The impact of pastoral farming and wildlife management practices on lion-livestock interactions in the Kgalagadi-South region of Botswana

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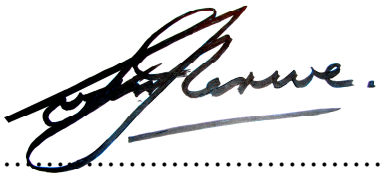
In memory of magic moments in the Kalahari

Dedicated to my wife, Francis, as well as Eugene, Mariselle, Theo, Petra and Thiani, with love and gratitude.

DECLARATION OF INDEPENDENT WORK

I, SAREL JOHANNES VAN DER MERWE, do hereby declare that this research project, submitted to the Central University of Technology, Free State for the degree MAGISTER TECHNOLOGIAE: ENVIRONMENTAL HEALTH, is my own independent work and has not been submitted before to any institution by myself or any other person in fulfilment of the requirements of any qualification.



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Summary

All over the African continent south of the Sahara Desert, African lion numbers are plummeting to levels where, over large areas of their remaining distribution range, extinction has become a real threat. The main reason for the decreasing numbers is the increasing conflict between livestock farmers and lions. Lions are forced to kill livestock where their natural prey has been squeezed out by livestock and associated farming practices, and the farmers find it necessary to protect their livelihoods, often through the indiscriminate killing of lions.

In the Kgalagadi-South region of Botswana, lion/livestock interactions present a challenge to livestock owners and wildlife managers alike. The relatively low ecological carrying capacity and occupied lion habitats in the Kgalagadi Transfrontier Park (KTP) force some expelled young adult and sub-adult lions southwards into the adjoining Wildlife Management Area (WMA) KD/15, which separates the KTP and the communal grazing area. This WMA most likely also contains resident prides. Some of these predators sporadically enter the livestock grazing area. Similarly, large stock often enters the WMA. It is mostly these boundary transgressions that result in livestock killing, and the reaction of livestock owners often leads to the killing of lions.

To gather information concerning the nature and extent of the situation, two questionnaires were prepared with the assistance of the Department of Biostatistics of the University of the Free State, South Africa. One questionnaire targeted livestock owners while the other was aimed at wildlife officials of the Department of Wildlife and National Parks in Botswana and SANParks in South Africa. Both covered the five-year period 2002-2006. A trial run was carried out to adjust to problem-specific circumstances before fieldwork commenced. Fieldwork was done during four consecutive seasons – in January, February, April and December 2007. Thirty livestock respondents and 13 wildlife officials were interviewed during the first two excursions into the study area. The third visit was to plot the cut-line between the WMA and the grazing area (by means of a Global Positioning System or GPS) and to make first-hand observations regarding

movement over the cut-line. During all four visits the environmental (including grazing) conditions and density and distribution of wildlife and stock were observed in both the WMA and the grazing areas.

The information gathered points towards a seemingly unsolvable situation. The exceptionally high daytime temperatures and food scarcity, brought about by erratic rainfall, overgrazing near boreholes, generally low carrying capacity and low phosphorus (P) levels, force large stock, i.e. cattle, horses, donkeys and mules, to graze far away from the safety of the cattle-posts during the cool hours of the night, thus making kraaling impractical. Such circumstances enhance exposure to lion predation especially in or near the WMA and the KTP fence. Some lions also penetrate deep into the grazing areas, especially in the arid western part of the study area.

This study revealed certain weaknesses in current wildlife and livestock management practices in the study area, the sum of which put both farmers and the lion population under extreme pressure. Most of these shortcomings can be rectified without drastic invasive methods. Such adjustments can result in improved livestock and wildlife utilisation and protection of the lions. For example: the placement of mixed phosphorus and salt licks near cattle-posts to fulfil the need for vital micro and macro elements; addressing unnecessary livestock losses, which contribute to a lower income and less tolerance towards predation (e.g. botulism, which may stem from stock chewing on bones in their desire for more phosphorus, and losses to black-backed jackal, *Canis mesomelas*, in poorly maintained kraals); more drinking troughs at boreholes to prevent unnecessary shoving and minimise energy waste; and the introduction of more bulls to herds to increase the calving percentage.

The study further concluded that there is little reason why stockowners should consider protecting lions. It suggests that significant value can be added to the wildlife (and the protection of lions) in the specific area by making farmers and other local residents share in the relatively untapped ecotourism potential of the area.

Opsomming

Dwarsoor die Afrika kontinent suid van die Sahara woestyn is die Afrika leeu se getalle oor groot areas van hulle oorblywende verspreidingsgebied besig om te tuimel na vlakke waar uitsterwing ‘n wesenlike gevaar geword het. Die hoofoorsaak van die dalende getalle is die toenemende konflik tussen leeus en veeboere. Leeus word geforseer om vee te vang waar hulle natuurlike prooi deur vee en geassosieerde boerderyaktiwiteite uitgedryf is, en boere beskerm hulle lewensmiddele deur leeus, dikwels voor die voet, dood te maak.

In die Kgalagadi Suidstreek van Botswana bied leeu/vee interaksies ‘n uitdaging aan veeboere en natuurbewaarders. Die relatief lae ekologiese drakrag en besette leeu habitat in die Kgalagadi Oorgrenspark (KOP) dwing sommige uitgeworpe jong volwasse en sub-volwasse leeus suidwaarts na die aangrensende natuurbestuurgebied wat die KOP skei van die kommunale weidingsgebied. Sommige van hierdie roofdiere infiltreer die weidingsgebied sporadies. Soortgelyk betree grootvee dikwels die natuurbestuurgebied. Beide hierdie voorvalle lei tot veeverliese, en veeboere reageer dan dikwels deur sodanige leeus dood te maak.

Ten einde inligting rakende die aard en omvang van die situasie te versamel, is twee vraelyste opgestel met die hulp van die Departement Biostatistieke van die Universiteit van die Vrystaat, Suid-Afrika. Die een vraelys was gerig op veeboere en die ander het beamptes van die Departement Natuurlewe en Nasionale Parke, Botswana en van die Suid-Afrikaanse Nasionale Parke geteiken. ‘n Toetslopie is onderneem om vraelyste aan te pas na gelang van die omstandighede in die studiegebied. Dertig veeboere en 13 natuurbewaringsbeamptes is persoonlik ondervra gedurende twee besoeke aan die studiegebied. ‘n Derde besoek het ten doel gehad om die ligging van die kaplyn tussen die natuurbestuurgebied en die kommunale weidingsgebied vas te stel deur middel van ‘n GPS (Globale Posisioneringsisteem), en om die teenwoordigheid van wildlewe waar te neem. Veldwerk is gedoen gedurende Januarie, Februarie, April, Mei en Desember 2007,

wat dus waarneming gedurende alle seisoene moontlik gemaak het. Meer omvattende inligting was egter nodig om akkurate gevolgtrekkings te maak, en dit is bereik deur middel van die vraelyste wat die vyf jaar periode vanaf 2002 tot 2006 gedek het.

Die versamelde inligting laat ‘n gevoel van hopeloosheid. Die uitermate hoë dagtemperature, wisselvallige reënval, oorbeweiding in die omgewing van boorgate en lae drakrag dwing grootvee soos beeste, perde, donkies en muile om ver van die veiligheid van die veeposte te wei gedurende die koel nagure, en maak die kraal van sulke vee vir beskerming teen roofdiere onprakties. Dié toedrag van sake verhoog blootstelling aan jag deur leeus, veral in of naby die natuurbestuurgebied en die KOP-heining.

Desnieteenstaande blyk dit by nadere ondersoek dat sommige leemtes in beide natuurlewe- en veebestuurspraktyke reggestel kan word sonder drastiese ingrype. Sodanige regstellings kan lei tot beter benutting van vee en wildlewe en beskerming van die leeus. Voorbeelde van hierdie regstellings is die uitplaas van gemengde sout- en fosfaatlekke naby veeposte om broodnodige mikro- en makro-elemente aan te vul (bv. lamsiek wat mag voortspruit uit die kou van bene weens die behoefte aan fosfaat); die aanspreek van sekere onnodige veeverliese wat bydra tot verlaagde inkomste en minder verdraagsaamheid teenoor leeus weens die jag van sodanige vee; onnodige kleinveeverliese as gevolg van rooijakkalse, *Canis mesomelas* weens swak kraalonderhoud; die voorsiening van meer suipkrippe by boorgate om onnodige stamp-en-stotery en gevolglike energieverlies te voorkom, en die voorsiening van meer bulle om die bul-tot-koei verhouding meer gunstig te maak.

Die studie het ook bevind dat daar min rede bestaan vir veeboere om leeus te beskerm. Die navorser is van mening dat beduidende waarde toegevoeg kan word tot die wildlewe (en die beskerming van leeus) in die spesifieke gebied deur veeboere en plaaslike inwoners te laat deel in die relatief onontginde ekotoerisme potensiaal van die gebied.

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CHAPTER 1

BACKGROUND AND RATIONALE

1.1 Introduction

Biodiversity and ecosystems are in a serious dilemma, with humans the cause of the current abnormally high extinction crisis. Large carnivores are especially sensitive to human activity and because their requirements predominantly conflict with those of local people, predators have been actively persecuted in most regions of the world (Woodroffe, 2000). These conflicts are the product of socio-economic and political spheres that are particularly controversial because the resources concerned have economic value and the predators involved are often high profile and legally protected (Graham, Beckerman & Thirgood, 2005).

Losing the top-of-the-range African predator, the African lion, to extinction would add to the further deterioration of biodiversity on the Sub-Saharan continent. Shalley (2005) provides a glimpse into the role of predators in balancing the scales of biodiversity: "Predators are central to conservation. In ecological terms, large predators are keystone species which, through their influence on the grazers and browsers, affect the entire ecosystem. The presence of large predators, such as lions, leopards and cheetahs, defines a healthy ecosystem: if an area supports them, it also supports healthy populations of other large mammals upon which they feed, and the vegetation that those require. In turn, these support the myriad smaller vertebrates and invertebrates. Similarly, large predators serve as ideal 'flagship species' inspiring great interest on the part of tourists and local people. They are central for all the wildlife-based enterprises that serve for viable economic alternatives to livestock rearing in much of Africa." If we cannot manage disease or the conflict between different African governments, where hundreds of thousands of human lives have been lost during the past decade (CIA, 2007) and war is endlessly being waged from one part of the continent to the other, how can we manage lion-livestock clashes successfully where pastoral farming is involved? Pastoralists are highly dependent on their livestock, and the slightest threat that they encounter is regarded as a major one (Bulte & Rondeau, 2005; Bagchi & Mishra, 2006). These factors all predict that extinction risks for carnivores will continue to increase, even

though human population growth is projected to decelerate during the new millennium (Woodroffe, 2000). This point to an urgent need for techniques to resolve conflicts between people and predators at either the local, national or international level (Woodroffe, 2000).

1.2 Human nature does not favour lions

The extinction of any wildlife species is both ethically and functionally unacceptable. Humans are also dependent on the earth's ecosystems for survival, and therefore on biodiversity and the conservation thereof. However, the history of mankind does not favour conservation. Attempts to conserve the lion, Africa's most impressive predator, is too often regarded as opposition to human progress. Many livestock owners struggle to survive and in no way can imagine that lions may be of value to them. For them the lion is, through predation, only the cause of further financial losses. Simultaneously, an adjoining wildlife protection area may be of no financial benefit for those livestock owners, but rather is a huge temptation because of the noticeably better grazing available on the other side of the fence or cut-line; so much more so where there is a lack of conservation education (ALWG, 2006). The dilemma also relates to illiteracy in general, since Sub-Saharan Africa is one of three large, global areas where one-third of all men and half of all women are illiterate (Holmern, Nyahongo & Røskaft, 2006; CIA, 2007). In the Kailali district of Nepal, illiteracy and the lack of conservation awareness among the indigenous Tharu community have been described as the major factors adding to the activities that are threatening the biodiversity of the area (Kafle, 2005). Illiteracy denies people knowledge and skills concerning better methods of food production, but also limits their participation in the development process (Nuwagaba, 2001).

In general it would seem that together illiteracy and ignorance form the major threat to conservation efforts – especially where pastoral farming adjoins protected areas. In the Kgalagadi-South region of Botswana (the study area in question), and especially within 2-3 km from water-points (Chanda, Totolo, Moleele, Setshogo & Mosweu, 2003),

overgrazing is obvious while the low and erratic rainfall causes regular drought spells – i.e. drought periods with an average of three, and a minimum of one to two, dry years occurring during any 10-year period (Van Vuuren, Hermann & Funston, 2005). Good grazing in the adjoining WMA will most probably result in attempts to utilise such grazing, and attempts to prohibit this will almost surely result in negativity towards wildlife conservation and antagonism towards wildlife officials (Boggs, 2000; Bagchi & Mishra, 2006). Officials of the Botswana Department of Wildlife and National Parks (DWNP) and South African National Parks (SANParks) are responsible for law enforcement in the study area, and expectedly have no easy task. Long-term deterioration of the natural habitat is seldom recognised by the presumably mostly conservation-ignorant livestock owners, or it is conveniently ignored.

Where communal farming results in overgrazing and continuous hardship for pastoralists, the hostility towards predators is generally intense and leaves little if any scope for arguments towards improved livestock husbandry and wildlife management (Woodroffe, 2000; Bauer, De Jongh, Princée & Ngantou, 2003; Graham *et al.*, 2005; Holmern *et al*., 2006). Consequently, there is a reluctance to co-operate with wildlife officials, probably due to fear of being overwhelmed by wildlife officials under the protection of the law, or the desire to obtain maximum advantage of grazing in adjoining, mostly better managed protected areas (Jackson & Wangchuk, 2004; Graham *et al*., 2005). Inadvertently, and even though the vast majority of wildlife officials are well educated and well informed regarding problem-solving techniques, human nature would tend to provoke a negative reaction from wildlife officials towards such perceptible lack of co-operation. Both the lack of conservation education and the inability to address conflict in a disciplined manner seem to be well demonstrated in the study area.

1.3 Lion numbers in Sub-Saharan Africa

During 2001 and 2002 the African Lion Working Group (ALWG) completed a census of free-ranging lions in Sub-Saharan Africa (ALWG, 2002a). The results sent shockwaves

through the international conservation community, leading to outcries for the upgrading of the lion to CITES I (CITES, 2004; Nowell & Bauer, 2004), as well as denial (ALWG, 2002b). Another, independent survey (Chardonnet, 2002) confirmed that the situation had indeed deteriorated since the publication of International Union for the Conservation of Nature and Natural Resources (IUCN) lion figures in 1996 (Nowell & Jackson, 1996). The 2004 publication of the latest ALWG figures (Bauer & Van der Merwe, 2004) concluded this controversy. The minimum number of lions in Sub-Saharan Africa was then estimated at 16 500 (Bauer & Van der Merwe, 2004) and the maximum at 47 000 (Chardonnet, 2002), significantly lower than the 1996 figures.

Closer to the study area there are indications that lion numbers have also declined in the Kgalagadi. Taken from SANParks information leaflets, between the early and late 1990s lion numbers declined by >20% in the then Kalahari Gemsbok National Park (KGNP) in the south-western Kgalagadi – from 140 to 110 (see also Castley, Knight, Mills & Thouless, 2002). A figure of just more than 400 lions was estimated for the greater Kgalagadi region, an area roughly 7.4 million hectares in size (Funston, 2001). The idea that lion numbers have declined is supported by the noticeable decline in the numbers of all large wild herbivores in Botswana (Perkins, 1996). One of the reasons for this decline is identified as the expansion of the livestock industry. Articles in local newspapers and wildlife and tourism magazines also claimed that lions had been over-hunted in Botswana, and a professional filmmaker insisted that lion trophies were becoming smaller due to all the large males being shot out (Bristow, 1994). A tour guide in Botswana resigned from his position because of the lion hunting that was taking place in photographic concession areas in the Okavango and wrote a letter to that affect to a tourism magazine (Harms: Personal comments).

Then, in 2004, two researchers working in the Okavango Delta in the northern Kgalagadi controversially claimed that lion lentivirus (LLV), which is closely related to human immunodeficiency virus (HIV) and feline immunodeficiency virus (FIV), was resulting in higher mortality rates amongst lion cubs and that “intensive research into the effects of

HIV and FIV has shown that these closely related viruses could affect reproduction in a variety of ways. Testosterone levels are reduced and ovulation impaired among some HIV-positive patients" (Kat & Nicholls, 2004). As a result of the subsequent intense debate on the deadliness (or not) of FIV, the ALWG published an FIV fact sheet stating the following: "African lions in eastern and southern Africa have the highest prevalence of FIV infection of any wild feline with nearly 100% of adults infected in several areas. Although recognised only in the last few decades, FIV has been present in wild lion populations for prolonged periods, possibly many thousands of years" (ALWG, 2004). The ALWG (2004) gave details about long-term studies, in the Serengeti in the mid 1980s and again in the 1990s, where lions infected at an early age showed no difference in survival when compared to those infected at a later age. Even during a severe outbreak of canine distemper virus (CDV) in 1994 there was no evidence that FIV-infected animals were more likely to die, claiming in effect that the FIV virus plays an insignificant role in the life expectancy of lions (ALWG, 2004).

Kat and Nicholls (2004) were also opposed to hunting as a conservation strategy and claimed that hunting, together with LLV, could lead to the lion's extinction over the next few decades. In opposition, several publications showed that hunting could be sustainable and that, as a conservation tool, the money derived from hunting could be ploughed back into the local communities (e.g. Whitman, Starfield, Quadling & Packer, 2004; Lindsey, Alexander, Frank, Mathieson & Romanach, 2006).

Through the ALWG discussions it became clear that, overall, the African lion *Panthera leo* was not as secure as was previously perceived (Personal observation). The main threats have been listed as the growth in human population numbers, the increased presence of livestock within lion distribution ranges, the resultant declining numbers of natural prey species, accompanying life-threatening situations where people are killed, and the lack of conservation education and consequential ignorance within the community (Ogada, Woodroffe, Oguge & Frank, 2003; Baldus, 2004; Cardillo, Purvis, Sechrest, Gittleman, Bielby & Mace, 2004; Graham *et al*., 2005; Packer, Ikanda, Kissui

& Kushnir, 2005; CIA, 2007).

1.4 Human-lion conflict: The complex and tense situation in the Kgalagadi-South region

During 1993 personal communication with police officers at the police station of Tsabong, a village in the south of the Kgalagadi-South region of Botswana, revealed a tense state of affairs between resident livestock owners and lions. Judging by the number of people awaiting trial for illegal lion killing, and the pile of dried lion skins just outside the police station, both lions and people were on the losing side.

The road from Tsabong, through the communal grazing area towards the Mabuasehube area of the Kgalagadi Transfrontier Park (KTP), effectively explains why the situation is so tense in the study area. Fifty kilometres north of Tsabong the road crosses into the Wildlife Management Area (WMA), known as KD/15, which separates the communal grazing area from the KTP. The difference in plant composition between the two areas is obvious: where fine stands of good grazing grasses, such as silky bushman grass *Stipagrostis uniplumis*, tall bushman grass *Stipagrostis ciliata*, small bushman grass *Stipagrostis obtusa* and Lehman's love grass *Eragrostis lehmanniana* (see Van Oudtshoorn, Troloppe, Scotney & McPhee, 1994) are obvious in the WMA, the communal grazing area shows little if any signs that these species exist. Instead, this area is dominated by indicators of overgrazing, such as annual sourgrass *Schmidtia kalahariensis*, the unpalatable shrubs bitterbos *Chrysocoma ciliata*, wild senna *Senna italica*, elands bean *Elephantorrhiza elephantina* and tumbleweed *Acrotome inflate*, palatable but hardy shrubs such as blue bush *Monechma incanum*, occasional thick stands of blackthorn *Acacia mellifera*, and an over-abundance of woody plants (Abel, 1997; Trodd & Dougill, 1998; Moleele, Ringrose, Matheson & Van der Post, 2002; Hagos & Smit, 2005; Vetter, 2005; Fraser, Dougill, Mabee, Reed & McAlpine, 2006; Personal observation).

The cattle with calves observed along the road up to nine kilometres into the WMA (despite the fact that no drinking facilities exist in the WMA) indicate that large stock (i.e. cattle, horses, donkeys and mules) enter the WMA primarily to consume larger quantities of food to maintain body condition (see also Knight, 1995; Aganda & Kgwatalala, 2005; Coetzee, 2007a). Where this may point towards a food shortage in the communal grazing area, it may also be a less costly solution to the feeding problems of livestock owners. Small stock (i.e. goats and sheep) do not wander far from cattle-posts, and their droppings and spoor were observed only in the WMA at those cattle-posts near Khawa where the WMA cut-line is nearby.

Large stock may look for greater volumes of grass for more than one reason. Phosphorus deficiency may be one of many reasons why large stock cover vast distances (Chanda *et al*., 2003; Katjiua & Ward, 2006). Cattle need approximately seven grams of phosphorus per day (Laing, 2005), and as the grass becomes dryer its phosphorus content decreases from a rare maximum of 0.123% in summer to 0.049% in winter. Wandering animals then tend to lose body weight partially due to their attempts to satisfy their need for phosphorus (Knight, 1995; McDowell, 1996; Di Marco & Aello, 2001; Mphinyane, 2001; Aganda & Kgwatalala, 2005; Hagos & Smit, 2005; Ward & Lardy, 2005; Coetzee, 2007b). Low phosphorus intake also causes reduced growth rates and poor reproductive performance (APRU, 1980).

Also, phosphorus alone is not the only component necessary to maintain body weight during winter: sufficient amounts of protein are necessary to enhance the effect of phosphorus for livestock (Coetzee, 2007b). Rangeland is the only source of food for livestock in the study area, and the quality and quantity of grass declines markedly during wintertime (Coetzee, 2007b), with the protein content dropping below 4% and the digestibility to between 35% and 45% – compared to over 50% when the grass is in a growing stage. In the arid and semi-arid area of the Kalahari, leaf flushing during dry periods provides valuable fodder to both cattle and browsing ungulates, especially during the stressful transition from spring to summer. In the semi-arid region of Namibia, for

example, cattle spend 71% of their time feeding on browse during the hot dry season (Katjiua & Ward, 2006). These examples highlight the importance of woody plants, not only as an indicator of plant responses to environmental conditions, but also economically in terms of fodder availability for livestock production (Katjiua & Ward, 2006; Sekhwela & Yates, 2006; White: Personal comments). Yet, although browse trees and shrubs contain high levels of minerals, especially phosphorus (Madibela, Letsob, Makobaa & Seitshiro, 2004), it is doubtful whether increased intake of browse provides sufficient phosphorus intake year-round. Overall, there is little doubt that the need for protein and phosphorus, especially during the dry winter months, drives large stock to cover vast distances to find their food, even at the expense of water intake.

Exceedingly long distances to water-points and exceptionally high daytime temperatures thus result in large stock often having to stay away from kraals and drinking-points for more than a day to obtain sufficient amounts of protein (Di Marco & Aello, 2001) and to satisfy their need for minerals such as phosphorus (Coetzee, 2007b). Having to graze during the night, away from the safety of the cattle-posts, would expose such large stock to predation, even more so near the KTP and near or in the WMA (Schiess-Meier, Ramsauer, Gabanapelo & Konig, 2007). One can imagine how vulnerable such clumsy, slow and attractive ungulates are to lions (see Hayward & Kerley, 2005). The absence of water-points far from cattle-posts and in the WMA convincingly proves that the higher quality and/or abundance of food are the major attraction for livestock.

The observation of numerous spoor and cow droppings up to and even into the WMA during more than 20 visits to Mabuasehube since 1993 strengthens this conclusion. Management practices are failing to keep livestock and predators apart in the study area, and several personal conversations with wildlife officials have revealed that this is indeed a management problem. Conservation legislation makes provision for the regulation of both livestock and wildlife, the protection to livestock owners, and the payment of compensation to any person who satisfactorily shows that he has suffered damage from the action of an animal (see section 2.8). But why are livestock then allowed in the

WMA? And how can government officials better enforce the legislation to ensure that no stock is allowed inside the WMA? What happens if lions do take livestock far away from the relative safety of cattle-posts, but still within the grazing area?

The very low density of natural lion prey species such as springbok *Antidorcas marsupialis*, gemsbok *Oryx gazella*, blue wildebeest *Connochaetes taurinus*, kudu *Tragelaphus strepsiceros* and red hartebeest *Alcelaphus buselaphus*, compared to the Mabuasehube area of the KTP, is evident when travelling through the grazing area. The fact that natural prey species are not in abundance in the study area, that livestock graze far away from the relative safety of cattle-posts at night and that lions are on the livestock owner's doorstep, worsen the problem of livestock predation.

1.5 Rationale

Concern for the wellbeing and survival of the lion population in the KTP and adjoining WMA was the main motivation for this study. The signs of rapid human population growth in Tsabong since 2000, the figures of lion killings in the study area (see Funston, 2001), and the dearth of information after the promulgation of the blanket lion-hunting ban in February 2001 (WCNPO, 2000) were of special concern.

The number of businesses in the region has increased visibly and, judging by the number of farmers that can be observed in town daily compared to the period 1993 to 1999 (Personal observation), livestock farming in the Kgalagadi-South region is booming. If increased livestock numbers and over-hunting (Chanda *et al*., 2003) have resulted in greater pressure on the lions' natural prey, then lion numbers are almost certainly also under pressure. It was important to determine whether the hunting ban had resulted in illegal and non-reported lion killings and whether livestock and wildlife management practices were contributing to the problem. Lack of or poorly managed conservation-incentive programmes, conservation education and community participation in wildlife management decisions could aggravate the situation (see Jackson & Wangchuk, 2004).

However, community participation does not guarantee conservation success, especially when government does not have the means to regularly attend community-based forum meetings (Bauer, 1999; Karanth, 2003; Treves & Karanth, 2003). Also, although it is crucially important that every study seeking to find answers to conservation problems should be area specific, this study could make a valuable contribution to lion conservation in general.

If livestock numbers increased to an extent where livestock owners were forced to let their animals graze in the WMA, the natural lion prey species could be forced further away or their numbers reduced through over-hunting (Verlinden, Perkins, Murray & Gaseitsiwe, 1998). This may bring livestock in even closer contact with the lions. Lions are opportunistic hunters that derive the bulk of their diet from medium-sized to large prey (Hayward & Kerley, 2005; Bauer, Vanherle, Di Silvestre & De Iongh, 2006), and with clumsy livestock such as cattle, donkeys and horses within their reach, it is unlikely that they would ignore such opportunities. Bagchi & Mishra (2006) demonstrated that high livestock numbers and low natural prey numbers resulted in increased livestock predation. Obviously, the higher the lions' success rate, the greater the tension between the livestock owners and the lions (see Bagchi & Mishra, 2006; Holmern *et al*., 2006). It has also been shown that the management of conservation efforts becomes increasingly difficult where humans are in conflict with carnivores (Holmern *et al*., 2006). After the blanket-hunting ban was promulgated, Problem Animal Control (PAC) wildlife officials in Botswana reported that the keeping of accurate PAC records was virtually impossible, as livestock owners feared that heavy penalties would be imposed on them should they report the killing of lions in defence of their possessions (Gadimang, 2005). PAC records could no longer be trusted as a barometer of the lion conservation situation in Botswana. Researchers also complained that not all photographic safari concessionaires were co-operative, making it even more difficult to gather information. Field observations and information received through whistle-blowers indicated that lions were still being killed, possibly even more so than before the ban (Lion Workshop, Kasane, March 2005). This was confirmed by researchers working in the Okavango Delta (Winterbach: Personal

comments), as well as PAC records that suddenly indicated zero figures in some areas. Livestock owners, in retaliation to the strict blanket lion-hunting (killing) ban, reportedly switched to the poisoning and gut-shooting of alleged livestock-killing lions (Lion Workshop, Kasane, March 2005), with these methods aimed at causing the lions to die far away from the livestock carcasses, thus making it extremely difficult to track down the culprits.

No mention of lion killings or the situation in the Kgalagadi-South region was made at the Kasane workshop. As Funston (2001) had reported on many lion killings in the Kgalagadi-South region prior to the blanket hunting ban, the question arose as to whether any lion killings in this area had been reported since the ban. It was also disturbing that government seemed quite placid about the situation in the Kgalagadi-South region and that no follow-up research had been done since the Funston report (Funston, 2001). Knowledge of the relative remoteness and inaccessibility of the study area strengthened the discomfort concerning lion conservation in the Kgalagadi-South region. Personal discussions with SANParks officials confirmed that lions are indeed an ongoing problem in the region (De Kock: Personal comments; Du Plessis: Personal comments). Further information received during casual conversations revealed that fence patrolling and maintenance are irregular and that the fence is not predator proof (Du Plessis: Personal comments).

This study surveys the pastoral farming practices and challenges amongst livestock owners and herders in the Kgalagadi-South region of Botswana and discusses the current wildlife management practices against the backdrop of the main findings.

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Personal comments

De Kock, M.: Machiel de Kock, at the time Section Ranger at the Nossob Rest Camp, KTP.

Du Plessis, N.: Nardus du Plessis, Senior Warden, Twee Rivieren Rest Camp, KTP.

Harms, P.: Peter Harms has visited Mabuasehube, KTP, several times and is keen on reading articles and watching television clips about Botswana wildlife.

White, R.: Richard White, groundwater specialist and communal farmer in the study area.

Winterbach, C.: Christiaan Winterbach, a lion researcher in the Okavango Delta since 1995.

CHAPTER 2

STUDY AREA AND APPROACH

2.1 Locality

The Kgalagadi district in south-western Botswana is situated along the borders of Namibia and South Africa. It covers a vast area of the Kalahari and contains the Kgalagadi-South region in its southern extremity (Figure 2.1), situated between the Nossob River in the west, the Molopo River in the south, the Kgalagadi Transfrontier Park (KTP) in the north and the Kgalagadi/Southern district boundary to the east. It covers an area of roughly 27 000 km^2 (World Gazetteer, 2006), which includes the study area of 16 400 km^2. The administrative centre is Tsabong (26^o 01' 05.9''S; 22^o 23' 55.4''E) at an altitude of 1000 m above sea level. More than one-third of the district is covered by the KTP, which extends into South Africa. The western part of the study area is separated from the KTP by a fence, but to the east the Wildlife Management Area (WMA), known as KD/15, serves as a buffer between the KTP and the grazing area, with only a cut-line to define the transition between rangeland and conservation area.

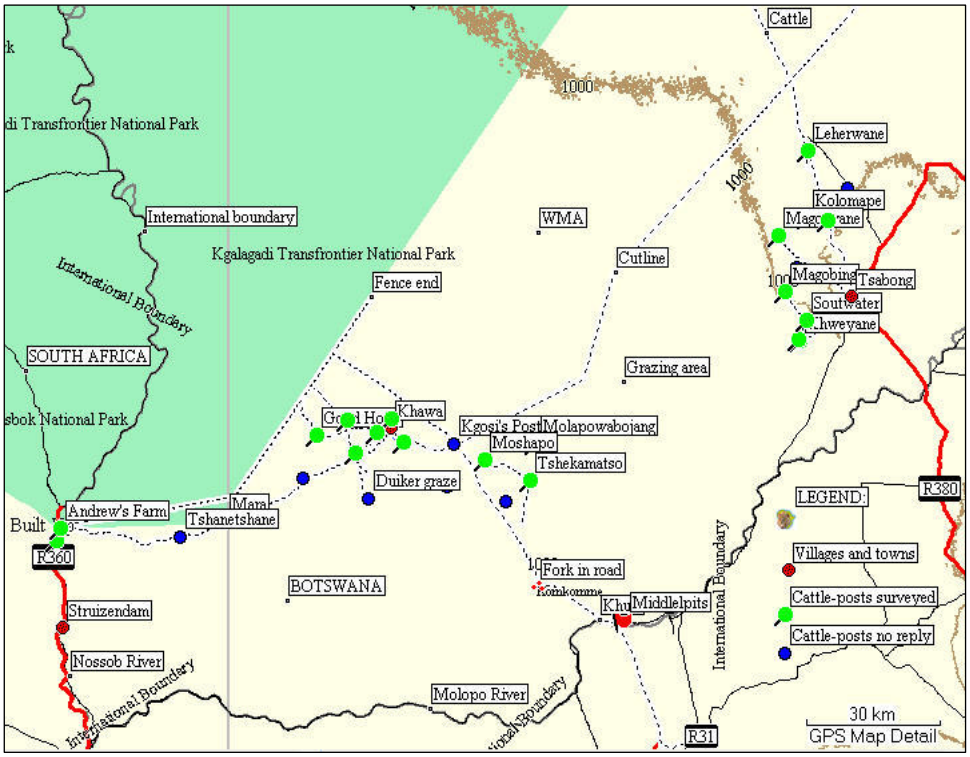

Figure 2.1 The location of the KTP, its fence, the WMA and cut-line, cattle-posts, the main town Tsabong, and other small settlements and villages

2.2 Geology

The soil type of the Kalahari is mainly Arenosol (Chanda, Totolo, Moleele, Setshogo & Mosweu, 2003), a deeply to very deeply developed soil type with poor differentiation between the different soil horizons. Texture is medium to fine sandy with a yellowish-brown to dark red colour. Drainage capacity is moderately good to somewhat excessive. Duricrusts, like calcrete, silcrete and ferricrete crusts, are widespread. These hard layers occur in different soil depths, from a few millimetres up to a few metres (Chanda *et al.*, 2003; Pule-Meulenberg, Moganane & Dikinya, 2005; Schwiede, Duijnisveld & Böttcher, 2005). The dune-savannah in the west stretches over *c*. 100 km from the Nossob River to Khawa, a settlement on the transition to the semi-arid desert. From there tree-savannah stretches further towards the east over a distance of some 190 km to Makopong, a village on the banks of the Molopo River, some 70 km south of the extreme eastern boundary of the study area.

2.3 Climate

The Kgalagadi-South region falls within the parameters of two categories of desert: an arid desert, with annual precipitation varying between 150 and 250 mm in the west and, towards the east, a semi-arid desert with precipitation between 250 and 400 mm with rainfall being irregular and occurring predominantly in the four months from January to April (Lovegrove, 2003; Parida & Moalafhi, 2008) – see Table 2.1 below.

Table 2.1 Rainfall statistics for Tsabong (Adapted from Parida & Moalafhi, 2008)

Name of rain-gauge station	Period of data	Average (mm)	Std dev. (mm)
Tsabong	1961–2003	318.5	140.7

The unpredictability in precipitation varies between 40% in the west and 30% in the east. The study area also falls within the 3000 – 4000 mm annual evaporation area. This high mean evaporation, which exceeds that of precipitation, further classifies the region as a desert and contributes to the low relative humidity: mean monthly relative humidity = 20–30% (Lovegrove, 2003). High daytime temperatures of up to 45°C during the long summer months and minimum temperatures as low as -5°C in winter make the Kgalagadi-South region an area of extremities (Jain, Lungu & Prakash, 2003). The average monthly mean, minimum and maximum temperatures and number of rainy days during the eight-year period 1996 – 2004 are shown in Table 2.2.

Table 2.2. Temperatures and rainy days at Tsabong for the period 1996 – 2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mean temperatures	28	28	26	22	17	14	13	16	21	25	26	27
Avg. max temperatures	34	35	32	30	25	23	22	25	29	32	33	34
Avg. min temperatures	19	20	17	12	7	2	2	5	10	15	18	18
Avg. rainy days	2	1	2	0	0	0	0	0	0	1	1	2

(Data derived from climate-zone.com, 2008)

2.4 Vegetation

The vegetation in the study area varies from dune-savannah in the west to tree-savannah in the east (Funston, 2001). The transition between the two coincides more or less with the 300 mm isohyetal line that cuts through Khawa. The plant composition of the arid desert to the west is noticeably different from that of the semi-arid desert to the east.

Large and even medium-sized trees are almost non-existent, and the few false umbrella-thorns *Acacia luederitzii* and camelthorns *Acacia erioloba* are small and withered. Even blackthorn *Acacia mellifera* is scarce, and only candlepod *Acacia hebeclada* and shepherd's tree *Boscia albitrunca* seem to be well-adapted. The dune crests, where the grazing load allows, are covered with Kalahari dunegrass *Stipagrostis amabilis,* a successful stabiliser of moving dune crests and very important food source for both large and small stock, and always closely associated with dunebush *Crotalaria spartioides* (Van der Walt & Le Riche, 1999). In the dune streets, driedoring *Rhigozum trichotomum* is dominant and associated with the good grazing grass known as tall bushman grass *Stipagrostis ciliata*. Small bushman grass *Stipagrostis obtusa*, one of the Kalahari's most valuable grasses (Van Oudtshoorn, Troloppe, Scotney & McPhee, 1994; Van der Walt & Le Riche, 1999; Van Rooyen, Bezuidenhout & De Kock, 2001; Thomas & Leason, 2005), is well represented in the dune streets. Sourgrass *Schmidtia kalahariensis* is also well represented and an indicator of overgrazing, although it is an important food source especially during the dry season (White: Personal comments).

East of Khawa and onwards to Mabuasehube, the vegetation becomes denser as the rainfall increases, and camelthorn and false umbrella-thorn become the most conspicuous tree species. In the extreme east of the study area, camelthorn is almost completely replaced by false umbrella-thorn. Grass coverage is obviously denser, with perennial grasses such as bushman grass more abundant compared to annual grasses such as sourgrass. However, thick stands of blackthorn are also signs of woody plant encroachment (Trodd & Dugill, 1998; Abel, 1997; Moleele, Ringrose, Matheson & Van der Post, 2002; Hagos & Smit, 2005; Vetter, 2005). Between Tsabong and the WMA, along the Mabuasehube road, the palatable bluebush *Monechma incanum* occurs in rounded clusters with signs of high grazing pressure. On this same road the difference in plant composition between the communal grazing and KTP areas is obvious, with the WMA a balance between the two, depending on the number of stock and the frequency with which stock graze here. Where fine stands of good grazing grasses, such as silky bushman grass *Stipagrostis uniplumis,* tall bushman grass *Stipagrostis ciliata,* small

bushman grass *Stipagrostis obtusa*, Lehman's love grass *Eragrostis lehmanniana* – all indicators of a healthy environment (Van Oudtshoorn *et al*., 1994) – are obvious in the KTP and large parts of the WMA, the communal grazing area shows few if any signs that these species exist. Instead, this area is dominated by indicators of overgrazing, such as annual sourgrass *Schmidtia kalahariensis*, the unpalatable shrubs bitterbos *Chrysocoma ciliata*, wild senna *Senna italica*, elands bean *Elephantorrhiza elephantina* and tumbleweed *Acrotome inflate*, palatable but hardy shrubs such as bluebush *Monechma incanum*, occasional thick stands of blackthorn *Acacia mellifera*, and an over-abundance of woody plants (Abel, 1997; Trodd & Dugill, 1998; Moleele *et al.*, 2002; Hagos & Smit, 2005; Vetter, 2005; Fraser *et al*., 2006). Closer to cattle-posts, signs of browsing on shrubs such as blackthorn *Acacia mellifera*, candlepod *Acacia hebeclada* and velvet raisin *Grewia flava*, and trees such as young camelthorn *Acacia erioloba* and false umbrella-thorn *Acacia luederitzii*, can be observed (Personal observation). The increased presence of those trees and shrubs closer to drinking facilities is also an indication of the over-utilisation of natural grasses (Hagos & Smit, 2005).

2.5 Fauna

In the KTP and KD/15 WMA a variety of game is present. In the communal grazing areas game animals are rarely observed (Personal observation). Eland *Tragelaphus oryx*, a nomadic species, can be found over the entire KTP and WMA, and sporadically appears in the study area. Similarly, gemsbok *Oryx gazella*, red hartebeest *Alcelaphus buselaphus*, springbok *Antidorcas marsupialis*, common duiker *Sylvicapra grimmia* and steenbok *Raphicerus campestris* are present and reportedly hunted in the grazing area (White: Personal comments). Blue wildebeest *Connochaetes taurinus* and kudu *Tragelaphus strepsiceros* are present in the KTP and the WMA, which is also a hunting concession area, and both species are hunted by livestock owners.

The larger and medium-sized predators are represented by the lion *Panthera leo*, leopard *Panthera pardus*, cheetah *Acinonyx jubatus*, wild dog *Lycaon pictus*, spotted hyena

Crocuta crocuta, brown hyena *Parahyaena brunnea*, black-backed jackal *Canis mesomelas*, caracal *Caracal caracal*, honey badger *Mellivora capensis*, aardwolf *Proteles cristatus* and Cape fox *Vulpes chama* (Skinner & Chimimba, 2005; Personal observation). Amongst the smaller carnivores the suricate *Suricata suricatta*, yellow mongoose *Cynictis penicillata*, slender mongoose *Galerella sanguinea* and striped polecat *Ictonyx striatus* are well represented (Personal observation). The Kgalagadi-South is also within the distribution area of the small-spotted genet *Genetta genetta*, African wild cat *Felis sylvestris lybica*, black-footed cat *Felis nigripes*, bat-eared fox *Otocyon megalotis*, and ground pangolin *Manis temminckii* (Skinner & Chimimba, 2005).

The principal burrowing mammals porcupine *Hystrix africaeaustralis* and aardvark *Orycteropus afer* are well represented, and signs of their presence can be observed all over the study area. Ground squirrel *Xerus inauris*, scrub hare *Lepus saxatilis*, Cape hare *Lepus capensis* and springhare *Pedetes capensis* are also common. The large number of small mammal species present in the Kgalagadi-South is indicated in Skinner and Chimimba (2005).

A wide variety of birds can be observed (see Hockey, Dean & Ryan, 2005). Ostrich *Struthio camelus*, kori bustard *Ardeotis kori*, korhaan *Eupodotis afra*, guinea fowl *Numida meleagris*, francolin *Francolinus adspersus*, grouse *Pterocles burchelli*, and many insect- and seed-eating birds are fairly common in the study area (Personal observation). Raptors are well represented, including several species of vultures.

Reptiles are also well represented (see Alexander & Marais, 2007). Some of the most noticeable are the Cape cobra *Naja nivea*, black mamba *Dendroaspis polylepis*, puffadder *Bitis arietans*, horned adder *Bitis caudalis*, molesnake *Pseudaspis cana* and leopard tortoise *Stigmochelys pardalis*. Common barking geckos *Ptenopus garrulus* can be heard at sunset and observed when they come out to forage.

2.6 Human component and infrastructure

The Kgalagadi district covers an area of 105 200 km², but has a human population of only 42 000 (World Gazetteer, 2006). More than 20% of the population (n=8 818) stays in the main town, Tsabong. The Struizendam settlement in the extreme west (see Figure 2.1) has 351 inhabitants, Khawa (on the transition to the semi-arid desert) has 580, Khuis (80 km south of Khawa) has 846 inhabitants, and Middlepits (situated at the border and on the banks of the Molopo River, five kilometres from Khuis) has 737. From Tsabong the tarred road leads for 190 km eastwards to Makopong, with a population of 1683 (also a border post on the banks of the Molopo River). The only other major roads in the study area are the dust road that leads from Tsabong in a north-westerly direction to the WMA cut-line (known as KD/15, and 51 km from Tsabong) and the Mabuasehube area of the KTP (60 km of thick-sand road from the cut-line), and the one that leads from Tsabong southwards towards and along the Molopo, and then Middlepits (101 km).

The cattle-posts in the west are served by a single four-wheel-drive track, originally made by donkey carts. This track begins at Struizendam and runs north-eastwards to Tshanetshane, the first cattle-post *en route*. The shortcut via Andrew's Farm, situated on the banks of the Nossob River near the Two Rivers border post, reduces the distance to Khawa with *c*. 35 km. This track offers breathtaking scenery, and the potential for ecotourism is considered outstanding. Also, due to the lay of the land, the dunes have to be crossed at right angles, offering one of Southern Africa's most challenging four-wheel-drive experiences. The 93 km distance from Two Rivers to Khawa takes three hours' non-stop driving.

Modern facilities such as electricity, running water and gravelled roads are non-existent over most of the study area, and it is only near larger centres such as Tsabong, or alongside main roads leading to other major centres, that such luxuries are available. At Khawa the only means of communication are the two-way radios at the police station and the clinic. If either one of the two radios is out of order, the remaining appliance is used

for all kinds of communication purposes, e.g. to report cases of critically ill people, for ordering provisions, and to report predation incidents to the Department of Wildlife and National Parks (DWNP) in Tsabong. The role of the *kgosi* (chief) is important, since day-to-day squabbles are sorted out efficiently, and meetings concerning the community's activities, including wildlife issues, are held at the *kgotla* (≈ Gathering place of the *kgosi*).

Khawa does not have potable water, and a tanker of the Department of Water Affairs delivers fresh borehole water weekly. This water comes from a governmental borehole some 35 km away, where it is pumped into 6000-litre tanks and provided by a "water man" on Tuesday and Friday mornings at two delivery points in Khawa. Inhabitants collect water on foot or by donkey cart and the odd pickup truck, mostly in 25-litre plastic containers. Such occasions serve as informal gatherings where both villagers and the nearest cattle-posts obtain water for household purposes. The only businesses are the "co-operation", which sells the bare necessities such as food, candles and paraffin, and the "Sand Dune Valley Bottlestore". The Tribal Office is the main building of the settlement where all official tasks are addressed. A clinic is functional, and weekly trips are undertaken from Tsabong to provide supplies and also to treat less serious ailments. The church is in the middle of the town.

The Tsabong area is different from the western part. The vegetation is denser, large trees are numerous, the visibility is reduced and dunes are unobtrusive. Most cattle-posts around Tsabong are within one day's travel by donkey cart or on horseback, and livestock owners and herders are regularly seen in town. With the DWNP's offices and police headquarters for the region situated in town, communication is better and, apart from livestock owners and herders, other people such as professional hunters and concessionaires visit the offices regularly. Hunting permits are issued, statements and appeals are addressed and livestock/wildlife issues discussed. The local people know one another well, and directions to cattle-posts are provided accurately.

Tsabong is a typical capital town, and just about any kind of service is available. Several

grocery stores, clothing shops, a pharmacy, a hospital, several schools, a wholesaler, a hardware store, liquor stores, a restaurant, filling stations, and several mechanical services are located here. All governmental services have offices in town, including the Kgalagadi District Land Board. The main road, as well as the whole stretch eastwards to Lobatse, is tarred. Just outside of town the gravel road running westwards is currently being upgraded to a tarred road that it will connect Lobatse via Tsabong, Middlepits and Khuis with Bokspits (the latter is situated alongside the road leading to Twee Rivieren, the south-westerly entrance to the KTP). Once this road is tarred, tourists will no doubt use it to travel to Tsabong, Lobatse and Gaborone (capital of Botswana), or to Mabuasehube. Alternative gravel roads, such as the road between Bokspits and Van Zylsrus, are corrugated to such an extent that tourists are wary of using them.
In the Makopong area the presence of a police station also improves communication, and both the *kgosi* and government officials play an important role in daily communication. In general it is not strange to receive messages through the police, often by means of personal visits to remote areas.

2.7 Farming practices

To the south of the study area and beyond the Molopo River lies South Africa. Travelling the fenced-off road, the modern livestock farming methods on the South African side are revealed as one fence, gate, windmill, reservoir and farmhouse follow another. In sharp contrast, on the Botswana side (and in the study area), the communal farming has no physical restrictions (such as fences or gates) and all kinds of livestock can be observed along and on the road. Very few dwellings can be seen from the road, and no farm names are shown.

Livestock owners and herders usually live as families around boreholes, in settlements such as Khawa or Struizendam, or in villages within reach of cattle-posts. Boreholes are usually attached to reservoirs or tanks, mostly with a single drinking-trough, situated in a kraal. More kraals are adjoined to the water trough. In areas where there is a shallow

water table (such as in pans and dry riverbeds) water is taken from hand-dug wells. The cattle owner, or more often a herder, provides the water to the livestock. More than one owner makes use of such a watering-point, which belongs to the original owner or his descendents (Burgess, 2006; Personal observation). Other users pay for the privilege to use such a watering-point, and a "water book" is used to keep record of the number of watering occasions per owner per month. At the end of the month or as per agreement, the users pay the owner in cash or otherwise per head of livestock, depending on the amount of water used.

As stock return to the cattle-posts at regular intervals, these sites also serve as places where the animals can be inspected and worked, including milking, feeding, castrating, cutting of hooves, treatment against disease or injury, and dehorning of males (females are not dehorned, leaving them able to defend themselves and their young against predators). Smaller kraals, usually made of wire-mesh and bush, are used to contain small stock overnight. Large stock is not kept in kraals and also grazes away from the safety of the cattle-posts, in some cases for considerable distances of up to 20 km and more (White: Personal comments.). A variety of dogs are present at each cattle-post. Means of transport to and from cattle-posts are typically donkey carts, horseback, or pickup truck. Telephone and/or power lines can only be seen in the vicinity of Tsabong and Makopong, or where tourism dictates the provision of infrastructure.

The obvious difference in veldt composition in the KTP and WMA points to over-utilisation in the grazing area. Animals graze only as far away from water as the amount of forage and their need to drink allows (see Chanda *et al*., 2003). Until some decades ago animals in Botswana, especially in the Kalahari sandveldt, were limited to drinking from pans and hand-dug wells throughout the year, and the dry Kalahari sandveldt was saved from commercial grazing. However, European Union financial assistance allowed for the drilling of boreholes and the development of livestock farming after independence in 1966, which opened the Kalahari sandveldt to more domestic grazing (Fraser, Dougill, Mabee, Reed & McAlpine, 2006). Where livestock farming once centred round the Mier

area in South Africa and on the Nossob River banks in Botswana, villages and cattle-posts for cattle, sheep and goat farming have now been developed all over. Unfortunately, this has also led to increased overgrazing (Main, 1987; Perkins, 1996; PANRUSA, 2001; Chanda *et al*., 2003; White: Personal comments).

Significant changes in grassveldt composition and a shift from herbaceous to woody plant species have taken place. Such bush-encroached ecosystems have comparatively low biodiversity and provide little fodder for livestock (Moleele & Perkins, 1998; Fraser *et al*., 2006). Through over-grazing, drought and the elimination of veldt fires, grass species have been reduced or completely replaced by thorny shrubs such as *Acacia mellifera*. Where in some cases as many as 900 head of cattle, or 600 sheep and goats, from nine cattle owners, must drink from a single trough, daily trampling and grazing results in a barren area with a complete lack of grass coverage (PANRUSA, 2001; Chanda *et al*., 2003). Apart from bush encroachment, perennial grasses have also been replaced by less palatable and less nutritious annuals (Jeltsch, Milton, Richard, Dean & Van Rooyen, 1997; Verlinden, Perkins, Murray & Masunga, 1998; Mphinyane, 2001; Rohde, Moleele, Mphale, Allsopp, Chanda, Smet & Ward, 2006). According to Mphinyane (2001) over-utilisation around water-points does not taper off until after *c*. 4000 m away. The situation worsens during autumn and winter (the dry period) when biomass decreases dramatically.

Consequently, at every borehole with drinkable water there is an area that is lost for grazing and, to a lesser extent, browsing purposes. Although large stock spends much time feeding on browse during the hot-dry season and, in the higher rainfall area at least, the larger bushes and shrubs near boreholes provide higher volumes of crude protein and phosphorus in their diet (Katjiua & Ward, 2006), the amount is not sufficient to be of any significance (McDowell, 1996). Small stock may benefit within limits, but is also forced to browse further away from the kraals during the cool hours of the day. Away from the cattle-posts and boreholes, along the KTP fence and in the WMA, the grass is in good condition, and stands of silky bushman grass *Stipagrostis uniplumis*, tall bushman grass

Stipagrostis ciliata and gha grass *Centropodia glauca* are in obviously better condition than the grass nearer to the cattle-posts (Personal observation).

As communal livestock grazing is practised directly adjacent to the KTP and/or the WMA (see Figure 2.1), only the KTP fence or the WMA serves as a buffer between large predators and livestock Occasionally large stock animals, such as cattle, donkeys, horses and mules, are observed with tooth and claw marks on their bodies. Most of these are thought to be inflicted by inexperienced sub-adult lions (Funston, Mills & Biggs, 2001; White: Personal comments), since adult, experienced lions seldom fail to kill large stock Unsuccessful hyena attacks, on the other hand, are associated with lost tails (Funston *et al*., 2001; White: Personal comment).

It has been shown that the more dependent a farming community is on its livestock, the less tolerant the owners are towards predation (see Bagchi & Mishra, 2006). Also, the higher the predation rate, the greater the tension between the livestock owners and predators (Bagchi & Mishra, 2006; Holmern, Nyahongo & Røskaft, 2006). On the other hand, the more wildlife authorities demonstrate understanding and sympathy towards losses suffered by farmers, and where sound conservation-incentive programmes are in place, the more livestock owners tend to tolerate livestock predation and the officials responsible for wildlife management. In Botswana the expansion of the livestock industry is regarded as one of the reasons why a noticeable decline in large wild herbivore numbers has occurred (Perkins, 1996). This is evident in the study area where the densities of springbok, gemsbok, blue wildebeest, kudu and red hartebeest are considerably lower than in the KTP (Personal observation). The low density of the lions' natural prey, the fact that livestock grazes mostly at night and far away from the relative safety of cattle-posts, and the situation where lions are virtually on the livestock owner's doorstep, all impact on the problem of livestock predation in the study area.

2.8 Conservation legislation

The Botswana government's approach towards the lion-livestock problem is revealed in the Wildlife Conservation and National Parks Act of 1992. This Act prohibits any domestic animal from straying into a national park and declares that any domestic animal found within a national park may be destroyed by a wildlife officer or a park attendant. The Act further makes provision for the protection and preservation of the animals and vegetation therein and allows for the setting up of local committees to give advice on the administration of the park and to define the functions of such committees. The Act defines a WMA as "any area of land declared to be a wildlife management area under section 15 and specified in the Third Schedule". The President may, by order published in the Gazette, declare any area to be a WMA, or abolish any WMA, or amend the boundaries of any WMA by adding new areas or by removing such areas. Regulations set by the Minister under section 92, in respect of any WMA, include the regulation of the grazing of any stock therein and any conditions or limitations concerning the husbandry of stock therein. Reference is made to conditions governing "the drilling, allocation and use of boreholes, the use of vehicles, the entry or presence therein of any persons other than residents thereof, and the culling of animals therein in accordance with any approved game animal utilisation scheme". Under section 46 (4) the Act provides that "compensation be paid, as be provided in regulations made under the Act, to any person who satisfactorily establishes that he has suffered damage from the action of an animal". According to section 46 (5) "the Minister may, by notice in *The Gazette*, determine rates of compensation to be paid in respect of claims made under the provisions of this section, where he considers such claims and such rates to be justified".

"(6) Any person who-

(*a*) Kills any animal in defence of property otherwise than in accordance with the provisions of subsection (1);

(*b*) Fails to report the killing of any animal in accordance with the provisions of subsection 2; or

(*c*) Uses, retains or disposes of any trophy or meat of the animal so killed otherwise than

under or in accordance with this section, shall be guilty of an offence and without derogation from his liability under any other provision of this Act shall be liable to a fine of P1000 and to imprisonment for 1 year".

The blanket lion-hunting ban was promulgated in February 2001 (WCNPO, 2000; ALWG, 2001) to specifically protect the lion. The concern that the ban may actually have led to an increase in lion killings is discussed in Section 1.5 (Chapter 1). The blanket lion-hunting ban was withdrawn in April 2003.

The Kgalagadi-South region is served by the offices of the DWNP from Tsabong and Mabuasehube in the central and eastern parts respectively, and to the west the SANParks officials are situated at Twee Rivieren. The DWNP has a Problem Animal Control Team that patrols the cut-line and fence and makes contact with livestock owners, while the SANParks officials only react to callouts from the DWNP when lions cause problems in the western duneveldt region. They are also the only ones with the equipment to tranquilise and translocate problem animals back into the KTP. Despite the availability of officials on both sides of the Nossob River, the more than 300 km long boundary between the protected areas and the rangeland of the study area makes proper management difficult, and it is virtually impossible for officials to be on the scene every time lions cross the boundary into the livestock grazing area.

2.9 Methodology

To gather information about lion-livestock interactions and the applicable management practices, this study aimed to collect a history of incidents from the five-year period 2002-2006. Information was gathered by means of questionnaires (Appendices A and B), filled in during one-on-one interviews with a representative sample of relevant livestock owners/herders and wildlife officials. A representative value of the sample was determined by comparing the number of respondents to the number of cattle-posts affected by lion depredation and the number of adult men per cattle-post. All relevant

wildlife officials at Tsabong and Two Rivers identified by senior management were interviewed. All respondents had to have practicable knowledge of the situation in the veldt, including the history of occurrences over the five-year period. It was also important that a livestock owner's/herder's answer had to portray the situation at that particular cattle-post. The rationale behind the composition of the different questionnaires included information derived from experience, and focussed on the situation and the geographic specifics. To avoid concerted responses, each group of respondents was interviewed without them having prior knowledge of the contents of the applicable questionnaire. All relevant issues had to be covered in the questionnaires, and livestock owners and wildlife officials had to be approached in such a way that the content of each question was understood. Similarly, accurate information regarding applicable legislation and governmental policies had to be obtained. Care had to be taken not to allow some individuals to manipulate the situation or influence others.

The questionnaires were firstly tested to ensure that the questions were relevant to the situation in the Kgalagadi-South region. Due to the extensive distance to the study area and the high costs involved, a trial was run by e-mailing a questionnaire for livestock owners to a selected individual who has extensive experience in the region and is also a livestock owner in the study area. The results were satisfactory and only a few questions were subsequently changed. In the case of the wildlife officials' questionnaire, it was decided not to do a similar trial run, since 60% of officials were stationed at Tsabong and the risk was too high that information would be shared with colleagues, resulting in a concerted response. The questions contained in the officials' questionnaire corresponded to a large extent with those of the livestock owners'/herders' questionnaire, and the composition of the questionnaire was considered satisfactory. Throughout the process honesty was a prerequisite. Although most of the livestock owners/herders were Afrikaans speaking, it was considered necessary to use interpreters to ensure that questions were understood correctly. The interpreter had to be literate to ensure an accurate understanding of the questions. Two interpreters were used. At Khawa the integrity of the *kgosi* was trusted to select an interpreter. In the Tsabong-Makopong area

the interpreter was a knowledgeable livestock owner. Accurate interpretation of questions by interpreters was tested by the replies of respondents and by repeating questions later on in the questionnaires. The accuracy of interpretation was tested by asking follow-up questions closely resembling the original, e.g. “how many dogs are allowed per herder at the cattle-post?” as opposed to “how many dogs accompany each herder to the veldt?”

Apart from interpretation the interpreter also had to know the region well enough to give directions to cattle-posts, and his affiliation with other livestock owners made introduction easier. He could also point out when information provided could be suspect, with especially the figures of livestock losses due to predation being important, since livestock owners could have amplified figures to convey an exaggerated message to government.

The lack of communication mechanisms made it almost impossible to make appointments ahead of time, and every day’s *modus operandi* was to drive out to the targeted cattle-post and to commence with the questioning after it was determined that the potential respondent suited the criteria as mentioned above. Campsites were chosen carefully to optimise every day’s research time. Prior knowledge of the situation and potential efficiency of respondents at a cattle-post was necessary, since the trip through the Kalahari sand was slow and time-consuming. These trips offered the opportunity to observe and make notes about the relative condition of rangelands, grazing patterns, and the density and distribution of stock and wild animals. Several photographs were taken of burrows underneath the KTP fence and of the methods being used to attempt to prevent repetitive burrowing.

Cattle-posts, the KTP fence and WMA cut-line (at a number of points), villages, roads and four-wheel-drive tracks were mapped to place the geography of the entire study area in perspective. For this purpose GPS waypoints were saved on the GPS map. Points where overgrazing commenced or ended were also plotted to calculate the extent of over-grazed areas. Photographs were taken of the houses, kraals, drinking-troughs, transport,

dogs and livestock (including those with fresh claw marks) at each cattle-post. At the end of each day, completed questionnaires were perused at the campsite to ensure that handwriting and notes could be deciphered while still fresh in the mind. Throughout, important and relevant notes were made in the margins of the questionnaires.

Interviews with wildlife officials were aimed at fieldworkers, scientists and educators. The fieldworker respondents were all Problem Animal Control (PAC) officers. The other officials included an education officer working amongst both the rural and urban community, and a biologist on a team performing game counts and research on a variety of subjects.

In total 30 livestock owners/herders and 13 wildlife officials were interviewed.

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CHAPTER 3

PASTORAL FARMING AND LION CONSERVATION IN THE KGALAGADI-SOUTH: A SYNOPSIS

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3.1 Introduction

In 1975 the number of free-ranging lions in Africa was roughly estimated at 200 000 (Myers, 1975). Twenty-seven years later a new guestimate mentioned numbers between 30 000 and 100 000 (Nowell & Jackson, 1996). More recent inventories indicate numbers of only between 28 854 and 47 132 (Chardonnet, 2002), and between 16 500 and 30 000 (Bauer & Van der Merwe, 2004) (see Table 3.1). Today fairly large numbers remain only in savannah and plains habitats where suitable prey animals still thrive (Estes, 1997; Mills & Harvey, 2001; Packer, Ikanda, Kissui & Kushnir, 2005). At the time the drastic decrease in lion numbers shocked the conservation world. Until then the general perception had been that all was well with the lion, with large numbers of 2000 in the Kruger National Park, 3750 in the Selous Game Reserve, and 2500 in the Serengeti ecosystems (Bauer & Van der Merwe, 2004). This sent a clear warning concerning the decline in lion numbers in Sub-Saharan Africa.

Table 3.1: Comparison of lion population estimates in two recent surveys

Region	**Average ALWG [1]**	**Average IGF [2]**	**Minimum ALWG**	**Minimum IGF**	**Max. ALWG**	**Max. IGF**
West	850	1 163	450	968	1 300	1 358
Central	950	2 815	550	2 092	1 550	3 538
East	11 000	15 744	8 000	11 268	15 000	18 811
Southern	10 000	19 651	7 500	14 526	12 500	23 425
Total	23 000	39 000	16 500	29 000	30 000	47 000

[1] African Lion Working Group

[2] International Foundation for the Conservation of Wildlife

(Data derived from Nowell & Bauer, 2004)

3.2 The extinction crisis

About 25% of the extant mammal species of the world are threatened by the current extinction crisis, with humans being the primary threat (e.g. Cardillo, Purvis, Sechrest, Gittleman, Bielby & Mace, 2004). In most regions of the world large carnivores are especially sensitive to human activity, as their requirements often conflict with those of the local people (Woodroffe, 2000; Mills & Harvey, 2001; Baldus, 2004; Bagchi & Mishra, 2006; Frank, Maclennan, Hazzah, Bonham & Hill, 2006). It is generally accepted that the main cause of destruction of the large carnivore populations in Africa is the indiscriminate predator-control methods used by settlers and pastoralists (Funston, 2001; Mills & Harvey, 2001; Frank *et al*., 2006). Livestock also squeeze out the other herbivores (= the natural prey) and, therefore, also the predators – especially the larger ones.

Both subsistence farmers and profit-conscious ranchers consider lions to be threats to their livestock, and take strong measures to eradicate them (Myers, 1975; Estes, 1997; Woodroffe, 2000; Mills & Harvey, 2001; Baldus, 2004; Bagchi & Mishra, 2006; Frank *et al*., 2006). "The importance of these factors means that the extinction risks for carnivores will continue to increase even though human population growth is projected to decelerate during the new millennium" (Woodroffe, 2000). Furthermore, lion kills are not restricted to livestock. More than 560 Tanzanians have been killed and at least 308 injured since 1990, with attacks having increased dramatically over the past 15 years (Baldus, 2004; Lichtenfeld, 2005; Packer *et al*., 2005). Generally speaking, however, man is still considered an unusual prey for lions, with only the odd lion individual that becomes a real specialist at killing humans for food (Guggisberg, 1975).

Another important factor in lion conservation in Africa is the fact that the continent is, per human, becoming smaller and smaller. "Africa has undergone major social, economic and political transformations. At the turn of the 20th century the total population was only 118 million, representing 7.4 percent of the world population. In the following 50 years

the population grew slowly, as high fertility rates were counteracted by high death rates due to poor health conditions, infectious diseases, civil wars and the struggle against colonialism. When mortality rates began to decline sharply from the 1950s onwards due to improved health conditions associated with economic development, there was a dramatic population increase. By 1997 the population was estimated at 778.5 million, more than 13 percent of the world population. It is projected that by the year 2025, the population in Africa will almost double to 1453 million, representing about 18 percent of the projected world population" (UNEP, 2000). In order to support this growth, natural open spaces are coming under increasing pressure for land use and development, and the substantial loss and fragmentation of natural habitat are the primary cause of species extinction and the decline of biodiversity (Nowell & Jackson, 1996; Mills & Harvey, 2001; Cardillo *et al*., 2004; Herrmann, 2004; Lichtenfeld, 2005; Van Vuuren, Herrmann & Funston, 2005). There is a strong correlation between human population densities and carnivore population decline in a region (Woodroffe, 2000; Cardillo *et al*., 2004) and it is of vital importance to realise that, while lions still roam over vast areas of the African continent, the extent of their range does not reflect their numbers.

Despite the loss of lions through illegal killing, accidental killing and problem animal control (PAC), the over-regulation of the conservation of lions can also have an adverse effect on lions. Generally, there is consensus amongst scientists that if the government fails to prevent or at least minimise livestock killings, then the killing of lions, regardless of whether or not it is legal, is considered by livestock owners to be justified. Under such circumstances no killings are reported, and the conservation officials remain uninformed. For this reason, in February 2001, the African Lion Working Group (ALWG) opposed a blanket hunting ban on lions by the Botswana Government (Van der Merwe, 2001; Patterson, 2004), as well as a 2004 proposal by Kenya that the lion should be upgraded to CITES I.

There is an urgent need for the development of techniques to resolve the conflicts between people and predators at local or regional level. In Africa the lion is persecuted to

various degrees of intensity, which is predominantly determined by the extent of the impact of the lions on livestock and human lives. The nature of different scenarios varies from one region to another, or even from one village to another, depending on the nature and extent of farming activities (Butler, 2000; Baldus, 2004; Packer *et al*., 2005; Bagchi & Mishra, 2006). Woodroffe and Frank (2005) indicated that mortality is four times higher among lions associated with livestock killing than among lions with no known history of livestock killing. Known stock killers also experience a lower reproductive rate, which results in natural selection against stock raiding (Woodroffe & Frank, 2005). A study by Ogutu, Bhola and Reid (2005) in the Maasai Mara National Reserve and adjoining pastoral ranches revealed that wild prey biomass on the ranches was, in the wet seasons, 2.6 times higher than in the reserve. In response hyena *Crocuta crocuta* density was 1.3 times higher on the ranches. Lion density, however, was eight times lower on the ranches than in the reserve. This points towards a shift in the lion population, with the populations on the pastoral ranches seemingly heading for extinction due to conflicts with pastoralism.

3.3 What has been done to address the conflict between livestock owners and lions?

Livestock-raiding lions can be classified as “habitual problem animals” or “occasional stock raiders”. Even among conservation authorities habitual stock raiders are killed, while occasional stock raiders are preferentially translocated (Stander, 1990). This principle is considered to also increase tolerance towards lions and at least offers some protection to a portion of lions in the vicinity of livestock. However, this action is totally dependent on co-operation between wildlife officials and livestock owners, the availability of funds, and the dedication and thoroughness of government officials (Berry, 2005). Current, widely attempted solutions to the problem of predation on livestock include compensation, trophy hunting, translocation of occasional livestock killers (Stander, 1990; Funston, 2001; Hemson, 2003; Whitman, Starfield, Quadling & Packer, 2004; Bulte & Rondeau, 2005; Lichtenfeld, 2005), the killing of habitual livestock

raiders, the fencing off of protected areas (Anderson, 1981), improved livestock management strategies, the shooting of lions inside national parks in the immediate vicinity of fences (Anderson, 1981), the culling of sub-adult males and to a lesser extent females, the prevention of livestock grazing in protected areas, and the education of locals (Anderson, 1981; Stander, 1990; Bauer, 1999; Funston, 2001; Hemson, 2003; Schumann, 2004; Lichtenfeld, 2005).

3.4 Reasons for the failure of measures taken to eliminate or reduce livestock killing by lions

Fencing remains the most obvious approach to prevent predation (Woodroffe, 1998; Hemson, 2003), with modern materials providing a number of choices to the wildlife manager and/or livestock owner. Apart from the high installation and maintenance costs involved, however, there are many factors that prevent fences from being used (see Owens & Owens, 1985; Main, 1987; Woodroffe, 1998; Mills & Harvey, 2001; Hemson, 2003). These include preventing animal individuals or groups from entering or leaving specific areas, which also impacts on gene-flow in a large number of species. Fencing is also not guaranteed to be 100% effective, with insufficient fence maintenance, theft, erosion, burrowing underneath fences, damage by elephants and stampeding ungulates, poaching, veldt fires and budget constraints all having an impact (Loveridge, Lynam & MacDonald, 2002).

Other factors that limit the success of large predator management are the lack of suitable translocation sites, translocation teams not responding to call-outs from livestock owners, invasive management plans not adhered to, regional economic crises and the accompanying slack in wildlife management programmes, inaccessibility, inadequate road and infrastructure maintenance, irregular surveillance, insufficient tourist accommodation, human impact on natural prey and habitat inside protected areas, shifting from “repressive” management to “participatory” management, and contradictory results with regard to compensation (Anderson, 1981; Stander, 1990; Funston, 2001; Bauer, De

Jongh, Princée & Ngantou, 2003; Berry, 2005; Bulte & Rondeau, 2005).

3.5 Synopsis of related research in Southern Botswana

As part of a comprehensive study of the lion population of the Kgalagadi Transfrontier Park (KTP), Funston (2001) conducted a questionnaire-based survey of farming areas adjoining the KTP in Botswana, Namibia and South Africa between December 1999 and September 2000. The survey covered all the larger predator species that were likely to be of economic importance in the region, including lion, spotted and brown hyena, leopard, cheetah, wild dog, black-backed jackal and caracal. Three groups of livestock were addressed in the survey, namely cattle, sheep and goats (= "shoats") and donkeys (which included horses and mules). The total lion population of the KTP at that stage was calculated at between 428 and 478 individuals. The enormous extent of livestock losses due to predation, relative to that of the other major natural causes, disease and drought, demonstrates the lions' significant impact on livestock farming in the Kgalagadi-South region (Table 3.2).

Table 3.2: Comparison of predation, expressed as a percentage of total annual livestock losses, in three regions adjacent to the Kgalagadi Transfrontier Park, December 1999 to September 2000

Livestock	Kgalagadi-South	South Africa	Namibia
Cattle	33.3	0.9	0.0
Sheep and goats	42.6	46.0	45.7
Donkeys	50.7	27.2	0.0
Mean relative percentage of losses due to lion predation	44.1	18.8	15.2

(Adjusted from Funston, 2001)

In the Kgalagadi-South, unlike in the other regions, predation accounted for the majority of annual livestock losses during the period in question, causing twice as many losses as disease and 28% more than drought. In this region it is generally believed that transgressing large predators from the KTP are the culprits. In comparison with areas in South Africa and Namibia, where these lions are tolerated or translocated, damage-causing animals and/or their kin in the study area are often shot (see Table 3.3). Also discomforting is the number of adult lionesses from boundary prides that are killed. In recent years (prior to 2004) at least one adult female was killed annually from a sub-population of five boundary prides that have home ranges adjoining these livestock grazing areas (Herrmann, 2004). Female-based, age-structured models, used to estimate the long-term viability of this KTP lion sub-population subjected to human-caused mortality, showed that an annual persecution rate exceeding two to three adult lionesses in the total KTP area will be unsustainable (Herrman, 2004).

Table 3.3: Number of predation incidents and lions shot over a four-year period in three regions adjacent to the KTP, February 1997 to March 2001

Area	No. of incidents	No. of lions shot
Kgalagadi-South	69	68
South Africa (Mier area)	9	0
Namibia	4	0

(Adjusted from Funston, 2001)

Densities of wildlife in the Kgalagadi-South ranching areas are significantly lower than in the KTP (Funston, 2001). This may also be an important contributing factor for predators taking livestock, and getting shot; especially when natural prey species migrate during the dry season. Funston (2001) described lions as the main predators of cattle, killing 0.8% of

animals per year. Leopards were the second most notorious predator, followed by spotted hyenas. These predators kill predominantly at night while cattle are out grazing. In comparison, donkeys and horses were only attacked by lions, which kill about 3.6% of the total number annually. Lions also mainly kill adult livestock. This concurs with the findings of a study in the Kruger National Park, where lions were found to prefer larger prey species such as buffalo *Syncerus caffer*, blue wildebeest *Connochaetes taurinus* and zebra *Equus burchelli* to impala *Aepyceros melampus* (Funston & Mills, 2006).

According to Funston (2001) no attacks on cattle occurred in kraals, and no cattle were killed in kraals (this was also found in South Africa and Namibia). This suggests that kraaling cattle at night might substantially reduce losses, but also that changes in kraal construction will not have any effect. In the Kgalagadi-South livestock owners attempt to hunt down marauding predators on almost all occasions, with lions getting shot in *c*. 75% of such "hunts". In one example, 46 southern boundary transgressions during February and March 1997 alone resulted in 51 lions being shot (Funston, 2001). Funston (2001) also found that, while 100% of all kills caused by lions were reported to government officials, only 62% of the respondents tried to keep their herds away from the park boundary. The majority of livestock owners (76%) strongly felt that, as part of an answer to the predation problem, the park boundary fence should be extended along the south-eastern border. Fifty-six percent of owners wanted the dead-end fence extended to as far as Mabuasehube. These livestock owners were mostly from the Khawa settlement, *c*. 25 km from the end of the fence, who had experienced problems with predators entering the ranching area by passing around the end of the fence. Livestock owners also stressed that the fence should be maintained by regular ranger patrols, preferably once a week. More than 50% of respondents sought a direct means of communication between the farmers and the KTP so that any predators present on the communal farming lands could be instantly reported to the park's officials, ensuring the fastest possible removal of raiding predators. Thirty-six percent of respondents stated that compensation should be paid out for livestock losses. Other suggestions included providing water to game along the boundary fence of the park (to prevent the southward movement of game during dry

seasons), constructing grazing camps (to protect livestock from predators), and educating the local people regarding the importance and functioning of the Kalahari ecosystem.

About 95% of livestock owners in the Kgalagadi-South region employ herders to help prevent predation and theft (Funston, 2001). Twenty-four percent of these owners provide their herders with a firearm, 28% ensure that dogs accompany the cattle, and 71% use dogs in the protection of small stock. Only 6% of all cattle, but 90% of small stock, are kraaled at night; the rest, together with all donkeys and horses, are allowed to graze freely and unattended. Kraals serve mainly to keep livestock contained for management purposes, and to a lesser degree to prevent predators from taking stock. The majority of livestock owners said that they would still use kraals in the absence of predators. Mesh and bush kraals were preferred, presumably because these were thought to be more effective for especially small stock protection.

In the Kgalagadi-South area about 59% of income is derived from cattle, 39% from small stock and 2% from donkeys and horses (Funston, 2001). Funston's study revealed that most livestock owners were interested in deriving income from free-ranging wildlife, although 21% were not interested because of the possible costs of fencing in the wildlife in order to claim ownership. Pro-wildlife-harvesting respondents were willing to reduce their livestock by a mean of 31%, provided that income from harvesting was good. Eighty-one percent of respondents indicated that they would like to earn some income from tourism. These respondents were prepared to decrease their livestock numbers by 27% if the income derived from tourism was equivalent to or higher than that from livestock sales. Most of the respondents approved of the trophy hunting of problem predators, while 76% of the respondents indicated that they would tolerate an increase in the density of lions should such hunting be allowed.

Funston's (2001) report was submitted to the Department of Wildlife and National Parks (DWNP) and South African National Parks (SANParks), but budget constraints and the inaccessibility of the area immediately adjoining the fence have prevented the

implementation of any of the proposals on a permanent basis. Marauding lions are still being captured and translocated, but not on a regular basis (Du Plessis: Personal comments). Compensation for livestock losses has also become more and more controversial. One major issue, for example, is the accuracy with which compensation amounts are calculated and paid out (Gadimang, 2005). Another reason is that compensation leads to a decrease in efforts to prevent damage and the intensification of conflict with predators (Bulte & Rondeau, 2005). "Furthermore, compensation programmes increase the return to agriculture and can therefore be viewed as a subsidy toward crop and livestock production" (Bulte & Rondeau, 2005; Gadimang, 2005). Each of these impacts can have adverse effects on the wildlife population that compensation actually intends to favour. In the Kgalagadi-South therefore, as in many other areas in Africa, lion-livestock conflict remains a major obstacle to community support of also other regional conservation initiatives.

3.6 Conclusions

According to Bagchi & Mishra (2006) communities are more tolerant towards predators where conservation-incentive programmes are in place. Bagchi and Mishra (2006) also found that (1) the more dependent a community is on income from livestock, the higher their level of intolerance towards predation, and (2) the lower the natural prey density, the more the predators focus on livestock. In Southern Africa the active management of predators, such as the translocation of stock-raiding lions and the killing of those that are proven to be habitual stock killers, has improved livestock-owners' tolerance towards such predators (Stander 1990). The seriousness of the situation concerning conflict between conservation efforts and farming communities in the Kgalagadi-South is, however, no exception to what happens in most other parts of Africa. Here high daytime temperatures, low rainfall and low carrying capacity aggravate the situation. Large stock is forced to graze far from cattle-posts, at night, while the low density of natural prey species makes livestock an attractive substitute for lions. Furthermore, the relative inaccessibility of the study area makes it extremely difficult to control the indiscriminate

killing of lions. The fact that none of Funston's (2001) suggestions could be implemented is of major concern. The blanket hunting ban on lions, proclaimed by the Botswana government in February 2001, has also resulted in the deterioration of relations between government and livestock owners. Reports during a lion workshop in March 2005 in Kasane, Botswana, indicated that, despite an increase in compensation for livestock losses, livestock owners were becoming increasingly dissatisfied with the situation, and that there was an increase in the poisoning and gut-shooting of lions and a drastic increase in the non-reporting of lion-livestock incidents in the Ngamiland district of the Okavango Delta (Gadimang, 2005). In Botswana, therefore, compensation for livestock losses due to lion predation does not seem to offer a final solution (Bulte & Rondeau, 2005; Bagchi & Mishra, 2006; White: Personal comments). On the other hand, the translocation of lions back into the KTP also has its problems. Not only is it expensive and often logistically impossible, but releasing an adult male lion into a pride's home range may lead to the killing of cubs (as witnessed in the study area by Heymans: Personal comments). Reports that SANParks officials are reluctant to use their subsidised vehicles for fence patrolling are disturbing, as are reports of poor maintenance of borehole pumps and water-points on the South African side (as reported to De Kock: Personal comments and Heymans: Personal comments). Blue wildebeest in particular need to drink regularly, and lack of water may alter their grazing patterns and movements, thereby having an effect on the lion population.

Moreover, the reluctance of livestock owners to kraal their cattle at night complicates the task of wildlife officials (Funston, 2001; Gadimang, 2005). The vast population increase and growth of the main town of Tsabong in the Kgalagadi-South region since 1991 may also be a good reflection of the increasing pressure on the ecosystem in the study area: population numbers of 3352 in 1991, 6591 in 2001 and 8818 in 2006 (= a 33.81% growth in five years vs. Botswana's total population growth of 10.47% for the same period) (World Gazetteer, 2006). Whereas in 1993 the fuel pumps in Tsabong were scarcely utilised, visitors to the region today have to wait their turn, even on Sundays. Many of the vehicles come from the Kgalagadi-South area to the west of Tsabong, and judging by the

appearance of the occupants and the loads being carried by the vehicles, many of them belong to farmers. The number of tourists and businesspeople entering or leaving Botswana at the border posts at McCarthy's Rest also seems to have increased markedly (Personal observation).

Where the Kgalagadi-South region's population, together with tourism, has grown noticeably over the six-year period since the previous survey (see Funston, 2001), no data is currently available on the number of either stock or lion losses in this area. Instead, all the information that is available emphasises the seriousness of the current situation in the Kgalagadi-South, the potential detrimental impact on lion conservation, and the urgency of finding solutions. From the 1999/2000 survey (Funston, 2001) it seems that livestock owners in general are inclined to co-operate if workable solutions to livestock predation are offered. The success of Community-Based Natural Resource Management (CBNRM) in Botswana prior to the hunting ban is further evidence of the opportunities that can be explored. Local population growth, poverty and the probable proportional increase of livestock numbers (and accompanying degradation of grazing veldt) may offer the greatest challenge in the process of finding a workable and practicable solution to both lion conservation and the future prosperity of the community.

Most importantly, comprehensive interdisciplinary research in the study area is needed to assist in developing appropriate conflict management strategies. Results of studies done elsewhere – e.g. by Kolowski and Holekamp (2006) who, along a Kenyan reserve border, found that monthly predation frequency was linked positively with rainfall and negatively with natural prey abundance and, in general, that improved fences, more watchdogs and high levels of human activity were not associated with lower livestock losses – may be valuable for incorporation in different areas. Research results in one area do not necessarily apply to other areas and so an area-specific survey with the emphasis on eventual solutions to lion-livestock clashes has become crucial for the Kgalagadi-South region.

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Personal comments

De Kock, S.: Stephanus de Kock, photographer and regular visitor to the KTP.

Du Plessis, N.: Nardus du Plessis, Senior Warden, Twee Rivieren Rest Camp, KTP.

Heymans, P.: Piet Heymans, renowned photographer and regular visitor to the KTP.

White, R.: Richard White, groundwater specialist and communal farmer in the study area.

CHAPTER 4

A SURVEY OF PASTORAL FARMING PRACTICES AND CHALLENGES AMONGST LIVESTOCK OWNERS AND HERDERS IN THE KGALAGADI-SOUTH REGION OF BOTSWANA

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4.1 Introduction

Within the agricultural sector in Botswana the lack of livestock ownership is seen as a significant cause of poverty. The distribution of cattle ownership is highly skewed and 47% of farmers do not own cattle. Most people who own cattle own small herds. Consequently, the poorest 71% of pastoral farmers own only about 8% of total traditional herds, while the richest 2.5% own about 40% (Osei-Hwedie, 2004). Other factors that contribute to persistent rural poverty in Botswana include alienation of communal land, limitation of hunting and gathering opportunities, gender inequality (with wide implications for female-headed households) and the continuing transition from a society based on pastoral farming to one based on a cash economy. This last factor has negatively affected families' ability to care for their members (Osei-Hwedie, 2004).

In the Kgalagadi-South, pastoral farming is practised on cattle-post production systems. These systems refer to unfenced rangeland where there are central water-points and communal grazing is practised. The cattle owner, or more often a herder, lives in a small hut near a borehole, and provides water to the livestock. The water is most commonly pumped from a borehole and is used by both animals and humans. Where the water is too saline, water for human consumption is transported from the nearest freshwater borehole, and two-wheeled donkey carts loaded with as many as eight 25-litre drums behind and under the driver's seat, drawn by teams of four or five donkeys, mules or horses, are a daily sight in the study area.

A conclusive account of the study area's carrying capacity is difficult to find, mainly due to the erratic rainfall, which varies noticeably per annum, and sporadic drought spells that occur. The region is subject to drought periods with an average of three, and a minimum of one to two, dry years occurring during any 10-year period (Moleele & Mainah, 2003; Van Vuuren, Herrmann & Funston, 2005). Figures varying between 30 ha/LSU (Large Stock Unit) (Wildlife Campus, 2007) and 14.3 ha/LSU (Bothma, 2000) reflect this trend.

A realistic mean figure for the carrying capacity was calculated between the two figures, and resulted in 22.15 ha/LSU or 0.045 LSU/ha. This figure was confirmed by a grazing specialist (Jordaan: Personal comments).

The Tribal Grazing Land Policy (TGLP) of Botswana was enacted in 1975 (Rohde, Moleele, Mphale, Allsop, Chanda, Smet & Ward, 2006). Its specific objective was the privatisation of communal rangelands on tribal land. This policy's Range Succession Model attempted to address rangeland degradation by encouraging ranching through the allocation of exclusive rights to farmer groups and individuals on newly designated commercial grazing land. The rationale was to promote the creation of large (6400 ha) ranches on communal land that would then be allocated, at a nominal lease rental, to individual farmers, with the precondition that such land had to be fenced. Therefore, tribal land was to be demarcated, fenced and allocated to individuals or syndicates on leasehold basis for 50 years. These TGLP ranches were generally demarcated some distance from established villages. This policy, however, did not succeed in addressing all the issues it was meant to, and the National Policy on Agricultural Development (NPAD) was enacted in 1991, mainly to reinforce the TGLP (Rohde *et al*., 2006). The NPAD called for 'acceleration in the fencing of communal areas'. It also reduced the area of ranches to be fenced, from 8 km x 8 km (6400 ha) to 6 km x 6 km (3600 ha), with the purpose of allowing more people to own ranches. In 1993 the Tribal Land (Amendment) Act, which requires land boards to work in the interest of all citizens of Botswana, was enacted. It forbids discrimination against non-tribe people, even if they have no prior claim. This act limits the rights of tribes and opens up land to speculation by outsiders (Taylor, 2006).

The current livestock production systems in Botswana are based on the TGLP and the NPAD. Various legislations and government directives have over time been promulgated to ensure quality production of livestock that complies with the standards of the European Union (EU), the major buyer of Botswanan livestock.

Today the following modes of livestock production systems exist in Botswana:

- Communal open (= not fenced) grazing/cattle-post system on tribal land;
- Private commercial fenced ranching;
- Livestock production based on TGLP ranches;
- Livestock production by speculators (where speculators buy animals and fatten them over a relatively short period through grazing and/or use of supplement feeds)

(Makenzi, Timan, Laltaika & Ubwani, 2004)

A large proportion of the population in Botswana resides in rural areas and is primarily dependent on subsistence agriculture and the use of renewable resources for their livelihoods. The climatic cycles of drought limit the potential of the area for intensive agricultural production. The dependency of the rural population on natural resources has, however, led to intensive use of natural resources in selected areas, especially close to water-points and in higher rainfall and better hard-veldt areas (Fraser & Mabusela, 2001; Chanda, Totolo, Moleele, Setshogo & Mosweu, 2003).

There has been a major decline in pastoral farming since the early 1980s. Employment in this farming sector declined from 121 000 (33% of the labour force) in 1984 to about 75 000 (15% of the labour force) in 1991. The sector has limited potential to generate income, a fact compounded by periodic droughts, which force many people to abandon pastoral farming (Osei-Hwedie, 2004).

This chapter describes the pastoral farming practices and challenges faced by livestock owners and herders in the Kgalagadi-South, as described by livestock owners, herders and wildlife officials.

4.2 Materials and methods

Two questionnaires, one for livestock owners (n=30; Appendix A) and one for wildlife officials (n=13; Appendix B), were used to collect data on livestock and wildlife management practices. Of the 30 livestock respondents 50% were livestock owners, 40% herders and 10% livestock managers at cattle-posts. Two of these respondents represented fenced-off ranches. The other ranches in the study area had experienced no livestock predation by lions (Van Zyl: Personal comments) and no questionnaires were filled in at those ranches. One-on-one interviews were conducted, with the help of an interpreter, at cattle-posts and wildlife offices at Twee Rivieren, Two Rivers and Tsabong. Completed questionnaires were analysed in conjunction with the Department of Biostatistics of the University of the Free State. Where percentage totals exceed 100, some respondents included more than one factor in their responses, while the n-factor remained unchanged. Small stock was converted to LSUs at six small stock units (SSUs) to one LSU (Jordaan: Personal comments).

To reach a reasonable conclusion about the extent of financial losses suffered due to lion predation over the five years 2002 - 2006, the total value of livestock lost to lion predation as perceived by respondents had to be calculated and the market-related values compared with amounts paid out as compensation by the Department of Wildlife and National Parks (DWNP).

The exact position of cattle-posts, the Kgalagadi Transfrontier Park (KTP) fence and the cut-line between the Wildlife Management Area (WMA) and the grazing area was determined by means of a Global Positioning System (GPS). Digital pictures were taken to illustrate certain phenomena, such as the KTP fence, kraals, drinking facilities, grazing habits and plant population composition. Satellite images were used to determine the impact of drinking places and kraals on changes in plant community structure.

4.3 Results and discussion

4.3.1 Grazing

Communal livestock farming in the arid south-western region of the Botswanan Kalahari demands special characteristics and endurance from the landowner. Erratic rainfall, low carrying capacity, extreme temperatures, lack of sophisticated forms of communication, difficult-to-negotiate sandy roads and poor-quality borehole water add to the daily struggle for survival of both humans and animals. This also affects the wildlife, which is either adapted to zero or very little free water intake or is forced to make use of man-made drinking facilities (Verlinden, Perkins, Murray & Masunga, 1998). The almost total lack of surface water worsens the situation. Although the total area demarcated to cattle-posts is, according to livestock owners, mostly 6400 ha (see Figure 4.1), circumstances and location dictate the grazing and browsing pressure and trampling of each area near a borehole. Where livestock owners cannot afford to buy sufficient numbers of breeding stock, the adjoining owners graze the areas not occupied by the lawful owner, making it difficult for the poorest to improve their source of revenue, or for livestock owners to rest and improve the quality of the veldt. It also seems that livestock owners are not aware of the decrease in allocated land from 8 km x 8 km to 6 km x 6 km (as stated in the NPAD).

Furthermore, where several cattle-posts have to water their livestock at one borehole (referred to as “syndicates”), livestock move across several designated areas to drink and an informal agreement dictates the circumstances. This agreement changes from one season to another, depending on the reliability of the borehole. Water rights are paid to either owners or syndicates on a monthly basis; if not in cash then per goat, sheep or large stock unit.

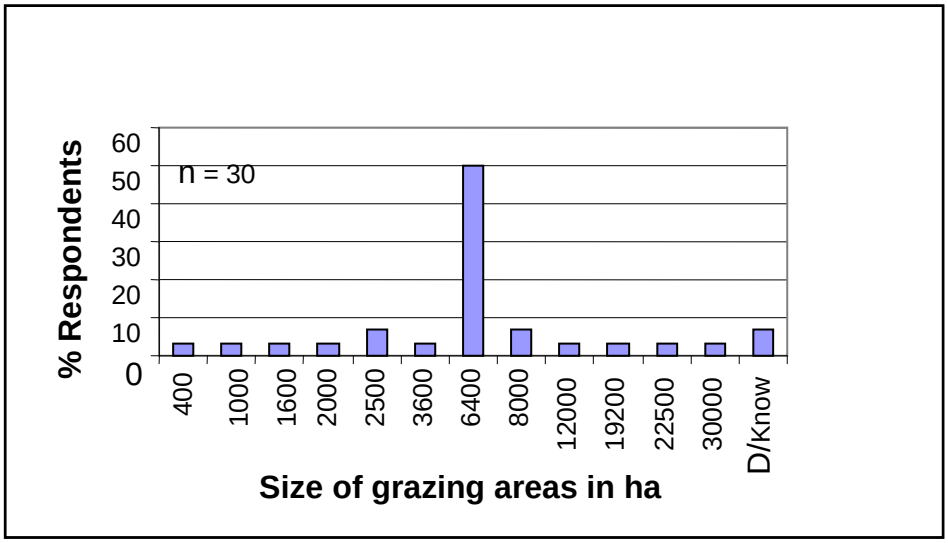

Figure 4.1 Respondents' account of grazing area size per cattle-post, expressed as percentage of respondents per category

Respondents had been staying at the specific cattle-posts for the following numbers of years: 10% had been staying for 10 years, 10% for 15 years, 10% for 20 years and 10% for 30 years. Three respondents had been staying at particular cattle-posts for 31, 38 and 60 years respectively.

Table 4.1 indicates the sizes of the various cattle-posts and the stocking rates. A first glance at the huge differences in stocking rates reported, varying from 0.002 to 0.769 LSU/ha, leaves the impression of chaotic farming practices. A factor hiding actual stocking rates is the fact that richer livestock owners simply graze onto the veldt of cattle-posts that have less stock. To better indicate this problem, cattle-posts have been listed in succession in Figure 4.2: From the dry west (150 mm p.a.; extreme left) to the wetter east (400 mm p.a.; extreme right). The unexpected decrease in stocking rate towards the higher rainfall region to the east may be due to respondents not including illegal grazing areas in the WMA near Khawa and at Leherwane Syndicate to the north and north-west of Tsabong.

Table 4.1 Respondents' account of cattle-post sizes and calculated stocking rates

Cattle-post	Grazing area (ha)	LSU	Ha per LSU	LSU per ha
Andrew's Farm	36000	102	353.5	0.003
Good Hope	6400	236	27.2	0.037
Good Hope	Unknown	NQ	NQ	NQ
Laasterus	2500	428	5.8	0.172*
Hartbeesfontein	2500	286	8.7	0.115*
Hartbeesfontein	Unknown	208	NQ	NQ
Willem's Post	3600	61	59.3	0.017
Tau's Post	1000	205	4.9	0.204*
Horse Care Syndicate	12000	640	18.8	0.053*
Mashopho	8000	53	151.8	0.007
Mashopho	6400	108	59.5	0.017
Molapowabojang	1600	1194	1.3	0.769*
Molapowabojang	2000	482	414.8	0.002
Tshekamatso	6400	NQ	NQ	NQ
Tshekamatso	19200	NQ	NQ	NQ
Khweyane	30000	NQ	NQ	NQ
Khweyane	6400	114	46.1	0.022
Khweyane	6400	96	67	0.015
Soutwater	6400	152	42.2	0.024
Soutwater	6400	232	27.5	0.036
Magobing	6400	115	55.8	0.018
Magobing	6400	130	49.4	0.02
Magojane	6400	410	15.6	0.064*
Mokaje	6400	d/k	NQ	NQ
Leherwane	6400	53	120.4	0.008

Cattle-post	Grazing area (ha)	LSU	Ha per LSU	LSU per ha
Leherwane	6400	35	182.9	0.006
Leherwane	22500	96	235.2	0.004
Leherwane	6400	16	391.8	0.003
Kolomape	6400	122	52.5	0.019
Tsope Ranch	8000	128	62.6	0.016

Figures that are unrealistically high (>0.045 LSU/ha) are marked with a (*). NQ refers to respondents' inability to quantify grazing area sizes or stock numbers.

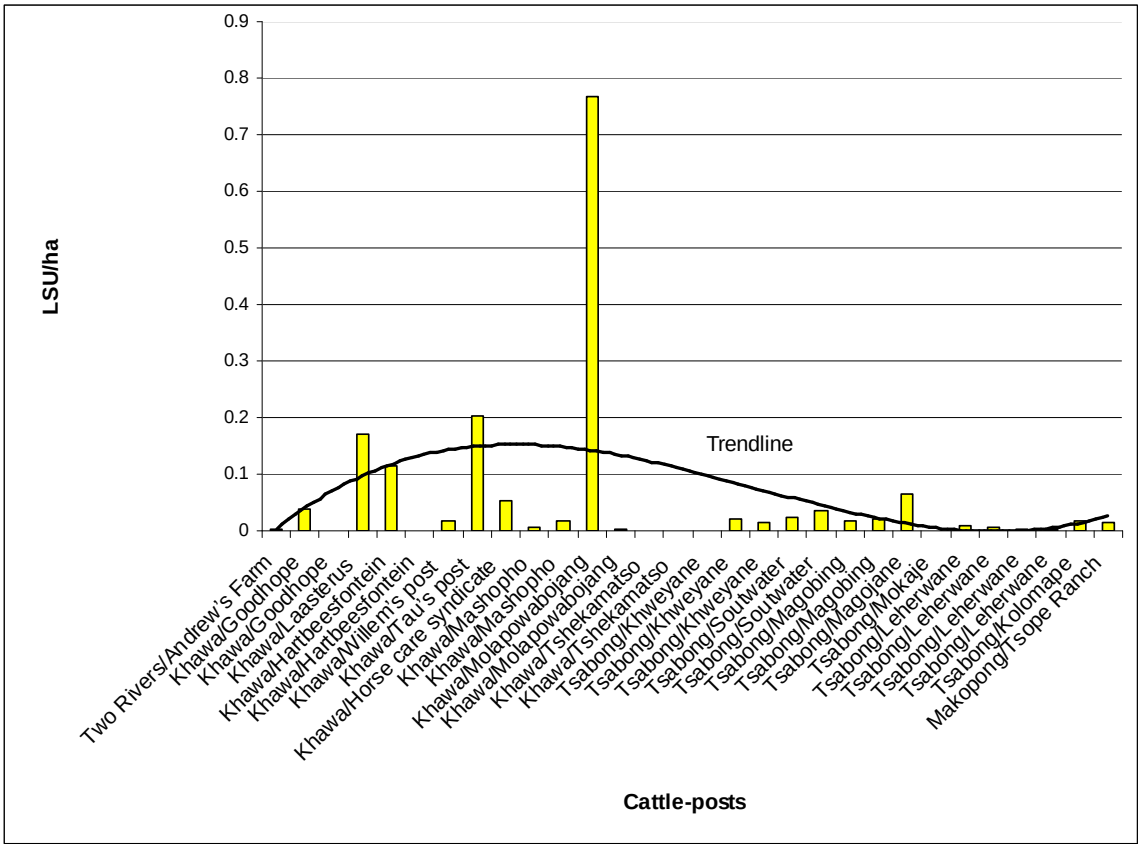

Figure 4.2 Stocking rates of all cattle-posts (n=30) listed in succession from west to east, demonstrating the seemingly irrational stocking practices

Almost all the cattle-posts with the highest stocking rates are situated close to the WMA cut-line (especially near Khawa) and both personal observations and responses from wildlife officials point towards heavy grazing into the WMA. In such cases actual stocking rates are difficult to calculate, but definitely less than those reported.

To come closer to a reasonable conclusion of real stocking rates, only cattle-posts with a maximum of 0.045 LSU/ha were used to produce Figure 4.3. However, even then the trend line indicates higher stocking rates in the dry west. The lower figures at Leherwane Syndicate, the most northern post on the Tsabong-Mabuasehube road, may be the result of concerted concealment, since personal observations exposed grazing up to nine kilometres into the WMA (also confirmed by wildlife officials).

However, if the western arid area does experience higher stocking rates in an attempt to generate higher income, higher mortality rates may be experienced during the seasonal dry months and/or extended droughts (Vetter, 2005). However, it is important to acknowledge that livestock do graze into the WMA, a circumstance that may result in higher livestock predation.

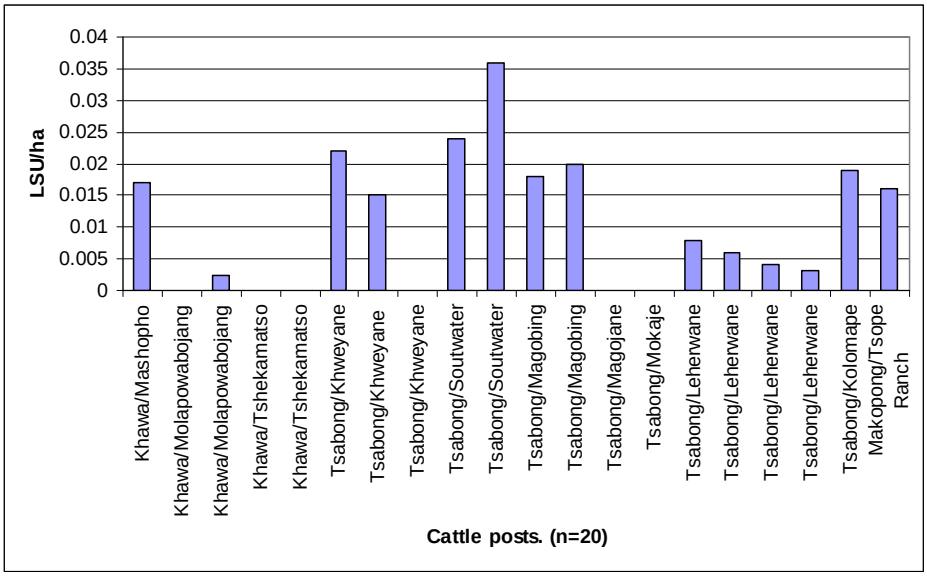

Figure 4.3 Stocking rates at cattle-posts *not exceeding* 0.045 LSU/ha

4.3.2 Kraaling

All large stock graze almost exclusively during the late afternoon and through the night and mostly return to drinking places during the morning hours. Only 10% of respondents were using their kraals for the protection of cattle against predators, and then only where signs of predators were observed. Similarly, 10% used kraals to protect donkeys, 3.3% to protect mules and 6.7% to protect horses. Kraals for large stock were mostly used for handling cattle (as indicated by 90% of respondents), donkeys (83.3%), mules (66.7%) and horses (80.0%). Additionally, 83.3% used kraals to feed cattle during drought, 63.3% donkeys, 50.0% mules and 66.7% horses.

During the cooler months or after rain in summer, animals sometimes stay away from the kraals for more than a day. The scarcity of food and low protein and phosphorus contents of grasses on the deep, sandy Aeolian soil make the area extremely low in organic matter and minerals (Mphinyane, 2001; Chanda *et al.*, 2003; Hagos & Smit, 2005) and force animals to graze further and further away from the relative safety of cattle-posts. The need for salt and phosphorus was also indicated by the regular midnight visits to the campsite near Khawa when herds of cattle regularly came to lick the barbeque grid and chew on bones that had been put out to determine whether jackals would come closer to human activities during the night (see Figure 4.4).

In contradiction to large stock, small stock graze and browse during the cooler early and late hours of the day, and do not wander further than some four kilometres from the cattle-posts. They return home before dusk, and are kraaled in enclosures made of jackal mesh, veldt poles, steel wire and in some cases thorny shrubs, which are stacked against the kraal walls to prevent access by jackals, by far the most troublesome predators on small stock in the study area. Still, some small-stock kraals were not predator proof and 66.7% of respondents acknowledged that predation of small stock occured inside kraals (*versus* 93.3% that included veldt as a location of predation on small stock). Some small-stock kraals had filled up inside with manure to an extent that goats especially would be

able to jump over easily; holes in steel mesh were not being repaired and some kraals were too small to house all small stock, meaning that some of them were simply being left outside at night. Dogs were kept to keep jackals away and/or to hunt them down.

Kraals were most commonly built with poles obtained in the veldt or, less frequently, purchased tar poles. Steel wires, and in one case 10 mm Ø steel cables, were used to control cattle, especially since handling of animals took place in the kraals. Some livestock owners were attempting to keep the calves in kraals by adding thorn bushes to the kraals.

Figure 4.4 Cattle at the campsite near Khawa regularly licked the barbeque grid and chewed on bones put out to lure jackals to the campsite. The picture was taken at midnight, January 2007, 3.1 km from the nearest cattle-post.

4.3.3 Drinking facilities

Nutrition of available food and thermoregulation play an important role in the ranging behaviour and grazing habits of large stock (Carvalho, Lammoglia, Simoes & Randel, 1995; Korthals, Chen, Hahn & Eigenberg, 1997; Brewer, 2005). In the study area the scarcity of drinking water and the unavoidable communal watering of livestock have far-reaching consequences for the natural grazing veldt near cattle-posts. Some boreholes provide water for livestock from more than seven adjoining cattle-posts. In such cases grazing areas inevitably become entangled as livestock walk to and fro, trampling grasses and other palatable shrubs to local extinction (Chanda *et al*., 2003). More nutritious perennial grasses are replaced with less edible annuals, such as sourgrass *Schmidtia kalahariensis*, and in some cases vegetation (apart from larger trees) is absent for distances of up to 3.3 km (e.g. at Tshekamatso) and 2.3 km (e.g. at Khawa) from boreholes. This leaves unproductive grazing areas of *c*. 3400 ha and 1660 ha, respectively, calculated at the specific water-points in the dry west (see Figure 4.5). No cattle-post could be found in the study area that did not show considerable signs of veldt degradation around the borehole.

Figure 4.5 Overgrazing and trampling in the vicinity of a borehole. The Kalahari dunegrass *Stipagrostis amabilis* in the foreground is some 500 metres away from the borehole. Picture taken February 2007.

According to Kay (1997) most herbivores can withstand heat and temporary water shortages well, but malnutrition develops when grasses lose their nutritional value and overgrazing results in less available food (Kay, 1997). In the study area some animals sometimes come to drink only once every four days (White: Personal comments) presumably in attempts to satisfy their nutritional needs. Due to high daytime temperatures in summer of up to 45°C (Jain, Lungu & Prakash, 2003), large stock is forced to graze during the cooler time of day, i.e. from approximately 16:30 to 07:30 (Personal observation). The hot time of day is spent in the shade of trees (see Figure 4.6), preventing excessive water loss (Di Marco & Aello, 2001; Carvalho *et al*., 1995; Kay, 1997). Respondents indicated that the cooler night temperatures (68.2% of respondents), higher moisture content of grasses (50%) and longer grazing period (31.8%) are the main reasons why large stock cannot be kraaled at night. Personal observations during fieldwork confirmed this trend. According to Lovegrove (2003) the moisture content of indigenous silky bushman grass *Stipagrostis uniplumis*, even when it appears dead and dried-out, increases from 9% during the day to 26% at night. Interestingly, also 72% of the gemsbok's feeding in the Kalahari is done at night (Knight, 1991).

Figure 4.6 Two tethered donkeys in the shade of a young camelthorn tree near Khawa in the study area. This picture was taken before 10:00 in January 2007; at 17:00 the temperature was still 42°C.

The Eurasian origin of African cattle means that their physiology and grazing behaviour are not fully adapted to the grasses, pastures and climate of Africa, and they suffer especially during times of drought (Kay, 1997). African cattle originated from western Asia some 2000 to 6000 years ago, deriving from the Indian race of aurochs, *Bos primigenius namadicus*, which would have been more accustomed to drought than the European race (Kay, 1997). Still, cattle need about twice as much drinking water during the hot summer months than during the cooler winter months. The daily water requirements of adult non-lactating stock under African ranching conditions are calculated as follows: 30 kg goat = 2.0 litres; 35 kg sheep = 1.9 litres and 350 kg zebu cow = 16.4 litres (Kay, 1997).

This means that, in the study area, a herd of 900 cattle (= the headcount at Horsecare Syndicate) would need some 14 760 litres of water daily in summer, while a goat herd of 300 animals would need 600 litres of water daily and 300 head of sheep another 570 litres. A syndicate (such as Horsecare Syndicate) thus needs a storage capacity of at least 15 930 litres to water livestock daily. This required volume of water can increase where the delivery capacity of the gravitation pipe (e.g. its diameter and distance from the reservoir or tank) and the trough size are not suitable – as is often obvious in the study area.

Almost the whole day is taken up by watering livestock. For example, large stock animals drink only small amounts of water when they arrive at the drinking-trough, and then wait for an extended period before they drink again. According to White (Personal comments) this is to prevent themselves from becoming nauseous (it has been documented that humans may become intoxicated from the over-rapid absorption of water, which lowers the osmotic pressure of the blood to an extent where the red blood cells burst, sometimes leading to a fatal form of cerebral oedema) (Kay, 1997). Ruminant animals are much less susceptible to this condition, as the water they drink first enters the rumen, which serves as a large reservoir. Obviously, the water is only slowly absorbed from the rumen or passed to the lower gut. This protects the animal against water intoxication and allows

some extra water to be stored in the rumen when drinking is infrequent (Kay, 1997). Due to the Kalahari water being saline, the reaction of cattle as described may well point towards a tendency of water intoxication. Since large stock remains at the water-points most of the day, some cattle-posts allow periodic drinking, which allows the animals to drink sufficient amounts of water to last, in some cases, for several days. Other posts, however, limit the drinking time in an attempt to save expenditure on fuel. Drinking water is not directly essential for an ungulate to chew and swallow food, even if the food source is very dry (Umphrey & Staples, 1992; Kay, 1997). The salivary glands of ungulates supply all the fluid that is required, and also provide the water for suspension of food in the forestomach (the reticulum) by rapidly circulating water from the blood.
Water is needed, however, to replace fluid lost from the body by excretion and evaporation. Animals that can store or conserve water well are able to forage long and far before they become so dehydrated that their appetite begins to fail and they must return to water.

Only one drinking-trough is provided in a kraal, even if there are more kraals adjoining one another at the cattle-post. These drinking-troughs are small, mostly *c*. 3 m long, 300 mm deep and 400 – 500 mm wide. Reservoirs to store water for the following day are also relatively small (in most cases 6000-litre nylon tanks). This results in animals having to wait for extended periods, in some cases more than a day, to drink. For example, in one case observed, animals had to wait for more than a day because the engine had run out of fuel. At the same post, some four days later, there was again no water available, as the driving-belt between the engine and pump had broken and there was no standby belt. At that specific syndicate nine cattle-posts were affected, with 900 large and 600 small stock having to drink daily. At another post, where yet again several posts had to water their stock, the rods of the mono pump stripped, and animals had to wait for two days to be watered.

The provision of better facilities at existing drinking places is within reach of livestock owners, and more drinking-troughs spread over a small area at boreholes would reduce

drinking time markedly. If maintenance and the availability of spare pumping equipment is improved and standby fuel kept for unforeseen problems, a noticeable improvement in this livestock management practice should be attained.

4.3.4 Large stock exposure to predation and associated losses

Large stock is dependent on sufficient intake of grass, except in the early growing season, when they switch to browsing for their daily nutrition (Sekhwela & Yates, 2006). The dry air and daily winds that prevail during the dry-hot months lead to the drying out and degeneration of grass leaves, especially sourgrass, so that fibre intake is lower and especially cattle look for sufficient crude protein and phosphate intake (Katjiua & Ward, 2006). Due to the relatively low carrying capacity of the Kalahari the animals are forced to graze away from cattle-posts to fulfil their daily nutritional needs, covering distances that make it uneconomical energy-wise to return daily to the safety of the kraals (Di Marco & Aello, 2001). Protection of large stock against predation by means of kraaling, therefore, does not seem practical in the study area.

Especially in the rainy season and in winter when temperatures are mild, cattle wander far from their home kraals, leaving them more vulnerable to large predators such as lion, spotted hyena, leopard, wild dog and cheetah. Cows with calves tend to remain closer to the kraal, as the calves are kept in the kraal until they are old enough to fend off small to medium-sized predators. Such lactating cows also need to drink water more regularly than dry cows. Small stock, i.e. goats and sheep, graze and browse in the vicinity of cattle-posts and were not observed further than 3.7 km from the nearest cattle-post. Dried-up boreholes, as was the case at Ntau's Post near Khawa, however, force the owner to let his sheep and goats drink at the next closest water-point (in this case Horsecare, a syndicate 5.9 km from Ntau's Post). Large stock (i.e. cattle, donkeys, horses and mules) grazes much further away. In one case a herd of cattle was observed 25.3 km away from Leherwane, the nearest cattle-post where drinking facilities are available; this herd was 9.1 km into the WMA.

Sixty percent of respondents indicated that lion predation on large stock occurred mostly during the dry winter months, while 13.3% stated that most losses occurred during the hot summer months, and 20% indicated that their losses were distributed throughout the year. For exceedingly wet summer months, however, 36.7% of respondents indicated that lion attacks on livestock increased as opposed to 20% who indicated that attacks decreased. The fact that large stock do not drink daily when there are lots of moist grasses available, therefore staying away from the safety of cattle-posts, consequently exposes them more to predation. Nevertheless, 70% of respondents were of the opinion that predation by lions increased during extended droughts (only 3.3% were of the opposite opinion), pointing towards a more complicated problem as might have been suggested above.

Other human-induced factors, such as low natural prey density, may also influence the number of stock losses due to lions. Verlinden *et al*. (1998) suggested that, in the southern Kalahari, the "selective wildlife utilization is a more important factor in the current distribution of common game species than avoidance of areas changed by livestock". In the wet season, areas with low grass cover are observable up to 10 km from boreholes. Within the first 2-3 km, however, there is almost no grass; not even the hardiest grasses such as tassel three-awn *Aristida congesta congesta* and sourgrass *Schmidtia kalahariensis*. Ostrich, common duiker, steenbok and springbok are less influenced by human settlements than other wildlife species. Springboks are attracted to vegetation types characterised by short grass and/or dwarf shrubs (Verlinden, 1997), which occur mostly in and around pans or ancient riverbeds, but also in areas closer to boreholes that are grazed by cattle. Even in highly grazed areas browse is generally still abundant or even locally increased, and these smaller, preferential browsers – springbok, steenbok and common duiker – are still found relatively close to cattle-posts. Gemsbok and eland, however, have been removed by hunting and poaching and much higher densities are observed far from cattle-posts and especially in the WMAs. Gemsbok is relatively easy to hunt with dogs, and their meat is also much sought after (Verlinden, 1997). During fieldwork only steenbok was observed in abundance, usually staying away from the immediate vicinity of cattle-posts. Springbok was very scarce and was observed

only once in a small group of five individuals that immediately fled from the vehicle. No gemsbok, eland or wildebeest were observed in the grazing area. Compared to the numbers of gemsbok and eland that were observed in the WMA, over-hunting in the communal grazing area is expected, thus leaving less natural prey available for the lions, should they cross over into the grazing area. The effect of rainfall on natural prey density, distribution and movement may also have an influence on the times and frequency with which lions do enter grazing areas.

Figure 4.7 reflects the hunting preferences of respondents, but does not indicate which game species is hunted most. Virtually all skins, horns and carpets observed at cattle-posts and in Khawa were those of springbok, save for one carpet made of springhare skins and offered for sale at Khawa.

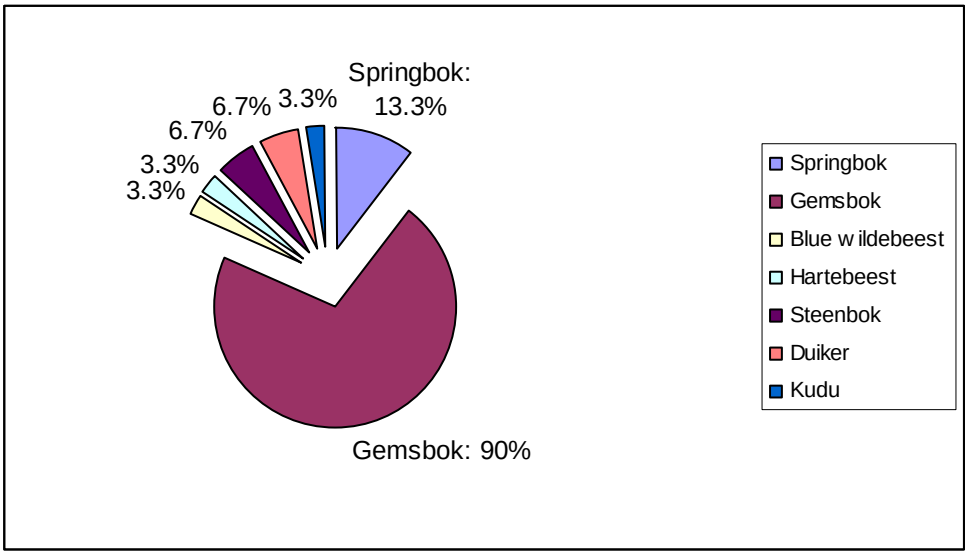

Figure 4.7 Game species preferred by livestock owners for hunting purposes

The very low presence of natural prey species in the communal area, together with the fact that large stock graze far away from the cattle-post at night, contributes to lions taking livestock. A total of 83.3% of respondents were convinced that no attempts to protect cattle against lion predation would be successful. A further 86.7% indicated that

donkeys, mules and horses could not be protected against lion attacks.

When the remaining *c*. 15% of respondents were asked how lion predation on livestock can be prevented, 40% were of the opinion that lions should be killed, 20% wanted the fence of the KTP to be extended along the WMA and 40% wanted the lions to be regularly chased far away from the cattle-posts.

The specific cattle-posts' location in relation to the KTP and WMA (Table 4.2) and the categories and numbers of livestock lost during the period 2002 to 2006 (Figure 4.8 and Figure 4.9) provide valuable insight in the impact of lion predation on livestock.

Table 4.2 Position of cattle-posts in relation to the KTP fence and the cut-line of the WMA

Cattle-post	Distance to KTP fence	Distance to WMA (km)
Andrew's Farm to KTP fence	Adjoining	Not
Tshanetshane to KTP fence (Allegedly no predation)	6.8	Not
Mara to KTP fence (Allegedly no predation)	5.1	Not
Pafeo to KTP fence (Allegedly no predation)	10.5	Not
Good Hope to KTP fence	7.5	17.8
Hartebeesfontein to KTP fence	11.2	11.3
Laasterus to KTP fence	16.7	16.3
Willem's Post to KTP fence	18.2	9.6
Ntau's Post to KTP fence	19.1	5.3
Horsecare Syndicate to KTP fence	24.3	7.5
Kgosi's Post (Allegedly no predation)	33.9	0.64
Moshapho	41.6	6.2
Tshekamatso	52.2	14.6
Molapowabojang	48.8	8.3
Khoyane	Not	41.6
Soutwater	Not	38.9
Dikgameng (Allegedly no predation)	Not	29.7
Magobing	Not	31.4
Kolomape	Not	23.2
Maleshe	Not	27.6
Leherwane	Not	13.6
Pebana	Not	17.1

Higher predation figures at Andrew's Farm, for example, may be due to its location directly adjoining the KTP at Two Rivers, despite the fact that the KTP fence largely serves as a buffer against lion infiltration into the ranch (Castley, Knight, Mills & Thouless, 2001). Burrowing animals such as aardvark and porcupine leave tunnels underneath the fence, large enough for predators to squeeze through. The ranch's own fences are completely inadequate, with jackal mesh only 1 metre high and two steel-wire strains on top increasing the height to barely 1.2 metres. The fences are even lower on the many dune crests due to wind-blown sand piling up against the fence. On two occasions the gates in the road to Tshanetshane and Khawa were found left open. Hartebeesfontein's animals graze mainly towards the KTP fence and the WMA cut-line, due to competition for grazing from Good Hope to the south-west, Laasterus to the south, Willem's Post to the south-east and Khawa and Ntau's Post to the east, exposing them to increased predation by lions from the WMA.

Horsecare is a syndicate where several cattle-posts water their animals and the high predation figure can be related to the large number of stock, as well as the fact that some of the animals graze towards and into the WMA - which is situated 7.5 km from the borehole and within easy reach of large stock. Similarly, Magobing and Magojane are situated closer to the WMA cut-line and exposed to resident lion prides. At Leherwane, which is also a syndicate, larger livestock numbers and competition from other cattle-posts result in livestock roaming north and north-westwards towards the cut-line and into the WMA. Respondents acknowledged that their livestock do graze in the WMA. When questioned, wildlife officials stated that livestock owners are only requested to remove their animals from the WMA, and no prosecution results from such transgressions.

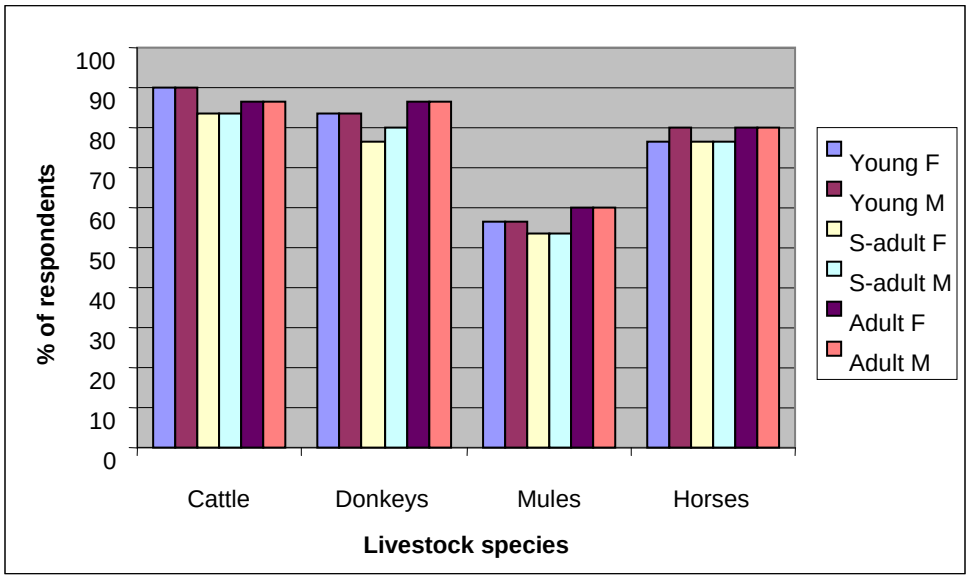

Figure 4.8 Large stock as lion prey as perceived by livestock owners. Percentages represent the respondents and not the numbers of livestock killed during the period 2002 to 2006. F = female; M = male.

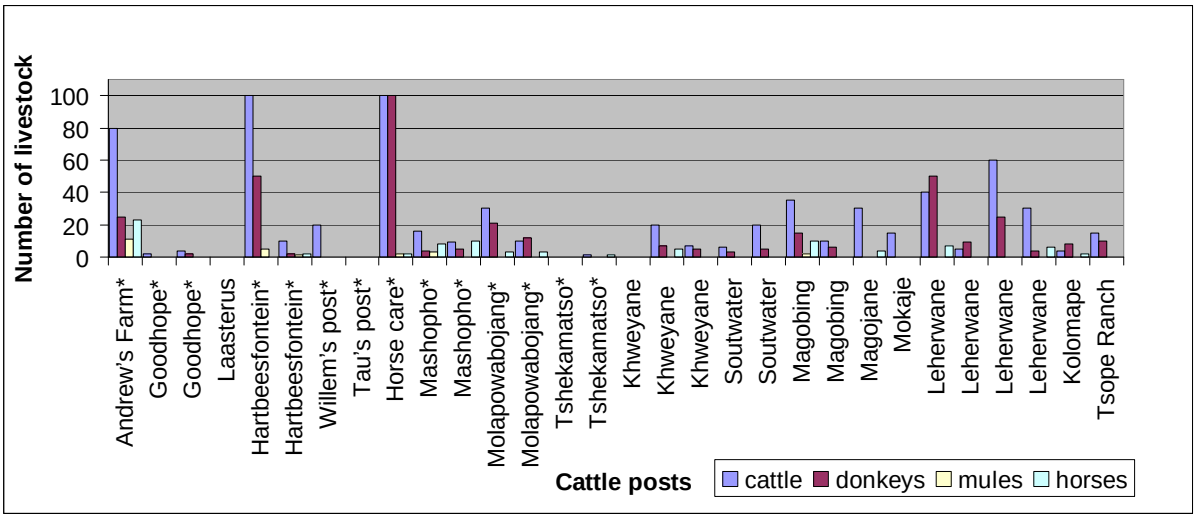

Figure 4.9 Large stock lost to lion predation per cattle-post, 2002 – 2006. Cattle-posts within 10 km of the KTP or WMAs are indicated with (*)

4.3.5 Predatory behaviour by lions

Responses to questions about why lions prefer large stock provide more insight into specific stock as preferred prey. More than 50% of respondents indicated that predation occurs at night away from cattle-posts where large stock cannot be protected by herders on horseback (Figure 4.10). A significant proportion (40%) suggested that it is because large stock are not kraaled at night, while others reasoned it is because lions prefer large stock due to larger quantities of meat per killing (*c*. 20% of respondents), or because small stock are kraaled at night at the cattle-post and are, therefore, protected from lions (*c*. 10%).

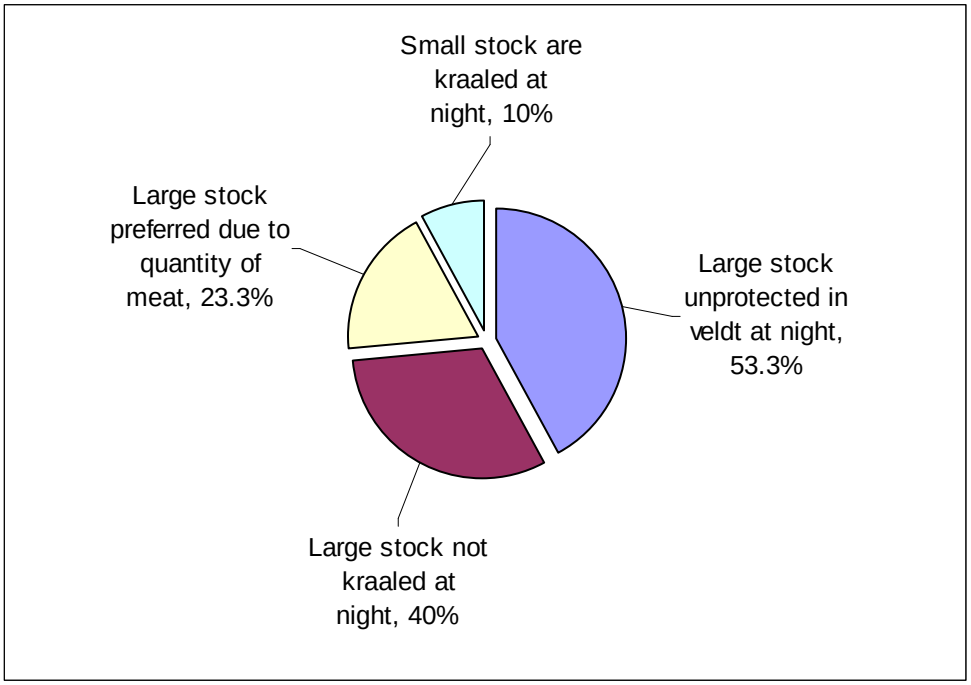

Figure 4.10 Livestock owners' reasons as to why lions prefer large stock as prey rather than small stock

When asked what time of day most lion attacks occurred, respondents indicated that attacks occur at dusk (more than 60%), at night (90%) and at dawn (70%) (Figure 4.11). Less than 20% stated that attacks also occur during the day. On the question as to why

lions do not attack during the day, most respondents answered that it is because the lions are cautious of humans.

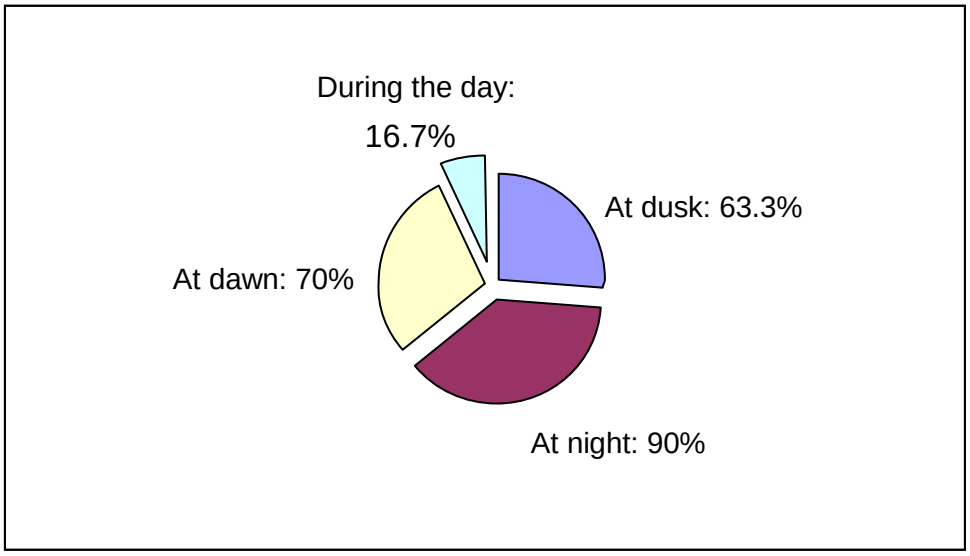

Figure 4.11 Time of day that lion attacks occur, according to livestock owners

A total of 96.7% of respondents pointed out that herders are not able or used to protect livestock against lion attacks, while 60% indicated that dogs did not accompany herders to protect livestock against large predator attacks. Two thirds of respondents agreed that lion attacks take place in the veldt, far away from cattle-posts (Figure 4.12). More than 50% said that attacks occur near the WMA (the author assumes that this includes attacks in the WMA, since livestock enter the WMA regularly) and a relatively small percentage indicated that lions attack large stock in the kraals or at drinking places.

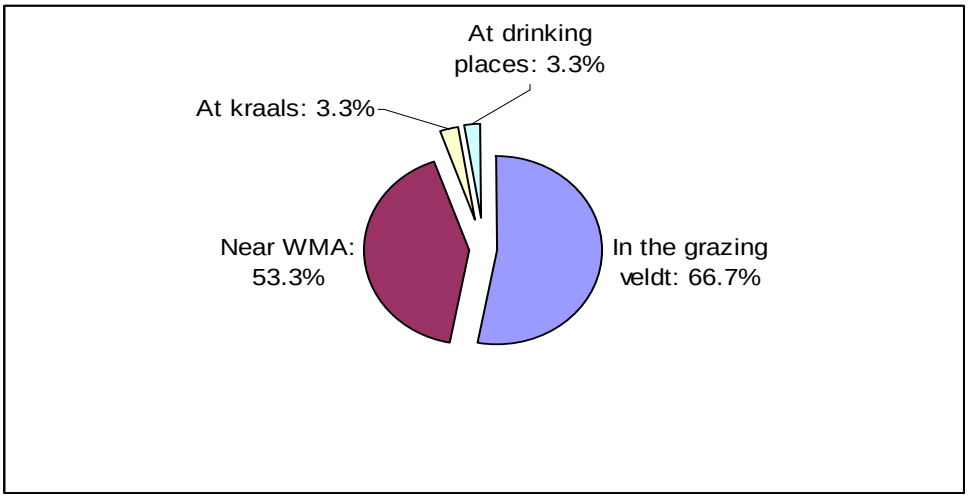

Figure 4.12 Location of lion attacks, according to livestock owners

The history of lion attacks, as analysed according to respondents' answers, unfolded as follows: 56.7% indicated a decrease in lion attacks from 2002 to 2006 and 36.7% an increase; 6.7% had experienced no losses due to lion predation (see Figure 4.13).

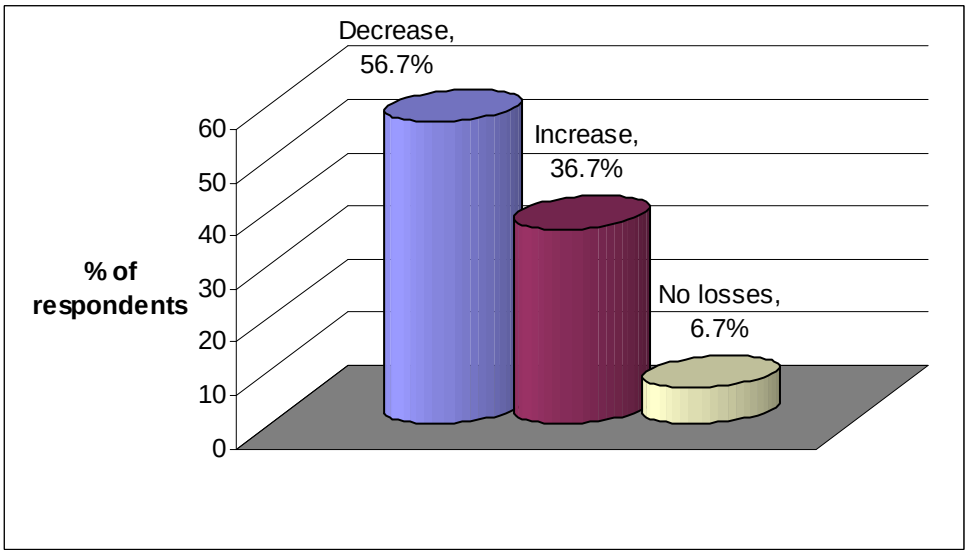

Figure 4.13 History of lion attacks on livestock since 2002, as perceived by livestock owners

When asked how often lion attacks occur, 63.3% of respondents answered “annually”, 20% said “monthly” and 10% “weekly”. Eighty percent of respondents could not detect any climatic or seasonal pattern in lion attacks over the years, and none of the 30 livestock owners and herders kept any written records of attacks or stock losses due to predation.

Most wildlife officials agree that the number of lion attacks on livestock dropped between 2002 and 2006 (Figure 4.14). There was nevertheless a fairly large percentage (>30%) that indicated increases at shorter intervals (from year to year); >50% indicated decreases during the same period. These figures can be regarded as an accurate account of the number of incidents reported, since the DWNP keeps record of all known incidents of lion attacks.

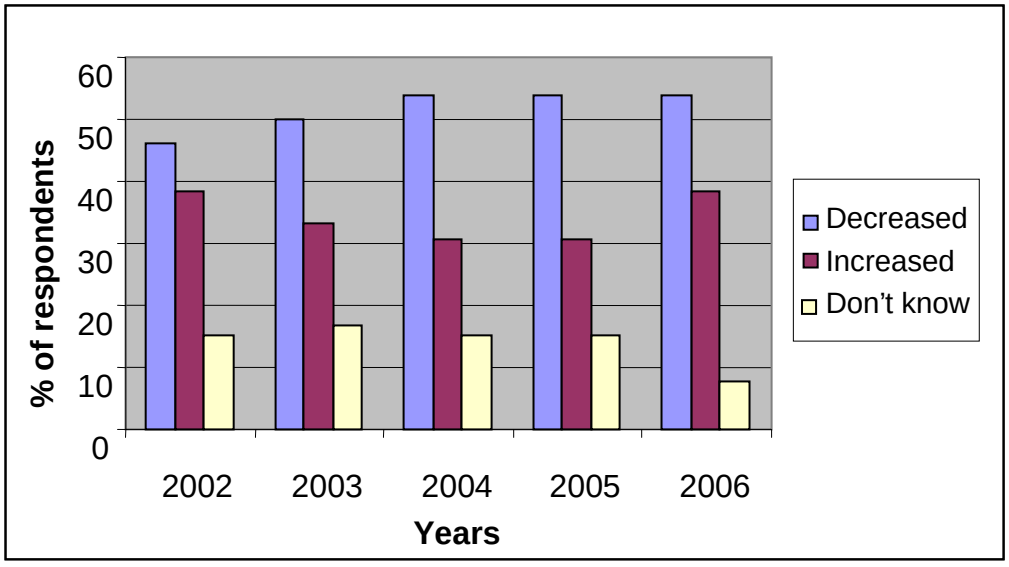

Figure 4.14 History of lion attacks, according to wildlife officials

The KTP was identified as the source of livestock-killing lions by 84.6% of wildlife officials, while 15.4% said that these lions originate from the WMA. Only 30.8% of officials responded that all lions or groups of lions that enter the study area prey on livestockm while 61.6% opposed this view. Ninety percent of livestock owner respondents indicated that the lions come from the KTP, while 20% stated that the lions

come from the WMA and 3.3% claimed not to know where the lions originate (see Figure 4.15).

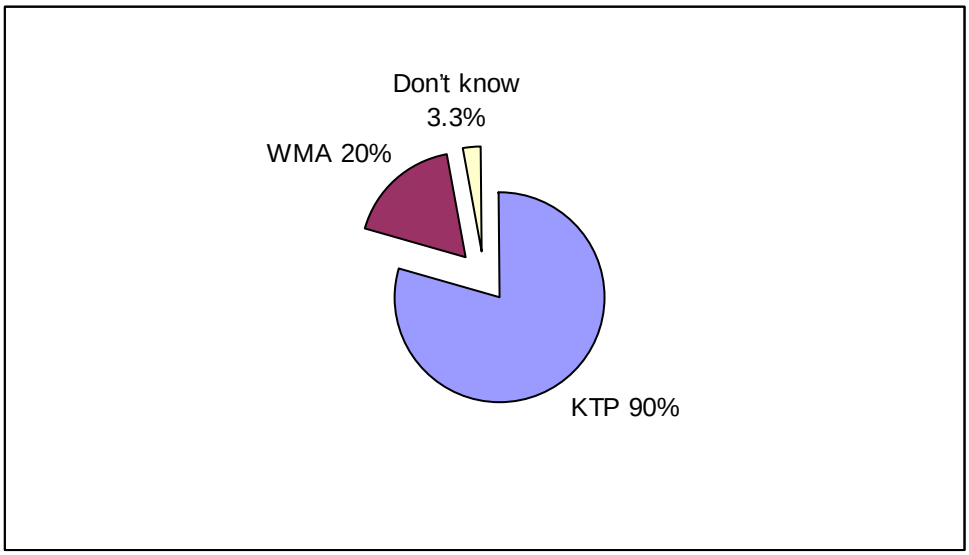

Figure 4.15 Origin of marauding lions, according to livestock owners and herders

A total of 86.7% indicated that marauding lions retreat to the KTP after killing livestock and 16.7% said that they move back into the WMA. Eighty percent of respondents indicated that all individuals or groups of lions that enter the grazing area prey on livestock and 13.3% indicated that not all lions are livestock raiders. A total of 3.3% said that they do not know whether all lions are livestock killers.

Reacting to the question of whether it is possible for lions and livestock to coexist, more than 75% of officials were positive; the remainder were sceptical that such a scenario would ever be feasible (Figure 4.16). According to the wildlife officials it is necessary to protect the lions in the study area for the following reasons: 50% indicated that the lions could generate money, 20% indicated that the lions must be protected for future generations to enjoy, 20% indicated that the lion is the top predator in the food chain, and 10% indicated that the lion is the kingpin tourist attraction in the area.

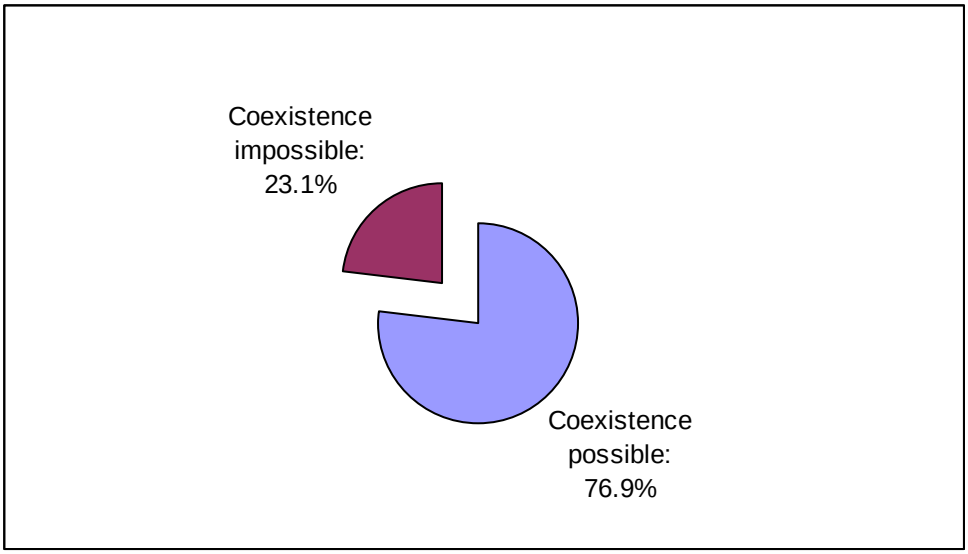

Figure 4.16 Feasibility of lion-livestock coexistence, as seen by wildlife officials

Livestock herders move between cattle-posts on a daily basis, looking for lost animals and seeking out their neighbours for conversation. A total of 33.3% of respondents indicated that during such conversations they receive reports of the presence of lions in the grazing area. The main form of transport is donkey cart or horseback, and knowing the area well saves time when a lost cow, donkey, mule or horse must be found. During such endeavours, herders look for signs of predators. Sixty percent of respondents become aware of the presence of lions and other large predators by identifying their spoor, 50% by observing skittish livestock, 33.3% by observing scattered livestock, and 30% by observing claw marks on the animals (at the kraals or in the veldt), while 23.3% are cautioned by roaring at night, 20% observe vultures, and 3.3% did not know how to observe signs of lions in their grazing area (see Figure 4.17).

Although respondents indicated that lions roar in the grazing area, it is highly unlikely that lions are heard every time they are present. Nomadic lions do not roar often when they are in the vicinity or territory of pride males, nor do lions roar if they are in competition with larger groups (McComb, Packer & Pusey, 1994; Heinsohn, 1997; Grinnell & McComb, 2001). If the average distance at which lions react to other lions'

roars is 2.5 km (Ogutu & Dublin, 1998) then it is doubtful if the human ear would detect roaring over greater distances. If the age structure of lions (see Figure 4.18 and Figure 4.19) is taken into consideration, the possibility that nomadic lions make up the majority of livestock-raiding lions becomes stronger.

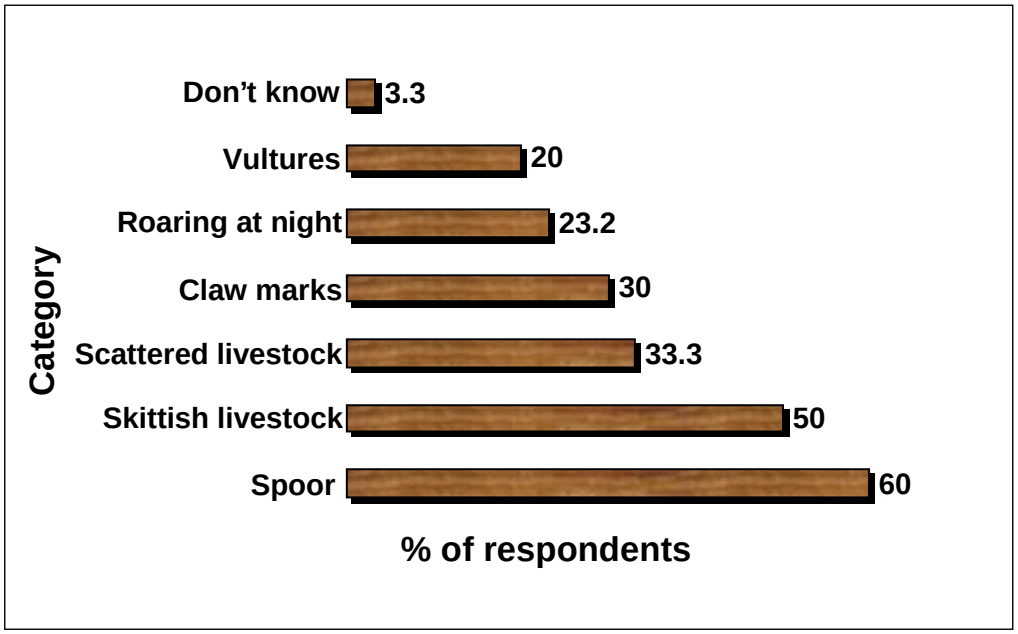

Figure 4.17 Methods of detecting the presence of lions in the grazing area, as provided by livestock owners and herders

Skittish livestock mostly retreat to the cattle-posts and the safety of the kraals. Weathered herdsmen know the signs but do not backtrack the spoor of such skittish animals, due to their fear for lions while on horseback. Such occasions are rarely followed up with an all-wheel-drive pickup truck.

4.3.6 Sex, age, numbers and group structure of lions

The dry Kalahari region does not sustain large numbers of game, due to its low carrying capacity, erratic rainfall and poor sandy soils (Eloff, 1973; Mills, Wolff, Le Riche &

Meyer, 1978; Perkins, 1996; Castley *et al*., 2002). This results in Kalahari lions demarcating their territories and defending them fiercely. Cub mortality is 40% during good years and 50% during average years. It may increase to 70% for second-year cubs and 90% for first-year cubs during poor years and/or due to young males being evicted from the pride. However, 30% of sub-adult females also leave the pride (Van Vuuren *et al*., 2005). Intrasexual competition for mates is generally more intense among males than females in polygynous species and one male can often monopolise several females (Trivers & Willard, 1973; Funston, Mills, Richardson & Van Jaarsveld, 2003). Males are therefore more likely to be evicted and must disperse to find territories and/or mates. With nowhere to go without risking being attacked by pride males, some sub-adults, mostly males, move out and away from established territories, which most probably include the grazing area.

Male lions are sexually mature at about two years of age but are not fully adult until about four. They may continue growing until approximately 7-8 years, with their manes not fully developed until at least five years of age. Lions between the ages of 0 and 24 months are generally considered cubs, while those between 25 and 36 months are sub-adults, and adults are 37 months and older (Smuts, Hansk & Whyte, 1978). For purposes of this study, both mane development and body size at 37+ months was regarded as sufficient to enable livestock owners to clearly distinguish between males and females, and between sub-adults and adults.

The data in Figure 4.18, therefore, leaves room for reservation and the question arises as to whether the fear of confrontation with lions while on horseback may play a role in the livestock owners' and herders' observations. According to these owners and herders, *c*. 13% of marauding lions are younger than 24 months, 40% are sub-adults, and 47% are adults.

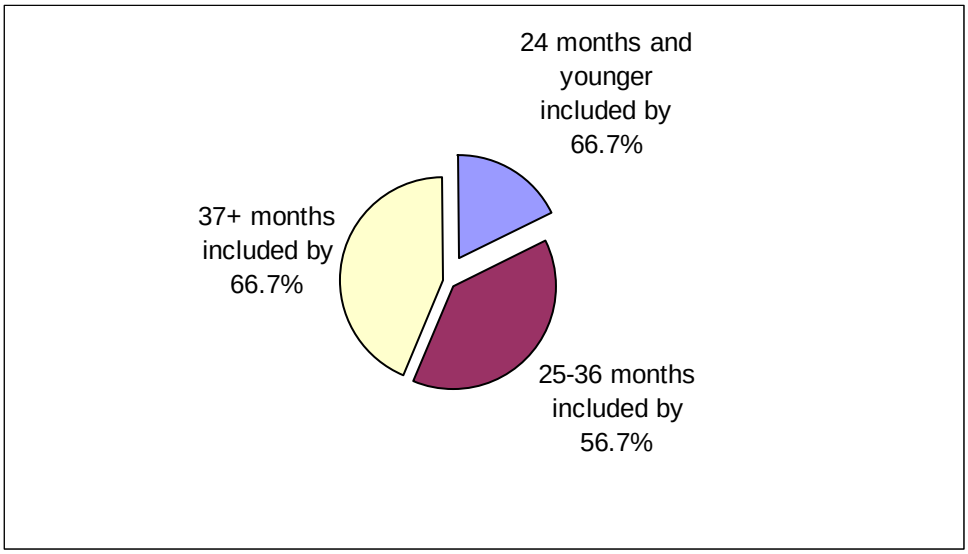

Figure 4.18 Age structure of lions in groups, as perceived by livestock owners and herders

In comparison, 69.2% of wildlife officials regarded sub-adult male lions as the culprits and 61.5% sub-adult females as the culprits, while 53.9% and 61.5% included adult males and females, respectively (see Figure 4.19).

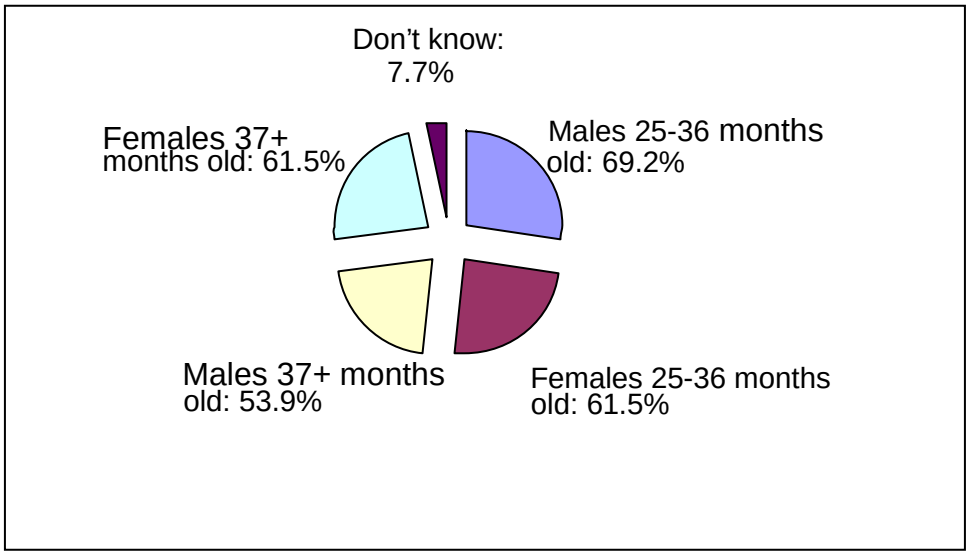

Figure 4.19 Age and sex of most troublesome lions, as observed by wildlife officials

Herders (53.3%) mainly sex lions by their mane development, 23.3% by body size and a further 16.7% did not know how to distinguish between sexes. The remainder said they never approach lions to determine the sex of lions. Males around two years of age can be mistaken for adult females since some individuals' manes at that age are not obvious and their body sizes compare well with those of adult females. Nevertheless, more than 85% of livestock owners and herders reported that both males and females enter the grazing area; only 6.6% of respondents said that it is only males that enter (Figure 4.20). Groups also do not necessarily refer to established prides, since some groups may consist of nomadic lions who presumably have not yet established themselves in prides, including groups of sub-adult and young males who are not ready for pride takeovers.

Most (50%) of livestock owners and herders replied that the average group size of lions is three, 20% said four, 6.7% said six and less than 5% reported any other size, including groups of two (NB: cubs of 12 months and younger were not included in the calculation of group size) (see Figure 4.21).

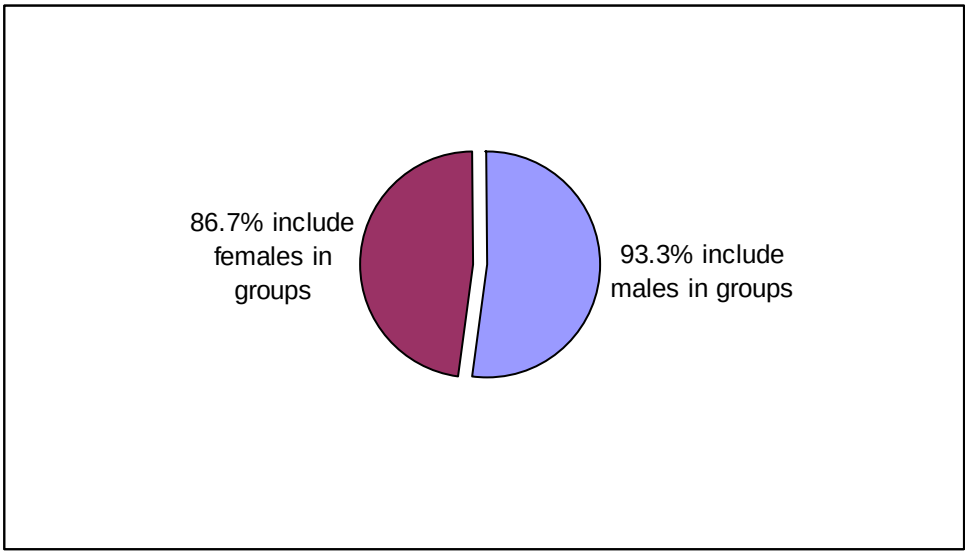

Figure 4.20 Sex ratio of lions in groups, as observed by livestock owners and herders

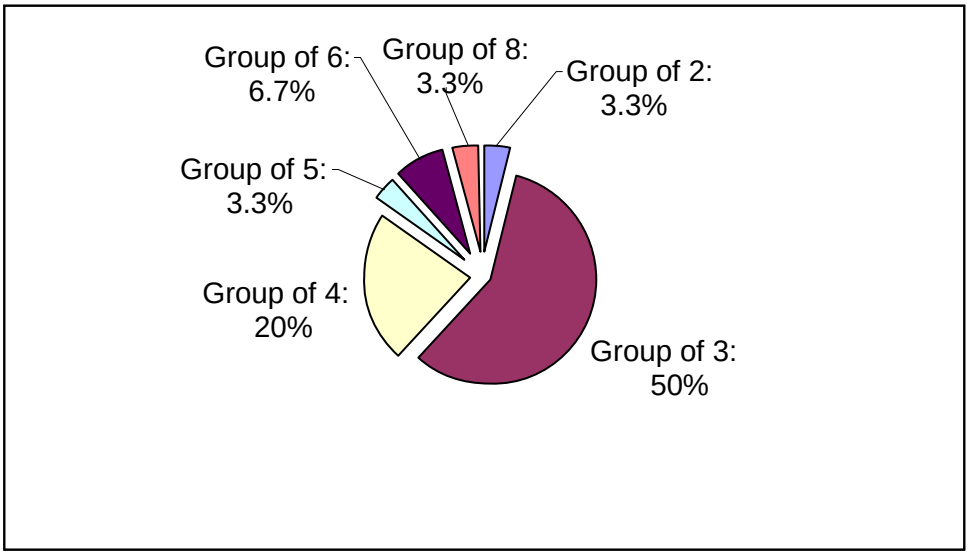

Figure 4.21 Group size of lions, as observed by livestock owners and herders

These reports differed from the response of wildlife officials where >45% and >35% indicated average group sizes of four and three, respectively (see Figure 4.22).

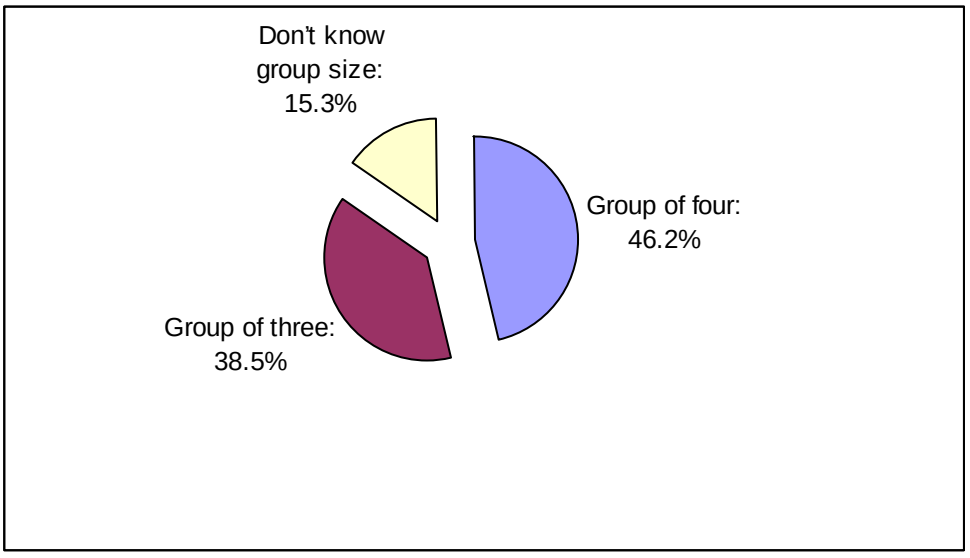

Figure 4.22 Group size of troublesome lions, according to wildlife officials

More than two thirds of livestock owners and herders were of opinion that lions in groups are the cause of most attacks on stock, while 30% said that solitary lions are the

culprits (see Figure 4.23). The wildlife respondents agreed that lions in groups are responsible for most attacks, with only 15.4% being convinced that solitary lions are the most troublesome (Figure 4.24).

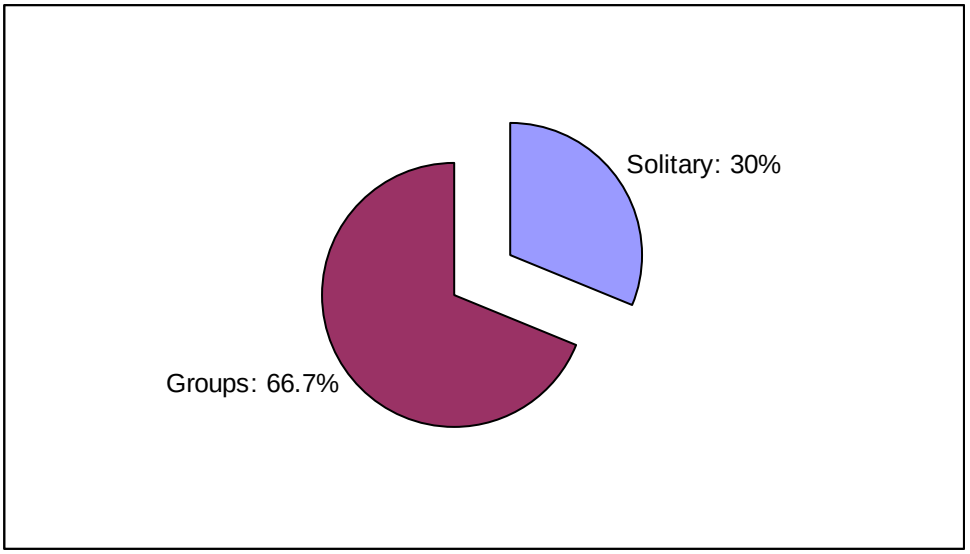

Figure 4.23 Solitary lions vs. lions in groups, as observed by livestock owners and herders. Group-related lions may point to resident prides in the WMA.

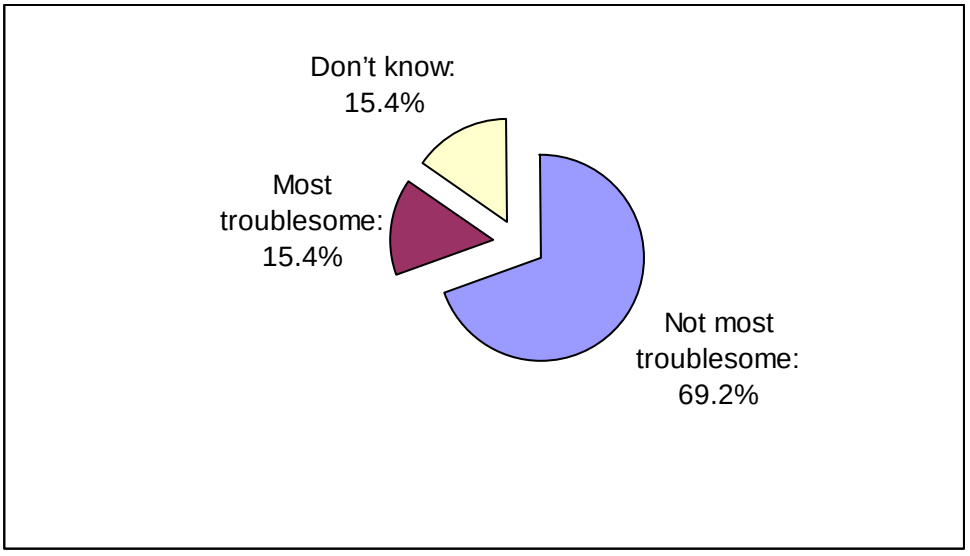

Figure 4.24 Solitary lions as livestock raiders, according to wildlife officials

Sixty-six percent of livestock owners and herders pointed out that the solitary lions were mostly male, while 34% were of the opposite opinion (see Figure 4.25).

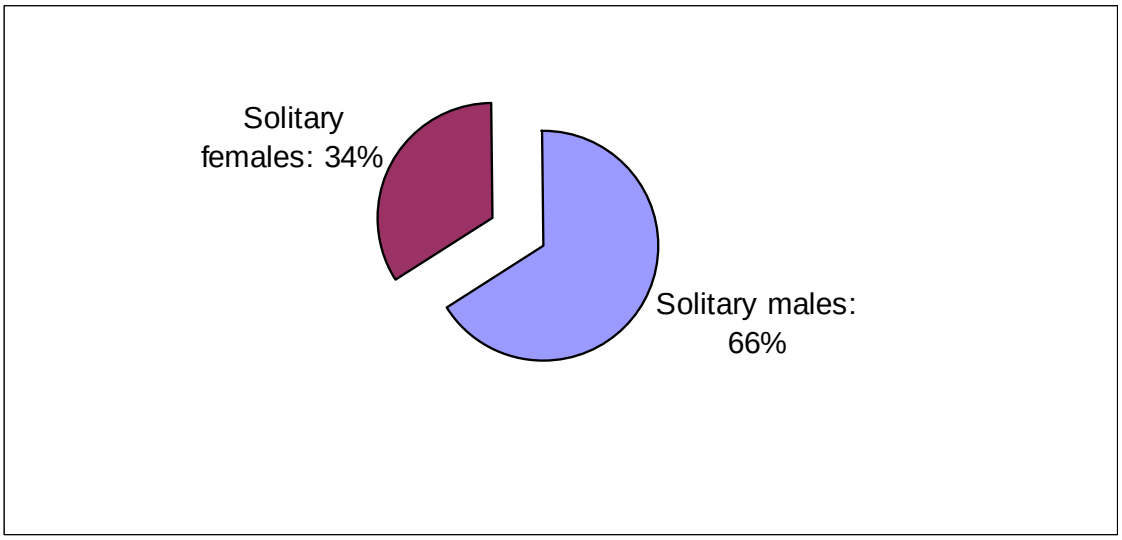

Figure 4.25 Ratio between solitary males and females, as perceived by livestock owners and herders. Solitary males may include pride males, but more likely sub-adult and adult nomads.

More than 60% of wildlife officials agreed that the solitary livestock killers are males, while 23.1% included both males and females, and less than 10% said that it is the females that are the culprits (Figure 4.26). The difference in figures between livestock owners and wildlife officials may be due to wildlife officials having records to refer to, allowing them to be more precise in their responses.

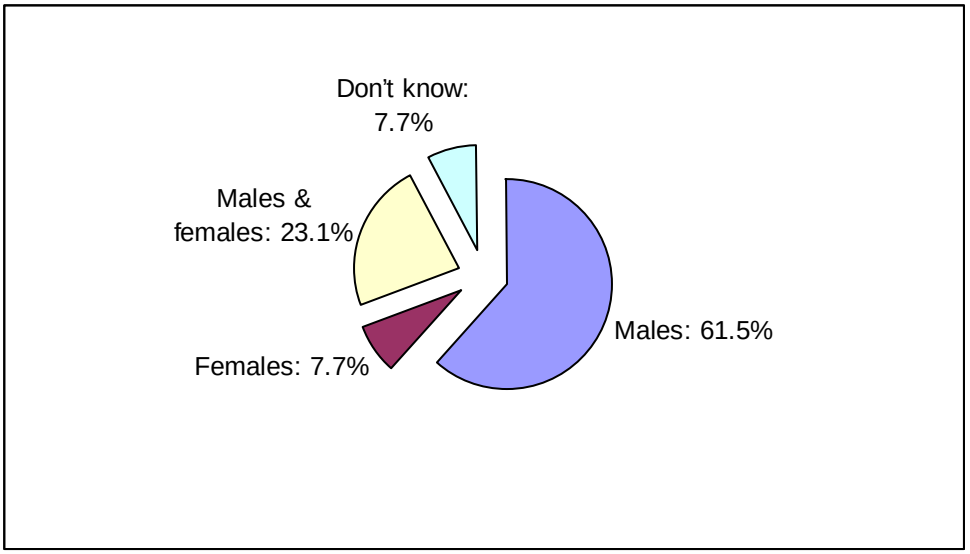

Figure 4.26 Sex ratio of stock-killing solitary lions, according to wildlife officials

A total of 36.7% of livestock respondents had observed cubs amongst the marauding lions, while 56.7% had never observed cubs with marauding lions in the grazing area. Only 3.3% had noticed an increase in the number of cubs over the five-year period 2002-2006.

A total of 76.7% of livestock respondents were of opinion that sub-adult lions (25-36 months old) do attack livestock, but 20% had never observed or seen signs of such attacks. The success rate of sub-adult lions when it comes to killing large stock was indicated as 63.3%, while 30% believed that sub-adults are mostly unsuccessful. To the question of whether there had been an increase in sub-adult lions, a more or less equal number of respondents replied positively (43.3%) and negatively (46.7%). The remaining 10% of respondents did not know, or the question was irrelevant due to the absence of stock raiding at their cattle-posts. During fieldwork, one horse and one cow were pointed out with claw marks on their bodies. The cow was observed the morning after the attack at the drinking trough and had bite marks on the top of the neck and claw marks against the shoulder blades. The fact that the cow had not been killed may be associated with inexperienced young predators and the fact that livestock owners do not dehorn cows,

which enables them to defend themselves against lion and other predator attacks (White: Personal comments).

Asked whether there had been an increase in the number of adult lions in the grazing area since 2002, 43.3% of respondents said “yes” and 56.7% said “no”. Also, an increase in lion prides had been observed by only 30%, while 60% said that lion prides had decreased.

According to wildlife officials, marauding solitary lions are sub-adults (69.2% of respondents), adults (76.9%), older males of eight years and older (46.2%), and older females (23.1%). Wildlife officials also mostly agreed that cubs do form part of marauding lion groups (92.3% of respondents).

4.3.7 Economic impact of lion predation

Compensation is regarded by some scientists as a valuable conservation tool, especially as it ensures that livestock raiding incidents are reported. Such reports enable wildlife officials to keep record of incidents, to identify habitual livestock killers and to remove problem animals (see Bulte & Rondeau, 2005). However, others are of the opinion that compensation leads to misuse and abuse of government funds and increased attempts to return to stock farming in unsuitable areas or areas that are already overutilised.

The DWNP offices at Tsabong kindly provided compensation tariffs for losses incurred in the study area (see Table 4.3).

Table 4.3 Compensatory amounts paid by government for livestock losses due to predation in Pula per species, age group and sex (information obtained from the DWNP offices at Tsabong, April 2007)

Animal	**Compensatory value**
Tolly	P 900
Bull	P 900
Cow	P 700
Horse	P 1400
Donkey	P 120
Foal	P 350
Mule	P 700 (was P 350)
Ox	P 900
Heifer	P 700
Calf	P 350

To calculate financial losses due to lion predation in the study area, meat prices as provided by livestock owners, and not by the Botswana Meat Commission (BMC), were used (Table 4.4). Dissatisfaction with the prices paid by the BMC lead livestock owners in the study area to rather sell to butcheries and other non-governmental outlets. The values shown in Table 4.4 reflect these higher rates, which are considerably higher than the compensation values.

Table 4.4 Value of livestock, as provided by respondents

Animal	Value on hoof
Cow	P 1650
Tolly	P 1280
Bull	P 2000
Ox	P 2000
Heifer	P 1100
Calf	P 350
Horse	P 1900
Horse sub-adult	P 1 260
Horse foal	P 400
Donkey	P 700
Donkey sub-adult	P 460
Donkey foal	P 150
Mule	P 1900
Mule sub-adult	P 1 260
Mule foal	P 400

With the exception of two cattle-posts in the Khawa area, none of the livestock owners and herders could provide the ages and sexes of their animals killed. Average age and sex ratios throughout the study area were therefore calculated according to the figures of these two cattle-posts. The ratio between young males and females was unfortunately not available, and it was not possible to determine exact figures by means of headcounting (= due to livestock being spread out over vast areas, irregular drinking habits, and livestock of different cattle-posts getting mixed in the vicinity of boreholes).

Some 86.7% of livestock owners acknowledged that they are compensated for livestock losses; 10% replied in the negative while 3.3% had suffered no losses due to lion predation. Figure 4.27 indicates the major discrepancy between compensation rates and the actual value of losses as reported by the livestock owners. All stock owners and herders reported that compensation covers less than 60% of actual losses; only 11.6% felt that compensation is more than 50% of the actual value; some respondents (11.5%) said that government pays only 40% of market value; 23.4% mentioned less than 40%, and 7.8% reckoned that compensation is less than 20% of actual losses. Livestock owners and herders know the market value of livestock, since regular sales take place, either by means of direct sale and to butcheries or on auctions. Some wildlife officials (53.9%) agreed that only a fraction of the market value of livestock is paid out. Only 7.7% indicated that fixed rates are paid out in accordance with the type and size of the animal lost to predation, and 7.7% said that they do not know what the compensation rate is. The feasibility of compensation was regarded by 61.5% of officials as a good system, 15.4% said that the scheme is not perfect but better than none, and 15.4% that it is not good, due to farmers being unco-operative.

The subsidisation of the construction of lion-proof kraals for large stock is regarded by 61.5% of wildlife officials as not a practical idea, while 38.5% stated that such a scheme would be feasible.

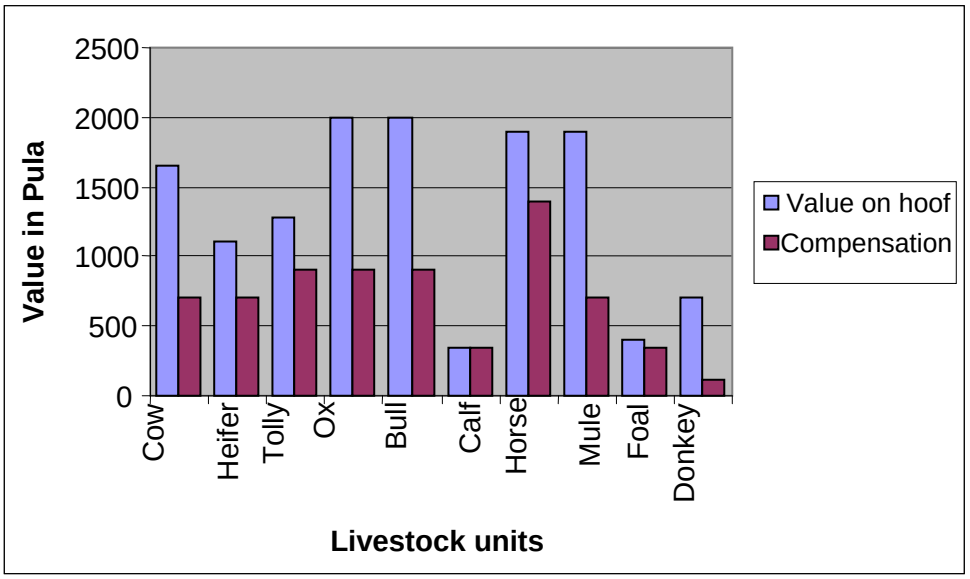

Figure 4.27 Compensation tariffs compared to commercial value of livestock, as seen by livestock owners and herders

To calculate real losses (see Table 4.5 and Figure 4.28) heifers and tollies were regarded as sub-adults with a commercial value of P 1 100 and P 1 280, respectively. As the ratio between male and female was taken as 50:50 (following Roche, Lee & Berry, 2006), the mean market value of P1190 per animal was used for sub-adults. All adult cattle were regarded as females since only 2.17% of all adult cattle are bulls, and adult bulls are also seldom taken by lions. For mules and horses, no differentiation was made between the values of males and females. As the DWNP tariff structure does not make provision for donkey foals or sub-adults, only adult animals were taken into consideration. Compensation paid for sub-adult cattle was calculated, again accepting that the sex ratio is 50:50, adding up to a mean of P800 per animal. In mules and horses sub-adults were regarded as adults (two years and older) and the rest was regarded as foals (White: Personal comments).

Table 4.5 Calculated losses and compensation due to lion predation for the period 2002 – 2006, as provided by livestock owners and herders

Livestock animal	**Number lost to predation**			**Average market value (in Pula)**			***Compensation paid*** [(#)] **(in Pula)**		
	Y*	S-a**	A***	Y	S-a	A	Y	S-a	*A*
Cattle	101	429	149	35 350	510 510	245 850	35 350	343 200	*104 300*
Donkeys	130	167	72	19 500	76 820	50 400	0	0	*8 640*
Mules	1	2	21	400	2 520	39 900	350	1 400	*14 700*
Horses	1	15	70	400	18 900	133 000	350	21 000	*98 000*
Subtotal	**233**	**613**	**312**	55 650	664 400	469 150	36 050	365 600	*225 640*
Total						**1 189 200**			***627 290***
Disparity									***-561 910***

** Young; ** Sub-adult; *** Adult*

[(#)] *Figures were calculated and do not reflect an actual case.*

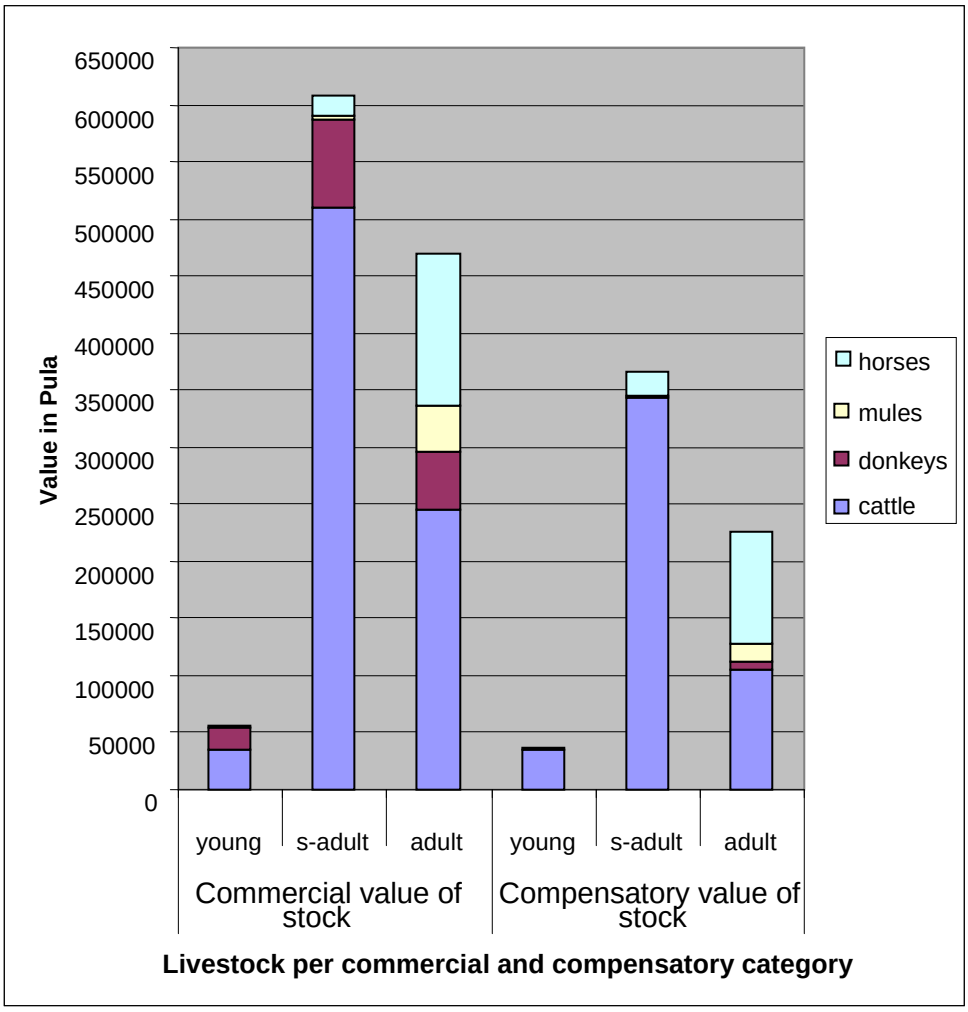

Figure 4.28 Calculated real losses compared to calculated theoretical compensation

Table 4.5 and Figure 4.28 show the significant difference between actual claimed losses and theoretical value paid out. In total *c*. 53% the value of all reported losses over the five years 2002-2006 was theoretically covered by compensation, with the percentages "recovered" for different kinds of animals and age classes ranging between 100% and 37%. Livestock farmers and herders are, in general, not satisfied with the amounts paid as compensation for livestock losses due to lion predation (Figure 4.29): 73.3% were of the opinion that higher compensation tariffs should be paid, 13.3% were satisfied with current tariffs, 6.7% were uncertain about the fairness of current compensation rates, and

another 6.7% had not suffered any livestock losses. A total of 46.7% of livestock owners and herders were of opinion that 100% of the commercial value should be paid out and the rest divided about the compensation rate (Figure 4.30): 6.7% were of opinion that 50% of the animal's value should be paid out, 3.3% that 75% would be more acceptable, and another 3.3% that 90% would be acceptable. Ten percent of respondents indicated that more than 100% should be paid out to enable them to purchase more bulls to improve breeding and stock quality.

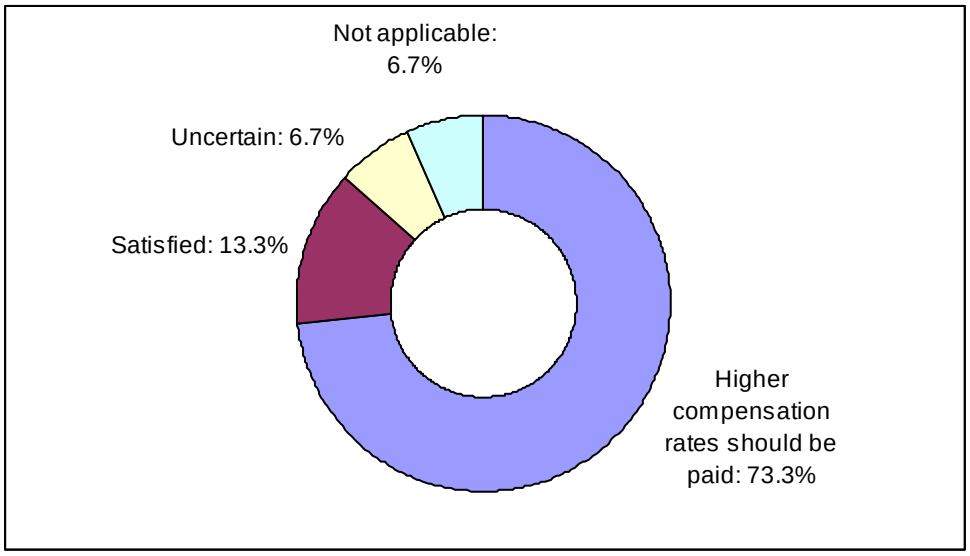

Figure 4.29 Livestock owners' views on compensation rates paid out for losses due to lion predation

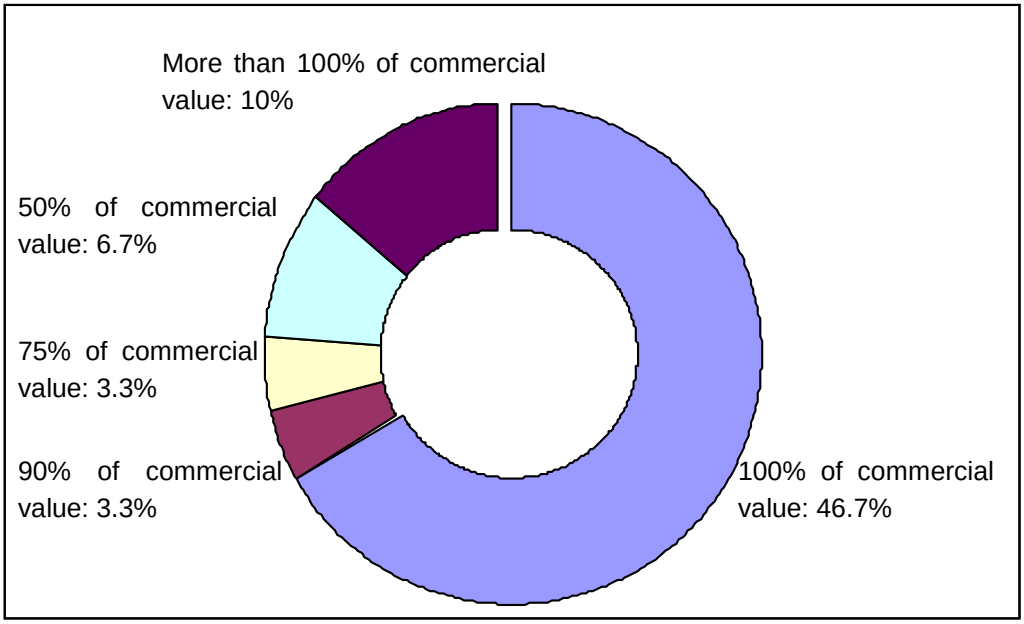

Figure 4.30 Livestock owners' views on the percentages of commercial value that should be paid out as compensation by government for livestock losses

Livestock owners and herders agree that the claim for compensation is a nuisance: 63.3% stated that an on-site investigation is essential before compensation can be paid, 43.3% mentioned that an affidavit should be signed, 16.7% that claimers must pass an interview process, 13.3% that the carcass must be shown and 6.7% that the brandmark on the animal must be shown.

4.3.8 Alternative livestock and lion management practices

When alternatives to the current compensation scheme were suggested, livestock owners and herders appeared sceptical. A total of 73.3% of all respondents were not willing to consider compensation in the form of lion-proof kraals, and only 10% indicated that they would consider such compensation (see Figure 4.31).

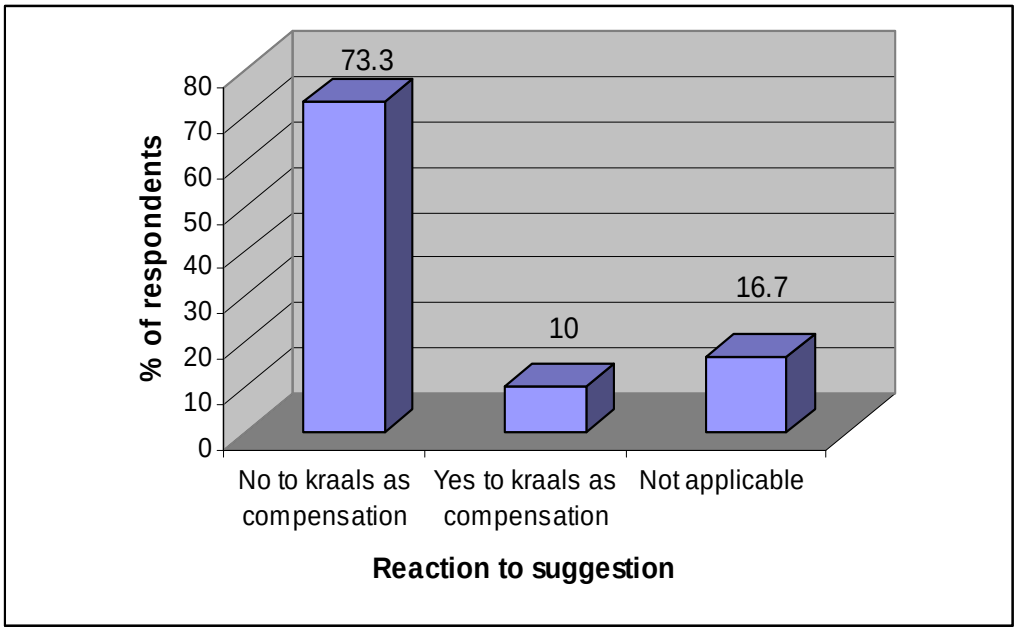

Figure 4.31 Livestock owners' reaction to a suggestion of kraal subsidies as substitute for compensation for livestock losses to predation

When asked if they would consider the kraaling of large stock overnight, 93.3% said "No" and only 3.3% were willing to consider it (Figure 4.32). A total of 16.7% of respondents saw the fencing off of farms as a solution, 10% suggested the killing of lions, and 6.7% each the reparation of the electric fence of the KTP and the fencing off of the WMA. A convincing 56.7% did not believe that any alternative method of farming would stop lion predation on livestock.

Figure 4.32 Livestock owners' suggestions for alternative measures against lion predation

A total of 38.5% of wildlife officials were of the opinion that an improved fence around the KTP would significantly reduce lion attacks on livestock, 23.1% answered that livestock should be kraaled at night, 15.4% that more patrols by DWNP officials, extended into the night, would reduce lion-livestock conflict, and 7.7% each said that livestock farmers should help with the maintenance of the fence, that herders should protect livestock at night, and that livestock owners and herders should keep livestock away from the WMA. Furthermore, 53.9% of wildlife officials were of the opinion that livestock owners should build predator-proof kraals to reduce predator attacks on large stock, but 38.5% said that this is not a solution to the predation problem. A total of 7.7% said that farmers are too poor to construct predator-proof kraals for large stock, while the same number of officials believed that farmers do have sufficient funds. A total of 15.4% of officials believed that only some livestock owners have sufficient funds to build such kraals (see Figure 4.33).

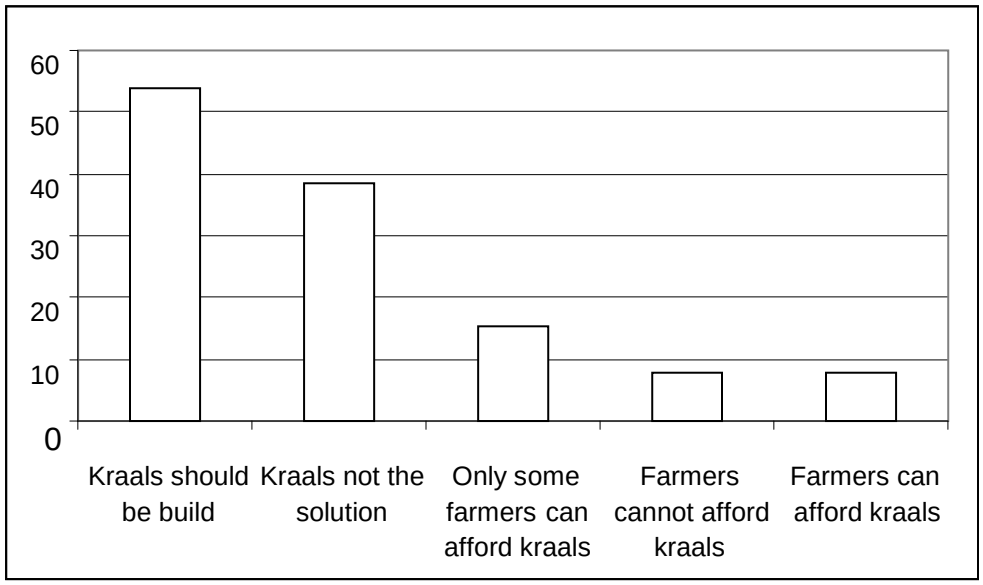

Figure 4.33 Wildlife officials' reaction towards a suggestion that predator-proof kraals may help to decrease stock losses

4.3.9 Complications, other than livestock losses, caused by lions

The possibility that parts of the grazing areas adjoining the KTP or the WMA are underutilised for fear of predation was investigated, and 30% of livestock owners and herders confirmed that they have to keep their livestock away from the KTP fence or the WMA, but 70% answered that they graze the full area.

A total of 73.3% of livestock owners and herders said that workers, family or friends had never been threatened by lions, but 26.7% answered that it had sometimes happened, while 96.7% indicated that lions had never threatened anybody near their houses, and 100% of respondents confirmed that nobody had ever been attacked or killed by lions in the study area. Nevertheless, 46.7% feared for their lives and/or the lives of their family, friends or workers. A total of 53.3% claimed not to be afraid of lions, while 56.7% were not taking any precautions to protect their households against lions, 13.3% had

strengthened their houses, 10% had erected some kind of a fence around the house to keep lions away, another 10% were keeping dogs to warn them against lions and 6.7% were keeping rifles for self-defence against lions. A total of 3.3% were actively patrolling the grazing areas to look for lions or lion signs and another 3.3% were lighting fires to scare away lions.

4.3.10 Other predators as livestock killers

Other stock predators are present in the study area, the larger ones said to also kill large stock (see Figure 4.34). Black-backed jackal and caracal are major predators on small stock (Figure 4.35), but no evidence could be found that they are also killing large stock in the study area. Despite the presence of wild dogs, no livestock killing incidents by them were reported over the five-year study period.

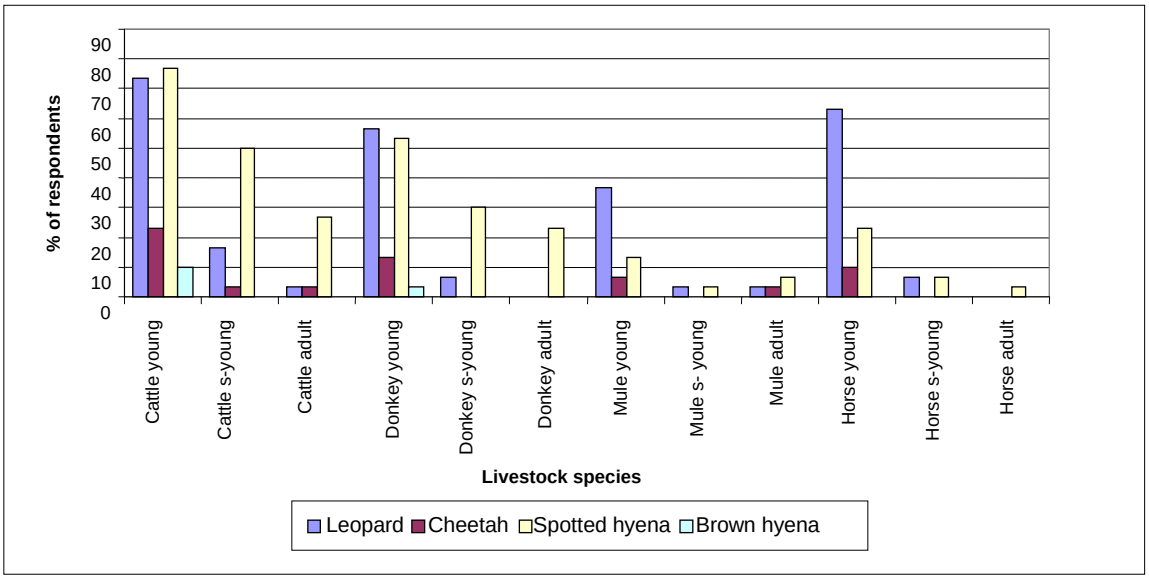

Figure 4.34 Large stock taken by predators other than lion, as reported by livestock owners and herders

Leopards prefer young cattle (according to 84.6% of respondents) to sub-adults (38.5%) and adults (7.7%) (Figure 4.34). The same applies to donkeys: young donkeys 30.8%, sub-adults 13.4% and adults 7.7%. Respectively 23.1% and 7.7% of respondents reported that leopards do take young and sub-adult mules, although no adult mules were lost to leopards over the five-year period. Similarly, young and sub-adult horses are preferred prey (46.2% and 7.7% of respondents, respectively) with no adults killed over the same period. Young, sub-adult and adult sheep were included as prey species by 53.9% of wildlife respondents and 53.9%, 61.5% and another 61.5% respectively included young, sub-adult and adult goats as prey species.

Cheetahs had killed young cattle according to 38.5% of respondents, but no-one had witnessed the remains or proof of killing of sub-adult and adult cattle during the five-year study period. Only 7.7% included young mules and horses as cheetah prey and none referred to sub-adult or adult animals (Figure 4.34). Young, sub-adult and adult sheep were included as cheetah prey by 23.1% of respondents, and 38.5% of respondents included goats of all ages (Figure 4.35).

Spotted hyenas were identified as predators of young (46.2% of respondents), sub-adult (38.5%) and adult (30.8%) cattle; 38.5%, 30.8% and 23.1% respectively of young, sub-adult and adult donkeys, and 30.8%, 23.1% and 15.4% respectively of young, sub-adult and adult mules (Figure 4.34). A total of 30.8% of respondents mentioned young horses as spotted hyena prey, 23.1% sub-adult horses, and 15.4% adult horses. Spotted hyenas also attack small stock of all ages (61.5% of respondents in the case of sheep, and 69.2% in the case of goats) (Figure 4.35).

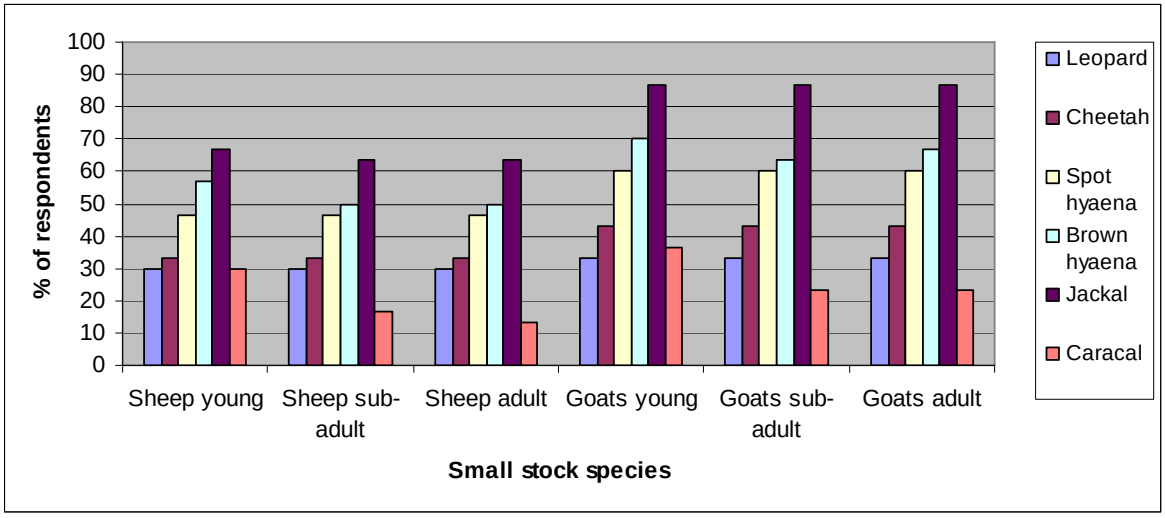

Figure 4.35 Small stock as preferred prey for other predators, as reported by livestock owners and herders

Brown hyenas were identified as killers of young cattle by only 7.7% of respondents, and no-one was aware of any sub-adults and adults having been taken (Figure 4.34). Similarly, 7.7% knew of brown hyenas as killers of young donkeys, mules and horses, but no-one mentioned sub-adults and adults of the same species for the 2002 – 2006 period. Both goats and sheep of all ages were identified as prey species of brown hyenas (by 46.2% of respondents) (Figure 4.35).

No large stock was included amongst the prey of the black-backed jackal (Figure 4.34), but small stock was mentioned at high rates: 84.6% of respondents for young and sub-adult sheep and goats, and 61.5% for adults of both kinds of small stock species (Figure 4.35). Caracals, like jackals, do not kill large stock and the percentages of respondents who included small stock as preferred prey were 30.8% for both sheep and goats of all ages (see Figure 4.35.).

Asked how they responded to predation by other livestock killers, livestock owners and herders answered as follows: 80% report leopard predation incidents to the DWNP, 43.3% cheetah, 73.3% spotted hyena, 60% brown hyena, 30% jackal, and 6.7% caracal; 10% of respondents kill leopard, 6.7% cheetah, 10% spotted hyena, 13.3% brown hyena, 43.3% jackal and 10% caracal. In response to the question of whether any compensation is paid out for losses due to predation by these predators, 36.7% said "Yes" for leopard and 56.7% "No"; 30% said "Yes" for cheetah, and 36.6% "No"; 23.3% said "Yes" for spotted hyena and 63.3% "No"; 13.3% said "Yes" for brown hyena and 70% "No"; 6.7% said "Yes" for jackal and 83.3% "No"; and 6.7% said "Yes" for caracal and 56.7% "No". The control of smaller predators, such as jackal and caracal, is done by means of killing with dogs – 23.3% of respondents replied that they keep three dogs, another 23.3% keep four dogs, 13.3% have five dogs, and 6.7% and 10% indicated that they keep seven and ten dogs, respectively. Only 3.3% and 6.7% said that they keep one and two dogs at the cattle-post, respectively. A total of 66.7% of respondents indicated that they keep dogs to kill jackals, 10% to kill caracals, 36.7% to warn against predators during the night, and 10% to warn against other dangers during the night.

Most livestock owners and herders (80%) are of opinion that legislation obstructs the protection of livestock in their designated grazing areas, but 20% believe that legislation is not a hindrance to them in their efforts to protect their livestock. Of those who responded positively to legislation being obstructive to livestock protection, 82.6% said that it prohibits the killing of livestock-raiding lions, and 4.4% each that the amounts paid out as compensation for livestock losses are too small, that the WMA is not fenced off (and thus did not separate livestock from lions), that the fencing off of farms is not allowed, and that it is an unnecessary burden to take a killed animal's skin and remains to the wildlife offices in Tsabong as proof of livestock predation.

To determine whether legal action is taken against illegal lion killers, respondents were questioned about the methods followed when such incidents occur. A total of 30.8% said that trespassers are jailed, 23.1% that a fine has to be paid, 15.4% that all herders are

thoroughly questioned to determine the factuality of information, and 7.7% that lion skins are confiscated. A total of 15.4% had not had any experience in this matter.

Misuse and abuse of compensation schemes occurs continent-wide, and it was essential to determine whether reports from livestock owners and herders in the study area are always a reflection of the truth. Wildlife officials are confident (69.2%) that their investigations on the scene prevented abuse of the compensation scheme, and 15.4% said that the presenting of the ears of a killed stock animal, evidence of lion spoor at the carcass and absence of negative reports from within the DWNP are further proof that false information is not offered to obtain compensation falsely. Another 7.7% referred to bite and claw marks on the carcass as sufficient proof of livestock predation by lions. Other predators in the study area also kill livestock, and 100% of respondents stated that lion spoor at the carcass is sufficient proof of the accountability of lions as killers as opposed to other predators, 53.9% included bite marks and 46.2% claw marks as sufficient proof of the type of predator that had caused the death of the prey animal. Other predators are identified by their spoor at the carcass (84.6%), method of killing (38.5%) and 15.4% by wounds and way of eating on the carcass. A total of 53.9% of respondents rely on the absence of signs of an attack as proof that the animal was dead when the lions found it, 23.1% on the absence of bite marks, 15.4% on the absence of claw marks and 7.7% on the condition of the carcass, an examination by a veterinarian, the thoroughness of the investigation at the scene and finally that lions do not scavenge.

4.3.11 Carrying capacity of the grazing area

According to several studies, woody plant species increase and grasses decrease in reaction to heavy grazing and trampling, especially near water-points in the dry Kalahari region of Botswana (Jeltsch, Milton, Richard, Dean & Van Rooyen, 1997; Verlinden, 1997; Verlinden *et al*., 1998; Moleele, Ringrose, Matheson & Vanderpost, 2002; Chanda *et al*., 2003; Rohde *et al*., 2006). In the study area livestock owners and herdsmen provided valuable information regarding the plant species composition and its trend to

change in reaction to grazing habits and stocking rates. Figure 4.36 provides an account of habitat change, with special reference to variation in plant community structure over the five-year period 2002 – 2006, as perceived by livestock owners and herders. Most (>70%) of respondents agreed that the density of palatable grasses had decreased, while the majority of those that did observe changes indicated that all other groups (i.e. unpalatable grasses and shrubs, as well as palatable shrubs) had increased.

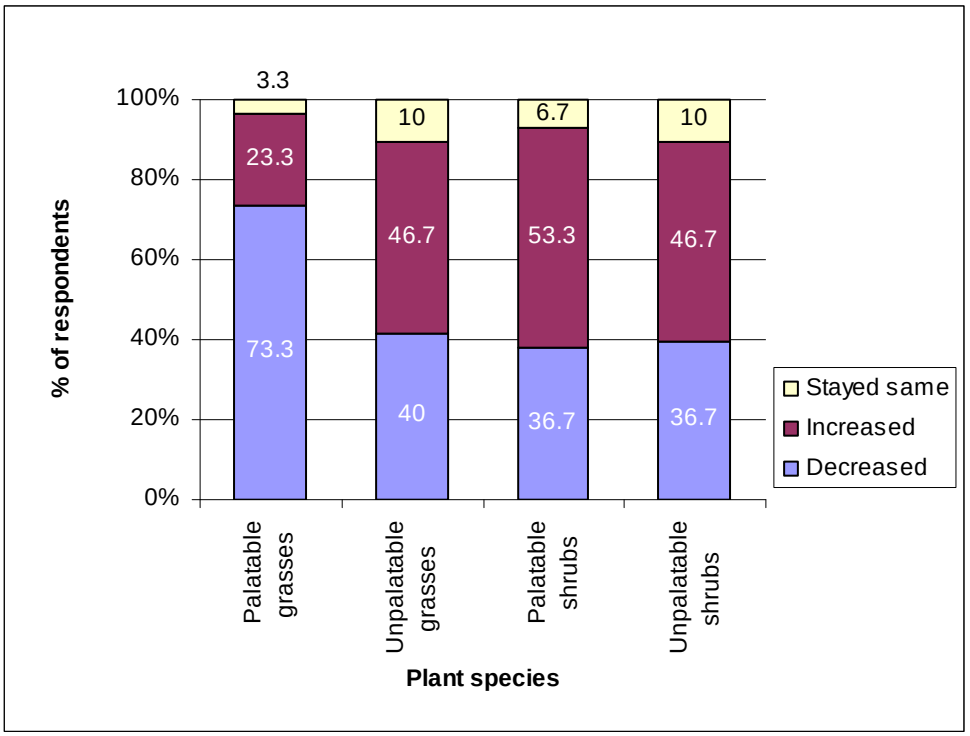

Figure 4.36 Changes in plant composition in the study area between 2002 and 2006, according to livestock owners and herders

Wildlife officials overwhelmingly (84.6% of respondents) responded that the veldt cannot support the numbers of livestock being farmed in the study area; only 15.4% were of opinion that the veldt is not overstocked. Furthermore, 45.5% stated that livestock owners feed animals to survive the critical part of the year, 27.3% that livestock numbers decline during the dry season due to starvation, 18.2% that livestock owners trek to other areas to overcome veldt scarcity, 9.1% that livestock survive by grazing in the WMA, and 27.3%

did not know what methods are used by livestock owners to see their animals through dry spells (see Figure 4.37). A total of 9.1% indicted that the State Veterinary Services subsidise additional food for the animals.

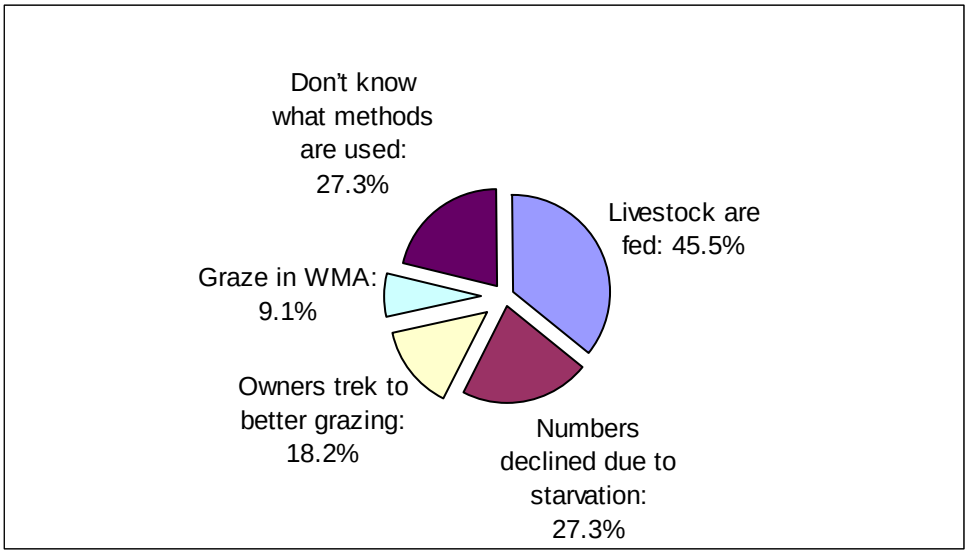

Figure 4.37 Wildlife officials' reports on how livestock owners manage to overcome livestock losses during droughts

Most wildlife officials (69.2%) indicated that some livestock owners had become dependent on grazing inside the WMA (Figure 4.38). Only 15.4% stated that owners were not reliant on the more abundant grass in the WMA, while another 15.4% were not sure whether the WMA plays a role in the survival of livestock during the dry season. Despite the indication by the majority of wildlife officials that the grazing veldt is overstocked, 53.9% said that the quality and quantity of grazing veldt is sufficient for livestock to get enough food during the day, and that large stock can be kept in kraals overnight to prevent lion predation; 38.5% said that due to grazing conditions, kraaling at night is not a practical solution, while 7.7% did not know if the veldt has the ability to sustain large stock if they will only be allowed to graze during the day. A total of 69.2% of officials said that the veldt will be able to sustain stock throughout the year if grazers are reduced significantly, 15.4% said that even then the veldt would not be able to carry

the animals throughout the year, and another 15.4% did not know if a reduction in grazer numbers would increase the veldt's ability to sustain the animals year round. A total of 53.9% of officials argued that the veldt would be able to sustain livestock throughout the year if browsers are reduced significantly, 30.8% that it would not, and 15.4% did not know if a reduction in the number of browsers would increase the veldt's ability to sustain animals year round.

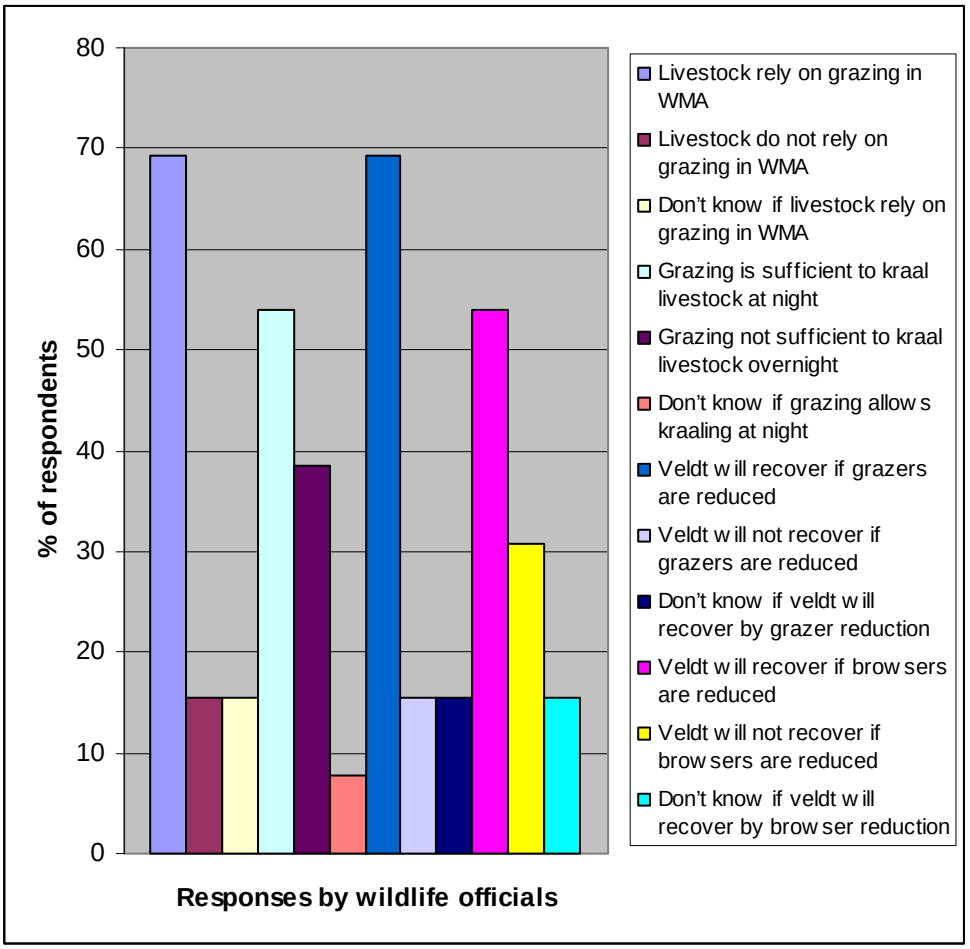

Figure 4.38 Wildlife officials' views on the impact of overstocking on grazing veldt and livestock owners' reliance on WMA grazing during droughts or dry months of the year

That the feeding of livestock would improve the carrying capacity of the grazing area is regarded by 61.5% of wildlife officials as true; 38.5%, however, said that such practice would not improve the veldt (see Figure 4.39). The reason why the feeding of livestock would improve the carrying capacity of the veldt is, as indicated by 46.2% of respondents, that a reduction of grazing pressure provides an opportunity for the veldt to recover. However, 23.1% said that livestock's natural grazing trend is to graze and browse the natural grasses, shrubs and trees first before it would turn to supplementary food. A total of 7.7% of respondents were convinced that the veldt is already damaged beyond rehabilitation.

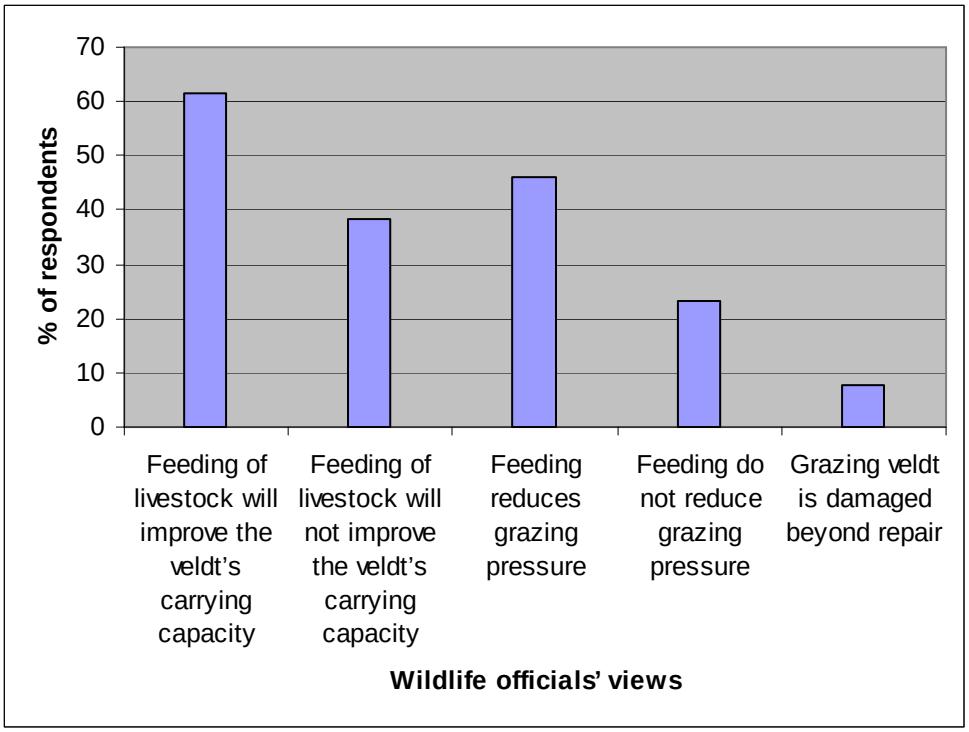

Figure 4.39 Wildlife officials' views on the effect of feeding of livestock on the grazing veldt during drought or dry months of the year

The majority of wildlife officials (92.3%) said that reducing livestock numbers is the most important counteraction against droughts and overgrazing. Only 7.7% were of a different opinion.

Overall, and in all livestock categories, more stock owners said that they had reduced numbers over the five-year study period than those who said they had increased their numbers (Figure 4.40). Sixty percent of livestock owners indicated that cattle numbers had been reduced, while 33.3% said that they had increased numbers; 6.7% said that their cattle numbers had stayed the same. A total of 43.3% of respondents maintained that donkey numbers had been reduced, 20% replied that donkey numbers had increased and 30% that their numbers had stayed the same. Mule numbers had been reduced by 33.3% of respondents, 13.3% had increased their mule numbers and 48.9% said that their mule numbers had remained unchanged. Forty percent of respondents said they had to reduce horse numbers, 26.7% that the numbers had increased and 16.7% that the numbers had stayed the same. Similarly, 40% had reduced sheep numbers, 26.7% had increased their sheep numbers and only 10% had kept their sheep numbers stable. Goats had been reduced by 43.3%, while 30% had increased their goat numbers and 16.7% said that their goat numbers had remained unchanged.

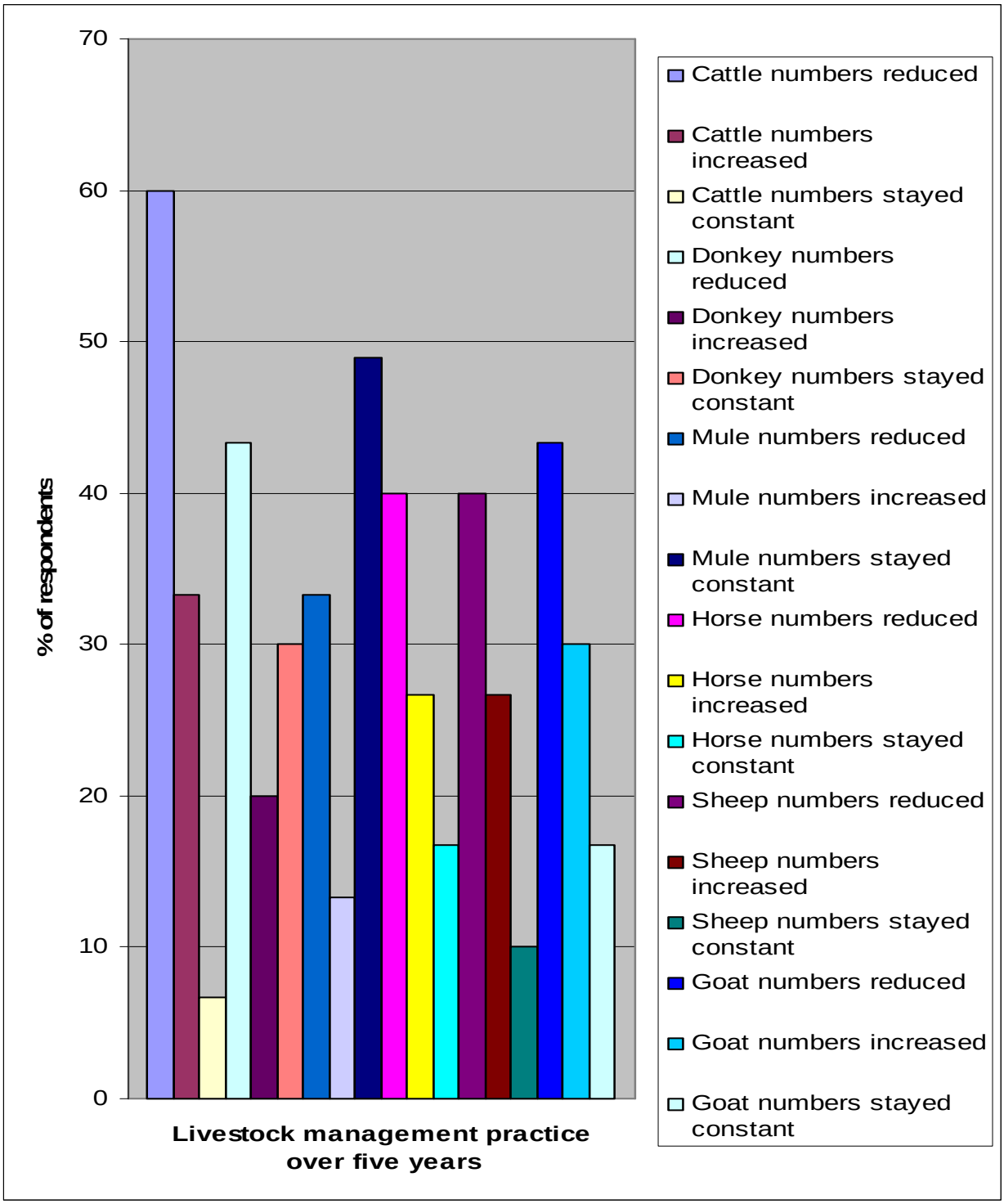

Figure 4.40 Livestock numbers managed in accordance with veldt conditions over the five-year period 2002 – 2005, according to livestock owners

The detrimental impact of grazing and browsing on the plant composition of the veldt in the study area has been described by a number of biologists, including Abel (1997), Trodd and Dugill (1998), Moleele *et al.* (2002), Hagos and Smit (2005) and Vetter (2005). Yet, the higher phosphate and crude protein contents of woody plants in early summer must be acknowledged as a valuable nutritional supplement, especially since a phosphate deficiency may have a negative effect on the reproduction of cattle in the study area. Similarly, the reduction of all livestock types, except the mule, indicates that livestock owners were forced to meet veldt conditions over the five-year period.

The opposing views of biologists regarding livestock management practices and the success or not of government attempts to regulate the utilisation of the commons reflect two worlds of scientific approach, which seem to be irreconcilable (Moleele & Mainah, 2003; Hagos & Smit, 2005; Aljoe, 2006; Fraser, Dougill, Mabee, Reed & McAlpine, 2006; Rohde *et al*. 2006). "Overgrazing is commonly thought to be inevitable in communal pastoral systems because people keep more livestock than they need for a variety of reasons and because of the problems inherent in communal ownership of the resource, where individual benefit is maximized at the expense of the communal resource. Increasing human population pressure, encroachment of rangelands by other land use, control of livestock diseases and the breakdown of traditional resource management structures are thought to contribute to the degradation problem" (Vetter, 2005).

Policies have been developed to correct the failure of earlier policies and to address the underlying or perceived threats to rangelands. Where land access in the past was governed by both formal and informal local institutions, policies have sought to replace these institutions with formalised institutions that have their power base and their means of control outside the communities. Free access, excessive animal numbers and overexploitation and subsistence modes of production have been addressed by imposing legislation which insists on the fencing of communal grazing land into ranches of

sustainable sizes and own water provision (Rohde *et al*., 2006). Yet, it is claimed that, "In every iteration of the rangeland policy process, they further entrench the problems they seek to avoid" (Rohde *et al*., 2006). "Privatisation leads to more boreholes, which leads to bush encroachment, leading to a loss of productive rangeland for cattle, leading landowners to drill additional boreholes in remaining grass dominant areas that then rapidly become bush encroached. This is especially troubling since the ecological literature suggests that a dry land's ability to support livestock depends on maintaining a diverse and heterogeneous landscape in terms of fodder resources and that bush encroachment can only be checked by fire events" (Fraser *et al*., 2006).

It may be significant to investigate these viewpoints further, since the traditional scientific approach to grazing practices is to fence off farms and internally divide them into grazing camps to group together different plant population compositions, departing from the view that differences in palatability and composition lead livestock to graze and browse selectively. Grazing patterns can then be manipulated by forcing livestock to digest less palatable plants in the absence of palatable ones. Simultaneously, encroaching plants such as driedoring *Rhigozum trichotomum* and blackthorn *Acacia mellifera*, are controlled by means of chemical treatment (Du Toit, 2001; Hagos & Smit, 2005) to eliminate competition with palatable grasses for nutrients and water.

4.3.12 Rainfall, veldt fire trends and solutions to drinking-water problems

Ninety percent of livestock owners and herders remarked that, on average, the region had experienced lower precipitation during the five-year period (Figure 4.41). However, 93.3% did not have a rain gauge and the 3.3% that did, did not keep regular records. A total of 83.3% of respondents also indicated that veldt fires had decreased markedly during this period. The lower rainfall may be the reason why veldt fires were experienced to be almost non-existent. If seen against the backdrop of the decrease in palatable grasses and the increase in unpalatable grasses, palatable shrubs and unpalatable shrubs, the tendency corresponds with other publications (e.g. Moleele *et al.,* 2002; Vetter, 2005;

Sekhwela & Yates, 2006) where a woody plant increase is accompanied by a decrease in grasses, to an extent where no veldt fires occur and/or do not spread. This is detrimental to the grass coverage, since veldt fires are important for the stimulation of grasses.

Seventy percent of respondents stated that they had experienced a shortage of potable water for livestock during the five-year study period (Figure 4.41), 30% had a sufficient quantity, and 66.7% and 11.1% indicated that they watered their stock at other cattle-posts and syndicates, respectively. A total of 22.2% said that they had to struggle through on their own when experiencing periods of water shortages.

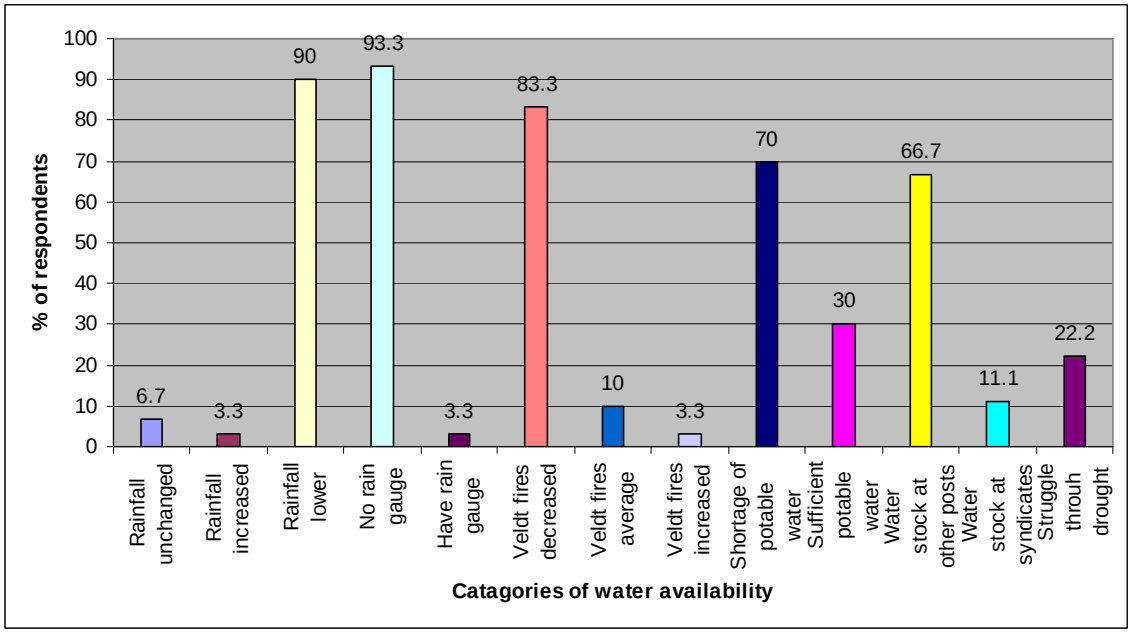

Figure 4.41 Livestock owners' and herders' remarks on rainfall, veldt fires and potable water availability during the period 2002 – 2006, when compared to the period prior to 2002

Improved water provision was regarded by 53.3% of livestock owners and herders as essential, but 43.3% was satisfied with the existing water sources. Only 36.7% regarded the drilling of extra boreholes as necessary to improve the provision of water, 6.7% wanted improved piping, 3.3% wanted water from the borehole of the Department of

Water Affairs near Khawa and another 3.3% was eager to have water reticulated into the grazing veldt.

4.3.13 Views of livestock owners and herders on income generation from wildlife in the study area

4.3.13.1 Boundary tourism

The vast majority of livestock owners (86.7%) were excited by the idea of wildlife being a potential source of income for pastoralists through boundary tourism, but some remained sceptical towards such an idea.

A total of 83.3% of respondents regarded a four-wheel-drive route along the KTP fence as having good potential to generate income for locals, opposed to 10% that did not think that it would be a viable plan (Figure 4.42). Fifty percent of livestock owners and herders stated that boundary tourism would scare away predators from the grazing area, 36.7% stated that it would not and 10% stated that they did not know whether such an activity would have any effect on predators such as lions. A total of 63.3% stated that such tourism activities would result in improved road maintenance, 16.7% that it would not and another 13.3% that they could not predict the outcome of such a venture. Asked whether they believed that tourism would result in other positive spin-offs such as electricity, telephones, governmental water provision and two-way radio communication, between 67% and 51% replied positively every time; less than 27% (but >20%) remained sceptical of such positive outcomes.

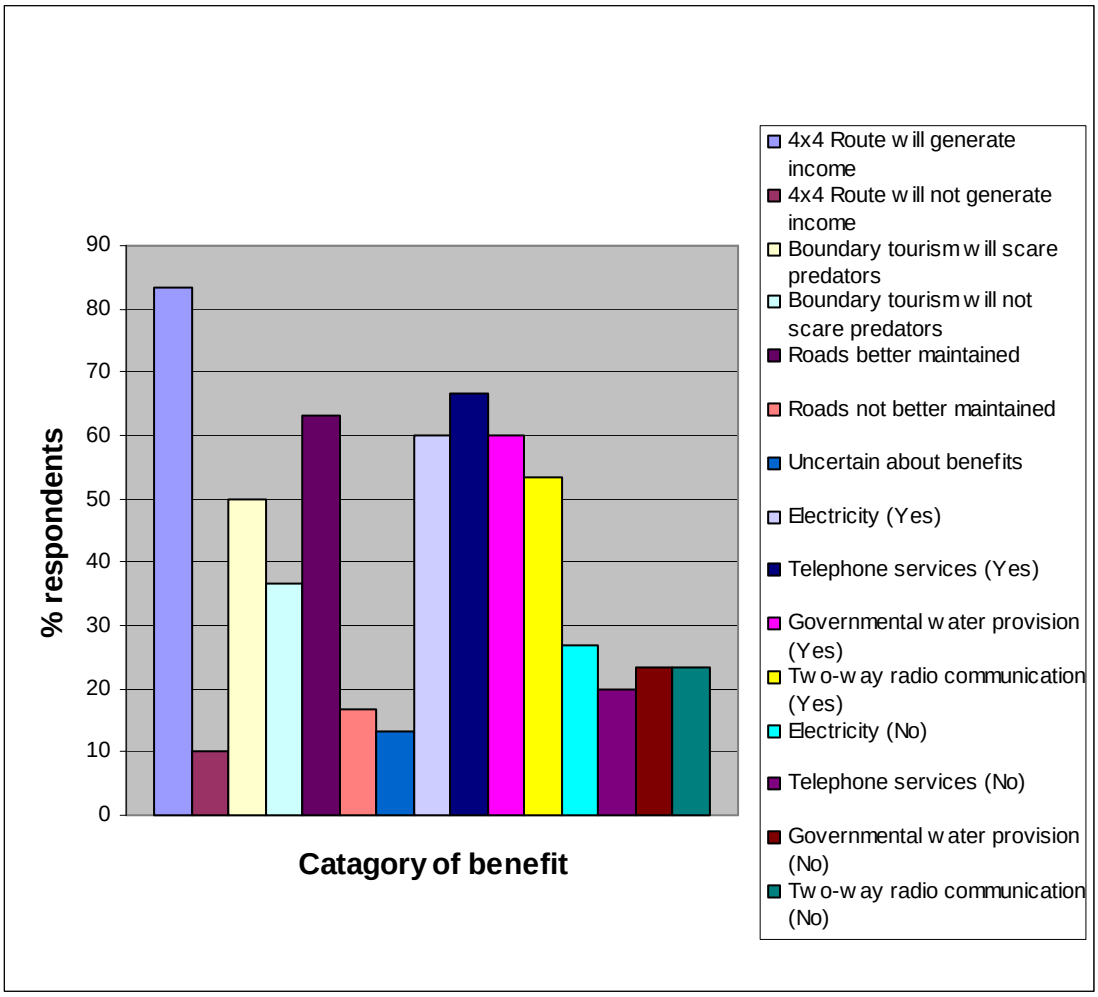

Figure 4.42 Livestock owners' views on possible income and services that may result from tourism

4.3.13.2 Trophy hunting

The hunting of lions for trophy purposes was supported by more than 80% of livestock owners, opposed to less than 15% who were against it (see Figure 4.43). More than 50% of wildlife officials said that lion trophy hunting would financially benefit livestock owners, but *c*. 45% were against such a scheme (see Figure 4.44).

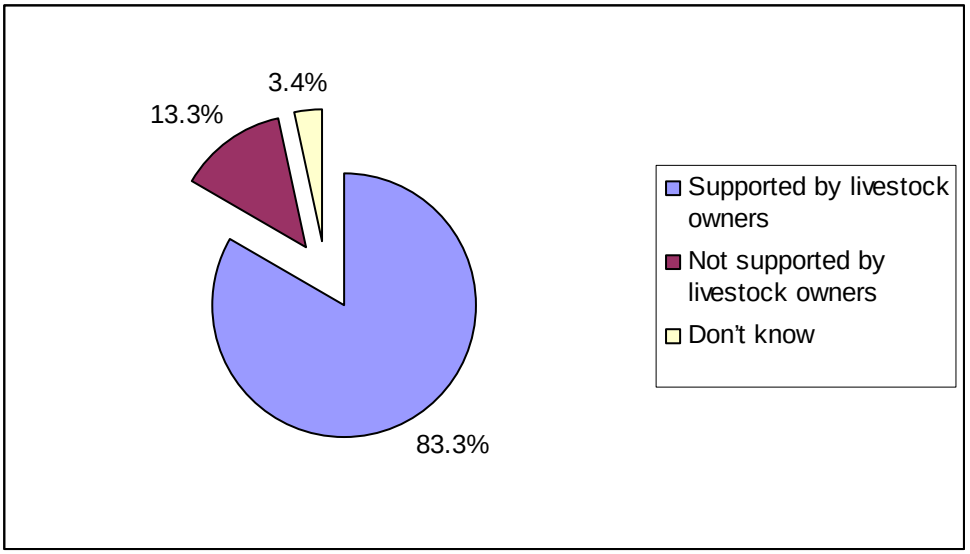

Figure 4.43 Livestock owners' views on the hunting of lions for trophy purposes

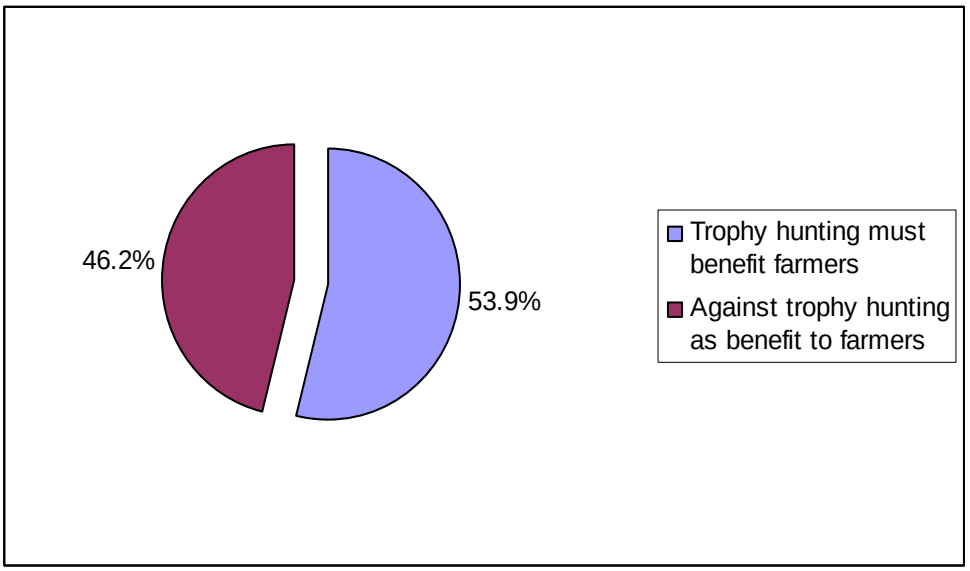

Figure 4.44 Wildlife officials' views on lion trophy hunting as a source of income for livestock owners

A total of 53.3% of livestock owners supported the proposal that money derived from lion trophy hunting should be channelled back to livestock owners, while 10% were against it (see Figure 4.45). A total of 16.7% felt that this was not applicable to them since lions do not kill their stock, and 3.3% was uncertain whether trophy hunting should be allowed.

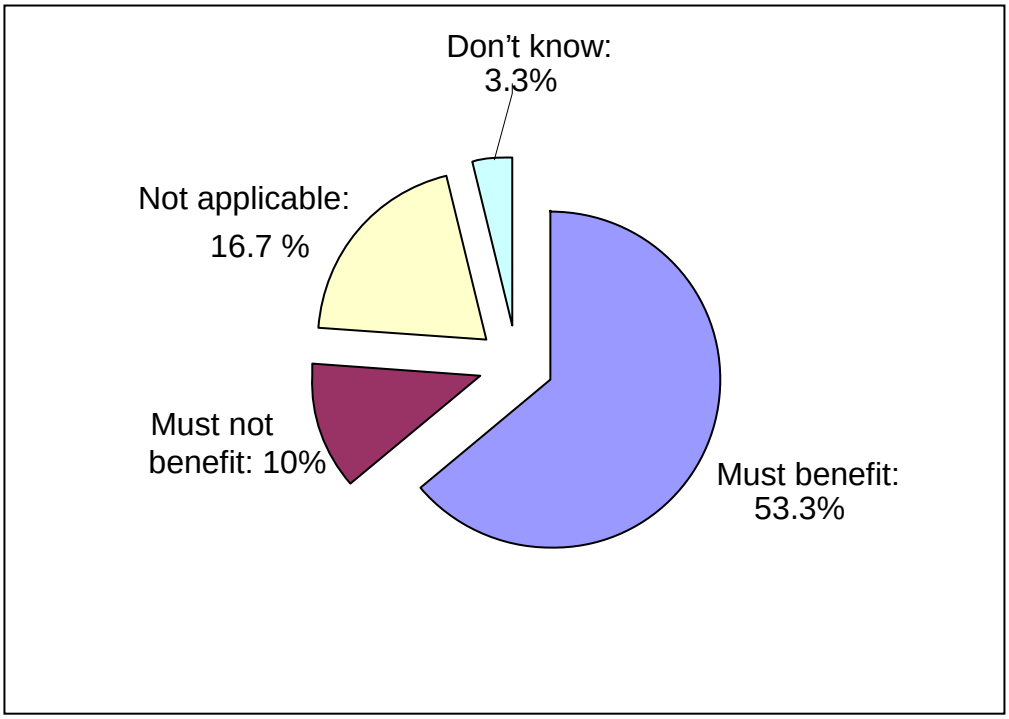

Figure 4.45 Livestock owners' views on lion trophy hunting as financial benefit to them

4.3.13.3 The role of education

A very high percentage (76.9%) of wildlife officials regarded education as an important tool in persuading livestock owners that it is essential to establish cohabitation between lions and livestock in the study area. A total of 15.4% added that such education should be a continuous effort, 7.7% said that education should only be performed by an experienced DWNP educator, and another 7.7% mentioned that other stakeholders such as non-governmental organisations (NGOs) must also be involved in such educational strategies.

4.3.13.4 Further comments by livestock owners and wildlife officials

Figure 4.46 reports on the additional comments (Question 40c in Questionnaire A) of livestock farmers and herders on what they see as important factors in dealing with the lion-livestock situation in the study area. A total of 6.7% of respondents perceived governmental subsidy for the purchase of food for livestock as valuable, 3.3% mentioned subsidy for the purchase of medicine for livestock, improved livestock quality was mentioned by 3.3%, a representative organisation for livestock owners by 6.7%, the provision of electricity by government to drive water pumps by 6.7%, higher remuneration for herders by 3.3%, better control over predators by 6.7%, better water provision by 6.7%, reduced regulation of meat prices by 3.3%, improved roads (*inter alia* so that predation instances can be reported more quickly and wildlife officials can act sooner) by 3.3%, discontinuation of prohibition of the killing of lions by 3.3%, and compensation of all livestock losses by 3.3%. A total of 43.4% of respondents did not want to make any additional comments to what was already covered in the questionnaire.

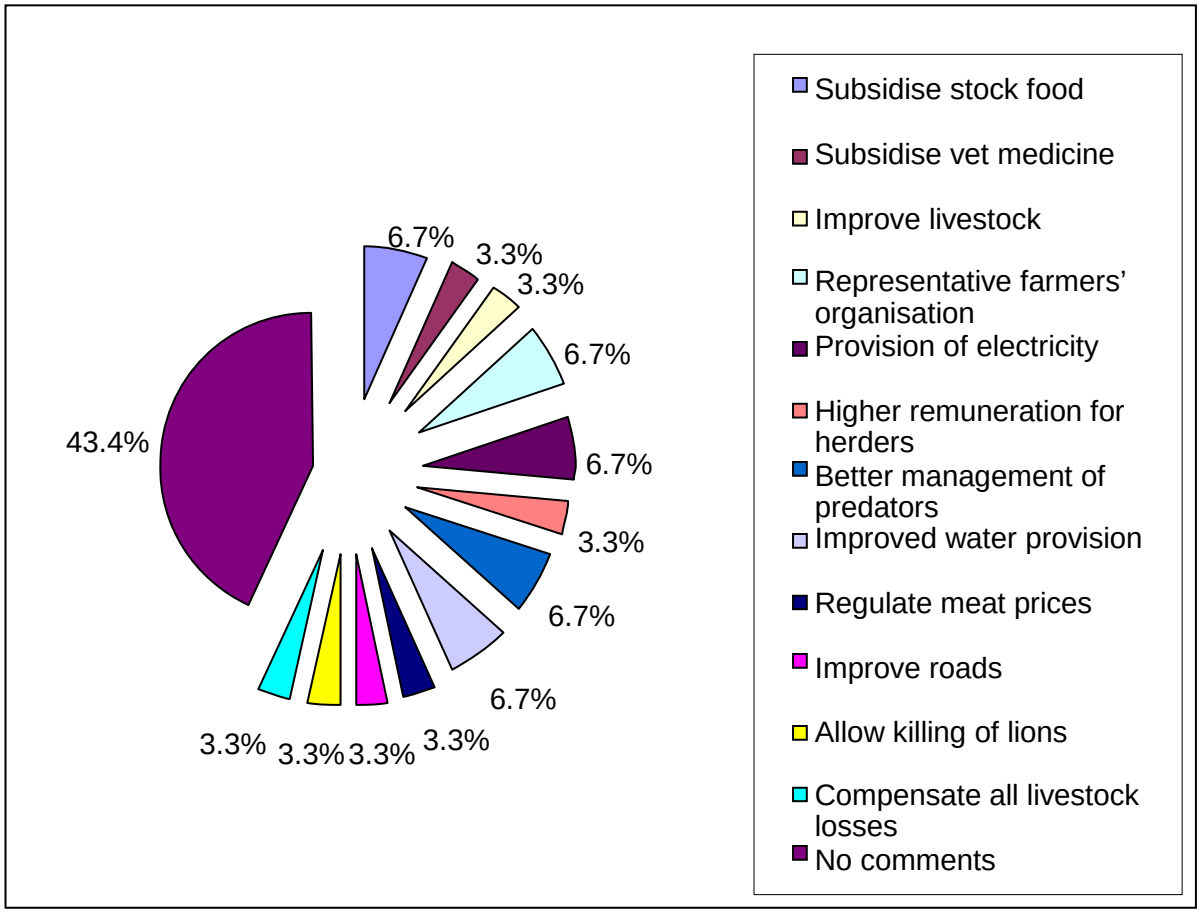

Figure 4.46 Additional comments by livestock farmers and herders in the study area

Wildlife officials reacted as follows when asked for additional information to improve the interviewers' knowledge of the influence of current livestock management practices on the lion-livestock interaction in the study area: 15.4% said that goodwill should be improved between farmers and officials to achieve success with the protective management of both lions and livestock, and 7.7% each that law enforcement must be well-organised, tourism must be promoted in the area, livestock should be kraaled at night, herders must accompany livestock during the day, the fence is a key factor to success, farmers should be educated to value lions, shortage of veterinary staff should be addressed, farmers should report livestock predation sooner, livestock owners are not

conservation oriented and there will always be conflict, irrespective of attempts to prevent it (see Figure 4.47). A total of 7.7% made no further comments.

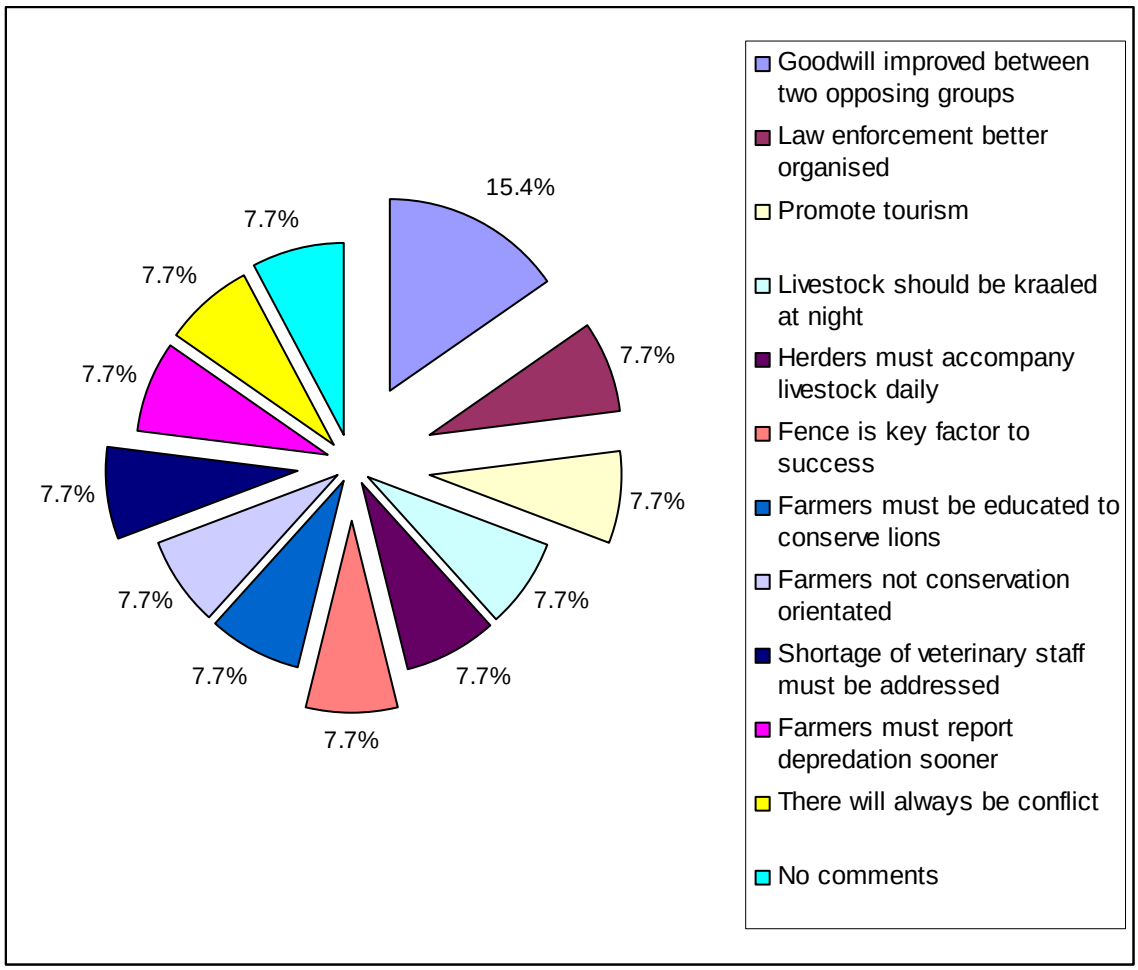

Figure 4.47 Additional comments by wildlife officials in the study area. Exploded slices refer to factors that can be addressed by government.

4.4 Conclusions

The current cattle-post farming system has been in use for centuries in Botswana. The almost depressing economical situation of stock farmers has led to overgrazing around the watering-points, and especially large stock are forced to graze far from the relative safety of cattle-posts. High temperatures and the extremely dry conditions also force

them to graze through the night and rest in shade during the day. At first sight this seems to be the only alternative to pastoral farmers and a convincing argument in favour of not changing the system – especially since it has succeeded in at least partially supporting the poorest of the poor and their families. This "unsafe" grazing far away from cattle-posts is, however, one of the major problems in the lion-livestock debacle. The majority of wildlife officials recognise this reality and understand the difficulties that livestock owners face when it comes to minimising losses due to lion predation.

Livestock graze according to available food and water and nobody seems to really take farm boundaries into consideration. Furthermore, the more wealthy livestock owners graze into their neighbours' land, making it difficult for the poorer livestock owners to improve the grazing conditions on their property, or their financial status by slowly increasing their livestock numbers. This lion-livestock problem should not be seen in isolation, but against the backdrop of many hardships of poverty, isolation and illiteracy. The financial losses that are suffered due to lion predation and the relative small amounts that are being paid out as compensation illustrate the financial stress pastoral farmers in the study area endure. On top of this, the top-down approach of allowing ranch development in communal areas gives rise to dissatisfaction with their own lifestyles while the rich are seen to be allowed to take away what belongs to the poor.

While stock farmers and herders call for more drinking facilities, spread evenly throughout the communal grazing area, consensus has not been reached that the drilling of more boreholes will solve the problem of overgrazing (Moleele & Mainah, 2003). Furthermore, the salinity of water in the area already results in many existing boreholes not being utilised and thus there is a high risk of drilling expensive boreholes, which may be of no value. Furthermore, it is not certain if the groundwater of the Kalahari is replenished by rainfall or whether it is ancient water contained in underground storage reservoirs that can be pumped empty due to lack, or complete absence, of replenishment from precipitation (Carlsson & Ntsatsi, 2000).

The TGLP stipulation that tribal land was to be demarcated, fenced and allocated to individuals or syndicates on leasehold basis for 50 years seems to be a well-designed tool for properly managed livestock units in the study area. However, the fenced ranches to the west of Tsabong belong to relatively wealthy people, some of them foreigners who realised the opportunity to make money, with no or very little benefit to local people (Van Zyl: Personal comments; White: Personal comments). This does not improve the negative approach of livestock farmers towards government, as is demonstrated by a pending court case between a group of livestock owners opposing the allocation of some 22 000 ha to foreigners for cattle breeding and game farming in the communal grazing area (White: Personal comments). Certainly, that was not the implication when the TGLP was drafted, but the Tribal Land (Amendment) Act of 1993, which requires land boards to work in the interest of all citizens of Botswana, forbids discrimination against non-tribe people, even if they have no prior claim. This act limits the rights of tribes and opens up land to speculation by outsiders (Makenzi *et al*., 2004).

Lack of good roads, transportation and communication facilities makes it impossible for livestock owners to promptly report livestock predation to the DWNP, resulting in late responses from officials, and many cases stay unsolved. The same stumbling blocks make the task of Problem Animal Control (PAC) officials just as difficult, with lack of back-up vehicles, fuel and personnel shortages adding to the problem. The efficiency of wildlife officials, and therefore the relationship with farmers, can only be improved if they have proper head office support in their endeavours to keep law and order in the Kgalagadi-South region.

The compensation system seems to be a good solution to losses suffered by livestock owners. However, the time lapse before payment is made and the 50% difference between compensation and real financial losses leaves livestock owners with dissatisfaction and frustration. This definitely contributes to the illegal killing of lions in the study area (White: Personal comments).

Livestock owners and wildlife officials agree that communication, poor roads, and lack of transportation and personnel are reasons for the slow reaction from both sides, and there is to a large extent agreement about the functionality of the KTP fence and the necessity for its improvement. Yet, they are in disagreement about the kraaling of large stock and the prevention of livestock predation: some wildlife officials believe that large stock can be kraaled at night while livestock owners are convinced that they cannot. Similarly, wildlife officials believe that livestock owners can prevent predation by keeping their animals away from the KTP fence and/or the WMA cut-line, and/or out of the WMA. In return livestock owners indicated that this is virtually impossible, especially during extended dry spells.

In general, there is resignation amongst livestock owners and herders that at least some lion predation on livestock is inevitable. Some feeling of positivity, however, remains. The role of education as a tool to convince livestock owners of the importance of the coexistence of lions and livestock, as seen by wildlife officials, is important. More specifically, a better understanding of the delicate processes incorporated into the biodiversity of the Kalahari can be accomplished. Both affected parties also seem to be positive about a number of possible initiatives (e.g. ecotourism and trophy hunting) to both relieve poverty and assist in the conservation of lions and their prey, and neither party is completely blind to the other's problems. In addition, this work has identified a number of relatively easy-to-solve issues (such as the condition of kraals and around watering-points, bull:cow ratios, the supply of phosphorus licks, etc.) which all add to the seemingly hopeless situation. It has also indicated some points on which farmers and wildlife officials differ, and around which the often poor relationships (which lead to a lack of cooperation) can be addressed. The role of both government and the *kgosi* in solving the lion-livestock problem should also be recognised. Most importantly, the uncertainty of whether it is legal to graze in WMA KD/15 should be resolved and adhered to.

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Personal comments

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Van Zyl, T.: Thomas van Zyl, manager of one of the superstores in Tsabong who farms together with South Africans on one of the ranches referred to in the text.

White, R.: Richard White, ground water specialist and communal farmer in the study area.

CHAPTER 5

WILDLIFE MANAGEMENT PRACTICES IN THE KGALAGADI-SOUTH REGION OF BOTSWANA: PERCEPTIONS OF WILDLIFE OFFICIALS, LIVESTOCK OWNERS AND HERDERS

Sections of this chapter have been submitted for publication in the following accredited journal: SA Journal of Science (ISSN: 0038-2353)

5.1 Introduction

The Wildlife Conservation and National Parks Act of 1992 makes provision for the protection and preservation of the animal life and the vegetation in a natural state in the Kgalagadi Transfrontier Park (KTP). The President may by order published in the Gazette, declare any area to be a wildlife management area, or abolish any wildlife management area, or amend the boundaries of any wildlife management area by adding new areas or by removing such areas. Regulations made by the Minister under section 92, in respect of wildlife management areas or any wildlife management area include the regulation of the grazing of any stock therein and any conditions or limitations concerning the husbandry of stock therein.

Under section 46 (4) the act makes provision for "compensation (to) be paid, as be provided in regulations made under the Act, to any person who satisfactorily establishes that he has suffered damage from the action of an animal"; (5) "The Minister may, by notice in *The Gazette*, determine rates of compensation to be paid in respect of claims made under the provisions of this section, where he considers such claims and such rates to be justified"; (6) "Any person who (*a*) Kills any animal in defence of property otherwise than in accordance with the provisions of subsection (1); (*b*) Fails to report the killing of any animal in accordance with the provisions of subsection (2); or (*c*) Uses, retains or disposes of any trophy or meat of the animal so killed otherwise than under or in accordance with this section, shall be guilty of an offence and without derogation from his liability under any other provision of this Act shall be liable to a fine of P1000 and to imprisonment for 1 year".

Consequently, legislation makes provision for the protection of wildlife and the compensation of losses suffered due to livestock predation. The tools are there for both wildlife officials and livestock owners to protect their interests within the ambit of the law. This chapter investigates to what extent the conditions of applicable legislation is adhered to.

5.2 Materials and methods

Two questionnaires, one for livestock owners and herders (n=30; Appendix A) and one for wildlife officials (n=13; Appendix B), were used to collect data about livestock and wildlife management practices. Of the 30 livestock respondents, 50% were livestock owners, 40% herders and 10% were managing livestock at cattle-posts. Two of these respondents represented fenced-off ranches. Other ranches in the study area had experienced no livestock predation by lions and no questionnaires were filled in at those ranches (Van Zyl: Personal comments). One-on-one interviews were conducted with the help of an interpreter at cattle-posts and wildlife offices at Twee Rivieren, Two Rivers and Tsabong. Completed questionnaires were analysed in conjunction with the Department of Biostatistics of the University of the Free State. Where percentage totals exceed 100, some respondents included more than one factor in their responses, while the n-factor remained unchanged.

Other methods used were the collection of information from the Department of Wildlife and National Parks (DWNP) offices in Tsabong where official documents, records and permits were made available. Further information was collected by means of personal interviews and e-mail communication with the WMA's concession holder, Mr Heine Strumpher.

5.3 Results and discussion

5.3.1 The role of fencing in addressing the predation problem

Wildlife officials overwhelmingly indicated that fencing plays, or should play, a most important role in addressing the lion-livestock issue (Table 5.1). A total of 53.9% of wildlife officials stated that the purpose of the fence is to protect livestock and predators against mishaps, that it is meant to protect livestock against predators (30.8%) and to reduce conflict between the DWNP and the community (7.7%). One hundred percent of

officials acknowledged that the DWNP is responsible for the maintenance of the fence, although 7.7% included South African National Parks (SANParks) officials as being co-responsible.

Table 5.1 Wildlife officials' views on different solutions to the lion-livestock clashes in the Kgalagadi-South

Task	**Percentage of respondents**
Fence is adequate and must only be properly maintained	15.4
An improved fence is a high priority	46.2
Extend the fence to Mabuasehube	7.7
Fence off WMA	7.7
* Electric fence must be repaired by DWNP	53.9
Electric fence must be improved by DWNP	15.4
Increase the fence height on dune crests	23.1
Increase the height of the whole fence	7.7
Place wire mesh beneath the fence to prevent burrowing	7.7
* Closing-up of burrows underneath the fence is DWNP's responsibility	84.6
* Patching of holes in the wire mesh is DWNP's responsibility	61.5
Removal of piled-up sand on dune crests DWNP's responsibility	7.7
* Irregular transport availability hampers effectiveness of DWNP officials	53.7
Unmotivated DWNP staff results in poor fence maintenance	15.4
Budget constraints hampers fence patrol and maintenance	15.4
Vegetation on the current fence is not removed regularly and causes damage	7.7
Insufficient equipment to maintain the electric fence hampers effectiveness	7.7
* DWNP is the sole institution responsible for fence maintenance	76.9
Other government departments should maintain the fence	15.4
* Livestock owners should contribute to the fence maintenance	53.9
Livestock owners should not contribute to fence maintenance	30.8
Livestock owners should contribute financially to fence maintenance	15.4

Livestock owners should physically help maintain the fence	38.5
* Fencing off of farms necessary to control predation	61.5
Farmers must kraal all livestock during the night	38.5
Livestock owners must keep their livestock away from the fence	7.7

(* where more than 50% of respondents agree that a specific solution may have a positive impact)

While only 15.4% of respondents regarded the current fence as adequate (if properly maintained), more than 45% suggested that it should be improved. More than 50% said that the fence, as is, should simply be repaired, while an additional 15% felt that the electric fence must be improved. Less than one third of wildlife respondents felt it necessary to raise the height of the fence, and only *c*. 8% that additional wire-mesh at the bottom, to prevent burrowing, is necessary.

More than 75% of wildlife respondents indicated that the DWNP is the sole institution responsible for fence maintenance, and this includes the closing up of burrows beneath the fence and the patching of holes in the fence. Nevertheless, more than 50% felt that livestock owners (and herders) should contribute to fence maintenance such as removal of piled-up sand and vegetation that cause damage to the fence; *c*. 40% felt that livestock owners should physically help to maintain the fence, and 30.8% were convinced that livestock owners should not contribute to any fence maintenance.

Major constraints that prohibit DWNP officials from effectively patrolling and maintaining fences are budget constraints, transport, insufficient equipment to maintain the electric fence, and the fact that some staff members are unmotivated to fulfil this task.

Almost two thirds of respondents felt it essential that farms must be fenced off (from the WMA and from each other) and almost 40% that livestock farmers must kraal their stock at night. Only 7.7% thought that keeping livestock away from the KTP fence would help.

The views of 6.7% of all livestock-owning respondents that the fence is effective against predators, and 40% who said that it is not, must therefore be seen in the light that about 50% of livestock-farming respondents farm in the Khawa-Three Rivers area, where effective maintenance of the KTP fence may have an effect on predation. A total of 46.7% (Tsabong area) said that the fence is too far removed from their cattle-posts to have any effect on livestock predation (Figure 5.1). The fact that two of the cattle-posts (Tshanetshane and Mara), which are within *c*. 10 km from the KTP fence, claimed that they had experienced no livestock predation by lions for the five-year period might also have had an effect on these figures. These claims of no loss are viewed with scepticism, as areas further away from the fence (e.g. Andrews's Farm, 13.9 km to the west of Tshanetshane, and the Mier area even further to the west), did report losses due to predation.

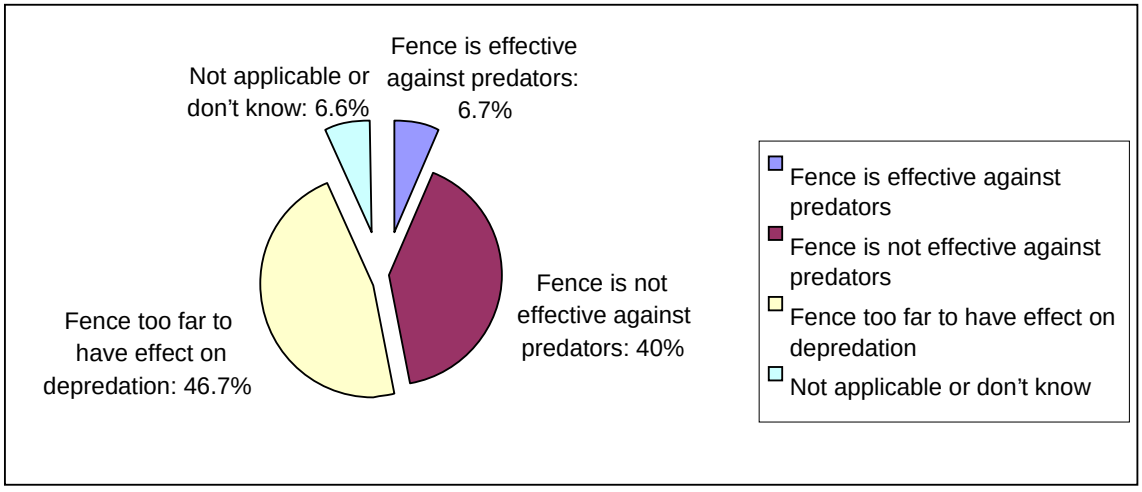

Figure 5.1 Effectiveness of the KTP fence against predators, according to livestock owners and herders

A total of 33.3% of respondents replied that DWNP officials do maintain the fence, while 6.7% felt that they do not; 56.7% said the question was not applicable to their cattle-posts due to their location in relation to the fence (Table 5.2). Asked if it would improve the situation if the fence were extended towards Mabuasehube, 70% said "Yes", and 23.3% "No". Seventy percent said that fencing off the WMA would be of no use against predators, and only 23.3% that it would.

Table 5.2 Percentage of livestock owners that replied "Yes" to questions regarding the KTP fence

Responses	**Percentage**
DWNP maintains the fence	33.3
DWNP does not maintain the fence	6.7
Question is not applicable due to the distance to fence from cattle-post	56.7
Fence must be extended towards Mabuasehube	70
Fence must not be extended to Mabuasehube	23.3
Fencing of WMA would be of no use against predators	70
Fencing of WMA would reduce predation	23.3

5.3.2 Direct actions against transgressors and livestock killers

Since other large-stock killers, such as leopard, spotted hyena, cheetah and brown hyena, are present in the study area or adjoining the KTP and WMA, it was necessary to determine whether lions as livestock-killing culprits are identified accurately by livestock owners and herdsmen. A total of 93.3% of respondents identified livestock killers by spoor, 33.3% included bite and claw marks on the carcass while 3.3% referred to the way the prey was eaten. Similarly, 90.0% identified other livestock killers by their spoor, 23.3% by bite marks on the carcass and 6.7% by the way the carcass was eaten.

The possibility of lions having eaten on an already dead animal was largely ruled out as 50% of respondents, indicated that spoor at the carcass would show whether an attack took place, 20% referred to absence of signs of a struggle, 16.7% looked for signs of the killing on the carcass and another 10% at the appearance and condition of the carcass. A total of 13.3% of respondents were of the opinion that lions do not scavenge.

A total of 53.3% of livestock owners and herders claimed to report predation incidents directly to the DWNP, 40% to the police and 3.3% claimed to track down the lions and shoot them (NB: the second figure is high due to the Khawa area's livestock owners having only the police to report to, who then radio information through to the DWNP offices in Tsabong). Following reporting of incidents, 46.7% of livestock owners and herders said that the DWNP chases the lions back into the WMA and/or the KTP, 40% that an on-site investigation is conducted by the DWNP and 23.3% that incidents are reported to SANParks, who then translocate the lions back into the KTP.

Well-kept records of lion translocation and other measures taken against livestock killing lions were received from SANParks (Figure 5.2 and Table 5.3 – kindly provided by Mr N. du Plessis, Snr Warden, Twee Rivieren). Fifty percent of these translocated lions were sub-adult males.

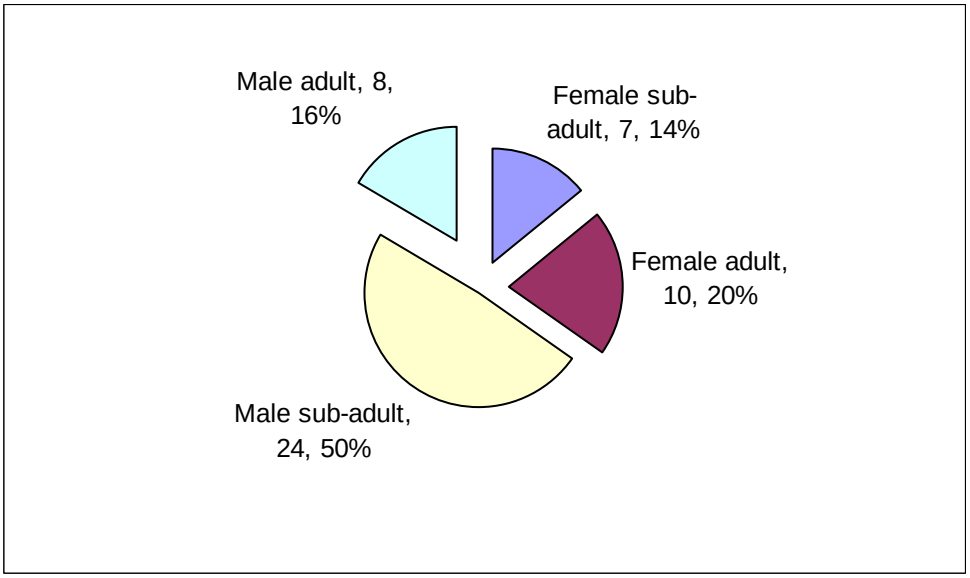

Figure 5.2 Kgalagadi-South lions translocated by SANParks during the period 2002-2006

Table 5.3 indicates how some transgressors discontinue transgressions after they have been translocated once or twice, while others become habitual livestock killers and have to be destroyed after several transgressions.

Table 5.3 SANParks' recordkeeping actions against transgressing lions

Date	Ref. No.	Location	Age	Male's Right-hand side rump shoulder	Status
07-01-2002 17-02-2002	KM55		3yr	T —	Hartbees to Dikbaardskolk – First offence Hartbees to Kwang– second offence
17-09-2001 22-01-2002	KM57		3yr	T Same brand as KM52	End of fence to Leeuwdril – First offence Molapowabojang to Kij Kij – Second offence
24-01-2002 16-03-2002	KM58		2.5-3yr	⊢	Khawa to Kij Kij – First offence Khawa to Baken 3 – Second offence

Date	Ref. No.	Location	Age	Male's Right-hand side rump shoulder	Status
	KM13				Offloaded at Kij Kij – First offence. 15-8-03 seen at Melkvlei
30-04-2003	Wesley / Rampokker	Darted NW of Hartebeest			Offloaded at Dikbaardskolk – Second offence
04-03-2004	KM13	Fly's Kop			Offloaded at Kameelsleep – Third offence
16-03-2004	KM13	Fence end			Spotted near Skrij Lodge 26 06 55 S / 20 16 45 E New scar on left shoulder
13-10-2004	KM13				Offloaded just south of Kij Kij – Fourth offence
	KM13		2-3yr	—	Kept in boma for 5 days and released at Cheleka, 82.3 km away – Fifth offence
13-01-2005	KM13	Mier farm			
19-01-2005	KM13	Same Mier farm			Released into TR boma. Offloaded at Mabua on 2-3-2005- Sixth offence
31-01-2005	KM13	Same Mier farm			Released in TR boma – Seventh transgression. KM13 was shot inside boma after seven boundary transgress-sions
20-04-2006	KM13	Blinkklippan Boy Kaiser			
26-04-2006	KM70				The brandmark on the right-hand side was overlooked and he was branded on the left-hand side too as follows:

Date	Ref. No.	Location	Age	Male's Right-hand side rump shoulder	Status
01-07-2003	KM70	Khawa	3yr		Offloaded at Melkvlei – Not enough drugs to reach Jan se Draai
04-03-2004	KM70	Fly's Kop			Offloaded at Dikbaardskolk – Second offence
16-03-2004	KM70	Fence end		Skin damaged on right rump during transport: hair loss. Can be confused with KM16! 	Offloaded at Kameelsleep – Third offence
16-04-2004	KM70	Good Hope			Offloaded at Melkvlei – Fourth offence (bad condition) with porcupine quills
20-04-2004	KM70	Good Hope	4-5yr		Offloaded at Auchterlonie – Fifth offence (poor condition)
05-05-2004	KM70	Tsane Tsane			Offloaded at Sitzas (condition improved well) – Sixth offence

Both KM13 and KM70 demonstrated the behaviour of a habitual transgressor, and the demands they place on wildlife personnel. One female, KF19 (not mentioned in Table 5.3) crossed the park's boundary nine times (Du Plessis: Personal comments).

Although efforts from wildlife officials to address livestock raiding lions are acknowledged, only 43.3% of livestock owners and herders knew what methods are used by wildlife officials to recognise habitual livestock killers, indicating the lack of communication between the two groups. Livestock respondents also answered that

DWNP officials only chase lions away from grazing areas and back into the WMA, and no brandmarking is done.

5.3.3 Responsibilities of wildlife officials concerning livestock predation by lions in the study area

Of the 13 wildlife officials (eight from DWNP; five from SANParks) interviewed, 30.8% were specifically responsible for problem-animal control, 30.8% were also involved in the translocation of lions, 23.1% had to chase lions away from cattle-posts and 13.4% said that they were also responsible for the protection of the lions. A total of 7.7% said that they were also responsible for fence maintenance, the issuing of hunting licences, water provision for offices at Two Rivers, and education. They did, however, all mention that the emphasis is on the prevention of livestock killing, even though tasks such as education and hunting licences are included in their daily routine. All the wildlife respondents (100%), of both SANParks and DWNP, said that all reported livestock predation incidents are responded to. These actions include translocation, the chasing away of lions, on-scene investigations, interviews with reporters either on the scene or at the Tsabong offices, or the taking of sworn affidavits. A total of 69.2% of wildlife respondents said that communication between officials and livestock owners or herders took place at the scene of the killing, and 23.1% that statements were taken at the offices. The 15.4% that indicated that they do not communicate with livestock owners were all SANParks officials, who responded only to requests from DWNP officials from the Tsabong office.

Asked what the average reaction time was to lion predation reports, 23.1% of respondents said four-and-a-half hours, 15.4% eight hours and 7.7% indicated one, two, two-and-a-half, three, four, twenty-four, forty-eight and seventy-two hours; the mean lapse time was 14.3 hours, and the median 4.5 hours. Procedures followed when at the scene of the killing include an investigation on the spot (84.6% of wildlife respondents) and reading spoor and other signs at the scene (30.8%), while 7.7% looked for bite and claw marks on

the carcass. Two SANParks officials indicated that they did not investigate scenes of the killing since they received the information of attacks from DWNP officials conducting the investigations themselves. All wildlife respondents (100%) were positive that their transboundary colleagues support them at all times.

Wildlife officials cover extremely long distances on narrow, deep sandy roads when responding to boundary transgressions. For example, when the report comes from DWNP in Tsabong, the easiest route for SANParks officials is along the KTP fence to Khawa, which is near the centre of cattle-post concentration in that area (and 110 km from Twee Rivieren). Once they have arrived at the scene of predation the lion(s) must be found and translocated to locations even further away than the point of transgression. One such trip would easily cover a distance of 180 km (e.g. the first offence of KM13 – see Table 5.3). Should officials from Tsabong react to reports in the Leherwane area, a trip for them would be *c.*130 km if the distance the lions have to be chased away is added. If translocation to Mabuasehube takes place, such as was the case with KM13's sixth offence, SANParks officials will have to drive 280 km and, if they must return the same day, it will involve a trip of 14 hours' hard driving.

Responses to what happens in the absence of vehicles and/or personnel when livestock predation is reported included: an alternative vehicle is made available (61.5%), 23.1% said that a vehicle is always available, and 7.7% that the report is followed up the following day. Another 7.7% responded that other officers, such as the police, are then requested to do the investigation. When transport and personnel are available, 61.5% of respondents indicated that an investigation is done on the scene of the killing, and 69% said that lions are translocated; 30.8% mentioned the brandmarking of transgressors before they are translocated.

Transport remains a problem despite the fact that interdepartmental co-operation results in alternative vehicles being made available when livestock killing incidents are reported. A total of 61.5% of officials were of opinion that this is the main obstacle in the execution of their daily tasks. Another disturbing situation is the fact that SANParks officials now have subsidised pickup trucks, which reportedly results in officials being reluctant to use their vehicles for fence patrolling (De Kock: Personal comments, as communicated to him).

According to 38.5% of wildlife respondents, the availability of staff is also a major stumbling block, with 30.8% mentioning that the irregular maintenance of the KTP fence causes further problems for them in the execution of their conservation duties. Only 7.7% saw the slow reporting of livestock-killing incidents, the chasing away of lions instead of translocating them, and the unavailability of a veterinarian to execute immobilisation for translocation purposes as major factors in them being less affective in the prevention of livestock-killing incidents.

Procedures followed after livestock-killing incidents have been reported provide us with a picture of lion predation habits and livestock preferences (see Figure 5.3). Interestingly, wildlife officials have opposing views to those of livestock respondents (see Figure 4.8), indicating that lions prefer adults above the young of cattle, donkeys, mules and horses.

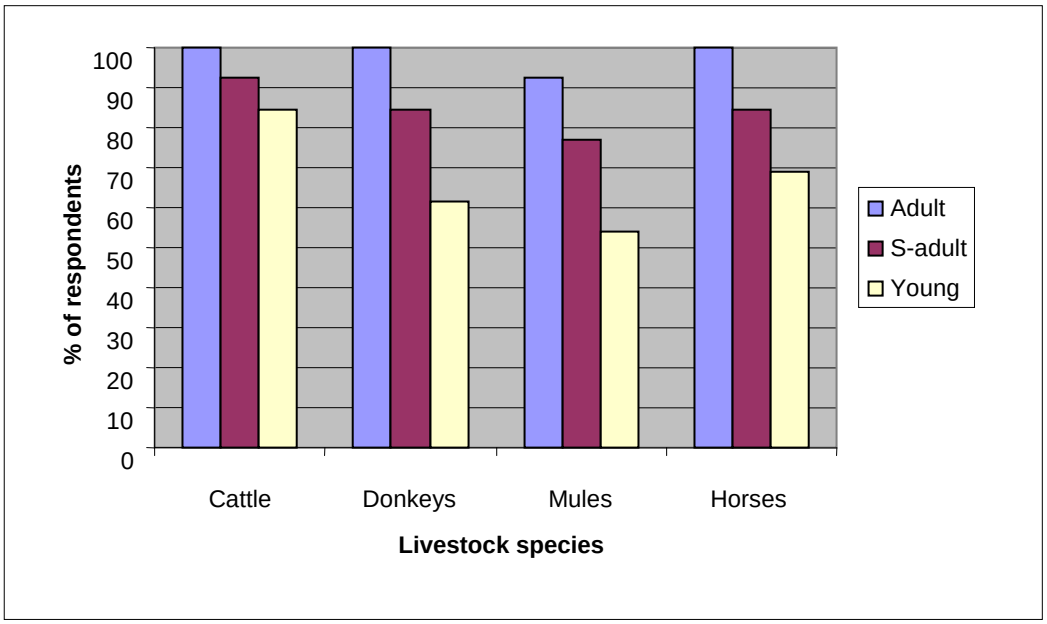

Figure 5.3 Large stock as the preferred prey of lions, according to wildlife officials

Although a relatively small percentage of wildlife respondents included adult sheep (15.4%), young sheep (7.7%) and young goats (7.7%) as lion prey species, the actual number of small stock killed over the five years is insignificant. Overnight kraaling of small stock at the cattle-posts prevents lions from coming into contact with such livestock, with the exception of the odd ewe that stays out at night immediately after having given birth (according to responses from livestock owners and herders). Mules, though they are seemingly less preferred as lion prey, may prove to be similarly targeted, but their relatively low numbers result in fewer incidents of predation.

5.3.4 Identification of livestock-killing lions and actions taken against them

Recognising livestock-killing individuals is important, as habitual offenders have to be dealt with efficiently. Such habitual livestock killers are finally either translocated over a great distance (according to 53.9% of wildlife respondents), killed (38.5%), chased back into the KTP (15.4%), kept in a boma while awaiting a decision from Senior Management (15.4%), kept in a boma for a month and released (15.4%), or

translocated to other reserves or game farms (7.7%). Such livestock killers all begin as casual transgressors, and if such a casual killer is caught in the act, it is necessary to make sure that the individual will be recognisable when it transgresses again. A total of 61.6% of wildlife respondents mentioned that a reference to the history of individual transgressors results in a lion being classified as a casual livestock killer or a habitual one. A total of 59.3% said that the absence of a brandmark is a sure indication of such a lion's status as a casual livestock killer / first-time offender, while 38.4% did not know how to identify casual livestock killers. If a transgressing lion is captured by SANParks, it is brandmarked and the particulars added to a database. DWNP officials, however, rely on body and facial markings, size, mane development and habits of such individual to remember its status as casual livestock killer. Casual killers or first-time offenders are identified (46.2% of them brandmarked) and either translocated into the KTP (46.2%), chased back to the KTP (23.1%), chased as far away as possible from the scene of transgression (7.7%), or captured and kept in a boma for one to three weeks before being released (7.7%).

A brandmark (according to 61.5% of wildlife officials), record in the database (15.4%), shyness (15.4%) or aggressiveness towards vehicles (7.7%) are signs that describe habitual livestock killers. Another 7.7% of officials included ear notches as a certain sign of habitual livestock killers.

When wildlife officials were asked how livestock owners identify alleged livestock-killing lions, 53.9% of respondents referred to spoor and tracking, 15.4% that livestock owners regarded all lions as livestock killers, and another 15.4% said that lions are regarded as livestock killers when they are observed at the carcass. Mane development, body markings, size and colour were pointed out as identification method by 7.7%, and another 7.7% said that livestock owners have no means of identifying livestock-killing lions. Interestingly, 77% of wildlife respondents said that livestock owners and herders identify livestock-killing lions accurately, 15.4% that identification methods are unreliable and 7.7% that accuracy varies from one person to another.

According to 53.9% of wildlife officials, livestock owners report all livestock killed by lions to DWNP and SANParks; 30.8% were sceptical about all incidents being reported. An equal numbers of respondents were of opinion that livestock owners do not illegally kill lions when found in the grazing area, and that livestock owners do kill lions. A total of 46.4% of respondents said that illegal lion-killing incidents are reported to the DWNP by informants, while 7.7% said that they become suspicious when vehicle tracks follow those of the lions. A total of 7.7% said that lion skins are reported; 7.7% said that there is no method to determine when an illegal killing took place, and 23.1% said that they have never experienced any illegal lion killing.

5.3.5 Livestock management practices that enhance predation, and the function of the wildlife management area against livestock predation

The perception of officials as to the purposes of the WMA varied, with 69.2% regarding this area as a tool to provide income for the local community through hunting concession levies; 38.5% indicated that it acts as a buffer zone between livestock and predators, 23.5% that it serves as a breeding area for game, 15.4% that it serves as an income source for government, 7.7% that it generates income through tourism, and 15.4% did not know what purpose the WMA serves. A total of 69.2% of respondents were convinced that the WMA serves as a buffer between livestock and lions, but 23.1% said that the WMA has no buffering effect and 7.7% did not know how effective the WMA is in keeping lions and livestock apart. A total of 55.6% of respondents agreed that wildlife species in the WMA can be managed in such a way that they serve as a protective mechanism against livestock predation, but 44.4% were sceptical of whether such a buffering effect would be of any significance. Seventy-seven percent of wildlife officials were certain that hunting in the WMA does not have a negative impact on wildlife and 7.7% that it does, while 7.7% were uncertain of the effect of hunting on wildlife. Respondents were divided about the possibility of increasing natural lion prey species in the grazing area. A total of 53.9% said that it would not be possible, while 46.1% said that it might be possible. Of

those who were positive, 33.3% suggested that livestock owners should purchase game, and 16.7% advised that control over hunting, livestock reduction and veldt burning, with game being allowed to breed, would increase game numbers in the grazing area. Of those respondents who replied negatively, 50% said that the natural prey species of lion could be increased in the WMA and 50% that it would not be possible.

The majority (>80%) of wildlife officials concluded that livestock owners allow their stock to graze in the WMA (Figure 5.4). Importantly, not all officials were convinced that this is illegal. According to the Wildlife Conservation and National Parks Act of 1992 the grazing of livestock in any WMA is subject to the Minister's decision and not prohibited entirely. Where such practices were regarded by 69.2% of respondents as illegal in the study area, 7.7% said that it is legal and yet another 7.7% did not know whether or not it is legal. Of those who regarded WMA grazing as illegal, 25% indicated that such practices take place because they are not allowed to arrest trespassers or confiscate livestock, and 12.5% each pointed towards insufficient staff numbers, insufficient transport, denial of trespassing by livestock owners and herdsmen, close proximity of some cattle-posts to the WMA, and the natural grazing behaviour of livestock.

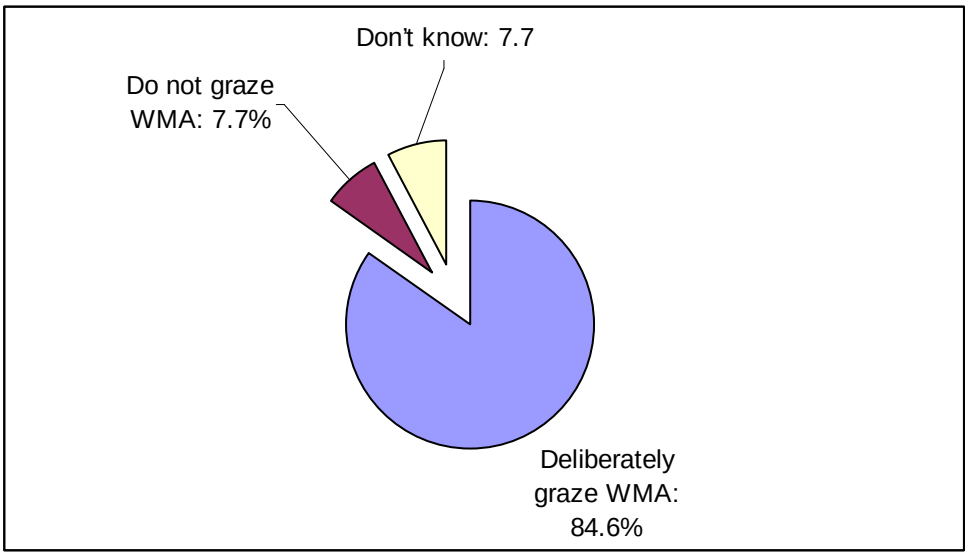

Figure 5.4 Wildlife officials' views on livestock owners' use of the WMA

A total of 66.7% of wildlife officials knew that KD/15 has been proclaimed as a WMA, but 33.3% did not.

5.4 Conclusions

The animal life and the vegetation in the KTP are protected through the Wildlife Conservation and National Parks Act of 1992. This Act also gives the Minister the right to draft regulations that include the regulation of the grazing of livestock and any conditions or limitations concerning the husbandry of livestock in a WMA. The Minister's decision about grazing in WMA KD/15 is, however, not clear. Reaction from officials reveals their frustration with the lack of support from Senior Management to take stronger action against farmers whose stock graze into KD/15, and also to provide proper funding for the fulfilment of their conservation tasks. On the other hand the uncertainty about whether grazing in KD/15 is legal, and the possible inconsequent way in which this issue is dealt with in the study area, most probably contributes not only to the fact that farmers go ahead in allowing their stock to graze freely in WMA KD/15, but also that farmers interpret it as a sign that DWNP officials are not well organised to handle the issue. The location of some cattle-posts almost on the WMA border, e.g. those south-east of Khawa, is also an enormous problem under current conditions.

Reluctance of some livestock owners and herders to answer questions may have hidden some irregularities, the worst being the possible illegal killing of lions. Such illegal killing is often concealed (Macdonald & Sillero-Zubiri, 2002; Baldus, 2004; Gadimang, 2005; Loveridge, Searle, Muridagomo & Macdonald, 2007) and it is possible that information on these mortalities is underrepresented in this study. Doubts also exist about the accuracy of data from Tshanetshane, Mara, Pafeo (all close to the KTP fence) and Kgosi's Post (240 m from the WMA cut-line): no questionnaires could be completed here since the owners/herders claimed that no lion predation takes place at their posts. However, considering the fact that adjoining cattle-posts do suffer considerable losses

due to predation, livestock killing at these posts is expected (see Anderson, 1981). To strengthen this view, Funston (2001) reported 12 livestock-raiding incidents and three lions shot in the immediate vicinity of Tshanetshane, and four lions were shot as a result of alleged livestock predation during the study period, 2002 – 2006.

Wildlife officials regard the improvement of the existing KTP fence, including reparation of the electric fence, increasing the height, closing holes in the wire mesh and closing burrows underneath the fence, as high priorities to reduce lion-livestock interactions. They do, however, regard the fencing of the WMA as not acceptable, as it may hamper natural game species' movements. The extension of the KTP fence to Mabuasehube would, for the same reason, not be acceptable. It must also be taken into consideration that lions have established territories in the KD/15 WMA (Funston, 2001; Druce, Genis, Braak, Greatwood, Delsink, Kettles, Hunter & Slotow, 2004; Fraser, Dougill, Mabee, Reed & McAlpine, 2006); a fence may not only interfere with their ranging behaviour, but also cut them off from the main KTP population.

In reply, livestock owners want the KTP to be fenced off, but not the WMA. This further supports the conclusion that the WMA is an important source of livestock grazing and also hunting of game species. The scarcity of game in the grazing area opposed to the abundance thereof in the WMA also gives livestock owners and herders the option to hunt in the WMA so they need not slaughter their income-generating livestock for own consumption. Given the relative inexpensiveness of hunting and the presence of four-wheel-drive pickup trucks, rifles and dogs at cattle-posts, it stands to reason that hunting in the WMA is general practice (Verlinden, 1997). Regrettably, lions may also be regarded as "competitors" due to them utilising the natural prey species in the WMA.

Although the translocation of livestock-raiding lions is generally regarded as ineffective (Stander, 1990; Woodroffe & Frank, 2005), at least some translocations do result in discontinuation of livestock killing and successful establishment of the individual lion in a different location. Similarly, the constant driving away of lions from the grazing area by

DWNP officials may result in some lions avoiding the grazing area, especially where such chases occur over relatively long distances.

There are indications that communication between DWNP officials and livestock owners is one-way and not as good as it should be. For example, only 43.3% of livestock owners and herders questioned knew what methods are used by wildlife officials to recognise habitual livestock killers, while wildlife officials were of the opinion that the methods used by livestock owners and herders to identify livestock-killing predators are accurate. This may be the result of interviews being held at the scene of a livestock killing, and livestock owners and herders having to explain how they know that a lion or lions were responsible for the killing. Furthermore, the visible actions taken by SANParks by immobilising, brandmarking and removing livestock killers in comparison to those of the DWNP leave a sense of disappointment amongst livestock owners, and their opinion of the DWNP does not reflect well on government. This is expected to have an impact on future working relations and the possible alterations of wildlife management strategies.

Wildlife officials agree that current livestock management practices contribute to lion predation. Large stock is not kraaled at night and food scarcity and high daytime temperatures force these animals to graze during the night, considerable distances away from the relative safety of cattle-posts. Yet, there is no alternative management strategy that can be recommended.

Wildlife officials also understand that the cost involved in travelling around in the grazing area in a pickup truck makes it impossible to check on large stock daily. Simultaneously, inspections on horses or donkeys are too dangerous in lion country, especially far away from cattle-posts. Obviously, looking for lost livestock at night without the safety of a pickup truck is out of the question.

The drilling of more boreholes to provide a larger number of drinking places is also viewed as a bad idea: more areas would be lost for grazing due to overgrazing and

trampling, and the existing bush encroachment would not decline when less trampling and grazing takes place at current boreholes. Overutilisation of groundwater and more intensive stock farming is also projected if more boreholes are to be drilled (Fraser *et al*., 2006).

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Personal comments

De Kock, S.: Stephanus de Kock, photographer and regular visitor to the KTP.

Du Plessis, N.: Nardus du Plessis, Snr. Warden, Twee Rivieren Rest Camp, KTP.

Van Zyl, T.: Thomas van Zyl, manager of one of the superstores in Tsabong who farms together with South Africans on one of the ranches referred to in the text.

CHAPTER 6

KEY FINDINGS AND RECOMMENDATIONS

6.1 Synopsis of key findings

The Kgalagadi-South region of Botswana presents a situation which, in various ways, differs from other scenarios in Africa where lions are in conflict with livestock. Small stock (goats and sheep) do not play an important role in the management challenges facing livestock owners and wildlife officials in their efforts to minimise lion predation: their nutritional needs are satisfied by the shrubs that are found in dense cover near boreholes, where woody-plant encroachment is the result of overgrazing and trampling (Hagos & Smit, 2005); those shrubs have a higher protein and phosphorus content than grass (Verlinden, 1997; Katjiua & Ward, 2006). Consequently, small stock do not have to wander far away from the cattle-posts and they return to sleep overnight in kraals at the cattle-posts, which lions avoid.

In contrast, large stock (cattle, donkeys, horses and mules) have to wander far away from the safety of the cattle-posts to satisfy their nutritional needs both quantitatively and qualitatively. Adequate intake of forages by grazing ruminants is essential to meet mineral requirements, but factors that greatly reduce forage intake, such as low protein (<7.0%) content and an increased degree of lignification, likewise reduce total minerals consumed. Cattle then change to, and prefer, browse with high crude protein and phosphorus content and avoid browse with high fibre content during the hot dry summer months and during the late winter months (Katjiua & Ward, 2006). Extra energy cost during excessive grazing is expected in pastures of limited availability. It is known that under such conditions cattle graze at high biting rates for long periods of grazing (Di Marco & Aello, 2001).

6.1.1 Climatic factors

After excessive grazing and browsing, the animals then have to return to the cattle-posts to drink in an environment where water is scarce and brackish, in some cases to such an extent that it is not suitable for human consumption (Du Plessis & Rowntree, 2003;

Bauer, Helda, Zimmerman, Linn & Kinzelbach, 2006). Daytime temperatures in summer can rise to 45°C, while winter days are sunny with night temperatures sometimes dropping to -10^{o}C (Lovegrove, 2003; DWNP & SANParks, 2005; Van Renssen, 2005; Melville & Bothma, 2006). Extremely dry air conditions result in livestock being forced to stay in the shade most of the day and large stock then having to graze during the cool hours of the night. During the dry, cooler winter months the animals graze for extended periods, including part of the day, but limited palatable food forces them to noticeably extend their grazing distances away from the boreholes. This forces animals to drink only every second to third day, and sometimes, when the distance to the drinking places may be as far as 30 km, they stay away from the water for even longer periods (Burgess, 2006; White: Personal comments).

Although cattle are adaptable to a wide range of climatic conditions, they can be severely affected by high daytime temperatures (Carvalho, Lammoglia, Simoes & Randel, 1995). Continuous hot, dry environments, with little air flow or cloud cover, cause signs of discomfort including shade-seeking, reluctance to leave the water, and increased respiration rate. Heat distress is generally marked by open-mouth panting, little or no feed consumption, and excessive drooling. Management practices to combat the effects require understanding of this phenomenon, and animal handling and routine treatment should be avoided during the hot hours of the day (Carvalho *et al*., 1995; Eigenberg, Hahn, Nienaber, Brown-Brandl & Spiers, 2000; Nienaber, Hahn, Brown-Brandl & Eigenberg, 2003).

6.1.2 Mineral and phosphorus deficiency

An additional reason for large stock having to graze far away from cattle-posts during the night is the overgrazing and trampling near boreholes, leaving little or no food available for – in some cases in the dry west – more than a kilometre from the borehole and drinking trough. Especially during the dry winter months or when extended droughts leave scarce food available, long distances have to be covered to consume sufficient

quantities of crude protein. However, when looking for food, it is not only protein that has to be consumed, but also minerals, especially phosphorus (McDowell, 1996; Verlinden, 1997; Laing, 2005).

Phosphorus is a macro mineral that all animals require and it works in conjunction with calcium to develop and maintain healthy bones and teeth. Phosphorus deficiency can result in reduced overall productivity in all types of cattle. In cows, signs of deficiency include reduced food intake, reduced rate of weight gain of their calves, reduced conception rates, anoestrus and reduced milk production. Reduced reproductive performance, however, may be a secondary effect due to reduced energy and protein intake caused by a phosphorus deficiency (Ward & Lardy, 2005). The phosphorus content of most plants in semi-arid regions averages 0.30% during the vegetative state, and drops to 0.15%. However, on the sandy soils of the Kalahari, grasses produce only 0.123% phosphorus in summer and the phosphorus content drops to 0.049% in winter, while the phosphorus requirement of grazing cattle is 0.17% - 0.59% (McDowell, 1996; Ward & Lardy, 2005; Katjiua & Ward, 2006). Plant minerals are dependent upon a number of factors, including soil, plant species and stage of maturity, as well as yield and climate.

Phosphorus is most likely to be deficient for grazing large stock worldwide and more so in the Kalahari (McDowell, 1996). During the dry seasons the range grasses are characterised by low protein values – lower than the maintenance requirement – and thus animals lose weight. Animals required to walk to obtain forage would also have greater requirements for structural minerals in bone, including calcium and phosphorus (McDowell, 1996; Verlinden, 1997). This is emphasised by the fact that livestock owners do not feed phosphorus licks in the study area and instead rely on bone-chewing to provide for their animals' needs for phosphorus (White: Personal comments), and it may be that the extreme distances that are covered to graze are not only because of the need for protein, but also the need for phosphorus and other minerals (Verlinden, 1997). Approximately 80% of the mammal's phosphorus is present in the bones and teeth

(Breves & Schröder, 1991), and carcases lying in the veldt consequently must serve as an important source of phosphorus for large stock in the study area.

6.1.3 Geophagia and pica

If sufficient amounts of bones are not readily available (see above), it leaves only an excessive intake of dry plant matter, limestone licking and soil eating to satisfy the craving for phosphorus and minerals (Verlinden, 1997; Elsenbroek & Neser, 2002). Yet, with the sparse grass coverage during dry months, it becomes difficult to digest sufficient amounts of grass to satisfy even protein needs, and the low phosphorus content of the dry grass forces large stock to satisfy their mineral needs by licking limestone.

Dune streets, pans and dry river banks where the limestone is exposed are used for mineral licking (Verlinden, 1997; Sahu, 2001; Pardo, Ristori, D'Acqui & Almendros, 2003). This was observed in the adjoining KTP, where gemsbok regularly licked a vertical limestone river embankment (see Figure 6.1), leaving the typical rounded hollows associated with mineral licking. Steenbok, though, preferred to lick the hard surface of the road where the fine sand had been blown away.

Figure 6.1 Gemsbok licking limestone in the KTP

Geophagia, the deliberate ingestion of soil, has been classified as a form of pica and has been associated with deficiencies of elements such as phosphorus (Elsenbroek & Neser, 2002). The ultimate cause of the geophagia in the study area is still unknown. Due to the insufficient amount of phosphorus in the soil and limestone it can be expected that soil licking and eating rather satisfy the animals' need for other minerals but not their need for phosphorus. The craving for phosphorus may, however, still be the main drive behind geophagia. If calcium is digested at much higher levels than phosphorus, it prevents the digestion of phosphorus even further, causing a negative chain reaction. Furthermore, the Kalahari soil contains an average of 8% manganese, 3% iron and 0.0024% cobalt, and an excessive intake of soil due to phosphorus deficiency may result in manganese poisoning in young calves and lambs (Elsenbroek & Neser, 2002).

In the study area both donkeys and cattle were observed licking and eating soil on the gravel road to Mabuasehube (see Figure 6.2), and the provision of dicalcium phosphate or monocalcium phosphate may be crucially important to ensure sufficient phosphorus intake and to cut down on unnecessary long-distance walking to satisfy the need for minerals and to prevent insufficient protein digestion and retarded growth. The calcium to phosphorus ratio should be considered at all times. Calcium works in conjunction with phosphorus to form bone. Because of the relationship between calcium and phosphorus, a proper balance must be maintained.

Based on extensive research on these two minerals, optimal performance occurs when the calcium to phosphorus ratio in cattle diets is between 1.5:1 and 2.0:1 (see Ward & Lardy, 2005). When the calcium to phosphorus ratio exceeds 6:1, or phosphorus remains deficient, reduced growth, feed deficiency and reproduction would result. Given that the calcium to phosphorus ratio tends to increase to 6:1 during the dry months, it should be better to rather provide monocalcium phosphate licks instead of dicalcium phosphate licks, which contains less calcium and more phosphorus (Ward & Lardy, 2005).

Figure 6.2 Donkeys on the limestone road between Tsabong and Mabuasehube licking minerals, presumably in an attempt to satisfy their craving for phosphorus

6.1.4 Water in a thirstland

Water, being a critically important commodity in a thirstland such as the Kgalagadi-South region of Botswana, should be regarded as equally important to livestock management as the supplementation of minerals such as phosphorus. Interestingly, only 36.7% of livestock owners and herders regarded the drilling of extra boreholes as necessary to improve the provision of water. This may be regarded as a hidden blessing, since limits must be imposed on the density of boreholes, if the conjunction of bush-dominant areas is to be prevented. As the spacing between boreholes has decreased in recent years, there are real fears that bush-encroached areas may join, reducing the ecological fodder diversity and availability, and thus pastoral productivity (Moleele & Mainah, 2003;

Fraser, Dougill, Mabee, Reed & McAlpine, 2006). However, woody species contribute significantly to cattle diet during the hot, dry season and early summer and to small-stock diet in general in the Kalahari, and the rehabilitation of encroached rangelands should take into account the role of browse in semi-arid environments (Katjiua & Ward, 2006).

Yet, the drilling of extra boreholes must be considered carefully. The Kalahari is the world's most extensive mantle of sand (African Encounter, 2009). A fundamental, but very difficult, problem in the evaluation of groundwater resources in the region is the estimation of the magnitude of any active infiltration from modern rainfall through the sand-cover to deep underlying aquifers.

The results of an exploration study of the unsaturated sand-cover, including its physical properties, chemical and isotopic profiles of its pore-water composition, were presented in a study by Foster, Bath, Farr and Lewis (1982). The profiles appear to exhibit evaporative features and to suggest that, in an area with a mean annual rainfall of 450 mm, diffuse recharge should not be presumed to be occurring where the sand-cover is more than *c*. 4 m deep.

Notwithstanding the abovementioned dangers of increased bush encroachment, some day-to-day management practices need to be observed. At all cattle-posts, even syndicates, only single drinking troughs are provided, where as many as 900 large stock and 600 small stock must drink daily. The old brick-built reservoirs are not maintained, and they have been replaced with 6000-litre nylon tanks, some of them on stands and others simply placed inside the original reservoir. A standard drinking trough is roughly 3.5 metres long, 450 mm wide and 350 mm deep. If the layer of bricks that have been knocked down by the animals in some troughs were to be replaced, at least the water-keeping quantity would increase, but the space around the trough would still be completely inadequate, causing unnecessary stress and shoving when thirsty animals must drink fast to prevent them from being chased away before they have had their share.

Poor planning at one syndicate resulted in the animals not getting water because of insufficient fuel, and, two days later, because of a broken driving-belt. No provision was made for standby belts or surplus fuel. Since all cattle-posts that allow their animals to drink at such a syndicate have to pay water rights, it is reasonable to expect that such day-to-day management issues should be addressed properly. The syndicate in question is situated within 4.2 km from Khawa, where a sizable general dealer's shop called the "co-operation" is situated. Arrangements could be made for the co-operation to keep stock such as driving-belts and fuel, yet the manager of the syndicate preferred to purchase fuel from Middlepits, some 80 km from there, and the belt had to be collected at Tsabong, 180 km away, meaning a difficult, very expensive 360 km drive to get the pump working again. Even if other important matters could be the reason for such a trip, a minor adjustment to management practices would still improve the situation markedly.

Figure 6.3 Livestock, desperate for water after the third day of no water being available due to a fuel shortage and a broken driving-belt, lick the moist soil at the drinking trough

Inadequate maintenance of borehole equipment also plays a role. If a team of herders struggles for more than two days to repair the pump, it means animals without water and less grazing time. The reparatory procedures revealed a flaw in pumping equipment maintenance: borehole pipes tend to break at the joints due to over-tightening in an effort to prevent leakage. According to borehole-pump experts, rusted threads, where the threading process had cut through the galvanising, cause "biting" due to high friction-induced temperatures and a weak spot in the pipe just above the thread. If a lubricant such as tallow or grease is applied to the threads, tightening would be easier and more secure, and the weakening of the pipes would be minimised. Simultaneously, the application of paint to threads when new piping is put in the borehole would result in a much longer lifespan and less interruption during drinking periods (Frost: Personal comments).

In case of a breakdown neighbours help out with drinking facilities for a day or two, and catastrophic situations seldom develop, but at some solitary cattle-posts the owners or herders have to collect water from neighbouring cattle-posts in 25-litre plastic containers by donkey cart until the pump has been repaired and activities can continue normally. At one solitary cattle-post where no borehole existed, the owner had to herd his large stock over a distance of 6.7 km to the nearest cattle-post with drinking facilities. Small stock receive water at the cattle-post by the owner transporting water in 25-litre containers to his kraals by donkey cart from the nearest cattle-post with a borehole.

The provision of one tank or reservoir at the cattle-post would cut down considerably on time spent on the road to gather drinking water for small stock and would leave much more grazing time for stock. With the harsh climatic conditions, insufficient water provision is a real drawback for such livestock owners, and although a pipeline from the nearest cattle-post seems to be a logical solution, it is doubtful, given the costs, lifestyle, poverty and farming traditions of the people, if such an option would be sustainable. The more equipment that is added to farming practices, the greater the chances are that new systems will fail due to poor maintenance. In most cases, however, much of the daily stress on livestock can be reduced by relatively minor adjustments to livestock

management practices, such as more drinking troughs and crawl-through facilities for small stock.

6.1.5 Kraaling practices

Kraaling is a component of pastoral farming practices that plays an important role in the day-to-day management of livestock. Large stock is handled for several purposes, such as treatment against diseases and injuries, dehorning, castration, milking, feeding, and capture for auction purposes. Small stock sleeps in kraals overnight to prevent predation by black-backed jackal, and to lesser a extent leopard, spotted hyena, caracal, cheetah and brown hyena. Wire mesh and thornbush branches are important components of small-stock kraals, the branches stacked tightly together against the mesh to discourage predators from burrowing underneath or crawling through holes in the mesh fence to gain access to the kraals (Ogada, Woodroffe, Oguge & Frank, 2003).

Regrettably, the maintenance of small-stock kraals is not up to standard. Some kraals have been located on the same spot for many years, and the droppings inside the kraals have accumulated to an extent where an adult goat can jump over the fence easily and it would be just as easy for any of the relevant predators to find access to such kraals. Furthermore, wire mesh is not maintained properly, and holes large enough for adult small stock to crawl through were observed in some kraals and, judging by the shiny appearance of the wire, had been in a state of disrepair for quite some time. Wildlife officials had also observed that kraal maintenance was not done regularly.

Figure 6.4 Poor maintenance of kraals gives access to predators, resulting in unnecessary losses to predation

6.1.6 Fencing

Wildlife officials pointed out unmotivated staff, insufficient transport and budget, vegetation that relay the electric current of the electrical fence and lack of equipment to maintain the fence as stumbling blocks when it comes to performing their duties properly. Consequently they are exposed to lions occasionally and should be equipped to address problems that arise from such situations professionally and safely. Lion-livestock clashes justify proper and regular fence maintenance, and an electric fence is more effective against predators and burrowing animals and less costly to maintain (Chardonnet, 2002; Frank, 2003; Anderson & Pariela, 2005). Poor maintenance of the electric fence may be due to lack of knowledge but more likely lack of motivation and negligence, because a

number of places were observed where the smooth iron plates used to alert wild animals had been fastened onto the electric fence, causing a short-circuit capable of damaging the energisers (see Figure 6.5).

Figure 6.5 A flat metal sheet, fastened to both the KTP electric fence and the main fence, causes a short-circuit resulting in damage to energisers

The result is an electric fence, with sun panels, electric strains and insulators mostly still intact, which runs along the southern KTP boundary for 93 kilometres but which is of no use to the Department of Wildlife and National Parks (DWNP) in its attempts to keep lions and livestock apart.

Similarly, attempts to close up burrows underneath the fence are not successful. Both aardvark and porcupine burrows underneath the fence, and the slats used to cover such burrows are not successfully restraining the animals. In most cases the slats are pushed

aside, and the same burrows are repeatedely used to gain access to the grazing area. Such burrows are large enough to let predators through (see Figure 6.6).

Figure 6.6 A burrow underneath the KTP fence. It had been covered with slats, but these had been pushed aside by either aardvark or porcupine. Such burrows are large enough to let predators, including lions, through.

6.1.7 Labour and remuneration

Livestock management in the southern Kalahari is totally dependent on herders. Most cattle-posts included in the survey were being managed by families, and in most cases herders were relatives of the owner. Nonetheless, herders still need to make a living and in some cases herders complained about the small wages paid by owners. In some cases the monthly earnings are P250 and a bucket of maize-meal. Judging by the general appearance of herders, they live a life of poverty: clothing is in poor shape and bridles

and saddles show obvious signs of disrepair. This may be due to some livestock owners themselves struggling to make a living. Similarly, poverty may be the reason for over-hunting in the study area, since the presence of dogs and the absence of other dangers point convincingly towards the hunting of game such as springhare, scrub-hare, steenbok, springbok and even gemsbok, where dogs are used to keep the gemsbok at bay until the hunter gets close enough to shoot (Packer, 1994; Verlinden, 1997; Packer, Altizer, Appel, Brown, Martenson, O'Brien, Roelke-Parker, Hofmann-Lehmann & Lutz, 1999; Frank, Hemson, Kushnir & Packer, 2006; Personal observation).

Such supplementation of the livestock owners' and herders' diet must become a necessity when times are tough. One occasion was witnessed where meat in an advanced state of decay was collected from a cattle-post for human consumption. A few herders' wives live in villages and towns, where the children must attend school, and the small salaries earned by herders cannot pay for school fees and possible transportation to school. In such cases additional income may be generated if the wife is also employed, but job opportunities are virtually non-existent.

6.1.8 Management practices that have a negative impact on livestock

Large stock was observed approaching the kraals and drinking troughs between 07:00 and 08:00 in the summer months, walking slowly, probably to save energy (Kay, 1997; Di Marco & Aello, 2001). Their late arrival at the drinking troughs may be due to them maximally utilising the grass' higher moisture content and the cool hours of the night (Knight, 1991; Lovegrove, 2003).

The early morning hours are when the herders, sometimes on horseback or on donkeys, herd the animals together to let them drink and to examine them for any ailments that require attention. Sometimes such activities do not come to an end within a reasonable time, especially at syndicates where several cattle-posts water their animals and the herding and disturbing of the animals continues up until 10:00 – and at one syndicate up

until 14:00. By then, the air is already swelteringly hot in summer and leaves the animals drained of the energy necessary to maintain their condition (Kay, 1997; Eigenberg *et al*., 2000; Di Marco & Aello, 2001; Nienaber *et al*., 2003).

Sometimes the animals wander as far as 30 km away from the cattle-posts, especially during the dry winter months, when the protein and phosphorus content of graze and browse is at its lowest, returning to drink only once every three or four days (Katjiua & Ward, 2006; Coetzee, 2007). Such extreme conditions have a severely negative impact on the energy obtained through grazing over such vast distances, and loss of body weight is inevitable, more so during the dry months (Kay, 1997; Di Marco & Aello, 2001). After such careless herding and disturbing of the animals they take to the shade, if they are not locked up in kraals, where they stay until after 16:00 and even later during summer. Only then do they start moving in the direction of their overnight grazing areas.

Donkeys, mules and horses are also affected since they have to drink more regularly than cattle (Martiniuk, 2004; Jordaan: Personal comments; Wiese: Personal comments). Nevertheless, it could not be established whether monogastric animals stay closer to boreholes and drink more often than cattle in the study area. At remote areas of the grazing veldt, though, only cattle spoor was observed.

At very few cattle-posts, where only a few posts water their livestock together, provision is made for small stock to drink undisturbed by providing crawl-through kraals that are only accessible to small stock, and they can settle down earlier than large stock. However, where several cattle-posts have to water their animals, such as at syndicates, the animals suffer exhaustion, since they must wait their turn, sometimes away from the shade while other posts' animals drink and then, when it is their turn, drink quickly to allow a large number of waiting animals to also drink. If the water supply from the tank is weak, it happens that animals have to slurp water from the bottom of the trough, pushing and shoving to quench their thirst. Due to the many animals having to drink at such posts, the quantity of water drunk by each animal is limited and too soon they are chased away

from the single trough to allow other animals to drink.

Over and above this malpractice, water with a high salt content tends to make the animals nauseous, and animals were observed drinking small amounts of water at a time when herders did not pressurise them to drink quickly (White: Personal comments; Personal observation). In some cases the quantity of water drunk by each animal is limited to save fuel costs. The animals are then herded back to their own posts where they have to wait for the cooler hours of the day to go out to graze or browse. In some cases cattle are kept in kraals during the day, and only allowed to leave at about 16:00. Many kraals either do not have shade, or the shade is insufficient to provide cover for all the cattle. Donkeys, horses and mules are not kraaled, but they stay at the kraals until late afternoon when it is cooler.

In the case of small stock, only some three to four hours of daylight are left when temperatures are low enough to allow browsing. They then return to the kraals where they are kept overnight. The higher nutrient content of browse closer to the cattle-post leaves them better off than large stock, which is more dependent on grass (Mphinyane, 2001; Vetter, 2005).

Apart from seemingly unnecessary herding and disturbing of the animals during the morning hours, the going out and grazing away from their cattle-posts in the late afternoon and the night offers the only way through which large stock can take in meaningful amounts of grass and browse. The grass has a higher moisture content, is softer to the lips and tongue, and is probably also more palatable during the night (Knight, 1991; Lovegrove, 2003). Simultaneously, the higher moisture content provides essential supplementation to their need for water. This is obvious when, after overnight drizzle, most large stock stay out in the veldt, preferring to graze rather than to waste energy on the long walk to the drinking trough (Di Marco & Aello, 2001; White: Personal comments; Personal observation).

Since the moisture content of silky bushman grass *Stipagrostis uniplumis* increases from 9% in the day to 26% at night (Knight, 1991; Lovegrove, 2003), it seems reasonable to accept that the annual sourgrass *Schmidtia kalahariensis*, with its porous and broad leaves, when dry, may contain even higher moisture levels during the night and this may also be the reason why this grass, due to it being relatively palatable, is eaten well during the dry season. Furthermore, due to this grass' preference for overgrazed sandy areas, it occurs in abundance in the study area and it may be worthwhile to look into this grass species as a possibly more important source of food for grazing animals than what is generally recognised.

Nevertheless, the great distances to be covered to ingest sufficient amounts of food tap energy from large stock, to the extent where they lose body weight the moment when conditions become less favourable (Kay, 1997).

6.1.9 Wildlife management

The DWNP officials are dedicated to conservation, and responses from wildlife officials indicate a willingness to solve the lion-livestock problems. However, the current system of chasing away lions when found in or near the grazing area causes dissatisfaction amongst livestock owners, as the lions return to the grazing area too often. As a result, wildlife officials are disliked and accused of not doing their work properly.

Although the DWNP attempts to address lion-livestock interactions, its methodology is questionable. When the density of the bushes in the central to eastern parts of the study area is taken into account, especially *Acacia mellifera*, *Rhigozum trichotomum* and *Acacia luderitzii*, it is virtually impossible to chase lions far enough away from the grazing area so that they would not return. Lions easily cover distances of 30 km and more per night (Eloff, 1999; Ogutu & Dublin, 2002; Hayward & Kerley, 2005) and they become agitated very quickly when they are pressurised, making such a task unnecessarily dangerous and risky, as reports in the DWNP offices at Tsabong clearly

reflect (DWNP & SANParks, 2005). Lions also learn quickly (Heinsohn, 1997; Eloff, 1999), and some individuals will without a doubt work their way around vehicles when officials are attempting to drive them away through dense bush.

In contrast, the SANParks team is more efficient, because they immobilise and brandmark the lions when found, and an immobilised lion can be transported and translocated to areas where the least danger of territorial behaviour from resident prides is expected. However, translocation is not in all cases successful and has its limitations (Hemson, 2003; Graham, Beckerman & Thirgood, 2005; Woodroffe & Frank, 2005).

6.1.10 Sport and trophy hunting

There is a lack of consensus among conservationists as to whether trophy hunting represents a legitimate conservation tool in Africa. Hunting advocates stress that trophy hunting can create incentives for conservation where ecotourism is not possible. “Clients are most interested in hunting in well-known East and Southern African hunting destinations, but some trophy species attract hunters to remote and unstable countries that might not otherwise derive revenues from hunting. Clients are willing to hunt in areas lacking high densities of wildlife or attractive scenery, and where people and livestock occur, stressing the potential for trophy hunting to generate revenues where ecotourism may not be viable” (Lindsey, Alexander, Frank, Mathieson & Romanach, 2006).

If livestock owners could profit from lion hunting, it would be well worth their effort to conserve the predators. As alternative sources of income it will simultaneously add value to lions, which would make it worthwhile to protect them against indiscriminate killing. Any joint effort that is driven by the community should be more attractive than any government-initiated projects (Frank, 1998). Apart from lion trophy hunting, income that is generated by hunting of all game species in KD/15 should also benefit the local community. Hunting concession money should partially be paid out to livestock farmers to ensure that the income makes game valuable and worth protecting for locals.

6.1.11 Conservation education

It is doubtful whether conservation education as currently applied makes any positive contribution towards lion conservation in the study area. Education must be approached in a comprehensive manner, getting the community involved in an organised and participatory way, and sufficient senior management and community leader support must be provided to ensure that educators are equipped to fulfil their tasks (Boggs, 2000; GoB, 2002). Otherwise, such attempts are merely academic and have no benefit in real terms. It needs to be stressed that only well-planned, high-level educational projects, sensitive to cultural values, seem to be successful in Africa (COMEDAF II, 2005) and such tasks should be performed by highly qualified and experienced staff.

6.1.12 Tourism

The recommendation by livestock owners that the Department of Tourism should assist with the conservation budget is noteworthy, especially if a relief of budgetary constraints would result in an increase in tourism to the study area. Simultaneously, an influx of tourism must result in money entering the financial arrangement of the local community. Over the past decade there was a boom in ecotourism all over southern Africa, including Botswana (Rozemeijer & Van der Jagt, 2000; Hachileka, 2005) with four-by-four enthusiasts organising themselves in clubs with constitutions and ethical codes to ensure that no damage is caused to the natural environment. These clubs are constantly on the lookout for new off-road challenges (Zondag: Personal comments) and the sandy road over the dunes from Two Rivers to Khawa offers an unequalled 100 km four-by-four challenge.

The cattle-posts along the two-track meandering road are spaced evenly enough to provide camping spots for tourists where potable water and other necessities can be purchased from owners. Simultaneously, such facilities would generate income for the proprietor without any demand from the environment (Boggs, 2000; GoB, 2002).

Firewood is not available between Two Rivers and Khawa, and tourists will have to be notified through advertisements and at border posts to take along their own firewood. The lack of game along the route should not have a negative impact on prospective tourists, because the beauty of the dune veldt is an attraction in its own right.

A further excellent opportunity for tourism also exists along the cut-line that separates the WMA KD/15 and the grazing area (see Figure 2.1). From where it leaves the KTP fence north-west of Khawa the cut-line follows a south-easterly direction to Kgosi's Post. Here it swings north-easterly and crosses the boundary between the Kgalagadi and Southern Districts 300 km further. Depending on the rainfall, a variety of game can be observed along the route, which runs through much denser thorn veldt savannah due to the higher rainfall. The possibility of observing lions along this route makes it even more attractive. Depending on the direction of approach, fuel can be obtained at Twee Rivieren, Middlepits, Tsabong, Makopong and Hukuntsi. The relatively close proximity of the Mabuasehube area of the KTP and well-established routes between Nossob and Mabuasehube offer an excellent holiday opportunity that may attract many visitors, bringing with them much-needed additional income to livestock owners and herders (Ashley & Roe, 1998).

6.2 Recommendations

This study has pointed out a number of shortcomings that can be explored in the aim of addressing lion-livestock clashes:

6.2.1 Livestock management practices

- Much of the Kalahari savannah vegetation is located on soil types that are not suited to intensive high-production farming techniques (Scope / Unep, 2004). The pastoral farming system has been practised for centuries (Fraser *et al.*, 2006; Samuels,

2006) and has resulted in considerable knowledge of local livestock management practices in arid and semi-arid environments. The top-down regulation of communal grazing is, therefore, regarded with cynicism, mainly because deeply-seated practices are not receptive to modernised agriculture and conservation practices, and because scientists may be regarded as having a haughty approach to pastoralists. This may be the core reason why wildlife officials, in their endeavours to secure the co-operation of livestock owners, experience difficulties in protecting lions from indiscriminate killing and preventing livestock predation. Although the government is attempting to incorporate the local community in its decision-making practices, the vehement resistance to wildlife officials amongst some livestock owners reveals a lack of proper participatory structures. It is of essence that government should consult with the community to establish better understanding and co-operation, without forcing its own methodology onto the livestock owners. This includes the *kgosi* system, since *kgosis* are also government representatives through the district municipalities that employ them. The suggestion of Fraser *et al*. (2006) that integration of local knowledge, scientific research and policy support should be initiated from the bottom up (i.e. putting the pastoralist first) will result in more case-specific solutions to different problems within the communal grazing system.

- Encroachment of rangelands for other land uses such as the fenced-off game ranches of outsiders causes outrage and negativity amongst pastoralists, which should be addressed as a matter of urgency. The Tribal Land (Amendment) Act of 1993, which requires Land Boards to work in the interests of all citizens of Botswana and which forbids discrimination against non-tribe people, even if they have no prior claim, contributes to the negativity towards government. This Act limits the rights of tribes and opens up land to speculation by outsiders that are looked upon suspiciously by livestock owners.
- The fencing of allocated grazing areas is likely to be rejected because, due to the different plant compositions, such allocated areas will have to be fenced off to prevent over-utilisation of more palatable plants, forcing the rotation grazing system

on a well-functioning age-old system, which will probably be resisted. Maintenance of such a system is also too costly for the pastoralist.

- The kraaling of large stock during the day serves no purpose, except when animals have to be treated or loaded for slaughtering purposes, and animals should be allowed to drink and rest in the shade of trees in the vicinity of the kraals, saving their energy for when it becomes cool enough to graze during the late hours of the day and through the night.
- The negative impact of phosphate deficiency and bone-chewing probably causes lower production and annually a number of deaths due to botulism. Monocalcium phosphate should be fed as supplement in a number of troughs at boreholes. The money invested by government to subsidise the purchase of phosphate licks would be recovered through increased fertility, reproduction and finally taxation. Higher reproduction without having to enlarge herds of livestock can be a conservation tool, because fewer cows will produce more income-generating meat, the loss of a cow will be less devastating, and the hostility towards lions will decrease as a result.
- Veterinary services could be made available, with mobile units visiting the communal grazing areas regularly. This should address *post mortem* examinations on site to quantify e.g. annual losses due to botulism, brucellosis, bovine tuberculosis and other, currently hidden, negative impacts on production figures. Such veterinary services can be provided by the Botswana Meat Commission (BMC) in a wide-ranging attempt to improve relations with communal farmers, to establish improved meat quality and increase business opportunities.
- Surplus livestock should be sold annually before the dry winter months to reduce the stocking rate and prevent overgrazing.
- The introduction of more bulls to herds will reduce the ratio of bulls to cows to 10 to 12 cows per yearling bull, 20 to 25 cows per 18-to-24-months bull, and 25 to 30 cows per older-than-24-months bull (Barthle & Reiling, 1999; Roche, Lee & Berry, 2006). The provision of phosphate licks should also enhance reproduction due to the positive interaction between protein, energy and phosphorus.

- More drinking troughs at boreholes may prevent unnecessary shoving, energy waste would be minimised, and more resting time may become available. Simultaneously, piping between boreholes, tanks and drinking troughs can be enlarged to increase delivery at the troughs and prevent shoving and pushing. Similarly, driving-belts and other necessities to ensure constant water availability due to improved maintenance of borehole equipment should be kept at the closest stores (e.g. at Khawa, Khuis and Makopong).
- The drilling of more boreholes should only be considered where distances to cattle-posts and syndicates are too great and the animals suffer excessive loss of energy and, during dry months, also body weight. More boreholes should not be considered a solution to overgrazing and trampling near boreholes.
- Livestock farmers may benefit from a livestock farmers' association where they can all-inclusively discuss community matters and strengthen their civil right to be heard on all relevant forums.

6.2.2 Wildlife management

- Section 92 of the Wildlife Conservation and National Parks Act of 1992 leaves loopholes by not specifically prohibiting grazing in wildlife management areas (WMAs), but includes "the regulation of the grazing of any stock therein and any conditions or limitations concerning the husbandry of stock therein". The enforcement, or lack thereof, of this Act in the study area is witness to the weaknesses of the Act, because grazing in the WMA, despite clashes between lions and livestock, is obviously allowed to an extent where any strict enforcement now will result in serious conflicts with the relevant livestock owners, because some livestock owners have become completely dependent on grazing in the WMA. Yet, the Act should be revisited and, if necessary, amended to capture livestock officials' law enforcement powers clearly.
- It is as important that wildlife officials have head-office support in their endeavours to

keep law and order in the Kgalagadi-South region. It is frustrating and demoralising when officials observe trespassing of the law and, despite it being expected of them to manage the lion-livestock clashes effectively, they are not allowed to act accordingly or supported in their efforts to act.

- Some cattle-posts in the Khawa area are situated too close to the WMA to prevent grazing in the WMA. It is highly unlikely that such cattle-posts can be shifted, but it consideration can be given to shifting the cut-line at Kgosi's Post northwards for 5 km. Although this will reduce the size of the WMA, it will also reduce livestock-lion clashes and retaliation against lions. Simultaneously that part of the cut-line should be defined by a fence similar to the existing fence, with adjustments as described above. To save costs, part of this new fence can be constructed with materials recovered from the remainder of the fence to the north-east of the intersection.
- Any further establishment of cattle-posts near the WMA should be discouraged.
- DWNP officials should also have the backup of a veterinary team to enable them to immobilise and translocate lions according to the same procedures as that of SANParks. Lions should be brandmarked, using the same system as SANParks, when found at the scene of livestock killing, and translocated away from the problem area. Accurate record must be kept of such immobilisations and translocations to identify habitual livestock killers and to act according to clear written guidelines from head office. Such veterinary services do not necessarily need to come from government, but could coincide with the veterinary services provided by, for example, the BMC, as mentioned in par. 6.2.1. Alternatively, wildlife officials should be trained to use immobilising equipment.
- Budgetary constraints should be addressed. This does not necessarily imply increased government expenditure, because companies that specialise in fencing material could be approached for sponsorship, including electric fencing material. Similarly, transportation, camping gear, etc. can be addressed, provided that fence and cut-line tourism is allowed, which would expose such companies to advertising.
- Fencing practices, including maintenance, must be improved, such as replacing

wooden slats with lay-flat wire mesh where burrows are to be covered. It will noticeably save expenditure if used wire mesh is purchased at auction for this part of fence maintenance. Similarly, extending the height of the fence on dune crests must be kept up and also stepped up. The renovation and, thereafter, sound maintenance of the electric fence should be regarded as a high priority.

- Extending the fence of the Kgalagadi Transfrontier Park (KTP) to Mabuasehube will have a detrimental effect on the migratory and seasonal movements of game and must not be attempted.
- Habitual livestock killers should be sold to private reserves or similar institutions where they can still roam free to a large extent, or should be killed only when no other solutions can be found. The hunting of problem animals is not recommended, since such practice may result in abuse.
- The WMA could be fenced off on the cut-line near Khawa and Leherwane to make it difficult for lions to enter the grazing area and to keep livestock out of the WMA. It is critically important, however, that livestock farmers be included in this decision-making process. Still, no continuous fence to Mabuasehube should be considered.
- Education is an important conservation tool, but the local community should be involved to such an extent that interaction is encouraged. Much can be learnt from people who have useful knowledge of the veldt and this will prevent the impression that government officials are looking down on locals. The current conservation committee members of the *kgosi* could be made nature custodians, involving members of the community in sensible conservation management of the region. Short courses on conservation could be presented to such community members to broaden their knowledge of conservation.

6.2.3 Compensation

- Although compensation tends to be controversial, the system still results in the reporting of livestock killing, enabling wildlife officials to keep track of trends and to

address livestock predation by lions accordingly. Simultaneously, regular reporting results in the regular presence of wildlife officials in the communal area, discouraging illegal activities such as lion killing and poaching.

- The lower-than-commercial-value compensation rates to certain extent prevent negligence in the protection of livestock against lion attacks. It also prevents the replacement of livestock killed by lions, which prevents overstocking, and rates should not be increased.
- Compensation should not be replaced by subsidy for the building of large-stock kraals, since large stock must graze overnight due to climatic conditions and this livestock management practice cannot be discontinued.

6.2.4 Tourism

- Tourism in Botswana has increased remarkably since 1994, with takings totalling approximately US$ 474 billion in 2002. This rapid expansion suggests that tourism has considerable potential to contribute toward Botswana's economic diversification away from dependence on diamond mining. A vast majority (90%) of tourists confine most of their holiday time to the Okavango Delta and the Chobe National Park. The immediate challenge is to ensure that the growth in tourism in the Okavango and Chobe-Kasane areas does not destroy the natural environment (Kaynak & Marandu, 2006) and to draw more tourists to the Kgalagadi district, which includes the Kgalagadi-South region (Taolo: Personal comments).
- The western part of the study area is virtually unknown as a tourism destination, yet offers unlimited challenges for all-wheel-drive tourism.
- An exciting experience would be for tourists to repair the fence along the cut-line of the KD/15 WMA while travelling between Khawa and Makopong. Such conditions can be built into tourism packages managed by the local community.

6.2.5 Sport and trophy hunting

- According to the 2004 "The Status of Southern Africa's Savannas" report to UNEP by the Southern Africa Savanna Research Network, the utilisation of wildlife can be divided into the following categories:
  1. National Parks and Reserves: game viewing and photographic safaris;
  2. Game-Hunting Areas: safaris and trophy hunting;
  3. Local Community Areas: subsistence hunting;
  4. Zoned Areas: game viewing and sport hunting.
- At present an undetermined percentage of the revenue from hunting licence fees for the KD/15 WMA hunting concession are allocated to the relevant community through the *kgosi's* office, but there are cases where livestock owners and herders are not aware that funds have been received on their behalf. From an individual farmer's perspective, the family suffers the damage to their livelihood but receives no benefits from hunting, thus livestock-killing lions have no financial benefit to them (Anderson & Pariela, 2005). However, if income derived from hunting and trophy hunting would reach the relevant livestock owners and herders, they may be much more lenient towards lions, and even protect them from being killed illegally (Funston, 2001; Whitman, Starfield, Quadling & Packer, 2004; Anderson & Pariela, 2005; Bulte & Rondeau, 2005; Lindsey *et al*., 2006). Judging by responses from livestock owners, income derived from hunting and trophy hunting would be welcomed. Similarly, wildlife officials are also not opposed to such a system.

6.3 The need for further research

For many decades scientists have been searching for a reasonably successful solution to lion-livestock clashes. Many attempts have been made to address the decline in lion numbers all over Sub-Saharan Africa, and some of these do work to a greater or lesser extent. However, in most cases lions still succeed in destroying their own futures by acting on instinct: killing the easiest and least risky prey. Today, red lights are

flickering for the future of the African lion, because human population growth results in continuous encroachment into the lions' natural habitats, causing the predators to turn to livestock for survival. Even more disturbing is the fatalistic approach by many people, including scientists, about the future of wildlife in general and, specifically, lions.

- There is a need for the development of a mechanism that repels lions successfully, shying them away from livestock. Modern technology should be employed to search for the development of such a mechanism, keeping technology within reach of poor communities where, for example, no cellphone coverage exists. Circumstances in the study area present the ideal opportunity to develop such a mechanism, because large stock grazes far away from cattle-posts and is not kraaled at night. Yet other areas where livestock are being kraaled may present similar opportunities, where the owner must be warned when lions approach the kraals under cover of darkness.
- The feasibility and possible detrimental effects of ecotourism ventures, such as four-wheel-drive routes through the western dunes and along the cut-line and fence, need to be investigated. In addition, the exact mechanism and the magnitude of co-operation amongst affected parties must be investigated.
- Sport and trophy hunting as an alternative source of income for the local community should be investigated, with special reference to the percentage of revenue going to the affected community, the administration of such money, and the safeguarding thereof against abuse and corruption.
- This study revealed the many questions related to livestock and wildlife management practices that remain unanswered in the Kgalagadi-South region. First and foremost is the possibility that the communal grazing system as practised by pastoralists is so deeply seated within the traditions of the community that even slight adjustments to their management practices may not be accepted. This phenomenon needs to be investigated and practical solutions found.
- Reproductive losses, due to exceedingly high daytime temperatures, need to be determined to discourage unnecessary disturbance of livestock during the heat of the

day. Similarly, the impact of improved drinking facilities on energy saving and body-mass maintenance needs to be measured.

- It may be fruitful to determine the extent to which phosphorus deficiency can be rectified in a communal grazing system at a cost-effective level and whether the supplementation of phosphorus would result in large stock returning to the kraals more regularly, simultaneously exposing cows to the bulls more often.
- Alternative and more effective methods to improve the effectiveness of the fence need to be investigated.

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Wiese, J.: Jannie Wiese, a farmer in the Omaheke (Gobabis) region of Namibia and a regular endurance competition participant at Fauresmith in South Africa.

Zondag, P.: Phanus Zondag, 2005 chairman of the Free State Off-Road Club.

APPENDIX A

EVALUATION OF THE IMPACT OF PASTORAL FARMING AND WILDLIFE MANAGEMENT PRACTICES ON LION/LIVESTOCK INTERACTIONS IN THE KGALAGADI-SOUTH REGION OF BOTSWANA

QUESTIONNAIRE FOR LIVESTOCK OWNERS

(All information in this questionnaire will be treated as confidential)

We are conducting a survey of the problems that you might experience with lions that kill livestock at this cattle post / ranch. We hope to learn from you how you address such problems, how you anticipate that the negative financial impacts of such problems can be eliminated or reduced, and more income generated from alternative sources.

1. Cattlepost / ranch particulars:

1a **Name** of cattlepost / ranch: ……...

1b **GPS readings**: long/lat (*ddmmss*)…..……...……

1c What is the **size** (area) of grazing veldt for this cattlepost / ranch? (*x1000ha*)

……

2 Respondent's particulars:

2a Respondent's **affiliation** with cattle post / ranch: *(E.g. owner, manager, lessee, herdsman)* ……

2b **How long** has respondent been staying at this cattle post /ranch:

(*Years*) ……..……

2c Respondent's telephone number:

……...…….

For office use

Number | | | 1-2

3-10

						,	
						,	

11-18

		19-20

		21-22

		23-24

3. Numbers and kind of livestock present at this cattle post / ranch:

3a Cattle: ***(x10)***

Sex	Young (11 months & younger)	Sub-adult (12 – 17 months)	Adult (18 months & older)
Cows	i.	ii.	iii.
Bulls	iv.	v.	vi.

25-27 28-30 31-33 34-36 37-39 40-42

3b Donkeys: (***x10***)

Sex	Young (17 months & younger)	Sub-adult (18 – 35 months)	Adult (36 months & older)
Mares	i.	ii.	iii.
Stallions	iv.	v.	vi.

43-45 46-48 49-51 52-54 55-57 58-60

3c Mules: (***x10***)

Sex	Young (17 months & younger)	Sub-adult (18 – 35 months)	Adult (36 months & older)
Mares	i.	ii.	iii.
Stallions	iv.	v.	vi.

61-63 64-66 67-69 70-72 73-75 76-78

3d Horses: (***x10***)

Sex	Young (17 months & younger)	Sub-adult (18 – 35 months)	Adult (36 months & older)
Mares	i.	ii.	iii.
Stallions	iv.	v.	vi.

1-3 4-6 7-9 10-12 13-15 16-18

3e Sheep: (***x10***)

Sex	Young (5 months & younger)	Sub-adult (6 – 14 months)	Adult (15 months & older)
Ewes	i.	ii.	iii.
Rams	iv.	v.	vi.

19-21 22-24 25-27 28-30 31-33 34-36

3f Goats: ***(x10)***

Sex	Young (5 months & younger)	Sub-adult (6 – 14 months)	Adult (15 months & older)
Ewes	i.	ii.	iii.
Rams	iv.	v.	vi.

37-39 40-42 43-45 46-48 49-51 52-54

4. Kraals, grazing practices and protection of livestock against lion attacks outside kraals at this cattle post / ranch:

4a Do you **have kraals** for the following livestock of this cattle post / ranch? (✓)

Kind of livestock	Yes	No	
Cattle			55
Donkeys			56
Mules			57
Horses			58
Sheep			59
Goats			60

4b What is the **purpose of kraaling** livestock at this cattle post / ranch? (✓)

Kind of livestock	Secure against predators	Handling (*Milking, treatment)*	Feeding (*Fodder, licks)*	Other (*Name*)	
Cattle					61-65
Donkeys					66-70
Mules					71-75
Horses					76-80
Sheep					1-5
Goats					6-10

4c What time of the day do **cattle** of this cattle post / ranch graze? [(✓) *or to nearest ½ hour*]

Day light hours	All day and night		11-12

13-21

…… , - ,

4d **If at night** too, can this practice be **stopped**? (✓)

Yes	No		22

4e **If no** to the above question, why? (*Carrying capacity/distance*)

…… 23-24

25-26

…… …… 27-28

4f What time of the day do **donkeys** of this cattle post / ranch graze? [(✓) *or to nearest ½ hour*]

Day light hours	All day and night

29

30-38

…….……. | | | , | | - | | | , | |

4g **If at night** too, can this practice be stopped? (✓)

Yes	No

39

4h **If no** to the above question, why? (*Carrying capacity/distance*)

…… | | | 40-41

| | | 42-43

…… | | | 44-45

4i What time of the day do **mules** of this cattle post / ranch graze? [(✓) *or to nearest ½ hour*]

Day light hours	All day and night

46

47-55

…….……. | | | , | | - | | | , | |

4j **If at night** too, can this practice be stopped? (✓)

Yes	No

56

4k **If no** to the above question, why? (*Carrying capacity/distance*)

…… | | | 57-58

| | | 59-60

…… | | | 61-62

4l What time of the day do **horses** of this cattle post / ranch graze? [(✓) *or to nearest ½ hour*]

Day light hours	All day and night

63

64-72

…… | | | , | | - | | | , | |

4m **If at night** too, can this practice be stopped? (✓)

Yes	No

73

4n **If no** to the above question, why? (*Carrying capacity/distance*)

…… | | | 74-75

| | | 76-77

…… | | | 78-79

4o How do you attempt to **protect the cattle** of this cattle post / ranch against attacks by lions if they are not kraaled at night?

…… 1-2
…… 3-4
…… 5-6

4p Do you think that lion depredation on cattle of this cattle post / ranch **can be stopped** even if they are not kraaled during the night? (✓)

Yes	No	7

4q **If yes** to the above question, how do you suggest can such lion attacks on cattle of this cattle post / ranch be stopped?

……

…… 8-9
…… 10-11
…… 12-13

4r How do you attempt to **protect the donkeys, mules and horses** of this cattle post / ranch against attacks by lions if they are not kraaled at night?

……

…… 14-15
…… 16-17
…… 18-19

4s Do you think that **lion depredation** on donkeys, mules and horses of this cattle post / ranch **can be stopped** even if they are not kraaled during the night? (✓)

Yes	No	20

4t **If yes** to the above question, how do you suggest can such lion attacks on donkeys, mules and horses of this cattle post / ranch be stopped?

……

…… 21-22
…… 23-24
…… 25-26

4u What **time of the day** do **sheep** at this cattle post graze?
[(✓) or to nearest ½ hour]

Day light hours	All day and night

27

28-36

……..……

4v Do you sometimes **lose sheep** due to lion depredation outside the kraals? *(✓)*

Yes	No

37

4w **If yes** to the above question, was lion depredation on sheep outside the kraal due to sheep having been outside the kraal after sunset? *(✓)*

Yes	No

38

4x Do you sometimes **lose sheep** due to lion depredation in the kraals? *(✓)*

Yes	No

39

4y **If yes** to the above question, how do lions get into the kraal?

……

…… 40-41

…… 42-43

…… 44-45

4z Do you think that lion depredation on **sheep** in kraals can be **stopped**? *(✓)*

Yes	No

46

…… 47-48

4aa **If yes** to the above question, how can such depredation by lions be stopped?

……

……. 49-50

……. 51-52

……. 53-54

4ab What **time of the day** do the **goats** of this cattle post / ranch graze / browse? *[(✓) or to nearest ½ hour]*

Day light hours	All day and night

55

56-64

…… | | | , | | - | | | , | |

4ac Do you sometimes lose **goats** of this cattle post / ranch due to lion depredation outside the kraals? (✓)

Yes	No

65

4ad **If yes**, was lion depredation on the goats of this cattle post / ranch outside the kraals due to goats having been outside the kraal after sunset? (✓)

Yes	No

66

4ae Do you sometimes lose goats of this cattle post / ranch due to lion depredation in the kraals?

Yes	No

67

4af **If yes** to the above question, **how do lions get into the kraals** of this cattle post / ranch?

……..……..……

…… | | 68-69

…… | | 70-71

…… | | 72-73

4ag Do you think that **lion depredation** on goats in kraals of this cattle post / ranch **can be stopped**?

Yes	No

74

……..…… | | 75-76

4ah **If yes** to the above question, **how can such depredation** on goats of this cattle post / ranch **be stopped**?

……

…… | | 77-78

…… | | 79-80

…… | | 1-2

5. Lion attacks on livestock of this cattle post / ranch:

5.1 Seasonal trends:

5.1a At **what time of the year** do most livestock killings by lions occur at this cattle post / ranch? *[(May – Sept = rainy season; Oct – April dry season, with up to 80% variation) (Don't know)]*

…… 3-4 5-6

5.2 Climatic influences:

5.2a Does **excessive rainfall** have an influence on lion raiding patterns on livestock of this cattle post / ranch? *(✓)*

Yes	No	7

5.2b Do **long periods of drought** have an influence on the patterns of lion attacks on livestock of this cattle post / ranch? *(✓)*

Yes	No	8

5.2c What **climatic situations** result in an increase of lion attacks on livestock in this grazing area? *(✓)*

Cold at night		9
Hot at night		10
Cold during the day		11
Hot during the day		12
Wind at night		13
Wind during the day		14
Rain at night		15
Rain during the day		16
Dew		17
Frost		18
Wind blowing towards the park fence		19
Wind blowing towards the usual direction of lion approach		20
Full moon		21
No moon		22

5.3 Lion preferences of livestock at this cattle post / ranch:

5.3a Kind and sex: *(✓)*

	Young		Sub-adult		Adult	
Kind	♀	♂	♀	♂	♀	♂
Cattle						
Donkeys						
Mules						
Horses						
Sheep						
Goats						

23-28
29-34
35-40
41-46
47-52
53-58

5.3b **Livestock numbers killed by lions** during the **past five years** in the grazing area of this cattle post / ranch: ***(2002-2006)***

5.3b(1) **Cattle:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adult					
Adult					

59-68
69-78
1-10

5.3b(2) **Donkeys:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adlt.					
Adult					

11-20
21-30
31-40

5.3b(3) **Mules:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adlt.					
Adult					

41-50
51-60
61-70

5.3b(4) **Horses:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adlt.					
Adult					

71-80
1-10
11-20

5.3b(5) **Sheep:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adlt.					
Adult					

5.3b(6) **Goats:** (*x10*)

Age	2002	2003	2004	2005	2006
Young					
S-adlt.					
Adult					

5.3c Why do lions prefer the kind of livestock referred to above?

……

……

6. Factors that influence lion attacks on livestock of this cattle post / ranch:

6a At **what time of the day** do lions attacks on livestock of this cattle post / ranch occur? [(✓) (Dusk, n*ight, dawn, day*)]

Dusk	Night	Dawn	Day

6b Do **attacks increase** when there are **no herders** with the livestock in the veldt of this cattle post / ranch?*[(✓) (elaborate)]*

Yes	No

……

6c Do **attacks increase** when there are **herders but no dogs** with the livestock in the veldt of this cattle post / ranch?

Yes	No

……

6d Do **attacks increase** when there are **no people at the house** of this cattle post / ranch?

Yes	No	Always people at house

21-30
31-40
41-50
51-60
61-70
71-80
1-2
3-4
5
6
7
8
9
10-11
12
13-14
15

7. Areas where lion depredation is highest:

7a **Where do** lion **attacks** on livestock of this cattle post / ranch **occur mostly**?

Kind of livestock	In kraals	At drinking place	In grazing veldt	Near fence	Near WMA
Large stock					
Small stock					

16-20

21-25

7b **Why** do lions attack livestock **at the above place(s)** mostly?

……

26-27

……

28-29

8. History of lion attacks on livestock of this cattle post / ranch:

8a Have **lion attacks** on livestock of this cattle post / ranch **increased** over the last five years? (✓)

Yes	No

30

8b **How often** do **lion attacks** on livestock of this cattle post / ranch **occur**? (✓)

Weekly	Monthly	Annually

31

8c Could any pattern in the occurrence of lion attacks on livestock of this cattle post / ranch be observed over the years? *(Elaborate)*

32-33

……

34-35

8d **Where do** the **alleged guilty lions** that move into the immediate area of this cattle post / ranch **come from**?

……

36-37

……

38-39

8e In **what direction** do the lion(s) **retreat** after the attack on livestock of this cattle post / ranch?

……

40-41

……

42-43

8f Do **all lions** or groups of lions that enter your area **prey on** the **livestock** of this cattle post / ranch? (✓)

Yes	No		44

8g **Is every boundary transgression** by lions **accompanied by attacks** on livestock of this cattle post / ranch? (✓)

Yes	No		45

8h **How do you determine** when **lions cross the boundary** of the park in the grazing area of this cattle post / ranch?

Reports	Tracks	Roars	46 47 48
Skittish livestock	Scattered livestock		49 50

8i **What percentage of lion attacks** on livestock of this cattle post / ranch **is successful**? (✓)

<25%	26-50%	51-75%	>75%	Don't know		51-52

8j **What percentage of lion attacks** on livestock of this cattle post / ranch **are unsuccessful but leaves injured animals**? (✓)

<25%	26-50%	51-75%	>75%	Don't know		53-54

8k How do you **determine when an attack by lions was not successful** on livestock of this cattle post / ranch? (✓)

Spoor	Reports	Claw marks on livestock	Presence of lions in immediate vicinity of the herd at the time		55-58

9 Lion numbers over the past five years:

9a Have **lion numbers** in the grazing area of this cattle post / ranch **increased** during the past five years? (✓)

Yes	No		59

9b Do you keep **record of lion numbers** as observed by you in the grazing area of this cattle post / ranch? (✓)

Yes	No		60

9c May I **take a picture** of your records of lions observed in the grazing area of this cattle post / ranch?
(Digital photo-<u>confirmation</u>)

Yes	No	Not applicable		61

10. Sex, age, numbers and group structure of marauding lions:

10a ***(Fill only spaces without shading)*** *(Cubs: 0 - 24 months; sub-adults: 25 – 36 months; adults: 37 months and older)*

Description	Age (*Months*)	♂ (✓)	♀ (✓)	Average group size (*Numbers*)	Yes (✓)	No (✓)		
Groups								62-63
Groups								64-65
Groups								66-67
Mostly solitary								68
Sex of solitary lions								69-70
Solitary lions								71-72
Increase in solitary lions?								73
Cubs present?								74
Increase of cubs?								75
Do sub-adults *<u>attack</u>* stock?								76
Do sub-adults ***<u>kill</u>*** stock?								77
Increase of sub-adult lions?								78
Increase of adult lions?								79
Increase of lion prides?								80

10b How do you determine the age of lions?

…….

……. 1-2 3-4

……. 5-6

10c May I please **take a picture** of your **records** of lions and lion-related incidents? (✓)

Yes	No	Don't have		7

11 Financial implications of livestock depredation and attempted depredation by lions at this cattle post / ranch during the past five years:

Financial implications	Pula p.a.(*x100*)		
Extent of financial losses due to injuries resulting in *compulsory slaughter*			8-9
Extent of veterinary medicine costs			10-11
Extent of expenses for veterinary services			12-13

12. Compensation:

12a Are you being financially compensated for losses due to depredation by lions on livestock of this cattle post / ranch? (✓)

Yes	No		14

12b **If yes** to the above question, **what percentage** of the market value of livestock losses due to depredation by lions on livestock of this cattle post / ranch is being paid out?

…… 15-16

12c **Who determines** the **market value** of the killed livestock?

…… 17-18

…… 19-20

12d **What conditions apply** to compensation being paid out for livestock losses due to depredations by lions on livestock of this cattle post / ranch? (*Positive identification of predator, etc*)

…… 21-22

…… 23-24

12e **Are you satisfied** with these conditions? (✓)

Yes	No		25

12f **If no compensation scheme exists**, are you of opinion that compensation should be paid to you for losses suffered due to livestock depredation by lions at this cattle post / ranch? (✓)

Yes	No		26

12g **What percentage of the market value** of livestock lost due to lion depredation at this cattle post / ranch **would you regard as reasonable as compensation?**

…….. | | | | 27-29

12h Would you prefer that compensation rather be rewarded by means of **government subsidy for the building of lion-proof kraals** for this cattle post / ranch? (✓)

Yes	No		30

12i Should **government cover all costs** for the building of **lion-proof kraals** at this cattle post / ranch? (✓)

Yes	No		31

12j **If yes** to the above question, **why?**

…….. | | 32-33

…… | | 34-35

12k **How many kraals** do you need **to better protect your livestock** against lions?

…… | | 36-37

12l **Would you consider building kraals for cattle** and other large stock to protect them **against lion attacks** at this cattle post / ranch? (✓)

Yes	No		38

……

12m Would you prefer to have **more kraals for small stock?** (✓)

Yes	No		39

13. Record-keeping of livestock losses due to lion depredation:

13a Do you **keep record of annual livestock losses** due to lion depredation? (✓)

Yes	No		40

13b May I take a picture of your records? (*Records exist: yes/no*)

Yes	No	No records exist		41

14. Actions taken against suspect livestock raiding lions:

14a **What actions** do you take when you observe **sign of lions** in the grazing area of this cattle post / ranch?

…… | | | 42-43
…… | | | 44-45

14b **What actions** do you take when you **observe lions** in the grazing area of this cattle post / ranch?

		46-47
……		48-49

14c **What actions do you take** when **lions attack livestock** of this cattle post / ranch?

		50-51
……		52-53

14d What **actions** are **taken by officials** of DWNP / SANParks once suspect livestock raiding **lions had been reported** and found in the grazing area or near this cattle post / ranch?

		54-55
……		56-57

14e What **actions** are **taken by authorities** to address casual livestock raiding by lions?

…… | | | 58-59
…… | | | 60-61

14f What **actions are taken by officials** of DWNP / SANParks once habitual livestock raiding lions have been **identified with certainty?**

…… 62-63 64-65 66-67

15. Identification of individual lions:

15a **Can individual lions be identified by you** or members of this household at this cattle post / ranch? (✓)

Yes	No

68

15b **If yes, how do you identify individual lions** when observed in the grazing area of this cattle post / ranch?

…… 69-70 71-72

…… 73-74

15c **Do you know what methods** are used by officials of DWNP / SANParks to **identify individual stock-raiding lions?** (✓)

Yes	No

75

15d Please **describe the methods** used by officials of the DWNP / SANParks **to identify casual livestock raiding lions**

…….…….. 76-77 78-79

……...……. 1-2

15e Please **describe the methods** used by officials of the DWNP / SANParks **to identify habitual livestock raiding lions**

……..

…….. 3-4 5-6

…….. 7-8

16. Recognition of lion signs at scenes of attacks or attempted attacks on livestock:

16a How do you know if **an attempt was made by lions** to attack **large stock** of this cattle post / ranch??

……

…… 9-10

…… 11-12

…… 13-14

16b How do you know if **an attempt was made by lions** to attack **small stock** of this cattle post / ranch?

……

…… 15-16

…… 17-18

…… 19-20

16c How do you determine that **the killing was done by lions** and not other predators on livestock of this cattle post / ranch?

…… 21-22

…… 23-24

…… 25-26

16d How do you **determine the killing was made by other predators** on livestock of this cattle post / ranch?

……

…… 27-28

…… 29-30

…… 31-32

16e How do you determine **if an animal was killed by lions**, or died because of other causes, e.g. disease or drought?

……

…… 33-34

…… 35-36

…… 37-38

17. Complications other than livestock losses caused by lions at this cattle post / ranch:

17a Do lions **<u>prevent</u> the utilisation of the entire grazing veldt** that is available to you at this cattle post / ranch? *(✓)*

Yes	No		39

17b **If yes** to the above question, what portion of the grazing veldt (*x1000 ha*) cannot be utilised for this cattle post / ranch?

…… | | | 40-41

17c **Where is this under-utilised part** of the grazing veldt situated? *(E.g. near fence/near WMA/in WMA)*

……..…….. | | | 42-43

17d **Can this** prevention of complete grazing veldt utilisation due to lion depredation on livestock of this cattle post / ranch **be neutralized?** *(✓)*

No	Yes	n/a		44

17e **If yes** to the above question, w**hat can be done** to prevent lions from depriving you from utilising all the available grazing veldt of this cattle post / ranch?

……..…….

…… | | | 45-46
47-48

…… | | | 49-50

18. Lions as a threat to humans:

18a **Was anyone** of your household or employees ever **threatened** by lions in the grazing area of this cattle post / ranch? *(✓)*

Yes	No		51

18b Was anyone of your **household or employees** ever **threatened by lions** at or close to this cattle post / ranch? *(✓)*

Yes	No		52

18c Was **anyone** of the household or employees of this cattle post / ranch **ever attacked** and injured by lions? *(✓)*

Yes	No

53

18d **Was anyone killed** in the process during such attack at or near this cattle post / ranch? *(✓)*

Yes	No

54

18e Do you fear for your own life, the lives of your family or employees' lives because of the presence of lions near or in the grazing area of this cattle post / ranch? *(✓)*

Yes	No

55

18f **Do lions** sometimes **come near the house** of this cattle post / ranch? *(✓)*

Yes	No

56

18g **Do lions sometimes take a threatening pose against humans** at the house of this cattle post / ranch? *(✓)*

Yes	No

57

18h **What measures have you taken** to protect the members of this household **against lion attacks?**

…… 58-59

…… 60-61

19. Livestock as preferred prey by other predators:

19a y = Young; s = Sub-adults; a = Adults

	Cattle			Donkey			Mule			Horse			Sheep			Goats		
	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a
Leopard																		
Cheetah																		
Spot h																		
Brown h																		
Jackal																		
Caracal																		

62-73
1-60

19b Do the **following predators attack** livestock **in places as indicated** below at this cattle post / ranch? *(✓)*

	Kraals		Veldt					
Predator species	Y	N	Y	N				
Leopard								61-64
Cheetah								65-68
Spotted hyaena								69-72
Brown hyaena								73-76
Black-backed jackal								77-80
Caracal								1-4

19c **How do you know if an attempt was mad**e by the above predator species to attack livestock of this cattle post / ranch?

……

……

……

……

		5-6
		7-8
		9-10
		11-12

20. Kinds of kraals used against predators:

20a **Kind of materials used** for kraals against different predators: (*Please specify*)

	Kraals	Gates					
Lions							13-16
							17-20
							21-24
							25-28
Leopards							29-32
							33-36
							37-40
							41-44
Cheetahs							45-48
							49-52
							53-56
							57-60
Spotted hyaenas							61-64
							65-68
							69-72
							73-76
Brown hyaenas							77-80
							1-4
							5-8
							9-12
Jackals							13-16
							17-20
							21-24
							25-28
Caracals							29-32
							33-36
							37-40
							41-44

20b **What percentage of attacks** on livestock **could you prevent** during the past five years?

	Percentages in kraals					Percentages in veldt				
Predator species	0-25	26-50	51-75	76-100	Don't know	0-25	26-50	51-75	76-100	Don't know
Lion										
Leopard										
Cheetah										
Spotted hyaena										
Brown hyaena										
Jackal										
Caracal										

45-50
51-56
57-62
63-68
69-74
75-80
1-6

21. Building, maintenance and possible improvement costs of kraals at this cattle post / ranch and source of building material:

21a Building, maintenance and possible improvement costs of kraals: (*Pula*)

Item	Costs (*x P100*)	Don't know	
All inclusive building costs per existing kraal for large stock			7-9
What would it cost to put up an improved predator-proof kraal for large stock?			10-12
All inclusive building costs per existing kraal for small stock as it is currently			13-15
What would it cost to put up an improved predator-proof kraal for small stock?			16-18
All inclusive costs to maintain an existing kraal for large stock per annum			19-21
Anticipated costs to maintain an improved predator-proof kraal for large stock per annum			22-24
All inclusive costs to maintain an existing kraal for small stock per annum			25-27
Anticipated costs to maintain an improved predator-proof kraal for small stock per annum			28-30

21b Where do you **obtain the material** used **to build kraals** at this cattle post / ranch from? *(New/2nd hand/veldt)*

Veldt	2nd hand	New				31-33

21c Do you have **commercial electricity available** at this cattle post / ranch? *(✓)*

Yes	No		34

21d Is it possible to erect electrical fences for kraals at this cattle post / ranch? *(✓)*

Yes	No		35

21e **What kind of electricity would you use** for electric fences at this cattle post / ranch? *(✓)*

Solar	12 volt battery	Commercial 220-240 volt				36-38

21f Is it **possible to build lion-proof kraals for cattle** of this cattle post / ranch? *(✓)*

Yes	No		39

21g Do you have **any suggestions** as to the **protection of cattle against lion attacks in the grazing veldt** of this cattle post / ranch?

……..…….

		40-41
…….…….		42-43
……..……..		44-45

22. Livestock owner's response to depredation by other predators:

22a **How do you respond to depredation by predators <u>other than lions</u>** on livestock of this cattle post / ranch?

Predator	Response			
Leopard				46-47
				48-49
				50-51
Cheetah				52-53
				54-55
				56-57
Spotted hyaena				58-59
				60-61
				62-63
Brown hyaena				64-65
				66-67
				68-69
Jackal				70-71
				72-73
				74-75
Caracal				76-77
				78-79
				1-2

22b Is **any compensation being paid for loss of livestock** due to depredation by the above-mentioned predators? *(✓)*

Leopard		Cheetah		Spot h.		Brown h.		Jackal		Caracal			3-8
Y	N	Y	N	Y	N	Y	N	Y	N	Y	N		

22c **If yes** to the above question, what **% of the market value** of livestock is being paid out?

…… 9-11

22d What **other forms of compensation** exist for livestock loss due to depredation by lions at this cattle post / ranch? *(Elaborate)*

…… 12-13

…… 14-15

23. Condition, maintenance and effectiveness of the KTP fence:

23a Does the **fence prevent large predators to enter** the grazing area of this cattle post / ranch? *(✓)*

Yes	No	No fence

16

23b **Do wildlife officials or others maintain the fence** where the grazing area of this cattle post / ranch adjoins the KTP? (*Elaborate*)

Yes	No	No fence

17

23c What **kind of reparatory work is being done** on the fence by officials where it borders the grazing area of this cattle post / ranch? (*methods*)

…..…….

18-19
20-21

……...…….

22-23

23d **How often is reparatory work being done on the fence** by officials where it borders the grazing area of this cattle post / ranch? *(✓)*

Weekly	Monthly	Six-monthly	Annually	Very seldom	No fence

24-30

23e Are shortcomings in the fence of such nature that **it offers no deterrence to predators** that enter the grazing area of this cattle post / ranch? *(✓)*

Yes	No	No fence

31

23f **Should the fence be improved** to ensure that predators cannot enter the grazing area of this cattle post / ranch? *(✓)*

Yes	No	No fence

32

23g What can be **done to improve the fence?**

……

……

33-34
35-36

……

37-38

23h **Who should be responsible for the costs** to improve the fence adjoining the grazing area of this cattle post / ranch?

…… 39-40
41-42
…… 43-44

23i Should the **fence be improved** to such an extent that **even smaller predators**, such as black-backed jackal and caracal **be kept out?** *(✓)*

Yes	No	No fence

45

23j **Is it practical to extend the fence towards Mabuasehube?** *(✓)*

Yes	No

46

23k Would **the fence be more effective** if it would be **extended southwards along the WMA KD/15?**

Yes	No

47

23l Would it be even **better if the fence would be extended around the WMA KD/15 towards Leherwane syndicate?** [(*Along the road between Tshabong & Mabuasehube*) (*Please elaborate*)]

Yes	No

48

4. Herdsmen:

24a **How many herdsmen** do you employ at this cattle post / ranch?

…… 49-50

24b **Does** the application of **herdsmen** to keep watch over livestock **reduce losses due to lion depredation** at this cattle post / ranch? *(✓)*

Yes	No	Not applied for such purpose

51

24c Do **herdsmen employed at this ranch have families** staying at this cattle post / ranch? *(✓)*

Yes	No

52

24d **Are children eager to learn and help out** on their own with the herding and handling of the livestock of this cattle post ranch? (✓)

Yes	No	Only some

53

25. Dogs, their functions and care:

25a **How many dogs** do you keep at this cattle post / ranch?

…… 54-55

25b **How many dogs are allowed per herdsman** at this cattle post / ranch?

…… 56-57

58

25c **What is the purpose of** the keeping of **dogs** at this cattle post / ranch?

……

…… 59-60

61-62

…… 63-64

25d Please indicate **how many lion attacks were diverted** during the past five years due to the presence of dogs with livestock **in the veldt** of this cattle post / ranch?

…… 65-66

25e Please indicate **how many lion attacks were diverted** during the past five years **due to the presence of dogs** with livestock **at kraals** of this cattle post / ranch?

…… 67-68

26. Natural prey species, their numbers, availability and reproduction:

26a Which **prey species stay year round**, which **migrate** in and out, and which **reproduce when in the study area?**

Prey species	Year round	Only during (*winter/summer /autumn/spring*) (*Select*)	Give birth in grazing area (*winter/summer /autumn/spring*)	Migrate with young into the grazing area (*winter/summer /autumn/spring*)	
Springbok					69-72
Gemsbok					73-76
Red harte beest					77-80
Steenbok					1-4
Duiker					5-8
Wildebeest					9-12

26b **Where** do the migrating **species come from** and **go to?**

Prey species	Where do they come from?	Where do they migrate to?	
Springbok			13-14
Gemsbok			15-16
Red hartebeest			17-18
Steenbok & Duiker			19-20
Others			21-22

26c Have the **numbers** of natural lion prey species **stayed stable**, or have they **increased** or **decreased** over the past **five years?** *(✓)*

Stable	Decreased	Increased		
				23

26d Have you kept **record of the movement of natural prey species** of lions **in the grazing area** of this cattle post / ranch? *(✓)*

Yes	No		
			24

26e May I please **have a look at your records?** *(Digital picture)*

Well kept	Incomplete

25

27. Respondent's account of age preference and availability of natural prey species of lions during the year:

27a Breakdown of **lion age preference of natural prey species** in the grazing area of this cattle post / ranch:

Prey species	Young		Sub-adult		Adult	
Springbok	5 months & younger		6-11 months		12 months & older	
Gemsbok	5 months and younger		6-23 months old		24 months & older	
Red hartebeest	5 months & younger		6-27 months		28 months & older	
Steenbok	2 months &younger		3-5 months		6 months & older	
Other						
Other						

26-28
29-31
32-34
35-37
38-40
41-43

28. Respondent's account of habitat and changes in composition, carrying capacity and stocking rate <u>over the past 5 years</u> in the grazing area of this cattle post / ranch:

28a **Plant** species **account:**

Plant species	Decreased	Increased	Stayed same
Palatable grasses			
Unpalatable grasses			
Palatable shrubs			
Unpalatable shrubs			
Invader species			

44-46
47-49
50-52
53-55
56-58

28b **Carrying capacity** account over the **past five years:**

Livestock species	Had to reduce numbers	Increased numbers	Numbers stayed the same		
Cattle					59-61
Donkeys					62-64
Mules					65-67
Horses					68-70
Sheep					71-73
Goats					74-76

28c Are there **incentives being offered by government** to **keep stock numbers down** in the study area? *(✓)*

Yes	No		77

28d **If yes** to the above answer, what **kind of incentives** are being offered to keep livestock numbers down in the study area?

		78-79
		1-2

…….

28e Has **wind erosion increased** in the study area over the **past five years?** *(✓)*

Yes	No		3

28f Has **water erosion increased** in the grazing area over the past 5 years? *(✓)*

Yes	No		4

29. Positions and numbers of boreholes, drinking troughs & reservoirs and occurrence of rainfall and veldt fires:

29a Positions of **boreholes:**

Borehole name/no.	Distance from post *(km)*	Human use	Stock use	Com-bined use		
						5-9
						10-14
						15-19
						20-24
						25-29

29bPositions of **drinking troughs:**

Trough name/no.	Near/at borehole no. *(✓)*	Distance to borehole if not at or near borehole *(km)*				
						30-32
						33-35
						36-38
						39-41
						42-44

29c Positions of **reservoirs:**

Reservoir name/no.	Near/at borehole no.	Distance to borehole if not at or near borehole *(km)*				
						45-47
						48-50
						51-53
						54-56
						57-59

29d Did you have **average, lower or higher than average rainfall** over the past five years at this cattle post / ranch?
[Year(s) from … to …]

Average	Lower than average	Higher than average								
							-				1-27
							-				
							-				

29e Did you have **more, average, or less** than average **veldt fires during the past five years** at this cattle post / ranch?

Average	Lower than average	Higher than average								
							-				28-54
							-				
							-				

29f Do you have **a rain-gauge?** *(✓)*

Yes	No		
			55

29g Do you keep **record of rainfall** at this cattle post / ranch? *(✓)*

Yes	No		
			56

29h May I please have a look at your **rainfall figures?** *(Take picture)*

No records	Poor records	Good records		
				57

29i My I please have a **look at the rain-gauge?** *(✓)*

Well placed	Incorrect	Damaged		58

30. Water reticulation, its components and possible government subsidy to improve drinking facilities:

30a How reliable is the delivery of boreholes of this cattle post / ranch?

Borehole name/no.	Never dries up, delivers constantly	Never dries up but delivery varies	Dries up during long droughts	
				59
				60
				61
				62
				63

30b Which time of the year is normally the **rainfall season?**

…… 64-70 [ ][ ][ ] - [ ][ ][ ]

30c Do you have **sufficient water sources** for your livestock throughout the year at this cattle post / ranch? *(✓)*

Yes	No		71

30d **If no**, how do you get **through periods of water shortages?**

…… [ ][ ] 72-73

30e Do you regard it necessary that the **water provision** for livestock of this cattle post / ranch **be improved?**

…… [ ][ ] 74-75

30f What **kind of improvements** are necessary to provide sufficient water to the livestock at this cattle post / ranch?

…… [ ][ ] 76-77

30g **Who is to carry the costs** of such improved water provision? (*Please motivate your answer*)

…… 78-79

30h Do you think that the shifting of **water points away from the fence/WMA** will reduce lion attacks on the livestock of this cattle post / ranch? *(✓)*

Yes	No	80

30i Would the **drilling of more boreholes** reduce lion attacks on livestock of this cattle post / ranch? *(✓)*

Yes	No	1

30j Would the drilling of **more boreholes improve your ability** to manage your livestock better? *(✓)*

Yes	No	2

31. Legislation and its benefits/limitations:

31a Does **legislation obstruct the protection of livestock** of this cattle post / ranch against depredation by predators? *(✓)*

Yes	No	3

31b **If yes** to the above question, **how does legislation obstruct** the protection of livestock by the owner of this cattle post / ranch against depredation by predators?

…….……. 4-5, 6-7

32. Time and effectiveness of communication methods as factors in efforts to prevent predator attacks on livestock:

32a What **amount of time** does it take **to report incidents** of depredation on livestock of this cattlepost / ranch? (*Hours*)

…….……. 8-9

32b What **complications and handicaps exist** with **reporting of incidents** of predator attacks on livestock of this cattle post / ranch to wildlife officials?

…… 10-11, 12-13

…… 14-15

32c **How do you communicate** with your fellow-livestock owners when lions have reportedly attacked your livestock of this cattle post / ranch?

		16-17
		18-19

……..….

32d **How do you communicate with the herders** of this cattle post / ranch when lions reportedly attacked your livestock?

		20-21
		22-23

……

32e **How do the herders of this cattle post / ranch communicate with you** when lions have attacked the livestock of this cattle post / ranch?

		24-25
		26-27

……...…….

32f **How do you communicate with officials** of DWNP and/or SANParks when lions have reportedly attacked the livestock of this cattle post / ranch?

		28-29
		30-31

……...…….

32g **Do you report lion attacks** on livestock of this cattle post / ranch **to the police?** *(✓)*

Yes	No		
			32

32h **How do you communicate with police** when lions have reportedly attacked the livestock of this cattle post / ranch?

		33-34
		35-36

……...…….

33. Communication forums:

Question	Y	N		
Does a communication forum exist which addresses matters arising from livestock attacks by lions in this region?				37
Are livestock owners of this region represented on the communication forum?				38
Are wildlife departments represented on the communication forum?				39
Are the police represented on the communication forum?				40
Is the Land Board represented on the communication forum?				41
Does the communication forum meet regularly?				42
Is the number of meetings per annum sufficient to address all problems?				43
Are the communication forum meetings being attended regularly by all representatives?				44
Are decisions and proposals of such meetings of the communication forum being forwarded to government(s) in writing?				45
Are such decisions and proposals being carried out?				46
Are the reasons for some decisions and proposals not being carried out due to budgetary constraints?				47
Are the reasons for some decisions and proposals not being carried out due to policy constraints?				48
Are written proposals being followed up by the committee of the communication forum?				49

Other organisations represented:

…… 50-51 52-53

34. Transport availability and cooperation of neighbours:

34a **What kind of transport is available** at this cattle post / ranch if lion attacks on livestock reportedly took place and you want to report the incident immediately?

…… 54-55 56-57 58-59

34b **Do you use the same transport to persecute lions** that have reportedly attacked livestock of this cattle post / ranch?

…… 60-61 62-63 64-65

34c **Do you take your neighbouring livestock farmers with** you in your vehicle when you attempt to persecute the alleged marauding lions of livestock of this cattle post / ranch? *(✓)*

Yes	No	
		66

34d What is the **condition of your transport** at this cattle post / ranch? *(✓)*

Good	Reasonably	Poor		67

34e **Are your neighbours to this cattle post / ranch cooperative** when livestock had been reportedly attacked by lions? *(✓)*

Yes	No		68

34f **Do your neighbours have transport available** should it happen that yours is not available during an attack by lions on livestock of this cattle post / ranch? *(✓)*

Yes	No		69

34g **Would your neighbours** to this cattle post / ranch **be willing to make their own transport available when you are in urgent need of transportation** when lions have reportedly attacked livestock of this cattle post / ranch? *(✓)*

Yes	No		70

34h **How reliable is transport of your neighbours** to this cattle post / ranch? (*Very/reasonably/unreliable*)

Very	Reasonably	Unreliable		71

35. Response to reporting:

35a **How do DWNP officials react** when lion attacks on livestock of this cattle post / ranch are reported to them?

		72-73
…….……..		74-75
		76-77

35b **How do SANParks officials react** when lion attacks on livestock of this cattle post / ranch are reported to them?

		1-2
……..…….		3-4
		5-6

35c **How do police officials react** when lion attacks on livestock of this cattle post / ranch are reported to them?

		7-8
		9-10
……		11-12

35d **How do hunters react** when lion attacks on livestock of this cattle post / ranch are reported to them?

		13-14
		15-16
……..……..…		17-18

36. Stumbling blocks to wildlife officials to carry out their duties:

36a Could you **point out stumbling blocks** that you are aware of which prevent officials of DWNP to react swiftly to reporting of attacks by lions on livestock of this cattle post / ranch? 19-20

…… 21-22

23-24

……

36b Could you point out **stumbling blocks** that you are aware of which prevent officials of SANParks to react swiftly to reporting of attacks by lions on livestock of this cattle post / ranch? 25-26

…….……. 27-28

29-30

……

36c Could you point out **stumbling blocks** that you are aware of which prevent officials of **DWNP** to dart and **relocate lions?** 31-32

…… 33-34

35-36

……

36d Could you point out **stumbling blocks** that you are aware of which prevent officials of **SANParks** dart and **relocate lions?** 37-38

…… 39-40

41-42

36e Could you point out **stumbling blocks** that you are aware of which prevent officials of **DWNP** to **patrol the fence** regularly? 43-44

…… 45-46

47-48

36f Could you point out **stumbling blocks** that you are aware of which prevent officials of **SANParks** to **patrol the fence** regularly? 49-50

…….……. 51-52

53-54

37. Law enforcement and powers of DWNP, SANParks & police to take action against transgressors of conservation laws:

37a **Do wildlife officials of DWNP have powers to arrest** illegal killers of lions in the region of this cattle post / ranch?

Yes	No		55

37b **Do wildlife officials of <u>SANParks</u> have powers to arrest** illegal killers of lions in the region of this cattle post / ranch? *(✓)*

Yes	No		56

37c **Do wildlife officials of <u>DWNP</u> have powers to confiscate** weapons, vehicles and equipment of illegal killers of lions in the region of this cattle post / ranch? *(✓)*

Yes	No		57

37d Do wildlife **officials of <u>SANParks</u> have powers to confiscate weapons, vehicles and equipment** of illegal killers of lions in the region of this cattle post / ranch? *(✓)*

Yes	No		58

37e **Does the police play a participatory and supportive role to <u>DWNP & SANParks officials</u>** in **incident reporting** of lion attacks on livestock of this cattle post / ranch? *(✓)*

Yes	No		59

37f **What does the police do** when incidents of livestock raiding by lions is being reported to them?

		60-61
……		62-63
		64-65

37g **What obstacles are the police facing** in their line of duty regarding lion attacks on livestock of this cattle post / ranch?

		66-67
……		68-69
		70-71

37h What is the **kind and extent of penalties for illegal lion killing?** [*Jail/(fine in Pula x100)/both]*

……		72-73
		74-75
……		76-77

37i Does the **police keep confiscated weapons, vehicles and equipment in safe storage?** *(✓)*

Yes	No		78

37j **Which police station(s) renders services** to this cattle post / ranch?

……...…….		79-80

38. Hunting for personal and commercial purposes and anticipated income to be derived from trophy hunting:

38a Does **hunting take place** in the **grazing area** of this cattle post / ranch? *(✓)*

Yes	No		1

38b If yes, what kind of game is being hunted?

		2-3
…….…….		4-5
		6-7

38c For **what purposes does hunting** take place?

		8-9
……		10-11
		12-13

38d Does **trophy hunting take place** in the grazing area of this cattle post / ranch? *(✓) (Additional information?)*

Yes	No		14

……...…….		15-16

38e If yes, **what kind of game** is being hunted for trophy purposes?

		17-18
…….....		19-20
		21-22

38f Who **receives the money for trophy hunting?**

		23-24
……		25-26

38g Do you **support the idea of shared income** *(% of the hunting fees be paid to the livestock owners of the region*) **from hunting** in the area of this cattle post / ranch? *(Elaborate)*

		27-28
……		29-30

38h If yes, **what %** do you anticipate **should go to the livestock owners?**

		31-32
……		33-34

38i What **kind of organisation should control the money obtained from hunting** and divide it to the community in this region?

……...…….		35-36
……		37-38

38j Should **lions** be hunted for **trophy purposes?** (*Please elaborate*)

…… 39-40 41-42

…… 43-44

38k Should a **% of the money** derived from lion trophy hunting be **channelled to local livestock owners?** (*Please elaborate*)

45-46

…… 47-48

38l **How much money can be made by you** if trophy hunting of lions would be permitted? *[(x100Pula/year) (comments?)]*

49-51

…… 52-53

38m Do you anticipate that **part of your income from livestock** farming can be **replaced by hunting?** *(Elaborate)*

54-55

…… 56-57

38n **What percentage** of your annual earnings through livestock do you think **can be replaced by trophy hunting?**

58-60

…… 61-62

38o Would you be **willing to reduce the number of livestock** in your possession **proportionally to the income derived** from hunting? *[(✓) (elaborate if necessary)]*

Yes X	No

63

…… 64-65

38p **Do you hunt** yourself, and if yes, **what kind of game** do you hunt in the grazing area of this cattle post / ranch?

66-67

…… 68-69

70-71

38q For **what purposes** do you hunt? 72-73

…… 74-75 76-77

38r **What % of your annual income** is derived **from** your own **hunting** in the grazing area of this cattle post / ranch?

…… 78-79

39. Boundary tourism:

39a Do you **regard wildlife as a potential source of income** from **tourism** for the local community in this area? ***(Please elaborate)***

		1-2
……		3-4
		5-6
……		7-8

39b Do you think that a **4X4 route along the fence** in the livestock areas **will generate money for the local community** in your area? *[(Yes/no) (elaborate if necessary)]*

Yes	No		
			9
……			10-11

39c **How much income do you believe such 4X4 route along the fence can generate** for your household at this cattle post / ranch annually? *[(x100Pula) (Other views?)]*

……..		12-13
……..…….		14-15

39d Will a **4X4 route along the fence create job opportunities** in the region of this cattle post / ranch? *(✓)*

Yes	No		
			16

39e Do you believe that **boundary tourism (along the WMA's) can replace part of your income from livestock?** *(✓)*

Yes	No		
			17

39f **What % of your income** from livestock at this cattle post / ranch do you believe **can be replaced by boundary tourism?**

		18-19
……		20-21

39g Do you think that the **activities associated with boundary tourism will chase away predators** and lessen livestock losses due to depredation by lions on livestock of this cattle post / ranch? *(✓)*

Yes	No X		
			22

39h Do you think that **boundary tourism** will result in **improved road maintenance** to the nearest town? (✓)

Yes	No		23

39i Do you think that **boundary tourism** will result in obtaining **facilities**, such as:

	Y	N		
Electricity				24
Telephone				25
Municipal/land board water				26
Two way radio communication				27
Other (*Specify*)				28

39j Do you think that **boundary tourism** will result in the **upgrading of existing facilities**, such as:

	Y	N		
Electricity				29
Telephone				30
Municipal/land board water				31
Two way radio communication				32
Roads				33
Other (*Specify*)				34

40. Human population at cattlepost/ranch:

40a **How many people** live at this cattlepost / ranch?

…… | | | - | | | 35-39

40b What is their relatedness to this cattle post /ranch?

		40-41
…….……..		42-43
		44-45

40c Do you have any further comments that might enable us to understand the situation with livestock farming at this cattle post / ranch better?

……		46-47
……		48-49
……		50-51
……		52-53
…..…….……		54-55
……		56-57

APPENDIX B

EVALUATION OF THE IMPACT OF PASTORAL FARMING AND WILDLIFE MANAGEMENT PRACTICES ON LION/LIVESTOCK INTERACTIONS IN THE KGALAGADI-SOUTH REGION OF BOTSWANA

QUESTIONNAIRE FOR WILDLIFE OFFICIALS

(All information in this questionnaire will be treated as confidential)

We are conducting a survey of the problems that you might experience with the management of lions that allegedly kill livestock in the Kgalagadi-South region, called "*The Study Area*" for the purpose of this questionnaire. We hope to learn from you how you address such problems, and how you anticipate that the situation can be improved, if need be, to prevent the indiscriminate killing of lions and unnecessary loss of livestock.

KGALAGADI-SOUTH QUESTIONNAIRE FOR OFFICIALS

……
……
……
……

1. Particulars of respondent:

1a Name of respondent: ……..……

For office use

1b Occupation: *(Rank)*

Number | | | 1-2

……..……..

1c Employer:

1d Locality | | 3-4

1e Postal address: ……..……..……..……. | | 5-6

E-mail address …….……. | | 7-8

2. Levels of authority within the organisation when problems between lions and livestock arise in the study area:

2a What are **your responsibilities towards the management of lions** in the KTP, with special reference to those which allegedly **kill livestock** in the study area?
(Give orders / physically involved)

| | 9-10

……

| | 11-12

……

| | 13-14

2b Who, within your authority / organisation is **the <u>most senior official</u> responsible** when **lions** and / or other predators **reportedly attack livestock** in the study area?

Name: ……..

Rank: ……..……... | | | 15-16

Locality: …….……. | | | 17-18

2c Who is **finally responsible** to **<u>physically attend</u>** to the alleged livestock killing by lions in the study area?

Name: ……..……..……

Rank: ……..……..…….. | | | 19-20

Location: ……..…….. | | | 21-22

3. Action taken when lions allegedly attack livestock in the study area:

3a What happens if **personnel and/or vehicles and/or equipment <u>are not available</u>** to follow up the report of alleged livestock depredation by lions in the study area? *(Alternative options)*

……..……..…… | | | 23-24

..……..…… | | | 25-26

3b If **personnel, vehicles and equipment <u>are available</u>**, what steps are taken by the responsible official(s) to address the alleged livestock depredation in the study area?

……..……..…… | | | 27-28

…… | | | 29-30

…… | | | 31-32

3c Does your **organisation attend to all incidents** as reported? *(✓)*

Yes	No		
			33

3d **<u>If no</u>** to the above question, for what **reasons** are **reports not being followed up?**

…… | | | 34-35

…… | | | 36-37

3e How do **officials communicate with livestock owners** after reporting of alleged livestock killing by lions in the study area?

……..…….……..…… | | | 38-39

…… | | | 40-41

…… | | | 42-43

3f What is the **reaction time?** *(From moment of reporting to the visit to the scene of the alleged killing in **hours**)*

……

…… | | | , | | 44-47

3g What **procedures** are followed **to determine** if alleged livestock **attacks by lions** / other predators in fact **did take place** in the study area? *(E.g. interviews/spoor/other signs)*

…… | | | 48-49

…… | | | 50-51

…..……...…… | | | 52-53

3h **Which authority reacts mostly** to reporting of livestock depredation in the study area? *(SANParks / DWNP/other)*

…… | | | 54-55

…… | | | 56-57

…… | | | 58-59

3i Are officials of both authorities **supportive to their transboundary colleagues** when response is expected from them by livestock owners **when lions reportedly attacked** livestock in the study area? *(✓)*

Yes	No		60

3j What **stumbling blocks** are in the way **of officials** to **prevent livestock killing by lions** in the study area?

……..……. | | | 61-62

…… | | | 63-64

4. Which of the <u>livestock groups</u> given below is preferred prey of <u>lions</u> in the study area?

4a **<u>Large stock</u>**:

Cattle	✓	Donkeys	✓	Mules	✓	Horses	✓
Adults (18 months & older)		Adult (3 years and older)		Adult (3 years and older)		Adult (3 years and older)	
Sub-adults (12 to 17 months)		Sub-adult (18 to 35 months)		Sub-adult (18 to 35 months)		Sub-adult (18 to 35 months)	
Young (11 months & younger		Young (17 months and younger)		Young (17 months and younger)		Young (17 months and younger)	

65-68

69-72

73-76

4b **<u>Small stock</u>**:

SHEEP	✓	GOATS	✓
Adult (15 months & older)		Adult (15 months & older)	
Sub-adult (6 to 14 months)		Sub-adult (6 to 14 months)	
Young (5 months and younger)		Young (5 months and younger)	

77-78

79-80

1-2

5. Which of the <u>livestock groups</u> given below is preferred prey of <u>other predators</u> in the study area?

y = young; s = sub-adults; a = adults

5a **<u>Leopard</u>**: *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

3-8

9-14

15-20

21-26

27-32

33-38

5b **<u>Cheetah</u>**: *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

39-44

45-50

51-56

57-62

63-68

69-74

5c **Spotted hyaena:** *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
Y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

5d **Brown hyaena:** *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
Y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

5e **Black-backed jackal:** *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
Y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

5f **Caracal:** *(✓)*

Cattle			Donkeys			Mules			Horses			Sheep			Goats		
y	s	a	y	s	a	y	s	a	y	s	a	y	s	a	y	s	a

6. Identification of alleged livestock-killing lions and procedures followed by officials after positive identification of livestock-killing lions in the study area:

6a How are **casual livestock-killing lions** being identified by officials in the study area?

……...…… 61-62

……..……..……..… 63-64

……..……..…… 65-66

6b What procedures are followed once a lion had been officially identified as a **casual** livestock killer in the study area?

……..……. 67-68

……..……. 69-70

75-80
1-6
7-12
13-18
19-24
25-30
31-36
37-42
43-48
49-54
55-60
61-66
67-72
73-78
1-6
7-12
13-18
19-24
25-30
31-36
37-42
43-48
49-54
55-60

6c When is a lion **considered by officials** as a **habitual** livestock killer in the study area?

…… 71-72

…… 73-74

…… 75-76

6d How are **habitual** livestock killing lions in the study area being accurately identified by officials?

…… 77-78

…… 79-80

…… 1-2

…… 3-4

…… 5-6

6e What **procedures** are being **followed** once a lion had been identified as a **habitual** livestock killer in the study area?

…… 7-8

…… 9-10

…… 11-12

6f **Are there**, in your opinion, **alternatives** to the action described in 6(e) above? *(✓)*

Yes	No	13

6g How are alleged livestock killing lions identified by **livestock owners** in the study area?

…… 14-15

…… 16-17

…… 18-19

6h In your opinion, **how reliable are methods of livestock owners to identify alleged livestock-killing lions** in the study area? *(✓)*

Unreliable	
Reliable	
Vary per person	

20

7. Sex, age and group structure of marauding lions:

7a What **age** and **sex group** of lion is the most troublesome? *(✓)*

Sub-adult males (25-36 months)	
Sub-adult females (25-36 months)	
Adult males (37 months and older)	
Adult females (37 months and older)	

21
22
23
24

7b What is the **group size** of lions (cubs 12 months & younger excluded) responsible for attacks on livestock in the study area?

…… 25-26

7c Are **solitary lions** mostly responsible for the killing of livestock in the study area? *(✓)*

Yes	No

27

7d What **sex** are **solitary lions** which are responsible for killing of livestock in the study area? *(<u>Could be both</u>) (✓)*

Male	Female

28-29

7e What **age group** do solitary lions belong to? *(<u>Could include all</u>) (✓)*

Sub-adult: 24 – 36 months old	
Adult: 37 months & older	
Old males (8 years and older)	
Old females (10 years and older)	

30
31
32
33

7f Do livestock-killing lions have **cubs** (*24 months old and younger*) **with them** during attacks in the study area? *(✓)*

Yes	No

34

8. Reporting of incidents:

8a Do livestock owners **report all alleged livestock killing incidents** by lions in the study area? *(✓)*

Yes	No

35

8b Are **livestock owners** allowed to **kill lions** when these lions allegedly killed some of their livestock? *(✓)*

Yes	No

36

8c Do livestock owners sometimes **kill lions** in the study area **without notifying officials?** *(✓)*

Yes	No

37

8d How do you determine when **lions had been killed** by livestock owners in the study area and the incident **not reported?**

…… 38-39

…… 40-41

8e What actions are being taken when it is discovered that a **livestock owner had killed a lion without reporting?**

…… 42-43

…… 44-45

8f How do you determine if **information provided by livestock owners** about incidents of alleged **livestock killing by lions** in the study area **is accurate?**

…… 46-47

…… 48-49

9. Accuracy of determining cause of death of livestock:

9a Are there **ways and means to confirm** if a farm animal had **indeed been killed by lions** in the study area? *(Name them)*

…… ☐☐ 50-51

…… ☐☐ 52-53

…… ☐☐ 54-55

9b Are there ways and means to determine if a farm animal had been **killed by predators other than lions** in the study area? *(Name them)*

…… ☐☐ 56-57

…… ☐☐ 58-59

9c Are there ways and means to determine if a farm animal had been **killed by domestic dogs** in the study area? *(Name them)*

…… ☐☐ 60-61

…… ☐☐ 62-63

9d Are there ways and means to determine if a farm animal had **died of causes other than having been killed by predators** in the study area? *(Name them)*

…… ☐☐ 64-65

…… ☐☐ 66-67

…… ☐☐ 68-69

9e Is it possible that livestock owners sometimes **incorrectly blame lions for the killing of livestock?** *(✓)*

Yes	No

☐ 70

9f **If yes** to the above question, could you determine **what <u>percentage</u> of <u>alleged killing by lions</u> were in reality <u>death by other cause</u>?** *(Other predators, disease, drought or other) (✓)*

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80			
											71-72

9g **Do livestock owners accept officials' professional opinion** regarding cause of death of livestock in the study area? (✓)

Yes	No		
			73

9h What actions do you take **when livestock owners refuse to accept your conclusion** about the cause of death of a farm animal?

…… | | | 74-75

…… | | | 76-77

9i **Do** DWNP / SANParks **regulations make provision** for your conclusion about the cause of death **overruling that of the livestock owner?** (✓)

Yes	No		
			78

10. Fence maintenance:

10a What were the **original reasons for the erection of the fence?** (*Prevent predators from entering the study area/ keep livestock out of the reserve?*)

…… | | | 79-80

…… | | | 1-2

…… | | | 3-4

10b Does the fence **effectively restrict the animals** it was meant for? (✓)

Yes	No		
			5

10c **Who is responsible for maintenance of the fence** along the southern boundary of the KTP adjoining the study area?

…… 6-7 8-9

10d **What does maintenance** of the fence along the study area **entail?**

…… 10-11

…… 12-13

…… 14-15

10e What are the **most important obstacles** in the way to **maintaining the fence** along the study area if any?

…… 16-17

…… 18-19

…… 20-21

10f Given **budgetary** constraints, **is it reasonable** to expect DWNP/ SANParks **to provide the funding** for **the improvement and extending of the fence** as indicated*? [(Motivate reply) (Scratch one name through if only one named institution is responsible])*

…… 22-23

…… 24-25

…… 26-27

10g Is there **another government department** that could or should **assist with the budgeting for and maintenance and improvement of the fence** along the study area? *(Name)*

…… 28-29

…… 30-31

10h Does any **grant from other countries or organisations exist** to support the **costing of fence** maintenance/improvement along the study area? *(Please elaborate-name country/organisation)*

…… 32-33

…… 34-35

10i **<u>If yes</u>** to the above question, **how effective is this funding** being utilised in the study area?

……..…… ☐☐ 36-37

……..…… ☐☐ 38-39

10j **If no such grant exist**, has such **possibility ever been considered?** *(✓)*

Yes	No

☐ 40

10k **Should livestock owners contribute towards the maintenance** of the fence, and **<u>if yes</u>**, in which way? *(Please elaborate)*

…… ☐☐ 41-42

…… ☐☐ 43-44

…… ☐☐ 45-46

11. Effectiveness of the fence:

11a Does **the fence** still **serve any purpose?** *(Please elaborate)*

…… ☐☐ 47-48

…… ☐☐ 49-50

…… ☐☐ 51-52

11b **Is there any better way than the fence to protect livestock** effectively against lion depredation in the study area? (*Elaborate*)

…… ☐☐ 53-54

…… ☐☐ 55-56

11c **Should the fence be improved** to be more effective to keep lions out of the study area? *(Please elaborate)*

…… ☐☐ 57-58

……..…… ☐☐ 59-60

11d **Will an upgraded, well-maintained fence be effective** against lions in the study area? *(Provide reasons for answer)*

…… 61-62

…… 63-64

11e **How can the fence be improved** to keep lions out of the study area? *(Material, electrification, etc.)*

…… 65-66

…… 67-68

11f (i) Is it feasible to **extend the fence towards Mabuasehube?**

Yes	No

69

(ii) **If yes**, for what distance? *(km)*

……..…….... 70-72

11g Would the **fence be more effective** if it would be **extended southwards along the WMA KD/15?** *(Please elaborate)*

……..…….. 73-74

……..…….. 75-76

……..…….. 77-78

11h Would it be **even better** if the fence would be **extended around the WMA KD/15 towards Leherwane syndicate?** *[(On the road between Tshabong & Mabuasehube) (Please elaborate)]*

……..…….. 79-80

…….. 1-2

12. Compensation

12a What **kind of compensation scheme** exists for livestock losses due to depredation by lions in the study area? *(Please elaborate)*

…… 3-4

…… 5-6

12b **<u>If applicable</u>**, **what conditions apply** to compensation being paid out for livestock losses due to depredation by lions in the study area? *(Please be specific)*

…… | | | 7-8

…… | | | 9-10

…… | | | 11-12

12c What is **your opinion regarding** the feasibility of **compensation schemes** for livestock lost due to depredation in the study area?

…… | | | 13-14

…… | | | 15-16

…… | | | 17-18

12d **Does compensation schemes exclude the poorest of the livestock farming community?** *(E.g. building of kraals being <u>rewarded</u> with compensation for livestock losses, while the poorest cannot afford the building of kraals without subsidy)*

…… | | | 19-20

…… | | | 21-22

12e **Should subsidy schemes for the building of lion-proof kraals be implemented** to ensure that all get equal access to funding?

…… | | | 23-24

…… | | | 25-26

12f Should **compensation still be paid out when subsidies are being paid** to livestock owners to build lion-proof kraals in the study area? *(Please elaborate)*

…… | | | 27-28

…… | | | 29-30

13. Communication forums to address depredation on livestock:

13a Provide **information about forums** for all role players *(✓)*

Question	y	n		
Does a communication forum exist which addresses matters arising from livestock attacks by lions in this region?			☐	31
Are livestock owners of this region represented on the communication forum?			☐	32
Are wildlife departments represented on the communication forum?			☐	33
Are the police represented on the communication forum?			☐	34
Is the Land Board represented on the communication forum?			☐	35
Does the communication forum meet regularly?			☐	36
Is the number of meetings per annum sufficient to address all problems?			☐	37
Are the communication forum meetings being attended regularly by all representatives?			☐	38
Are decisions and proposals of such meetings of the communication forum being forwarded to government(s) in writing?			☐	39
Are such decisions and proposals being carried out?			☐	40
Are the reasons for some decisions and proposals not being carried out due to budgetary constraints?			☐	41
Are the reasons for some decisions and proposals not being carried out due to policy constraints?			☐	42
Are written proposals being followed up by the committee of the communication forum?			☐	43

13b Name **other organisations** represented on the forum.

…… ☐☐ 44-45

13c **How often** does the communication **forum meet**, including people form the **study area?**

…… ☐☐ 46-47

13d **What other organisations should also be included** into the communication forum?

…… ☐☐ 48-49

…… ☐☐ 50-51

14. Grazing practices of livestock owners in the study area:

14a Does **livestock graze in Wildlife Management Areas** (WMA's) adjoining the study area? *(✓)*

Yes	No

52

14b Are such **grazing practices legal?** *(✓)*

Yes	No

53

14c **<u>If no</u>** to the above question, **why are livestock owners** of the study area being **allowed to graze** adjoining WMA's?

……..……...…… 54-55

……..……..……. 56-57

14d Which of the **WMA's adjoining the study area are proclaimed** per Government Gazette? *(Name them)*

58-59
60-61
62-63
64-65

……..……..……

……..…….

14e **Why** are the **remaining WMA's** adjoining the study area **not yet proclaimed?** *(Please elaborate)*

……...……...…… 66-67

……...……. 68-69

14f Is there any **possibility that un-proclaimed WMA's will be gazetted** in the near future? *(Please elaborate)*

……..……...…… 70-71

……..……..……. 72-73

14g Will such proclamations **change livestock farming practices** in the study area? *(Please elaborate)*

……...……...…… 74-75

……..……...…… 76-77

15. Wildlife Management Areas (WMA's) and their role in the conservation of lions:

15a What is the **purpose of WMA's?**

……..……..…… ☐☐ 78-79

……..……. ☐☐ 1-2

……..…….. ☐☐ 3-4

15b **Do WMA's have a buffering effect** against livestock depredation by lions in the study area? *(✓)*

Yes	No

☐ 5

15c **If yes** to the above question, **can natural prey species be managed to create a buffer against livestock depredation** in the study area? *(Please elaborate)*

…….…….. ☐☐ 6-7

……..……. ☐☐ 8-9

15d In your opinion, **does hunting in WMA's have any effect on numbers of natural prey species** of lions in the study area? *(Please elaborate)*

……..……..…… ☐☐ 10-11

……..……. ☐☐ 12-13

15e Can natural lion **prey species be increased** in the **grazing area** of the study area? *(Please elaborate)*

……. ☐☐ 14-15

……..…… ☐☐ 16-17

15f **If yes** to the above question, **how can natural prey species be increased** in the **grazing area** of the study area?

…… ☐☐ 18-19

…… ☐☐ 20-21

15g **If no**, can natural lion prey species **be increased in the WMA's?**

☐☐ 22-23

……..…… ☐☐ 24-25

15h **<u>If yes</u>** to the above question, (15g) **how can natural lion prey species be increased in the WMA's?** *(Elaborate)*

…… ☐☐ 26-27

…… ☐☐ 28-29

…… ☐☐ 30-31

16. Improved livestock management practices and its possible role in lion conservation in the study area:

16a Can the **grazing veldt** of the study area **carry more** natural lion prey species? *(✓)*

Yes	No

☐ 32

16b In your opinion**, would an increase** in natural lion prey species in the study area **result in less livestock depredation** by the lions? *(Please elaborate)*

…… ☐☐ 33-34

…… ☐☐ 35-36

16c Do you have any **alternative proposals** as to how **to decrease** or even stop livestock depredation in the study area? *(Elaborate)*

…… ☐☐ 37-38

…… ☐☐ 39-40

16d In your opinion, can a **change in livestock management practices** in the study area reduce, or even stop, depredation by lions? *(✓)*

Yes	No

☐ 41

16e **<u>If yes</u>** to the above question, how can **management practices** be **improved** to prevent livestock depredation in the study area?

…… ☐☐ 42-43

…… ☐☐ 44-45

…… ☐☐ 46-47

16f If improved livestock management practices **include reducing of livestock numbers** in the study area, how do you propose could livestock **<u>owners</u> compensate** for their loss of income if any?

…… ☐☐ 48-49

…… ☐☐ 50-51

…… ☐☐ 52-53

……..……. ☐☐ 54-55

17. Carrying capacity of the grazing veldt in the study area, its ability to support livestock owners and their families and anticipated positive impact of improved livestock management systems:

17a In your opinion, **can the grazing veldt** of the study area **support the current number of livestock** year round? *(✓)*

Yes	No	☐	56

17b **<u>If no</u>** to the above question, **how do livestock owners manage** to keep their livestock alive during the dry period of the year in the study area?

……..…….. ☐☐ 57-58

……..…….. ☐☐ 59-60

17c Have some **livestock owners** become **dependant on grazing veldt in WMA's** to keep sufficient numbers of livestock to support their families? *(✓)*

Yes	No	☐	61

17d **<u>If yes</u>** to the above question, **how do livestock owners** whose grazing **areas do not adjoin the WMA's** in the study area **cope** with their livestock throughout the driest period of the year?

…… ☐☐ 62-63

…… ☐☐ 64-65

…… ☐☐ 66-67

17e **What percentage** of **livestock die** annually in the study area **due to drought** and resulting insufficient grazing veldt:

(i) In the **dry west**, away from WMA's?

……..……...…….. ☐☐ 68-69

(ii) **In the east**, where grazing areas adjoin WMA's?

...…….……...…….. ☐☐ 70-71

17f Is the **quality and quantity of grazing veldt** in the study area **sufficient** to keep large stock, such as **<u>cattle, in kraals</u> during the night,** preventing them from grazing through the night? [*(Keep them secure against lion attacks) (Please elaborate)]*

……...……...…… ☐☐ 72-73

……..……...…… ☐☐ 74-75

17g In your opinion, can the **grazing veldt only support livestock** sufficiently year round **if the number of <u>grazers</u> be reduced** in the study area? *(Please elaborate)*

……...……. ☐☐ 76-77

……..……...…… ☐☐ 78-79

17h In your opinion, can the grazing veldt only support livestock sufficiently year round if the **number of <u>browsers</u> be reduced** in the study area? *(Elaborate)*

….……..……...…… ☐☐ 1-2

……..……..…… ☐☐ 3-4

17i Does a **government subsidy scheme exist,** which helps farmers through:

(i) The **dry periods** of the year or during excessive droughts, *(✓)*

Yes	No

☐ 5

(ii) **<u>If yes,</u> what %** of the feeding costs **is being subsidised?** *(Distinguish between government figures and commercially-based figures)*

☐☐☐ 6-8

…… ☐☐☐ 9-11

17j **<u>If no</u>** to the above question, is it **feasible to establish** government **subsidised livestock feeding schemes** in the study area during dry spells?
(Cost weighed against increased income - Elaborate)

…… 12-13

…….…….…… 14-15

…… 16-17

17k (i) In your opinion, **would the feeding of livestock** during droughts **result in an improvement** of the natural **carrying capacity** of the grazing veldt in the study area? *(✓)*

Yes	No	18

(ii) **Please motivate you answer** under (i) above:

……..……. 19-20

…… 21-22

17l (i) **Should livestock rather be reduced during prolonged droughts,** in stead of providing government subsidies for feeding schemes?

Yes	No	23

(ii) **If yes** to (i) above, would that entail **selling** also **part of the breeding stock?** *(Please elaborate)*

……..……. 24-25

17m **Is it possible**, given their financial status, for all livestock owners **to construct lion proof kraals** in the study area?
(Please elaborate)

……. 26-27

…….……..…… 28-29

17n **If no** to the above question, **how can lack of funding** to construct lion proof kraals **be overcome?** *(Please elaborate)*

…… 30-31

…… 32-33

17o In your opinion, would it **reduce depredation** if **drinking facilities would be shifted further away from the fence?** *(Elaborate)*

…….……. ☐☐ 34-35

…….……. ☐☐ 36-37

17p In your opinion, would an **increase of drinking facilities** in the grazing veldt of the study area result in **more natural prey species coming into the study area?** *(Elaborate)*

…… ☐☐ 38-39

……..……..…… ☐☐ 40-41

17q Would the provision of more drinking facilities have to include the **drilling of extra boreholes** in the study area? *(Elaborate)*

…… ☐☐ 42-43

…… ☐☐ 44-45

18. Natural lion and other predator prey species as additional financial benefit and alternative source of income to livestock farmers in the study area:

18a In your opinion, would an **increase in natural prey species** in the study area result in lions and other predators **killing less livestock?** *(Elaborate)*

……..……..…… ☐☐ 46-47

……..……..…… ☐☐ 48-49

18b **Is the grazing veldt** in the study area **capable of carrying more natural lion prey species?** *(Elaborate)*

……..……..…… ☐☐ 50-51

……..…….. ☐☐ 52-53

18c Would an **increase in natural lion prey species** result in **compulsive reduction of livestock numbers** in the study area? *(Elaborate)*

……..……..…… ☐☐ 54-55

……..……..…… ☐☐ 56-57

18d In your opinion, would an **increase in natural prey species** in the grazing veldt of the study area **result in more lions** entering the study area? *(Elaborate)*

…… ☐☐ 58-59

…… ☐☐ 60-61

18e **<u>If yes</u>** to the above question, are you of opinion that an **increase of lions** due to more prey species in the study area can result in **financial spin-offs, such as tourism?** *(Elaborate)*

…… ☐☐ 62-63

…… ☐☐ 64-65

18f Would you regard **lion trophy hunting** as a possible **financial spin-off** for livestock owners in the study area? *(✓)*

Yes	No	☐	66

18g **Please elaborate** on the answer given in the **above question:**

…… ☐☐ 67-68

…… ☐☐ 69-70

…… ☐☐ 71-72

…… ☐☐ 73-74

…… ☐☐ 75-76

18h In your opinion, can natural **lion prey species be utilised** as **<u>alternative</u> income source** for livestock farmers in the study area? *(Elaborate)*

…… ☐☐ 77-78

…… ☐☐ 79-80

18i Is it possible that an **increase of lions** in the study area, if due to **increased prey species** numbers, might result in an **increase in livestock killings?** *(Elaborate)*

…… ☐☐ 1-2

…… ☐☐ 3-4

Caracal				

18j **<u>If yes</u>** to the above question, **have you witnessed an increase in lions numbers** in the study area **during an increase of natural lion prey species** before*? (Elaborate)*

…… 5-6

..…… 7-8

……..…….. 9-10

18k Has such **increase in lion numbers** resulted in **increased livestock depredation?** *(✓)*

Yes	No		

11

18l **Which** natural **lion prey** species **stay year round**, which **migrate** in and out, and which **reproduce** while in the study area?

Prey species	Stay year round *(✓)*	Only present during (*winter/summer /autumn/spring*) (*Select*) *(✓)*	Give birth in grazing area (*winter/summer /autumn/spring*) (*Strike through*) *(✓)*	Migrate with young into the grazing area (*winter/summer /autumn/spring*) (*Strike through*) *(✓)*	
Springbok					12-14
Gemsbok					15-17
Red hartebeest					18-20
Steenbok					21-23
Other					24-26
Other					27-29

18m Natural **prey species preference by other predators** in the study area:

	Spring-bok (✓)	Gems-bok (✓)	Red harte-beest (✓)	Steen -bok (✓)	Other (✓)	Other (✓)	
Leopard							30-35
Cheetah							36-41
Spot. hyaena							42-47
Brown h.							48-53
Jackal							54-59

						60-65

18n Where do the **migrating species come from** and go to annually?

Prey species	Where do they come from?	Where do they migrate to?		
Springbok				66-69
Gemsbok				70-73
Red hartebeest				74-77
Steenbok				1-4
Other				5-8

18o Which **game numbers stayed constant**, and which have **increased** or **decreased** <u>over the past five years</u> in the study area? *(✓)*

	Constant	Decreased	Increased		
Springbok					9
Gemsbok					10
Red hartebeest					11
Steenbok					12
Other					13
Other					14

18p Do you have any **explanation** as to the **reasons** for the decline / increase in natural prey species numbers in the study area?

……..……. | | | 15-16

……..……. | | | 17-18

19. Existing kraals and their effectiveness against lions and other predators in the study area:

19a(i) Are **kraals sufficient protection against lion** depredation on livestock in the study area? *(✓)*

Livestock species	No kraals exist	No	Yes		
Cattle					19
Donkeys					20
Mules					21
Horses					22
Sheep					23
Goats					24

19a(ii) **Please elaborate** on your **answers above**: (*How do lions get hold of kraaled livestock?*)

…… 25-26

…… 27-28

19b Do the **following predators attack livestock** in **places as indicated** below in the study area? *(✓)*

	Kraals		Veldt	
Predator species	y	n	y	n
Leopard				
Cheetah				
Spotted hyaena				
Brown hyaena				
Black-backed jackal				
Caracal				

29-30
31-32
33-34
35-36
37-38
39-40

19c What can be done to **convince livestock owners** to improve the effectiveness of their kraals in the study area? *(Elaborate)*

……..……..…… 41-42

……..……..…… 43-44

…….. 45-46

19d How can livestock owners be financially supported to build predator proof kraals in the study area?

……...…… 47-48

……..……..…… 49-50

20. Lion attacks on livestock:

20a At what **time of the year** do **most lion attacks on livestock** occur in the study area? [(*May – Sept: dry season; Oct – April: rainy season, 80% irregularity*) (*Guesstimates/facts?)](✓)*

May – September	October – April

51

……

20b Does **excessive rainfall** and **drought** result in increased or decreased livestock killing by lions in the study area? (✓)

Climatic factor	Increase	Decrease
Excessive rainfall		
Excessive drought		

20c What other **factors result in an increase of lion attacks** on livestock in the study area?

Factor	(✓)
Cold at night	
Hot at night	
Cold during the day	
Hot during the day	
Wind at night	
Wind during the day	
Rain at night	
Rain during the day	
Dew	
Frost	
Wind blowing towards the park fence	
Wind blowing towards the usual direction of lion approach	
Full moon	
No moon	
Other (Specify)	

20d Could any **other pattern** in the occurrence of lion attacks be observed? *(Elaborate)*

……

……

20e Do lion **attacks increase** when there are more **young animals** amongst livestock in the study area? *(✓)*

Yes	No

21. Lions as a threat to humans:

21a Have lions ever **threatened human lives** in the study area?

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……
……

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65
66
67
68
69-70
71-72
73

<10%	11-20%	21-30%	31-4	

74-75

76-77

21b Have lions ever **killed livestock owners**, members of their family or people employed by livestock owners in the study area?

Yes	No

…….
…….
…….
……

22. History of lion attacks on livestock:

78

22a Have lion attacks on livestock increased or decreased over the last five years in the study area? (*Guesstimates/facts?*)

Year	Increased	Decreased
~~July 2001-June~~ 2002		
~~July 2002-June~~ 2003		
~~July 2003-June~~ 2004		
~~July 2004-June~~ 2005		
~~July 2005-June~~ 2006		

79
80

22b **How often** do **lion attacks** on livestock occur in the study area? (*Guesstimates/facts?*) *(✓)*

Weekly	
Monthly	
Quarterly	
Annually	

1
2
3

4

22c **From where** do the alleged livestock-killing **lions** that move into the study area **come from?**

……

22d In **what direction** do the **lions retreat** after attacks in the study area?

5-6

……

22e Do all lions or groups of lions that enter the study area prey on livestock? *(✓)*

7-8

Yes	No

22f **What percentages** of lions that enter the study area do **prey on livestock?** (*Guesstimates/facts?*)

9

		-			10-14

22g **What percentage of lions** that prey on livestock **become habitual livestock killers?** *[(Guesstimates/evidence?)(✓)]*

<10%	11-20%	21-30%	31-40%	41-50%	>50%

22h How often are **boundary transgressions accompanied by** lion **attacks on livestock** in the study area? *(Guesstimates/evidence?)*

Daily	Weekly	Monthly	Once per six months	Once per annum

22i How do you **determine** when lions **cross the boundary** of the park into the study area?

..……

……...……

……...……

22j **Where do** lion **attacks** on livestock **occur** in the study area? *(Veldt/kraals/drinking places/other)*

……...…… 21-22

……...…… 23-24

23. Cohabitation: 25-26

23a Is it possible for **lions and livestock to coexist** in the study area? *(Elaborate)*

…… 27-28

…… 29-30

23b **Why is it necessary to protect the lions that occur in the study area** against <u>indiscriminate killing</u>?

……
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		-			15-19

	20

	31-32	livestock owners' livestock management practices have on the interaction between lions and livestock in the study area?
	33-34	
	35-36	…… …… …… ……
	37-38	
	39-40	…… …… …… ……

23c Is it possible to educate and **convince livestock owners** about the necessity to establish **cohabitation** between lions and livestock in the study area? *(Elaborate)*

…….……...…… …… …… …… ……

23d Who should fulfil the role of **conservation educator** amongst the livestock owners in the study area? *(Elaborate)*

…… …… …… ……

23e Is there any **NGO or CBO that can fulfil the role of educating** the community about conservation, biodiversity and cohabitation?

…….……...……

…… 41-42

24. Additional information:

43-44

Is there any additional information that you can provide to improve our knowledge regarding the influence that pastoral

45-46

☐☐	47-48
☐☐	49-50
☐☐	51-52
☐☐	53-54
☐☐	55-56
☐☐	57-58
☐☐	59-60
☐☐	61-62
☐☐	63-64
☐☐	65-66
☐☐	67-68
☐☐	69-70

THANK YOU FOR YOUR KIND COOPERATION