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Assessment and mitigation of human-lion conflict in West and Central Africa

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Abstract

The lion (*Panthera leo*) is most threatened in West and Central Africa; livestock encroachment and indiscriminate killing of lions are the main threats. Human-lion conflict mitigation is therefore key to persistence. Several experiments were carried out in the region to assess and mitigate human-lion conflict. In Pendjari National Park in Benin, enclosures of clay instead of the usual thorny branches reduced depredation figures by half. Around the Niger side of 'W' National Park, depredation was estimated at US$138 per household per year and occurred mostly while grazing; people identified improved herding as the most appropriate measure. A livestock corridor through a chain of protected areas has helped reduce conflict in Benoue National Park, Cameroon. Close monitoring and enclosure improvements reduced depredation from 9 to 0 attacks in enclosures and from 60 to 18 on the pastures of six villages around Waza National Park, Cameroon. Cases in Chad and Guinea identified yet other mitigation measures, including the use of dogs, sensitisation over rural radio and using relevant Sourats from the Koran; data on effectiveness are lacking, however. These projects illustrate a varied suite of mitigation options and demonstrate that mitigation can be effective if the method is judiciously chosen and adapted to local circumstances.

Keywords: carnivores; corridor; depredation; enclosures; livestock.

Introduction

Large carnivores present a special challenge in conservation science owing to their large ranges, low densities and propensity for conflict with livestock (Woodroffe 2001). Lion (*Panthera leo*, Linnaeus 1758), cheetah (*Acinonyx jubatus*, Griffith 1821), hyena (*Crocuta crocuta*, Erxleben 1777), wild dog (*Lycaon pictus*, Temminck 1820) and possibly other carnivore populations are small and fragmented in West and Central Africa (Nowell and Jackson 1996, Bauer and Van Der Merwe 2004). Lion densities in West and Central Africa are low, typically between 1 and 3 lions/100 km^2 (Bauer and Van Der Merwe 2004). Low lion densities correspond with low prey densities in West and Central Africa (Hayward et al. 2007, Bauer et al. 2008), but also with anthropogenic threats, leading to classification as Regionally Endangered in West Africa on the IUCN Red List, as opposed to Vulnerable Overall (IUCN 2009).

As in the rest of Africa, human-lion conflict ranks among the most important threats to lions (IUCN 2006a,b). In some Eastern and Southern African areas, conflict involves chronic man killing (Treves and Naughton-Treves 1999, Packer et al. 2005), but human casualties in West and Central Africa appear to be rare incidents; we therefore focus on depredation of livestock. Such depredation can provoke lion killing in various forms: Problem Animal Control, retaliatory killing and pre-emptive killing. Methods commonly used include, in decreasing order of target specificity: shooting culprit on a carcass, luring lions to bait in a conflict area, poisoning carcasses killed by lions, opportunistic shooting, snaring and poisoning.

Considerable experience in mitigation of large carnivore conflict exists in East and southern Africa (Marker 2002, Frank et al. 2005). The present paper presents experiences with various conflict assessment and mitigation methods that were implemented in West and Central Africa in 2005–2006.

Materials and methods

Our discussion is mainly based on data from six study areas in the Soudano-sahelian savannah belt: 'W' National Park (NP) in Niger, Northern Guinea, Pendjari NP in Benin, Zakouma NP in Chad and Waza NP and Benoue NP in Cameroon. Activities in Niger were executed as part of an EU-funded conservation project. The other five sites each worked with an operational budget of Euro 3200-, provided by IUCN Netherlands. Activities were technically supported by the West and Central African Lion Conservation Network but implemented in partnership with respective national conservation authorities.

In the buffer zone of 'W' NP in Niger, a study was conducted to assess conflict and to study perceptions and locally proposed actions; semi-structured interviews were held with five households per village in 32 of the 87 villages in the Park periphery. The interviews included a quantitative assessment of depredation figures, differentiated by predator species, by season and by livestock species (whereby sheep and goats were often lumped into 'shoats'). They also included a qualitative assessment of opinions and a discussion on mitigation techniques.

Similar semi-structured interviews were also held in 11 villages and 6 nomadic camps around Zakouma NP in Chad, but owing to cultural sensitivity we could not obtain precise figures on livestock and used frequency of depredation incidents as a proxy instead. Large carnivores were also surveyed with the use of calling-stations in and around Zakouma NP; 43 call-ups were performed inside the NP and 9 additional call-ups on the border, following the protocol of Ogutu and Dublin (1998). These actions were intended to provide baseline data for mitigation measures in the near future.

Baseline data were already available in Benin and Cameroon, showing lion densities of 1–3 lions/100 km^2 and medium (Benoue NP and Pendjari NP) to high (Waza NP) depredation figures (Bauer and De Iongh 2005, Sogbohossou and Tehou unpublished data). Various mitigation techniques were practised in these areas.

In Benin, 13 improved cattle enclosures were installed in 10 villages around Pendjari NP, in addition to a community radio sensitisation campaign. These improved enclosures were basically similar to local houses, except that the ground surface was larger (4×4×1.2 m for 15 small or medium cattle). They were constructed by the villagers using sun-dried clay bricks covered with a clay/cement mixture ('banco'). Villagers supplied sand and water, we covered the expertise and other costs; around US$150 each. In five villages, the project further assisted local people in integrating the use of these enclosures in their production systems by assisting in the creation of fodder plantations and the use of manure and compost for organic cotton. Monitoring was achieved through comparison of damage figures before (2004) and after (2005–2006) the intervention, although they continue to be used. Effectiveness was tested with a t-test.

In Cameroon, two different sites were involved in this study: Benoue NP and Waza NP. The Benoue area is a large East-West belt of contiguous conservation areas across North Cameroon, with increased conflict during the annual North-South movements of nomadic cattle. Based on a series of meetings with communities and authorities, a corridor was created and materialised with signboards. This corridor is a narrow strip of land some 30 km long, running parallel to the highway that cuts across the conservation area. Semi-structured interviews were held with users of the corridor for monitoring purposes.

Waza NP, in contrast, is a small isolated hard-edged park with serious depredation in the buffer zone. The area is relatively remote and there is no easy access to imported materials such as barbed wire or cement. In view of post-project sustainability we opted for not introducing foreign technology and for intervening through local elites. Six villages in the buffer zone were selected and 75% of the pastoralists in these villages participated in upgrading their enclosures to standards of 'best local practice', using a sufficiently thick layer of thorny shrubs and/or earth walls and with a safe gate (either made of wood or using a complete *Acacia seyal*, Delile, crown as a 'gate-plug'). Monitoring of the effectiveness of the enclosures was achieved by comparing depredation figures of participating and non-participating pastoralists and was tested with a t-test. Conflict was particularly intense in a pasture area with a permanent water well on the southern border of the NP. Two 'eco-guards' were appointed to regularly patrol this area; they gave extra protection to livestock outside the NP and controlled livestock movement into the NP.

Work in Guinea was hampered by the sometimes instable situation in the country, meaning we could not obtain solid data on conflict or carnivore populations. Anecdotal evidence, however, suggested a moderate level of conflict and justified some mitigation measures, which were methodologically innovative. Firstly, religious leaders were invited to prepare statements and sermons on nature in general and carnivore conservation in particular, using relevant Sourats (verses in the Koran). These materials were distributed to and used by several mosques and community radio stations. Secondly, 'local hunters' associations were assisted in optimising their 'lion repellent techniques', walking side by side with approximately 100 m spacing between the members. While walking, they regularly whistled and shot blanks with artisanal firearms filled with the ash of *Anthonotha crassifolia* (Baill.; J. Léonard) mixed with bat guano to generate irritating smoke. This technique was periodically used to chase lions from inhabited areas to nearby conservation areas, over distances varying between 10 and 40 km. Effectiveness could only be assessed as immediate observed lion displacement due to the above-mentioned constraints on longitudinal damage monitoring.

Results

The exact depredation figures could not be determined precisely around Zakouma NP due to cultural sensitivity, but 32% of villages and 63% of nomadic settlements reported regular depredation incidents. Data for the other areas are

Table 1 Quantitative assessment of large carnivore depredation in study areas.

	Predator numbers, guesstimates		Annual depredation		Mean annual damage per stock-keeping household (note that units differ)
	Lions	Hyenas	Cattle	Shoats	
'W' NP Niger	110	n/a	56	339	US$138
Waza NP	50	100	727	5791	US$370 or 2.1% of herd
Pendjari	45	94	n/a	n/a	US$196–350 per affected household
Benoue NP	40	n/a	n/a	n/a	4.3% of herd (nomads only)

presented in Table 1. The improved enclosures around Waza NP in Cameroon and Pendjari NP in Benin led to a considerable decrease in depredation (Table 2) with a significant impact ($t=2.88$; d.f.$=7$; $p<0.05$). Surveillance of the main pasture area South of Waza NP by 'eco-guards' reduced depredation to 18 cattle, compared to 60 the year before. The corridor through the Benoue area in North Cameroon was used by nomadic herdsman for a short period, but was later abandoned. Herdsman indicated that losses to cattle thieves far outnumbered losses to depredation, and with water and pastures as additional pull factors they decided to return to more diffuse movements through the Protected Areas.

Observed mitigation measures around Zakouma in Chad included the use of dogs, herdsmen and the circular shape of settlements, with houses surrounding livestock. People were generally well armed and successful in deterring carnivores once alerted to their presence. Keeping livestock in houses at night was not considered feasible, because respondents insisted they must always keep a fire going with the cattle at night to prevent insect-borne diseases. In Niger, however, the park boundaries appeared to be more permeable, and large herds of livestock wandered around freely, sometimes even at night, with no or few herdsmen. Although respondents did not want lions in their proverbial backyards, they all expressed that lions should continue to exist in the area and were prepared to tolerate some depredation. Respondents declared that more labour in the form of improved surveillance of their herds was the best management option if depredation became intolerable. They also thought that predators could be chased away by disturbance, analogous to routinely practised elephant deterrent methods. This is exactly what was tested in Guinea and found successful, at least as a short-to-medium term solution on a limited spatial scale.

Discussion and conclusion

Human-lion conflict has adverse consequences for people and carnivores, whereas mitigation aims to benefit both. The monitoring programs described above had depredation incidents as the main parameter, and the observed decrease in depredation numbers was directly relevant for people and livestock. Improved enclosures significantly decreased depredation figures; other mitigation measures were identified but their effectiveness remains unverified (e.g., corridor, dogs, circular village, herdsmen, lion repellents).

An implicit assumption has been the direct correlation between livestock depredation and reciprocal lion killing, but this assumption remains untested. It appears unfeasible to gather the necessary intelligence to monitor the killing of large carnivores, and depredation will probably remain a proxy in future similar projects. The suitability of this proxy has been demonstrated in Kenya, where lion killing was significantly correlated with both cattle and shoat depredation and hyena killing was significantly correlated with shoat depredation (Ogada et al. 2003). There is also reasonable doubt, however, as general 'biophilia', protection and opportunity costs and risk perception affect the relation in area-specific ways.

Apart from the link between depredation and lion killing, there is a more diffuse impact on local people's attitudes towards wildlife in general. The link between local people's attitudes, benefits from protected areas and losses caused by wildlife is well documented (Rao et al. 2002, Sekhar 2003). People are generally more supportive of nature conservation and more tolerant to wildlife damage if they receive substantial benefits from protected areas (Bruner et al. 2001). Furthermore, the case of the corridor showed that lion conflict should be seen as only one part in herder decision-making; among other elements that need to be taken into account are water availability and security (this study), and poaching and disease (Dar et al. 2009).

Improved enclosures appear to be economically efficient, ecologically effective and culturally acceptable under many social arrangements (e.g., shared use). Still, people do not invest much effort in their construction, and even those that were built by the project were not used full-time. Reasons given for not building or using enclosures all revolved around lack of labor: construction, removal of dung after usage and supply of fodder. In some cases, the herds were also too large for enclosures. The livestock sector is very extensive, but people do see the technical and economic advantages of intensification. Conditions throughout the region are rapidly changing, and intensification could be an inescapable option in the future (Moritz et al. 2002). Until then, the building of enclosures must be viewed realistically: we do not expect many villages to adopt it but it remains the instrument of choice for managers to deal with incidents in settlements to show that mitigation is possible and to show empathy and collaboration between management and local people. For increased effectiveness, it should be accompanied by sensitisation, fodder/hay production and use of dung as manure, because adoption is greatly enhanced by direct or indirect economic benefits for herders and farmers.

Table 2 Depredation in two study areas, comparing improved enclosures with non-intervention situations.

Area	Carnivore	Improved enclosure		No intervention	
		Cattle	Shoats	Cattle	Shoats
Waza NP	Lion	0	0	6	3
Waza NP	Hyena	0	0	0	17
Pendjari NP	Lion	4	2	12	28
Pendjari NP	Hyena	0	14	1	25

The only mitigation measure that is universally practised throughout the region, and maybe throughout rural Africa, but which has received little attention from human-wildlife conflict specialists, is the use of magic (including animist and religious practices). Every single individual we met invested important sums of money (average approximately equivalent to one head of livestock per year) in magical protection, e.g., by paying for prayers by a professional 'marabout', purchasing amulets or acquiring derivatives of various wildlife species. The effectiveness of these measures is irrelevant here; they should receive far more attention as a starting point for community discussions and can be integrated to ritually mark the transition to newly introduced livestock practices. It can also be incorporated as a sensitisation instrument, as shown in Guinea through the use of nature-friendly Sourats on community radio.

Another common measure is the use of noise to chase lions away. This has been shown to be potentially effective in Guinea and anecdotal reports state that it is sometimes also practised in Burkina Faso, but it has not been tried at a larger scale. It was tried once in a specific area in Benin, organised by the Professional Hunter of Porga, adjacent to Pendjari, and was effective for some months. This method is widely practised for elephants (Hoare 2001, Zhang and Wang 2003) and needs to be further developed. It is also theoretically sound as regular harassment of lions in grazing areas would create 'landscapes of fear' (Brown et al. 1999), as even benign activities such as tourism can cause stress to lions (Hayward and Hayward 2009).

Throughout the region, livestock frequently enters Protected Areas. The depredation figures presented here could constitute a substantial part of lion diet in these areas. This trend of wildlife replacement by livestock is likely to surpass tolerance levels at some point and could lead to increased indiscriminate lion killing. Conservation authorities generally put much effort into anti-poaching, but this should also be accompanied by anti-grazing activities to reverse the trend. In some cases, illegal entry could also be countered by the supply of water for livestock at some distance from Protected Areas. In any case, depredation mitigation should go together with measures to increase wild prey densities, especially where livestock has become a substantial part of the diet of small lion populations.

Local people are important for the success of conservation (Rao et al. 2002), especially for species such as lion, but their attitude is influenced by net benefits, i.e., more than offsetting wildlife damage (Bauer 2003). Conservation policies should integrate traditional and local conservation practices, because we demonstrated that some of these can be effective in conflict mitigation.

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References

Bauer, H. 2003. Lion conservation in West and Central Africa. Integrating social and natural science for wildlife conflict resolution around Waza National Park Cameroon. PhD thesis. Leiden, The Netherlands.

Bauer, H. and S. Van Der Merwe. 2004. Inventory of free-ranging lions *Panthera leo* in Africa. Oryx 38: 26–31.

Bauer, H. and H.H. De Iongh. 2005. Lion (*Panthera leo*) home ranges and livestock conflicts in Waza National Park, Cameroon. Afr. J. Ecol. 43: 208–214.

Bauer, H., N. Vanherle, I. Di Silvestre and H.H. De Iongh. 2008. Lion–prey relations in West and central Africa. Mamm. Biol. 73: 70–73.

Brown, J.S., J.W. Laundre and M. Gurung. 1999. The ecology of fear: optimal foraging, game theory, and trophic interactions. J. Mamm. 80: 385–399.

Bruner, A.G., R.C. Gullison, R.R. Rice and G.A.B. da Fonseca. 2001. Effectiveness of parks in protecting tropical biodiversity. Science 291: 125–128.

Dar, N.I., R.A. Minhas, Q. Zaman and M. Linkie. 2009. Predicting the patterns, perceptions and causes of human-carnivore conflict in and around Machiara National Park, Pakistan. Biol. Conserv. 142: 2076–2082.

Frank, L.G., R.B. Woodroffe and M. Ogada. 2005. People and predators in Laikipia District, Kenya. In: (R.B. Woodroffe, S. Thirgood and A. Rabinowitz, eds) People and wildlife, conflict or coexistence? Cambridge University Press, Cambridge, UK. pp. 286–304.

Hayward, M.W. and G.J. Hayward. 2009. The impact of tourists on lion *Panthera leo* behaviour, stress and energetics. Acta Theriol. 54: 219–224.

Hayward, M.W., J. O'Brian and G.I.H. Kerley. 2007. Carrying capacity of large African predators: predictions and tests. Biol. Conserv. 139: 219–229.

Hoare, R. 2001. A decision support system for managing human-elephant conflict situations in Africa. IUCN/SSC African Elephant Specialist Group, Nairobi, Kenya.

IUCN. 2006a. Conservation strategy for the lion in West and Central Africa. IUCN SSC Cat Specialist Group, Douala, Cameroon.

IUCN. 2006b. Conservation strategy for the lion in Eastern and Southern Africa. IUCN SSC Cat Specialist Group, Johannesburg, South Africa.

IUCN. 2009. 2009 IUCN red list of threatened species. IUCN, Gland, Switzerland.

Marker, L. 2002. Aspects of cheetah (*Acinonyx jubatus*) biology, ecology and conservation strategies on Namibian farmlands. PhD thesis. University of Oxford, Oxford, UK.

Moritz, M., P. Scholte and S. Kari. 2002. The demise of the nomadic contract: arrangements and rangelands under pressure in the Far North of Cameroon. Nomadic Peoples 6: 127–146.

Nowell, K. and P. Jackson. 1996. Wild cats: status survey and conservation action plan. IUCN, Gland, Switzerland.

Ogada, M., R. Woodroffe, N.N. Oguge and L.G. Frank. 2003. Limiting depredation by African carnivores. Conserv. Biol. 17: 1521–1530.

Ogutu, J.O. and H.T. Dublin. 1998. The response of lions and spotted hyenas to sound playbacks as a technique for estimating population size. Afr. J. Ecol. 36: 83–95.

Packer, C., D. Ikanda, B. Kissui and H. Kushnir. 2005. Lion attacks on humans in Tanzania. Nature 436: 927–928.

Rao, K.S., R.K. Maikhuri, S. Nautiyal and K.G. Saxena. 2002. Crop damage and livestock depredation by wildlife: a case study from Nanda Devi Biosphere Reserve, India. J. Environ. Manage. 66: 317–327.

Sekhar, U.N. 2003. Local people's attitudes towards conservation and wildlife tourism around Sariska Tiger Reserve, India. J. Environ. Manage. 69: 339–347.

Treves, A. and L. Naughton-Treves. 1999. Risk and opportunity for humans coexisting with large carnivores. J. Hum. Evol. 36: 275–282.

Woodroffe, R. 2001. Strategies for carnivore conservation: lessons from contemporary extinctions. In: (J.L. Gittleman, S. Funk, D.W. Macdonald and R.K. Wayne, eds) Carnivore conservation. Cambridge University Press, Cambridge. pp. 61–92.

Zhang, L. and N. Wang. 2003. An initial study on habitat conservation of Asian elephant (*Elephas maximus*), with a focus on human elephant conflict in Simao, China. Biol. Conserv. 112: 453–459.