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A lion population under threat : understanding lion (Panthera leo Linnaeus, 1758) ecology and human-lion interactions related to livestock predation in Waza National Park, Cameroon

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Threat of rapid extermination of the lion (*Panthera leo*) in Waza National Park, Northern Cameroon

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Male lion in Waza National Park, Cameroon

ABSTRACT

Lion populations in West and Central Africa are small and fragmented. In areas where park management is weak, the lion is threatened with extinction. Wildlife management requires knowledge of the population size. The population of lions in Waza National Park (Waza NP) was assessed by individual identification of members of the population. The population was estimated to consist of 14-21 individual adult lions. The age structure was skewed towards adults, with cubs comprising 22% of all lions identified. The sex ratio was also skewed at 1:3 (male: female). Two out of four collared lions were lost to illegal, retaliatory killings within one year; and probably two more males and one more female were also killed during this period. The lion population appears to have declined during the last five years, with a loss of six lions per year, which is a much higher rate than observed in previous decades. Human-livestock pressure has increased tremendously in this period, resulting in frequent human-lion conflicts. To ensure the survival of the lion in Waza NP and in the entire region, the park management needs to intensify efforts to attenuate the pressure from humans and their livestock.

keywords

lion population decline, retaliatory killings, Cameroon

2.1 Introduction

Lion populations in West and Central Africa are under serious threat. Bauer *et al.* (2003) had previously expressed their fears of an increasing risk of extinction of the lion in this region but the situation seems to have aggravated in recent years. Currently, the lion is classified as *Regionally Endangered* in West Africa (Bauer & Nowell, 2004). Unlike in East and Southern Africa where, with a few exceptions, lion populations are large and relatively stable, the West and Central African lion populations are small and their ranges are generally fragmented (Nowell & Jackson, 1996; Bauer & van der Merwe, 2004). Recent estimates in this region range from only 1750 (Bauer & van der Merwe, 2004) to nearly 4,000 individuals (Chardonnet, 2002). Concurrently, a decline of the natural prey base of the lion has been observed in this region (East, 1999; Fischer & Linsenmair, 2001; de Iongh *et al*., 2004; Scholte, 2007; Caro & Scholte, 2007), accompanied by a substantial increase of livestock (Binot *et al*., 2006; de Iongh & Bauer, 2008). Semi-nomadic herding activities in the Sudano-Sahelian belt increase the frequency of interactions between humans, livestock and wildlife, leading to an increase of human-lion conflicts. The replacement of natural prey by livestock and the subsequent increase of human-lion conflicts may therefore be a core factor in the present decline of the West and Central African lion population.

In Waza National Park, the above trends are all being observed. The lion population seems to have declined from 100 individuals in 1962 (Flizot, 1962) to between 40- 60 in 2002 (Bauer *et al*., 2003; Bauer & van der Merwe, 2004). Similarly the population of the Western kob antelope (*Kobus kob kob*), which is the most abundant natural prey in Waza NP, has dropped dramatically from 25,000 in 1962 to about 6,000 in 2000 and to below 1,600 in 2007 (de Iongh *et al*., 2004; Scholte, 2007; Omondi *et al*., 2007). Regarding livestock, Scholte *et al*. (2003) reported that after the reflooding in 1994, a threefold increase in livestock grazing intensity was observed around Waza NP due to an immigration of pastoralists into the Logone floodplain. According to these authors, antelope numbers increased only slightly as a consequence of the reflooding. These findings were confirmed by an aerial survey conducted by Worldwide Fund for Nature in early 2007, which revealed 21,000 heads of livestock within a 5 km buffer of the park as opposed to only about 2,600 heads of natural prey counted in and around the park (Omondi *et al*., 2007). Recent studies by Croes *et al.* (2011) demonstrated extremely low lion densities in the hunting zones situated between the three national parks in

the Bénoué complex, indicating a recent declining trend in lion numbers. This study explores the changes that might have taken place in the Waza lion population over the years. It presents the lion population status and highlights the illegal killing of lions in and around the park.

2.2 Methods

Study area

This study was performed in the Waza NP located in northern Cameroon. About half of the park (the northern and eastern side) is located within the floodplain of the Logone River. Here the topography is flat with clay soils that are prone to seasonal inundation. The south-western side of the park is situated on sandy deposits of the fringe of the Lake Chad basin. At 320 m above sea level, this part of the Park is about 20 m higher than the north-eastern part. It is slightly undulating, with height differences of a few meters, and is never flooded. The climate of the area is semi-arid tropical.

Waza NP hosts a rich wildlife and is a popular destination for tourists because animals are easily sighted on its open floodplain. The park has no flowing permanent water source but is nourished by flood waters from the rivers Logone and Logomatya as well as rain water. Water is held in artificial and natural reservoirs in the park but during the dry months of the year most of these waterholes dry out. However, waterholes in the floodplain section of the park and a few in the woodland retain water all year round. The park has three distinct vegetation zones, from the west to the east: woodland zone (31%) dominated by *Sclerocarya birrea*, acacia zone (27%) dominated by *Acacia seyal* and floodplain (42%) which consist of grassland. The first two vegetation zones are located in the south-western side of the park while the third vegetation zone is located in the north-eastern side of the park.

Sampling techniques

A combination of methods including total count through individual identification of members in the population and a camera trapping survey were used to census the Waza NP lion population. However, the small number of lion photos taken during the camera trapping survey did not allow for statistical analysis using the program "CAPTURE". The main ap-

proach used for assessing the lion population in Waza NP was therefore a total count, which meant identifying individual lions during the study period, from May 2007 to June 2008. In this way, a description of the entire lion population was achieved by directly observing the lions during field work, lion collaring and from photos made during the camera trapping survey.

At each lion encounter, lions were identified and their location mapped within the park. A pre-structured form was filled in, indicating group size and group composition. Individual features, such as vibrissae patterns, scars and ear cuts were drawn on a full face outline and other features such as broken teeth were noted (Pennycuick & Rudnai, 1970). Photographs of each individual were taken when possible. Assessment of age was done as described by Smuts *et al*. (1970) and Schaller (1972). Structured questionnaires deposited at the entrance to the park were completed by tourists, tour guides and park guards. Questions dealt with when and where lions were sighted, group size and group composition. A total of 95 forms were completed and analysed during the research period. These forms were checked regularly and recent lion sightings were verified by visiting the reported sites.

Lion collaring operations were conducted in May 2007 and May 2008 in Waza NP for monitoring purposes. Four Vectronic GPS-PLUS collars equipped with a VHF transmitter, supplied with a Handheld Terminal that communicates with the collars, were fixed on two male (Adam and Jean-Pierre) and on two female lions (Elizabeth and Fanne) in May 2007. One Vectronic GPS-PLUS collar and two African Wildlife Tracking GPS GSM collars were fixed on one male (Falama) and two female lions (Rossie and Fanne) in May 2008, respectively. Lions were attracted within darting distance using a calling station set-up adapted from Ogutu & Dublin (1998). Calls were played for 30-45 minutes, alternating with 15 minutes of silence, until lions appeared. An MP-3 player connected to a 400 Watt amplifier and two speakers (50 Watt each) placed on the roof of the car supplied the sound playback. Before attaching the bait (kob antelope) firmly to a tree, a trail of about 1 km was made in different directions. Darting was accomplished using a Dan-inject immobilization gun with a 1.5 ml dart containing Zoletil 100. Lions that responded to the calling stations were identified.

A camera trapping survey was conducted from 5 March to 17 April 2008 to provide further information about the lion population in Waza NP. Our

set-up was adapted from Karanth & Nichols, 1998; Karanth & Nichols, 2000 and Henschel & Ray, 2003. Camera trapping sites were selected based on cues such as lion tracks, droppings, sightings and presence of waterholes, while large gaps were randomly filled based on lion minimum home range size in the park. The survey was accomplished by dividing the park into three sampling blocks that almost respected the three vegetation zones of the park. Given the number of cameras available, all 21 cameras were placed in the first block and relocated twice to the second and third blocks for two weeks each. Cameras were revisited after six days to replace batteries and/or film. In accordance with the sizes of the vegetation zones of the park, 22 trapping sites were in the woodland zone, 11 in the acacia zone and 30 in the floodplain zone, bringing the total number of trapping sites to 63. These trapping sites were also considered as sighting sites for they were considered potential sites for encountering lions and were visited at least twice.

Each camera (stealth Cam type MC2-GV), with a built-in infrared movement sensor, was attached to a tree at knee height. A trail, bait and catnip (pheromone) were used to lure lions to the cameras. The kob antelope was chosen as bait and the trail of approximately 300 m was made by dragging the bait ($1/10^{th}$ of an adult kob) from different directions to the trapping site. The bait was attached on a tree opposite the camera at 1.5 m above the ground. The catnip was sprayed at the base of the tree holding the bait and on surrounding trees to retain the lion in the vicinity (McElvain *et al.*, 1942 and Hill *et al.*, 1976).

2.3 Results

Based on the total observations from May 2007 to June of 2008, including the period of the camera trapping survey, a total of 26 individual lions (adults plus cubs) were identified in Waza NP (Table 2.1). At the end of the study period, two collared male lions were killed by livestock owners. In January of 2008, rumours of the killing of a group of lions, one carrying a collar, in a Cameroon-Nigerian border village prompted the tracking of collared lions out of the park. A signal was received from 'Jean-Pierre' in a peripheral village south of the park. After a search in the village with the strongest signal strength, the collar was found hanging from a tree. GPS data obtained from the collar revealed that the lion stopped activity at another location 4 km from where the collar was found. The location was visited and after an intensive search, lion scat was collected but there

were no signs of the lion carcass. At about 700 m from this location (the next location fix), a cattle carcass was found. Attempts to investigate the village nearest to these sites were aggressively frustrated. Visits to other location fixes outside of the park revealed many cattle carcasses. The villagers were intolerant of livestock depredation by lions. When a signal was later received from 'Adam', the situation was similar. Although the time interval between when he was killed and when the collar was discovered was relatively short, no carcass was recovered. Visits to his location fixes also revealed carcasses of raided livestock.

An adult female and two other adult males were probably also killed. Two large cubs (CM1 and CM2) and one small cub (C9) most likely also did not survive. Of the 18 individual lions remaining, three were males, eleven females and four cubs. All sightings made by tourists, guides and guards were verified and there were no other individuals identified. There were also no new individuals in photographs taken during the camera trapping survey besides those already known. Lions identified during the camera trapping survey were F4, M4, C7, C8, CM5, CM6, M3 and Falama (Table 2.1).

Table 2.1 **Observations of individuals and groups of lions in Waza NP from May 2007 to June 2008. F = adult female; M = adult male; CM/CF = male/female cub,*= killed, M1, M2 & F2 = probably killed, CM1, CM2 &C9 = probably death, CF3 & CF4 = cubs to sub-adults**

Date	Location	Group composition	Group size	Encounter
05-05-07	Gobe	Jean-Pierre, Elizabeth, F1, CM1, CM2, CF3, CF4	3	Collaring
06-05-07	Gamzemia	Fanne	1	Collaring
10-05-07	Louloubaya	Adam, M1, M2, F2	4	Collaring
17-05-07	Sawarware	Jean-Pierre	1	Telemetry
17-05-07	Gobe	Elizabeth, F1, CM1, CM2, CF3, CF4	2	Telemetry
20-05-07	Dalazoa loop	Adam, M1, M2, F2	4	Telemetry
21-05-07	Sawarware	Jean-Pierre	1	Telemetry
21-05-07	Sawarware	M3, F3	2	Field work
21-05-07	Gobe	Elizabeth, F1, CM1, CM2, CF3,CF4	2	Telemetry
21-05-07	Talabal	Fanne	1	Telemetry
16-01-08	Kouloudika	CM5, CM6	0	Field work
19-01-08	Louloubaya-Bodelaram	F4	1	Field work
23-01-08	Village south of park	*	0	18-11-07

02-02-08	Louloubaya-Bodelaram	F4,M4,C7,C8,C9	2	Field work
07-03-08	Bodelaram	F4,C7,C8	1	Field work
20-03-08	Sawarware	Fanne	1	Field work
29-03-08	Kouloudika-Louloubaya	Adam	1	Telemetry
08-04-08	Gamzemia	Falama	1	Field work
15-04-08	Mbouiet-Zeila	F1,F3,F5,F6	4	Field work
15-04-08	Goumboure-maram	Rosie, F7,CM5,CM6	2	Field work
16-04-08	Mengeng	Falama	1	Field work
16-04-08	Mengeng	M3	1	Field work
16-04-08	Gamzemia	Fanne	1	Field work
29-04-08	Waza NP limit	*	0	04-04-08
30-04-08	Dalazoa	F4,M4,C7,C8	2	Field work
01-05-08	Gamzemia-Mengeng	Fanne,M3	2	Field work
18-05-08	Gamzemia	Falama	1	Collaring
18-05-08	Gouboure-maram	Rosie,CM5,CM6	1	Collaring
19-05-08	Sawarware	Fanne,M3,F8,F9	4	Collaring
28-05-08	Alaza	F5,F6	2	Field work
28-05-08	Alaza	Falama	1	Telemetry
04-06-08	Alaza	Fanne, F8	2	Field work
05-06-08	Toukouneram	M3	1	Field work
11-06-08	Gouboure-maram	F4,M4	2	Field work
12-06-08	Mbouiet	Elizabeth	1	Telemetry

Collaring = lions sighted during collaring operations, Telemetry = lions sighted after receiving signals from collars and Field work = lions sighted during other field activities other than telemetry

The total surface area which was visited at least twice, including the roads and all camera trapping sites, represented 63% of the park. One may be tempted to extrapolate the number of identified lions to the total area of the park. This is not realistic however, as in the hot dry season both natural prey and cattle remain close to waterholes and lions follow their prey. All waterholes within the park were inside the investigated

area. Therefore, the observed number is assumed to be the total population inside the park. However, there may also be a number of lions close to waterholes outside the park, where the cattle concentration is also high. It is assumed that this would consist of seven adult individuals at most. Therefore, the total Waza lion population is assessed at 14-21 adult individuals.

In total six lion groups were mapped in this park. There were two groups in the woodland zone. One consisted of two small cubs, a female and an adult male whose mane was not well developed. The other was made up of two older male cubs and two adult females. The remaining four groups in the floodplain zone showed the fission-fusion patterns, splitting up at times into singles or pairs. A group of four adult females was identified, occasionally seen in pairs; a group of an adult female, two sub-adult females and an adult male; and two solitary adult lions, male and female. The sex ratio based on mature individuals was 1:3 while the percentage of cubs in the population was 22%. The average group size of lions in this park was 1.6. Figure 2.1 presents the population pyramid, which shows an upside-down structure.

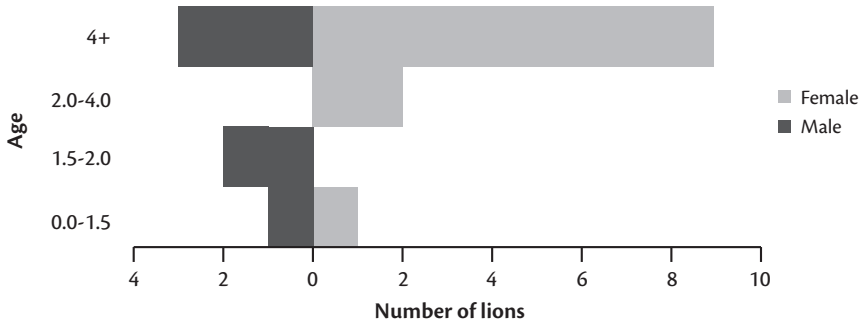

Figure 2.1 **Population pyramid of Waza NP lions in 2008 (n=18)**

During the camera trapping survey, a total of 1914 photographs were taken: 1008 "blank" photos, 437 photos of carnivores (12% large carnivores and 36% small carnivores), 186 photos of herbivores (21%) and 283 photos of humans and/or cattle (31%) (Figure 2.2). Blank photographs included those triggered by monkeys, birds, falling leaves and sand storms. The human and/or cattle category consisted of herdsmen, cattle, poachers and probably fishermen, all within the park. In the woodland zone of the park, 2 out of the 22 camera trapping sites had photo-

graphs of humans and/or cattle; in the acacia zone 1 out of 11 and in the floodplain 17 out of 30.

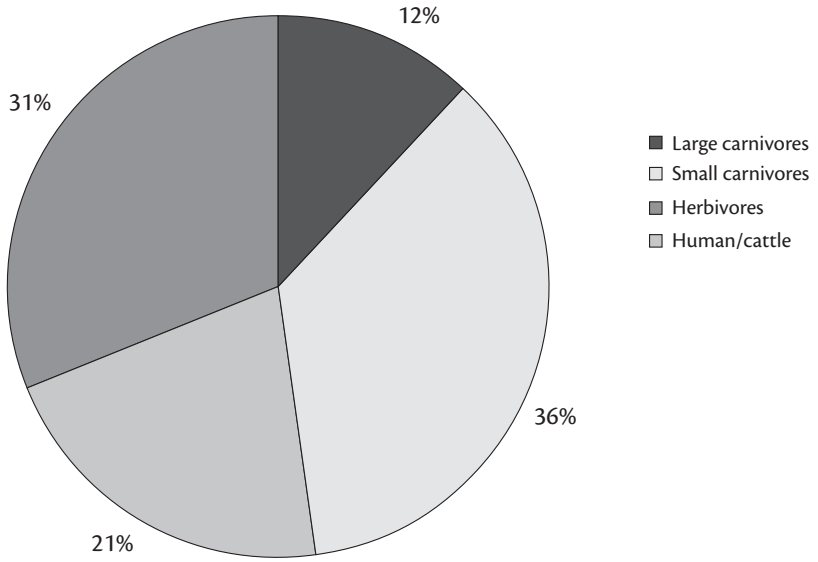

Figure 2.2 **Percentage of photographs taken of large carnivores, small carnivores, herbivores & humans/cattle in Waza NP, 2008 (n=906)**

2.4 Discussion

The current estimate of 14-21 adult lions in Waza NP differs greatly from the estimate of Bauer *et al*. (2003) and Bauer & van der Merwe (2004). The decline reported by Bauer *et al*. (2003) from 100 individuals in 1962 to 40-60 individuals around 2002 implied that approximately one lion was lost every year. The present findings when compared with Bauer et al. (2003) and Bauer & van der Merwe (2004) demonstrate an alarming rate of about 6 lions lost in Waza NP each year. At this rate, the lion will most likely be extinct in Waza NP within the next four years. There may be more than the assessed seven lions further away from the periphery of the park, given the fact that GPS data from the collared lions indicate that lions do make long excursions outside the park. However, such large scale movements were unlikely during the critical period that the survey was conducted. At this period all water dries out except for waterholes in the park and a few at the periphery that retain water. Most natural prey congregate at these waterholes and lions do stay close for easy meals.

The killing of two reproductive males within one year represents a higher percentage of research lions (50%) lost to illegal, retaliatory killings than that (25%) reported by Bauer (2003). Although the numbers are too small to give much weight to this difference, they must not be overlooked given the small size of this population. The death toll may be higher than the confirmed cases as indicated above. 'Adam' for instance, was in a group of four lions during collaring (a coalition of three adult males and one adult female). He was sighted several times with the members of his group after collaring. Rumors about the killing of this group in a Cameroon-Nigerian border village were effectively confirmed from the GPS data of 'Adam' which revealed that this group was located around the borders between November and December of 2007. When he was sighted in March of 2008, he was alone. Adam, however, met his end at the hands of nomadic Uuda pastoralists during a short excursion to their camp, 500 m from the park limit. 'Jean-Pierre', the other collared lion killed, left his group shortly after collaring. Because of seasonal floods and the dispersal of the declining natural prey population, lions leave the park and follow migrating nomadic livestock. Outside the park, lions raid livestock and consequently come into conflict with humans. Retaliatory killings are illegally carried out by livestock owners using bow and arrows poisoned with cobra venom. These results together with the case reported by Bauer (2003) suggest that lions are regularly being killed illegally in and around this park, even though there are no systematic records. Although lions are mostly killed in retaliation for taking livestock, poaching seems to be going on as well. The carcasses of both lions were never recovered. Communities around the park attach socio-economic value to various parts of the lion and there are indications of trade in these animal parts.

The lion population age structure is skewed towards adults, indicating a negative growth for the lion population in this park. External threats such as illegal killings which increase mortality in this population will likely drive it to local extinction if the causal factors are not halted. The presence of cubs in the population (22%) and a sex ratio of 1:3 however, indicate that the population still has a reproduction capacity.

The results of the camera trapping survey supported the conclusion that the human-livestock pressure on the park is very heavy. Out of 63 trapping sites, human/cattle were present at 20. Compared to other groups of animals captured by the camera traps, human-livestock represented 31% of the photographs. During field work, poachers, fishermen, herds-

men and cattle herds ranging from 150 to 2,000 heads were occasionally encountered. This situation confirms the conjecture made by Scholte (2003) that the disappearance of wildlife in nearby Kalamaloué National Park due to advanced human encroachment forms was a bleak perspective for Waza NP.

Nevertheless, although the current status of the Waza lion population seems critical, there are still possibilities for this population to fully recover and stabilize. Studies in East and Southern Africa have shown that lion populations are resilient. When park management is good, ensuring better habitat conditions, a lion population is able to recover within a short period of time. This suggest that, if an immediate attempt is made by the government to stop all illegal activities within the park and its peripheries, the lion population in Waza NP will recover. Specifically, the park boundaries should be clearly demarcated to prevent intrusion by herdsmen and their livestock. Furthermore, an increase in security patrols would substantially increase the effectiveness of conservation efforts, as demonstrated by Hilborn *et al*. (2006) and Dobson & Lynes (2008). Eventually, management should consider raising awareness and sensitizing all communities involved.

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