural communities. We evaluate the depredation of domestic livestock by large carnivores in the pheripheral zone of the WTP, and we estimate its economic impact. Methods used consisted of interviews in a sample of 32 villages of the 87 villages present in the study area, preselected according to criteria related to the presence of predation. A total of 154 people were interviewed, chosen among those whose livestock were attacked by carnivores. During the course of this study between 2000 and 2006, 3271 livestock of different species were attacked by wild carnivores. This equals an average number of 468 livestock per year or three (3) heads of livestock per person per year. The majority of attacks (593 cases during the 7 months) were caused by caracal or jackal (267 attacks, often impossible to distinguish which of the two caused the attacks), followed by spotted hyena (193 attacks) and lion (125 attacks). In contrast, the depredation caused by leopard (3 attacks), cheetah (2 attacks) and wild dog (2 attacks) are very rare. Among the species attacked most frequently are small ruminants (sheep and goats) followed by cattle and donkeys. The attacks occur mostly at night at grazing sites and during the rainy season. The total economic losses for all people interviewed between 2000 and 2006 are estimated at approximately FCFA 82,242,014 or USD 149,530. This loss equals an annual average of FCFA 76,291 or USD 138 per year per person. Of people interviewed, 81.53% had a negative attitude towards predators, while 14.28% confirm that they would kill predators, and 30.51% indicate they have no means to stop attacks. Only 6% of interviewed actively defend their livestock from wild carnivores. An information and training programme of rural populations on the prevention of carnivore attacks and on the value of carnivores in the environment is necessary to prevent an increase of problems in the coming years.

Introduction

Niger is located in the Sahelian zone, containing important natural resources such as wildlife. Unfortunately, these natural resources are threatened by several factors, for example climate change and human population growth. As elsewhere in Africa, habitat loss in Niger led to the disappearance of wildlife outside protected areas. The W Transboundary Park (located between Niger, Benin and Burkina Faso) still harbours important populations of several wildlife species. Increased contact between people and wildlife, resulting from habitat loss and fragmentation has recently led to conflicts which are often related to the loss of livestock incurred by wildlife. An example is predation of domestic livestock by carnivores. Economic losses are regularly recorded by livestock holders living along the borders of the parks as a result of livestock entering the park in search of grazing grounds or when carnivores enter the villages. As a result, carnivore numbers have been reduced both in retaliation for stock losses and through expansion of farmland into natural habitat. The present study was conducted to better understand the situation regarding carnivore-livestock conflicts around the Park W in Niger.

Study area

The study was conducted in the peripheral zone bordering the W Park in Niger (PRW/N; figure 10.1), comprising:

- The Wildlife Total Reserve of Tamou (RTFT) covering an area of 76.000 ha of PRW/N. It is located between latitudes 12°8' and 12°50 North and longitudes 2°06 et 2°24 East. It defines the North Eastern border of PRW.
- The partial Wildlife reserve of Dosso (RPFD), with a surface of approximately 306 000 ha, separated from PRW by the river Niger.
- The 'Ayinoma' zone (ZA) which is part of RTFT.

The peripheral zone is limited by the departments of Kolo (canton Kirtachi and Kouré), of Say (canton Tamou) and of Birni Ngaouré (canton Harikanassou and Boboye); in the south by the river Niger and the border with Benin. To the West by the W Park in Niger and, finally to the North by the border with Burkina Faso and the canton of Tamou.

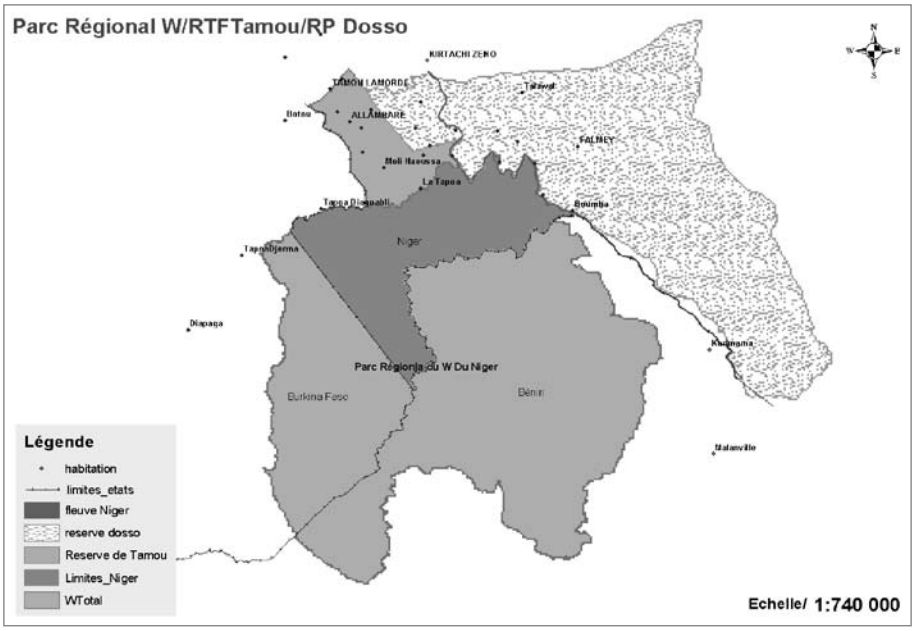

Figure 10.1 Park W and surrounding reserves in Niger, Benin and Burkina Faso

Study outline

Several studies conducted on conflicts between local populations and large carnivores throughout Western (Pendjari Biosphere Reserve in Benin, Niokolo – Koba National Park, Senegal) and Central Africa (Waza National Park and Bénoué National Park in Cameroun) (Téhou 2005; Di Silvestre & Novelli 1998, Di Silvestre 2003; Bauer 1995, 2003; Saleh 2005; Gomsé 2005) reported a variety of threats affecting certain species of wildlife, particularly carnivores. These threats are often related to predation on livestock by carnivores. Studies conducted in the W Park in Benin and Burkina Faso revealed similar problems related to the increase in conflicts between people and wildlife (Di Silvestre 2003).

Inhabitants of villages bordering the Park W often complain to park management staff about damage incurred by large carnivores. Since these people are lacking knowledge on this specific topic, they have difficulties answering survey questions adequately. This lack of information on the current status of livestock predation around the WTP is the major reason for initiating the present study.

Objectives

The general objective of this study is to conserve the large carnivore population of the W park in Niger and its peripheral zone and to limit conflicts between these carnivores and rural communities around the park. More specifically, we will:

- identify and determine the loss of livestock through predation;
- estimate economic losses incurred through predation;
- delineate high risk zones and identify what species were responsible for the attacks;
- propose mitigation measures and solutions for local communities while conserving livestock herds as well as the large carnivore populations.

Methods

The method used is based on a sociological investigation within a sample of certain villages. Public meetings as well as individual questionnaires among local communities are used for the interview survey. A list of 87 villages was chosen among a total of 276 villages where interviews were conducted.

The selection of these 87 villages was based on certain criteria such as the proximity of the villages to the wildlife area, the presence of predation incidences, the presence of livestock holders, and the socio-administrative structure of the villages (Casti 2004). A total of 32 of these 87 selected villages were then randomly surveyed. In each village, five heads of household were selected among those who had been victim to livestock predation by carnivores. The selection for people to be included in the interviews was done according to a list presented during the public meetings. Socio-professional categories were further evenly distributed over the five households with two pastoralists or livestock holders, one agro-pastoralist or farmer-livestock holder, one farmer, and finally one independent person who did not own any livestock and was thus presumed to be 'neutral'.

Results

A total number of 154 persons (usually five per village) were interviewed in 32 villages. Data was collected during 6 months distributed over a period of 7 years between 2000 and 2006. Seven carnivores were identified to be mainly responsible for the attacks on livestock: caracal, jackal, hyena, lion, leopard, cheetah and wild dog (figure 10.2). Through these questionnaires we not only identified species responsible for attacks, but we also re-established the presence of leopard, cheetah and wild dog which were previously believed to be extinct in the area. Depredation was focussed on five types of domestic animals: cattle, donkeys, pigs, camels and small ruminants, further categorized as goats and sheep. A total of 3296 heads of captured livestock were attacked by carnivores between 2000 and 2006, of which 3271 were effectively killed and 25 only injured. A general preference for adult individuals (95%) was seen as compared to young or juvenile individuals. The majority of attacks took place at night and more attacks took place during the rainy season than during the dry season (figures 10.3 and 10.4).

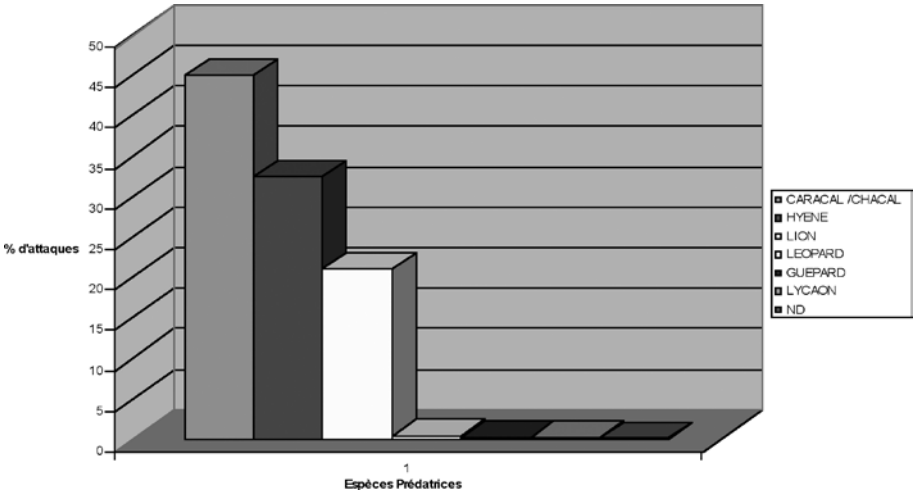

Figure 10.2 The most important large carnivore species responsible for attacks on livestock around park W in Niger

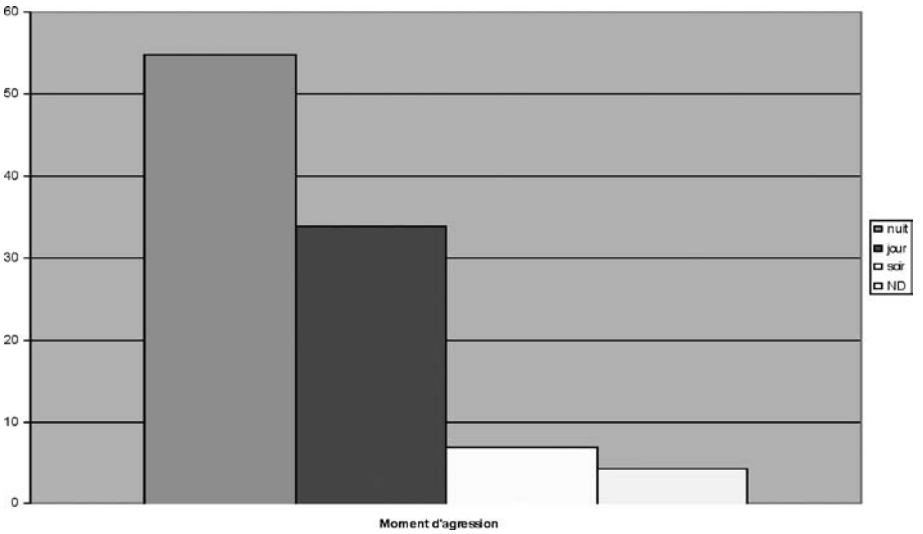

Figure 10.3 Period (time of day) during which attacks take place around W National Park, between 2000-2006

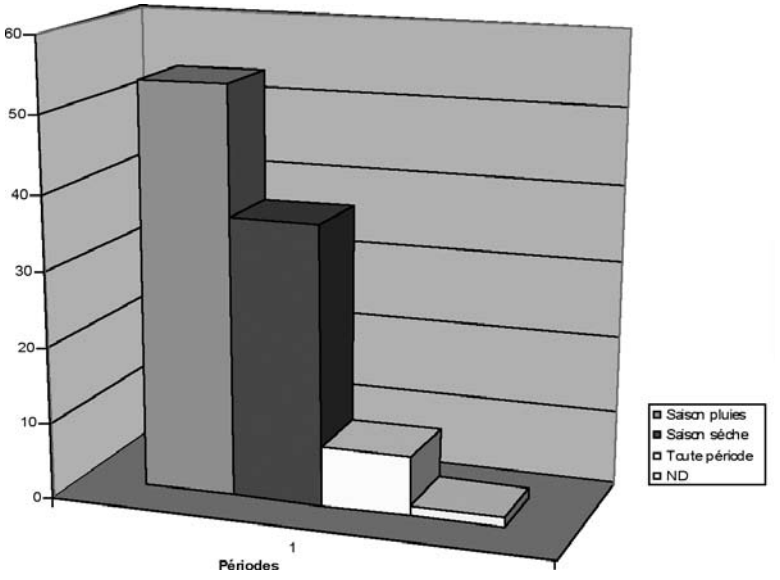

Figure 10.4 Season of attacks by carnivores on livestock around W National Park, between 2000-2006

Attacks took place close to the house, in the farm lands or at the edges of the village with most attacks in the farm lands. Small ruminants were most often victim to attacks by carnivores whereas losses among pigs and camels were rare (table 10.1). Overall, caracal and/or jackal were responsible for most attacks on livestock, followed by spotted hyena

and lion. Leopard, cheetah and wild dog were only responsible for a minor part of all attacks.

Table 10.1 Livestock taken by each species of predator between 2000 and 2006

Prey	Small Ruminants	Cattle	Donkeys	Pigs	Camels	Un-ID	Total
Caracal/jackal	267	0	0	0	0	0	267
Hyena	166	17	8	2	0	0	193
Lion	37	83	3	0	1	1	125
Leopard	3	0	0	0	0	0	3
Cheetah	2	0	0	0	0	0	2
Wild dog	2	0	0	0	0	0	2
Unidentified	1	0	0	0	0	0	1
Total	478	100	11	2	1	1	593

The number of livestock owned by the interviewed people at the time of the last interview (April 2006) was estimated at approximately 7559. A number of 3271 heads was estimated to be killed between 2000 and 2006. It is difficult to relate the total number of heads killed to the number of heads owned, since the number of livestock owned varies at each point in time. The annual number of livestock taken by each predator and the number of livestock killed per species are presented in Tables 10.2 and 10.3. While the number of livestock killed by carnivores is a large proportion of the current heads owned, the attacks take place at irregular intervals. Tables 10.4 and 10.5 illustrate that predation also varies considerably between areas and villages.

Table 10.2 Annual number of livestock taken by each species of predator between 2000-2006

Prey	Caracal/ Jackal	Hyena	Lion	Leopard	Cheetah	Wild dog	Un-ID	Total
Small Ruminants	39	23	6	0,4	0,3	0,3	0	69
Cattle	0	2,4	12	0	0	0	0	14,4
Donkeys	0	1,14	0,4	0	0	0	0	1,18
Pigs	0	0,2	0	0	0	0	0	0,2
Camels	0	0	0,14	0	0	0	0	0,14
UNID	0	0	0,14	0	0	0	0	0,14
Total	39	27	19	1	1	1	0	85

Table 10.3 Number of livestock heads killed by each species of carnivore between 2000 and 2006

Prey	Caracal/ Jackal	Hyena	Lion	Leopard	Cheetah	Wild dog	Un-ID	Total
Small Ruminants	1594	813	313	11	6	4	10	2751
Cattle	0	54	335	0	0	0	0	389
Donkeys	0	12	2	0	0	0	0	14
Pigs	0	5	0	0	0	0	0	5
Camels	0	0	2	0	0	0	0	2
UNID	0	0	100	0	0	0	10	110
Total	1594	884	752	11	6	4	20	3271

Table 10.4 Livestock losses per village

No.	Village	Number of attacks	Number of victims	Percentage successful attacks (%)	Predators responsible
1	Touhoré	40	6	15	Caracal/jackal
2	Dobèyzé	56	9	16	Caracal/jackal; hyena
3	Tamou Kaïna	21	10	47,61	Hyena, caracal/jackal, lion
4	Tankoundé M	30	8	26,6	Lion, hyena
5	Ouro Hesso	100	11	11	caracal/jackal
6	Bantoularé	40	11	27,5	caracal/jackal, hyena
7	Loubadjé	63	8	12,69	hyena
8	Gosso	35	29	82,85	Lion, hyena, caracal/jackal
9	Djabouga (BF)	107	4	3,7	hyena, lion
10	Tapoa Djagorbi (BF)	50	11	22	hyena, lion, caracal/jackal
11	Forgossogo	40	10	25	hyena
12	Dungel	30	15	50	caracal/jackal, hyena, lion (2 attacks)
13	Tchalla Goungoundi	87	11	12,64	caracal/jackal, hyena, lion (1)
14	Banié Bangou	40	9	22,5	caracal/jackal
15	Karey Kopto	65	18	27,69	caracal/jackal, lion, hyena, leopard (3), cheetah (2)
16	Zou Kwara	70	10	27,69	caracal/jackal, hyena, lion
17	Koumbourfou	20	8	40	caracal/jackal
18	Korogoungou	80	40	50	caracal/jackal, lion hyena

19	Baniguitti Ouro Dolé	35	10	28,57	hyena, lion, caracal/jackal
20	Djagoga	80	10	12,25	hyena
21	Bédi Kwara (Weryg)	80	9	11,25	hyena, lion
22	Tolondi	40	11	27,50	hyena
23	Bossia	80	10	12,50	caracal/jackal, lion
24	Birigambou	100	13	13	caracal/jackal, lion, hyena
25	Tallawal	120	10	8,33	caracal/jackal, hyena, lion, wild dog
26	Pamboua	25	3	12	caracal/jackal, lion, hyena
27	Allambaré	100	9	9	hyena
28	Baniguitti (BF)	20	13	65	hyena, lion
29	Kwara Margou	20	8	40	Lion, hyena, caracal/jackal
30	Moli Haoussa	20	14	70	Lion, caracal/jackal, hyena, cheetah
31	Pékinga (Bénin)	40	7	17	Lion, hyena
32	Tilawa (Bénin)	20	–	–	–

Table 10.5 Predation by zone 2000-2006

Zone	Number of attacks per zone	Number of successful attacks	Percentage of successful attacks per zone	Responsable predators
Riverine zone (RPFD)	325	81	24,92	Caracal/jackal, lion, hyena, leopard, cheetah
Zone Ayinoma	218	58	26,60	Hyena, lion
RTFT	251	50	19,92	Hyena, lion, caracal/jackal
Periphery RTFT	257	48	18,67	Caracal/jackal, hyena, lion
RPFD	256	34	13,28	Caracal/jackal, hyena, lion
Bufferzone PRW/N	120	31	25,83	Lion, hyena, caracal/jackal, cheetah
Periphery of Burkina Fasso	177	28	15,81	hyena, lion, caracal/jackal
Zone Plateau (RPFD)	90	18	20	Caracal/jackal, hyena, lion
Periphery of Benin	60	7	11,66	Lion, hyena, fox
Total	1754	355	–	–

Average prices of the different types of livestock are used to estimate economic loss. A total of 3271 heads between 2000 and 2006 is equal to a loss of approximately 82,242,014 FCFA or 149,530 USD. This is equal to an average annual loss of 76,291 FCFA or 138 USD for each livestock owner, resulting in a relatively low economic impact of wild carnivores predations.

People's opinions about the carnivores vary greatly. Although people generally respond in a hostile manner to carnivores intruding into their territories, they believe that predation of livestock by carnivores is part of a natural phenomenon. Of the people interviewed 82% are unhappy with the presence of carnivores in their vicinity. As possible solutions to the predation problem, people indicate that enclosures could be improved and herders should accompany livestock to the grazing grounds, whereas most people believe that there is not much that can be done to improve the situation (30 % of the interviewed people). Only 5% of the interviewed indicate that they are actively protecting their livestock against predation by carnivores.

Recommendations for the conservation of large carnivores in W Park in Niger

Several recommendations can be formulated from the results of this study:

- Since most losses are incurred by the relatively small caracal and jackal, accompanying livestock to the grazing grounds is expected to successfully deter these predators
- Enclosures should be improved where possible and enclosures should be guarded at night either by herders or by dogs.
- It should be investigated whether a compensation system could be used to support the victims and to solve the problem
- If it is possible to identify the carnivore responsible for more attacks up to the level of the individual, a system called PAC (Problem Animal Control), used in southern and Eastern Africa could be implemented whereby the responsible predator is tracked down and killed by professional hunters.
- Before implementing any method of control at the species level, it is necessary to get a better understanding of the present wild carnivores populations in WTP. It is therefore recommended to survey all species of carnivore using adequate methods.

- All protected areas, livestock corridors and legal settlements for nomads should be well delineated to minimize the impact of herders moving through the area with their livestock.
- It is advised to implement an information program for local communities bordering the protected areas, especially since most people currently have a hostile attitude towards carnivores.

Conclusions

Considering the intensive livestock holding practices and the importance of the protected area to a variety of wildlife species, the study area is a high risk area for conflicts between wildlife and livestock owners, with conflict mainly resulting from competition between humans and wildlife for habitat and food. Domesticated livestock frequently enter the protected area in search for grazing grounds and predators are subsequently sometimes attracted towards villages surrounding the park in search for livestock. This initiates potential conflicts between people and carnivores.

The results of the current study revealed that there is a real problem of human-carnivore conflicts around the PRW. More than 3271 heads of livestock were killed by carnivores between 2000 and the beginning of 2006 among 154 livestock holders. This is a concern not only to the victims themselves but also to the people in charge of the management of the protected areas. Management plans should therefore be implemented in the entire peripheral zone to mitigate the current conflict problem and to protect the present carnivore populations.

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11 Current status of wild dog Lycaon pictus in West Africa: the case of Pendjari Biosphere Reserve in the Republic of Benin

Tehou Comlan Aristide

Abstract
Presently, the wild dog is threatened with extinction throughout its distributional range, but particularly in the West African sub-region. Until the 1970's wild dogs were still regularly observed in all protected areas of West Africa. In the Republic of Benin, observations were recorded between the Sudano-Guinean and Soudano-Sahelian savanna zone; since then, the species has become extremely rare and even absent from certain parts of the country. However, starting from the year 2000, attempts are being made towards the recovery of the species in 'W ' Transfontier Park and in Pendjari Biosphere Reserve in North Benin, due to changing political efforts for park management which have been implemented by the Benin government in the framework of the National Centre for the Management of Wildlife Reserves (CENAGREF). Recently, the frequency of wild dog observations has become more regular in the Pendjari Reserve, as was concluded from the numerous publications. It should be mentioned that the direct observations between 2002 and 2007 were made as a result of data collection methodologies on trails and transect lines developed by the Ecological Service of the Reserve. The number of observations during counts varied between 1 and 6 individuals with groups of 2, 3, 4, 5 and 6 individuals. Since 2006, a technique has been developed for the localization of wild dog dens, in order to allow for constant monitoring of the species in the future.

Introduction

The Pendjari Biosphere Reserve is located in the extreme north-west of the Republic of Benin. Its geographical limits are 10°30' to 11°30' North and 0°50' to 2°00' East, covering a surface area of 4711 km² of which 2660 km2 is covered by Pendjari National Park, 1800 km² is covered by peripheral zones and 251 km² by the zone of Konkombri.

The wild dog is presently threatened with extinction in the West and Central African sub-region. While they were still regularly observed until the 1970's in all protected areas, including 'W' Reserve, Arly NP, Pendjari Reserve, Oti-Mandori and Kéran (WAPOK) as well as in the protected reserves of Nigeria, Ghana, Guinea and Senegal, observation records have currently become very infrequent.

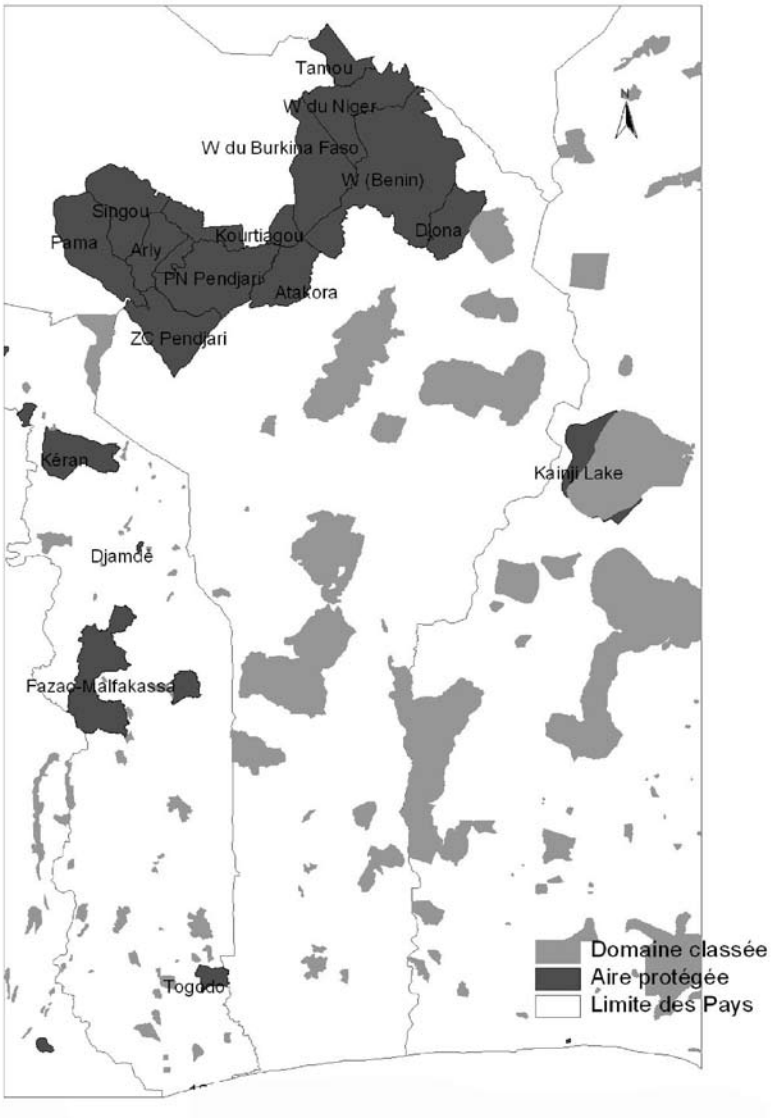

Figure 11.1 The protected areas of Benin

In the Republic of Benin, several observations have been recorded between the Sudano-Guinean and Soudano-Sahelian savanna zone (between the forest blocks of Mount Koufé and the two National Parks; figure 11.1). After the 1970's the species has become extremely rare and even absent from certain parts of the country. Fortunately, from the year 2000, the progressive recovery of the species in the 'W' Trans border Biosphere reserve and the Pendjari Biosphere Reserve is being stimulated, due to changing political rules for park management which have been implemented by the Benin government in the framework of the National Centre for the Management of Wildlife Reserves (CENAGREF).

Materials and methods

Methods are primarily based on direct observations along trails and from 'imaginary' transect lines which are 7 km long (fixed transects), developed and implemented for data collection on abundance and biological diversity in the reserve. These methods are further supplemented by line transects on foot covering 10-12% of the reserve and 15-16% of suitable habitat for Buffon's kob (*Kobus kob*). Transect line surveys (figure 11.2) were conducted between December and June each year, starting from the season 2002/2003. Materials used included a GPS for recording geographical positions, a compass and ecological data collection forms.

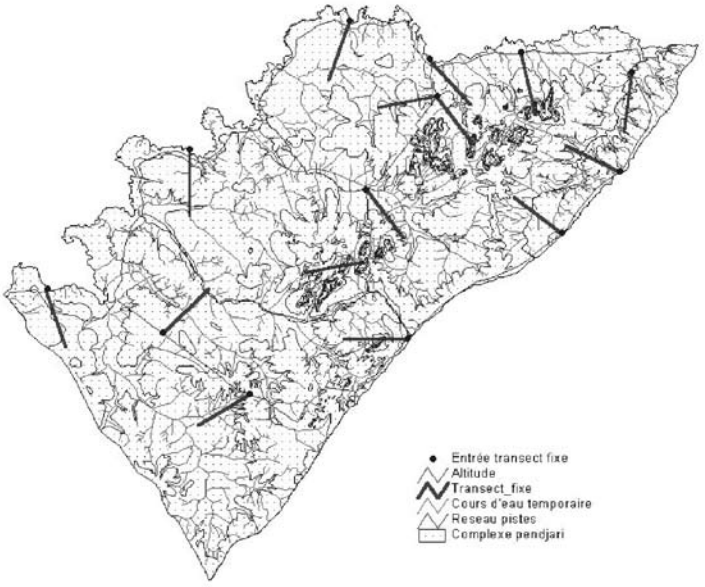

Figure 11.2 Overview of fixed line transects for ecological monitoring in Benin

Results

Frequencies of observations become more regular in the Pendjari Biosphere Reserve, as was concluded from the following publications: Sinin *et al.* 2000 (two contacts); Sinin *et al.* 2001 (one contact); Tehou 2002 (two contacts); Tehou 2003 (one contact); Tehou 2004 (one contact); Tehou 2005 (five contacts); Tehou 2006 (five contacts) and Tehou 2007 (four contacts). The direct observations between 2002 and 2007 were made as a result of data collection methodologies on trails and transect lines developed by the Ecological Service of the Reserve (figure 11.2). The number of observations during counts varies between 1 and 6 individuals with groups of 2, 3, 4, 5 and 6 individuals) figure 11.3.

Since this year, a technique has been developed for the localization of wild dog dens, in order to allow for constant monitoring of the species in the future.

The figure 11.4 shows us the evolution of contacts between 2000 and 2006, with a growing tendency curve of the rate of contact.

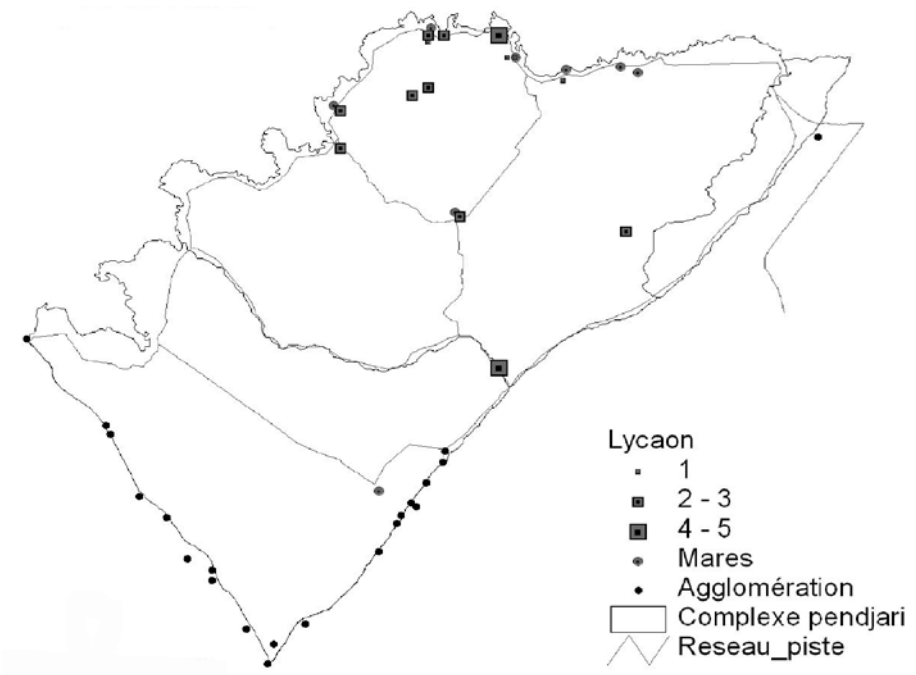

Figure 11.3 Status of Wild Dog in Pendjari Biosphere Reserve

Table 11.1 Different observations of wild dogs in Pendjari Biosphere Reserve. Lycaon in West Africa (Pendjari National Park) By Tehou Aristide 2007, ROCAL West Africa

Date	Hour	GPS location or approximate location of observation		Information on observer (qualified or not)	Number of Lycaon observed
		Y = E	X = N		
15/04/2000	9	11°37	1°45	qualified	3
17/04/2000	9	11°19	1°72	qualified	2
20/032001	8	11°35	1°36	qualified	2
30/11/2002	7	11°01	1°56	qualified	5
7/03/2002	18	11°42	1°57	qualified	1
5/03/2003	9	11°45	1°49	qualified	2
25/12/2004	18	11°39	1°64	qualified	1
01/2005	8	11°45	1°47	qualified	2
07/02/2005	17	11°20	1°50	qualified	6
12/03/2005	9	11°38	1°47	qualified	3
24/12/2005	18	11°46	1°47	qualified	1
10/01/2005	7	11°45	1°56	qualified	5
18/02/2005	19	hotel	hotel	qualified	1
11/02/2006	7	11°45	1°56	qualified	4
14/02/2006	8	11°44	1°47	qualified	1
09/02/2006	11	11°30	1°36	qualified	2
07/07/2006	8	11°21	1°51	qualified	2
07/07/2006	11	11°42	1°58	qualified	1
28/11/06		11°39	1°66	qualified	1
08/01/07	18	11°38	1°61	qualified	2
12/01/07	17	11°38	1°61	qualified	6
28/01/07	10	11°38	1°61	qualified	3
12/03/07		11°20	1°50	qualified	1
12/03/07		11°20	1°50	qualified	2

Wild dogs were observed in zones of Arly (11°46 E 1°60 N; 11°48 E 1°39 N; 11°38 E 1°20 N) and in the complex W (11°49 E 1°92 N; 11°50 E 2°15 N) but we have no information currently on Nigeria. WAP = Parc W, Arly and Pendjari.

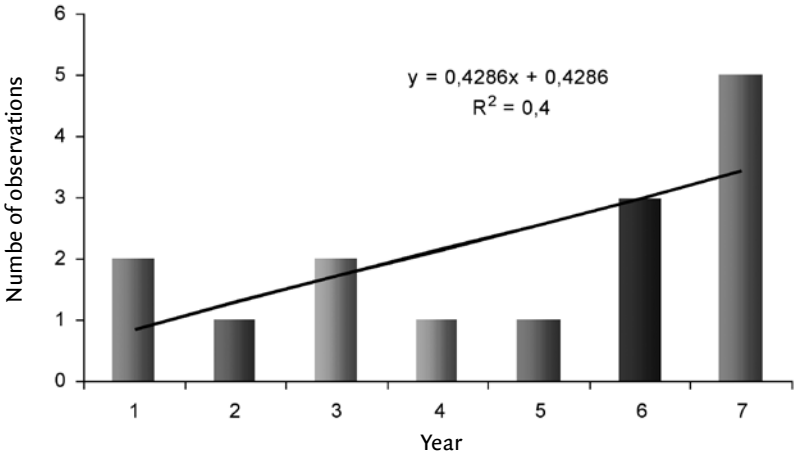

Figure 11.4 Trend of wild dog observations between 2000 and 2006.

Recommendations

To improve the monitoring of wild dogs, the following recommendations have been formulated:

- the rapid implementation of a permanent monitoring system for the Republic of Benin;
- initialize scientific research projects on population dynamics of the species at two levels:
  1 the local level,
  2 at the level of the shared ecosystems of WAPOK;
- the development of a database on wild dog observations for West Africa;
- organize an inventory mission to investigate the status of wild dogs in Nigeria ;
- develop strategies for the conservation of the species in West- and Central Africa.

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