Abstract: This report covers the proceedings of the First Tanzanian Lion and Leopard Conservation Action Plan Workshop held on February 20th-22nd 2006. The workshop brought together key stakeholders to assess existing information and establish a consensus on priorities for research and conservation of lion (*Panthera leo*) and leopard (*Panthera pardus*) in Tanzania. Tanzania holds important populations of both species: recent estimates suggest the country is home to half the world's lions. All participants at the workshop recognised Tanzania's importance in the conservation of both species, as well as the economic importance of the species for generating revenue through photographic tourism and through sport hunting. Both lions and leopards are fairly widespread across Tanzania, but there are better populations of lions inside protected areas. Information on leopards is particularly poor, as the species is highly cryptic and very hard to monitor. The group agreed that there was a need to get better information on both species, and given the importance of the species for hunting, it was important to obtain information on status of populations to ensure that they are being managed in a sustainable way. The group identified methods currently available for gathering such information, including spoor counts, call-in playback counts, tourist photos, detection dogs and transects, all of which had potential in certain circumstances. Questionnaire data and records of attacks on people were thought to be particularly useful for gathering information quickly on the distribution of both species at a national level, particularly for lions, however, only radio collars could be used to collect unambiguous data on ranging patterns and demography for lions, although for leopards, camera trapping surveys could also be fairly effective. The group discussed potential threats to lion and leopard conservation and agreed that prey availability, land use and land cover change, anthropogenic killing, inadequate management and disease may pose important threats to the conservation of these species. Of these threats, retaliatory killing, land use change and the problems arising from inadequate management were the most important factors affecting lion and leopard conservation. The acceleration of the Wildlife Management Area (WMA) process would go some way to address the latter threat. Finally, the group used a regional strategic plan developed at a southern and eastern Africa meeting in Johannesburg at the end of 2005 to develop a national action plan for lion conservation. This plan was readily transferable to the leopard. The group selected specific activities relevant to Tanzania and specified the details as to how they would be implemented in Tanzania. This allowed the development of a logical framework that could be used to plan lion and leopard conservation on a national scale. The WMA process, as implemented by Wildlife Division, is critical to the success of many of these activities, whilst monitoring and conservation targeted research, particularly addressing conflict issues, were priorities to be implemented under TAWIRI that will address information requirements.

The Tanzania Lion and Leopard Conservation Action Plan

Tanzania Wildlife Research Institute (TAWIRI)

20-22nd February 2006, TAWIRI, Arusha, Tanzania
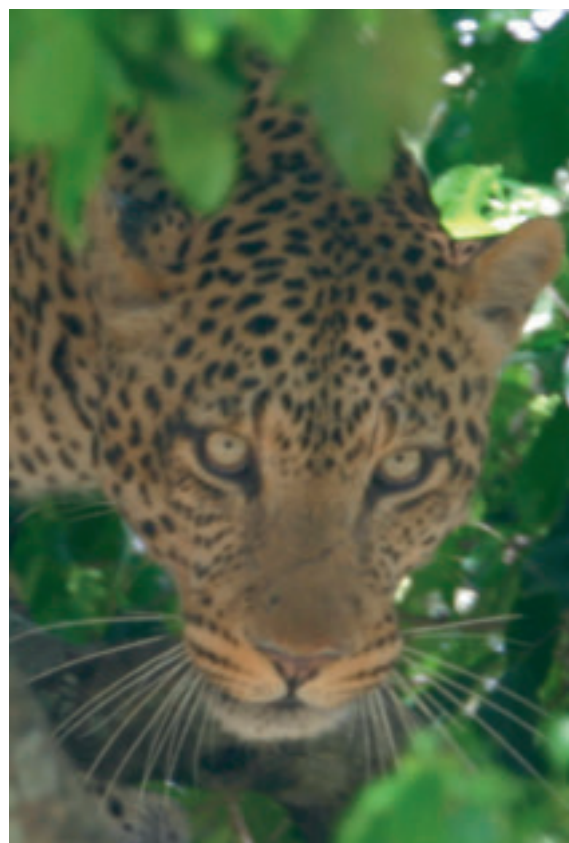
Tanzania Lion and Leopard Conservation Action Plan

Craig Packer, Laly Lichtenfeld, Charles Trout, Mathew R. Kiondo, Novatus Magoma, Edwin Konzo, Linus Munishi, Chediel Kazaeli, Mwemezi Rwiza, Nebbo J. Mwina, Julius Kibebe, Alexander Lobora, George Sabuni, Sarah Durant, Inyasi A. Lejora, David Erickson, Dennis K. Ikanda

Edited by Durant, SM, Whitman K, Lichtenfeld, L, Lobora, A and Lejora, I

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1. Agenda

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08.45-08.50	Official opening	George Sabuni
08.50-09.00	Self introduction	All
09.00-09.30	Meeting background	Sarah Durant
09.30-09.45	Agreement on the agenda	Alex Lobora
09.45-10.30	"Best Practices" for Trophy Hunting of African Lions	Craig Packer
10.30-10.35	Group photograph	All
10.35-11.00	Tea / coffee	
11.00-11.30	The risk of living with lions: Human-lion conflict in the Tarangire ecosystem	
		Laly Lichtenfeld
11.30-11.45	Lion and Leopard distribution and abundance	Alex Lobora
11.45-12.30	(a) What do we know? Distribution Density Trends	All
	(b) What do we need to know? Significant data gaps	All
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Day 2

Time	Event	Responsible
Information and conservation needs		
08.30-09.00	Outline of research methods	Sarah Durant
09:00-10:30	Prioritization of information needs: Lions	
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14:30-15:30	Recommendations for conservation: Lions	All
15:30-16:00	Tea / coffee	
16:00-17:00	Recommendations for conservation: Leopards	All

Day 3

Time	Event	Responsible
08.30-09:30	Summary of previous 2 days: Distribution, data gaps, threats, information needs	Sarah Durant
Regional Priority setting for research and conservation		
09:30-10:30	Lions	All
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16:30-16:45	Summing up	Facilitator
16:45-17:00	Official closing	Representative from TAWIRI

2. EXECUTIVE SUMMARY

This report covers the proceedings of the First Tanzanian Lion and Leopard Conservation Action Plan Workshop held on February 20th-22nd 2006. The workshop brought together key stakeholders to assess existing information and establish a consensus on priorities for research and conservation of lion (*Panthera leo*) and leopard (*Panthera pardus*) in Tanzania. Tanzania holds important populations of both species: recent estimates suggest the country is home to half the world's lions. All participants at the workshop recognised Tanzania's importance in the conservation of both species, as well as the economic importance of the species for generating revenue through photographic tourism and through sport hunting.

Both lions and leopards are fairly widespread across Tanzania, but there are better populations of lions inside protected areas. Information on leopards is particularly poor, as the species is highly cryptic and very hard to monitor. The group agreed that there was a need to get better information on both species, and given the importance of the species for hunting, it was important to obtain information on status of populations to ensure that they are being managed in a sustainable way. The group identified methods currently available for gathering such information, including spoor counts, call-in playback counts, tourist photos, detection dogs and transects, all of which had potential in certain circumstances. Questionnaire data and records of attacks on people were thought to be particularly useful for gathering information quickly on the distribution of both species at a national level, particularly for lions, however, only radio collars could be used to collect unambiguous data on ranging patterns and demography for lions, although for leopards, camera trapping surveys could also be fairly effective.

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Finally, the group used a regional strategic plan developed at a southern and eastern Africa meeting in Johannesburg at the end of 2005 to develop a national action plan for lion conservation. This plan was readily transferable to the leopard. The group selected specific activities relevant to Tanzania and specified the details as to how they would be implemented in Tanzania. This allowed the development of a logical framework that could be used to plan lion and leopard conservation on a national scale. The WMA process, as implemented by Wildlife Division, is critical to the success of many of these activities, whilst monitoring and conservation targeted research, particularly addressing conflict issues, were priorities to be implemented under TAWIRI that will address information requirements.

3. INTRODUCTION

The First Tanzanian Lion and Leopard Conservation Action Plan Workshop was held 20th-22nd February 2006 in the meeting room in the Tanzania Carnivore Unit, at the Tanzania Wildlife Research Institute (TAWIRI) headquarters in Arusha. The workshop brought together stakeholders to assess existing information and set priorities for conservation of lion *Panthera leo* and leopard *Panthera pardus* in Tanzania. The workshop was attended by 17 participants from TAWIRI, Wildlife Division (WD), Tanzania National Parks (TANAPA), Ngorongoro Conservation Area Authority (NCAA), Forestry and Beekeeping Division (FBD) together with a representative from the hunting community and experts from the Serengeti Lion Project and the People & Predators Fund (Appendix 1).

At an international level lions were classified as vulnerable by IUCN in 2004, due to a reduction of 30-50% in total population size over the last three lion generations – around 20 years (the average generation length for lions is 6.5 years (Packer et al. 2001)). Leopards were classified by IUCN as least concern in the most recent assessment of the species in 2001. Although leopards are thought to be declining world wide, it is not thought to be declining fast enough to warrant classification as threatened. It should be noted, however, that the leopard was classified as vulnerable in assessments in 1986, 1988, 1990, and it was only in 1996 that it's status was reduced to that of least concern.

Tanzania is crucial to the continued survival of lions, as it holds close to half the remaining estimated global population (IUCN Cat Specialist Group. 2006). The status of leopards within Tanzania and internationally is less clear, however Tanzania is certainly an important country for the conservation of this species. The importance of both species to Tanzania is not only aesthetic. Lions and leopards are two of the most important species for attracting tourists to wildlife destinations, maintaining Tanzania as one of the world's top safari destinations, and securing substantial economic revenue. Sport hunting of these species is also a major source of foreign revenue in Tanzania. For examples, in the early 1990s, lions contributed to 12% of Tanzania's annual revenue from trophy fees, despite only accounting for roughly 2-4% of the total number of animals taken as trophies in any given year (PAWM, 1995, Whitman 2006). Lions and leopards are therefore two of the most economically important species in the entire country. The recent international decline in lion and, probably, leopard, is therefore a significant cause for concern for Tanzania, as well as the international community. Both species tend to come into conflict with people and their livestock as they can take livestock and will occasionally attack and kill people, which present particular challenges to their conservation. Tanzania is particularly unusual amongst other range states in that it holds large numbers of these species outside the protected area system: elsewhere in Africa, lions and leopards are becoming more or less entirely confined to protected areas.

In January 2006 an international workshop on lion conservation was held to initiate a world-wide strategy to halt or reverse the decline in lion numbers (IUCN Cat Specialist Group. 2006). This workshop produced two major outputs:
   1. a map of lion distribution and a list of priority lion populations
   2. a log frame to form the basis of an international strategy for lion conservation.
The Tanzania Carnivore Monitoring Unit's data helped to inform the mapping process, whilst several of the delegates at this workshop helped construct the logframe. The advanced stage of the international planning process for lion conservation and resultant logframe means that this workshop was structured somewhat differently from previous workshops. The participants agreed that the logframe, developed by the world's experts in lion and protected area conservation and management, including many of the delegates present, should be used as a framework for planning at a national level within the workshop. The logframe was perceived to be transferable to leopards, and hence could be used to plan for both species.

TAWIRI, through the Tanzania Carnivore Monitoring Project, has been collecting information on all carnivores in Tanzania, including lions and leopards, since 2002. This information was used to inform the planning process. Despite their international and economic importance, information on lion and particularly leopard in the country is still limited, making it difficult to plan for the conservation of these species. This workshop aims to document what we currently know about lion and leopard status and conservation across the country and to set priorities for future research and conservation. These proceedings form a draft chapter for the lion and leopard section in a National Carnivore Conservation Action Plan.

Fig. 1   Participants at the meeting, from back and starting from left: Back Row: Craig Packer. Middle row: Charles Trout, Dennis Ikanda, Novatus Magoma, Sarah Durant, Alex Lobora. Front row: Linus Minushi, Edwin Konzo, Laly Lichtenfeld, Nebbo Mwina, Inyasi Lejora.

3.1 Presentations

3.1.1. "Best Practices" for Trophy Hunting of African Lions
Craig Packer

African lions are one of the most economically valuable species in Africa, prized by trophy hunters and photographers alike. But lion numbers are believed to be declining throughout the continent, and in 2004 Kenya requested that the lion be up-listed to Appendix I at CITES – a move that would have effectively banned all lion trophy hunting. At CITES-COP 13, wildlife representatives from the SADC countries successfully persuaded the Kenyans to withdraw their proposal on the

condition that a series of species-status workshops be held in different regions of Africa. The West African and Eastern/Southern African Workshops both reached similar conclusions: the lion's conservation status is threatened by habitat loss and increased conflict with humans. Responsible trophy hunting, it was concluded, is an essential tool for managing and conserving large numbers of lions outside the National Parks. Thus there is little impetus to alter the lion's current CITES classification from Appendix II.

The lion conservation meetings reached two important conclusions. First, Tanzania is unique in Africa in being home to an extraordinary number of lions. Countrywide estimates of lion numbers are extremely crude, but there is a clear consensus that Tanzania is home to 33%-50% of all remaining lions in Africa. Tanzania is also the only country with significant numbers of lions outside of National Parks – and the only country with an extensive distribution of lions outside any sort of wildlife management area. Second, well over half of the remaining lion habitat exists within areas set aside for trophy hunting. In Tanzania, there are five significant ecosystems with large lion populations: the Serengeti, Masai Steppe, Selous, Moyowosi-Kigosi-Ugalla, and Rukwa-Rungwa-Ruaha. Of these, only the Serengeti is largely gazetted as a National Park; all the rest are primarily set aside for trophy hunting. It is therefore essential to engage the trophy hunting industry as partners in conserving the lion for future generations.

Trophy hunting has traditionally been based on a quota system, but lion quotas have never been set scientifically. In addition, the lion has a complex social system whereby the loss of even a single resident male from a lion "pride" could result in the loss of all the small cubs in the pride through infanticide by the replacement males. To address the complexity of this issue, my research team developed a sophisticated computer simulation based on 40 yrs of long-term data in the Serengeti National Park (Whitman 2006). The model accurately mimics the behaviour of a real population, enabling us to perform removal "experiments" that follow the consequences of specific harvest strategies. In particular, we varied the number of lions harvested from the simulated population each year (to capture the effects of different quota sizes) and the minimum age that males could be included in the harvest. Trophy hunting can indeed have a negative impact on lion populations, but only if males as young as 3-4 yrs are included in the harvest (Fig. 2). Trophy hunting of males that are 5 yrs or older has a much more modest effect, and there is almost no effect when hunting is restricted to males that are at least 6 yrs old.
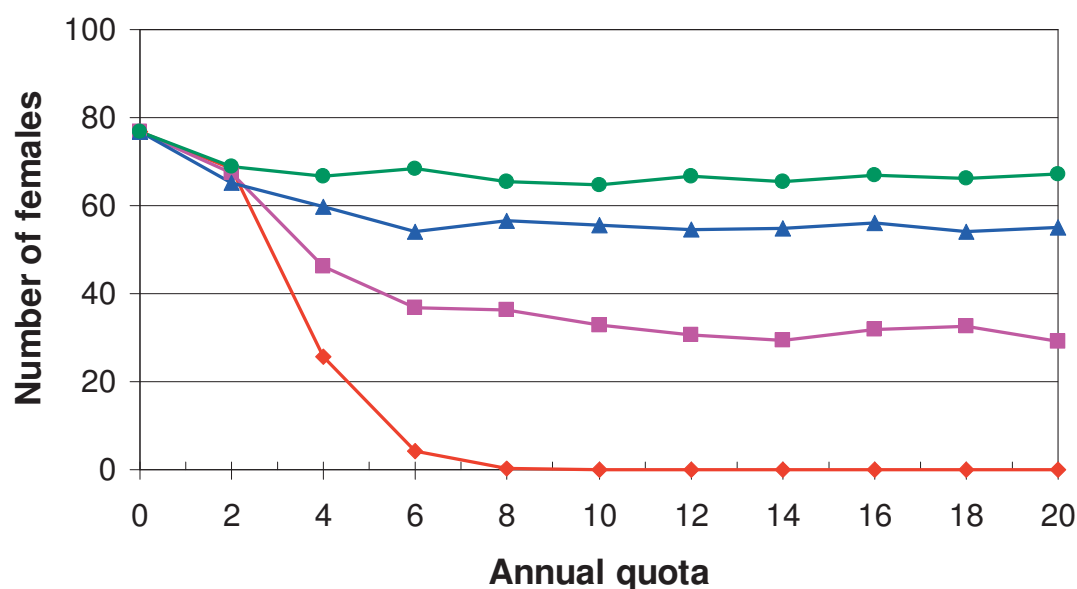

Fig. 2. Number of adult females after 30 yrs trophy-hunting as a function of quota size and male age in a hypothetical population. Average outcome after 100 runs is shown from shooting males of the following ages: ≥3 yrs (red), ≥4 yrs (pink), ≥5 yrs (blue), ≥6 yrs (green). (Whitman, et al. 2004).

After publication of these models in March 2004, TAHOA passed a resolution in June 2004 to restrict lion hunting to males that are at least 6 yrs of age. The lion issue was considered at CITES in October 2004, and the 6-yr age minimum helped prevent the reclassification of the lion to Appendix 1. In March 2005, Botswana re-opened lion hunting after a four year ban and implemented a 6-yr minimum of trophy males. Niassa Reserve in Mozambique adopted a 6-yr minimum in September 2005, and Zimbabwe in January 2006.

An age-minimum for lions has two important advantages over the traditional quota system. First, it is impossible to obtain accurate large-scale census data on lions. The only reliable method for counting lions is through individual recognition and intensive study as has been conducted in the Serengeti and Ngorongoro Crater since the 1960s. These are the ONLY long-term lion study sites in the world – no similarly detailed data are available from any other country in Africa. The Serengeti and Ngorongoro are both unusually accessible with open habitats, and the lions in both areas are exceptionally tame and observable. Despite years of effort in Tarangire National Park, it has been impossible to obtain comparable data on the Tarangire lions; and although there have been short-term radio-telemetry studies in South Africa's Kruger and Kalahari Parks, Namibia's Etosha Park and Zimbabwe's Hwange Park, none were extensive enough to provide population estimates.

The Ngorongoro Conservation Area Authority and MWEKA have conducted annual ground counts of the large mammals on the floor of Ngorongoro Crater since the late 1960s. Over this same period, we have maintained records of the lion population based on individual recognition, so we know the actual population size over this entire period. Ground counts not only underestimate the actual population size by a substantial margin, but the accuracy of these estimates is so variable that dozens of surveys would be required to pick up a three-fold change in population size (Fig. 3). And Ngorongoro Crater is the easiest ecosystem in the world to count lions!
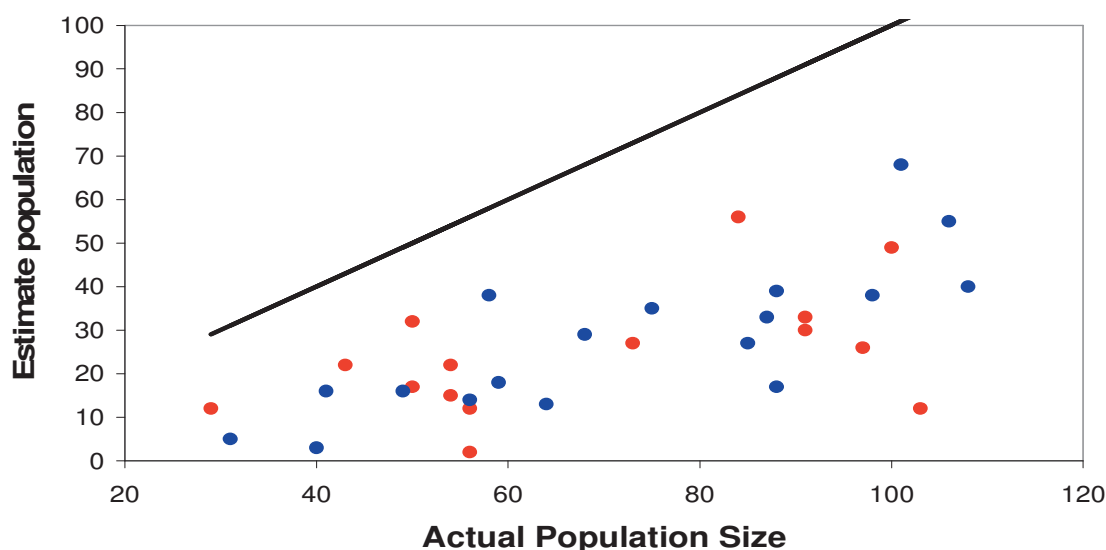
Fig. 3   Total number of lions encountered during systematic ground counts of the lions in Ngorongoro plotted against the actual number of lions living in the Crater at the time of each census. Red circles indicate dry season censuses; blue are wet season.

Wildlife biologists in Kenya, South Africa, Zimbabwe, Botswana and Namibia have all experimented with census techniques such as call-ups and spoor counts to obtain rough estimates of lion numbers. However, when we have applied these methods to our study populations in a similar manner, it is clear that they all have significant shortcomings (Fig. 3). For example, call-ups (where scientists broadcast recordings of hyenas feeding at a kill or prey animals giving distress calls) only attract a subset of the population. Females with cubs are much less likely to respond to the call-up, and lions generally won't respond in areas where they have been subject to human

persecution. With spoor counts, the lions' tracks are only visible in soft soil, and estimates have to be calibrated against a known density – and the calibration curve has to be adjusted according to season (with more tracks being visible in the rainy season). Thus spoor counts are useless in areas with unknown numbers of lions. In our experience, only one short-term census technique gives accurate estimates: a helicopter survey was 100% accurate in our study area, but the team could only cover 50 km^2/hr – making the method prohibitively expensive.
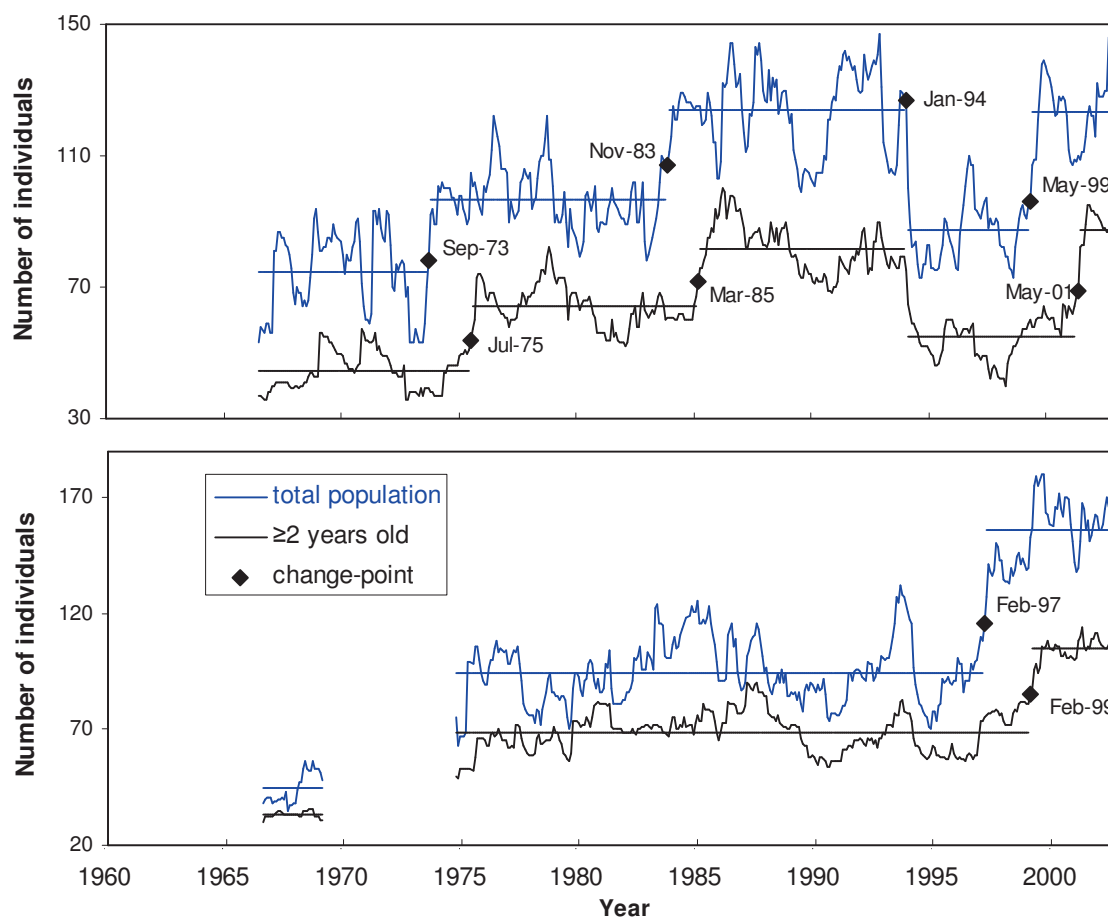
Fig. 4   Lion population sizes each month in the Woodlands (top) and Plains (bottom) regions of the 2,000 km^2 Serengeti Lion Project study area. All animals are individually recognized from natural markings, and each pride has been monitored by radio telemetry since 1984.

Besides the incredible expense, a fundamental problem with conducting such censuses is that lion populations can change dramatically in a very short amount of time. For example, disease outbreaks in the Serengeti and Ngorongoro have caused up to 75% declines over a matter of months, and population increases can be almost as dramatic (Fig. 3). Thus population estimates would have to be frequently up-dated – an exercise that would absorb considerable time and resources that could better be spent on anti-poaching and community conservation.

The second major advantage of an age-minimum is that by inspecting the lion trophies before export, the hunting industry will be subjected to greater transparency, and data from the inspections will provide wildlife authorities with greater information on the state of the underlying lion populations. Stable or growing populations show a pyramidal age structure with many more young animals than old. By restricting trophy offtake to older individuals, the number of new recruits to the "eligible" pool would provide a reasonable estimate of recent population trends. Thus the total offtake of 6-yr old males each year would provide important information on the lion-conservation status of the hunting reserves throughout the country – and at no cost to the wildlife management authorities, since the "search effort" for eligible trophy males would be borne entirely by the hunting companies themselves.
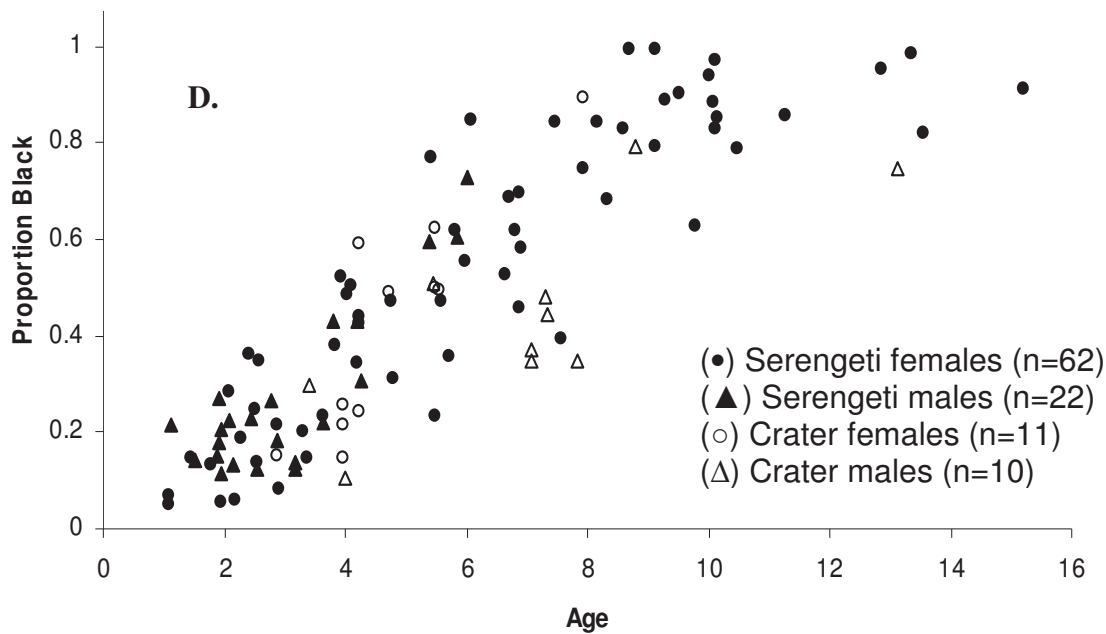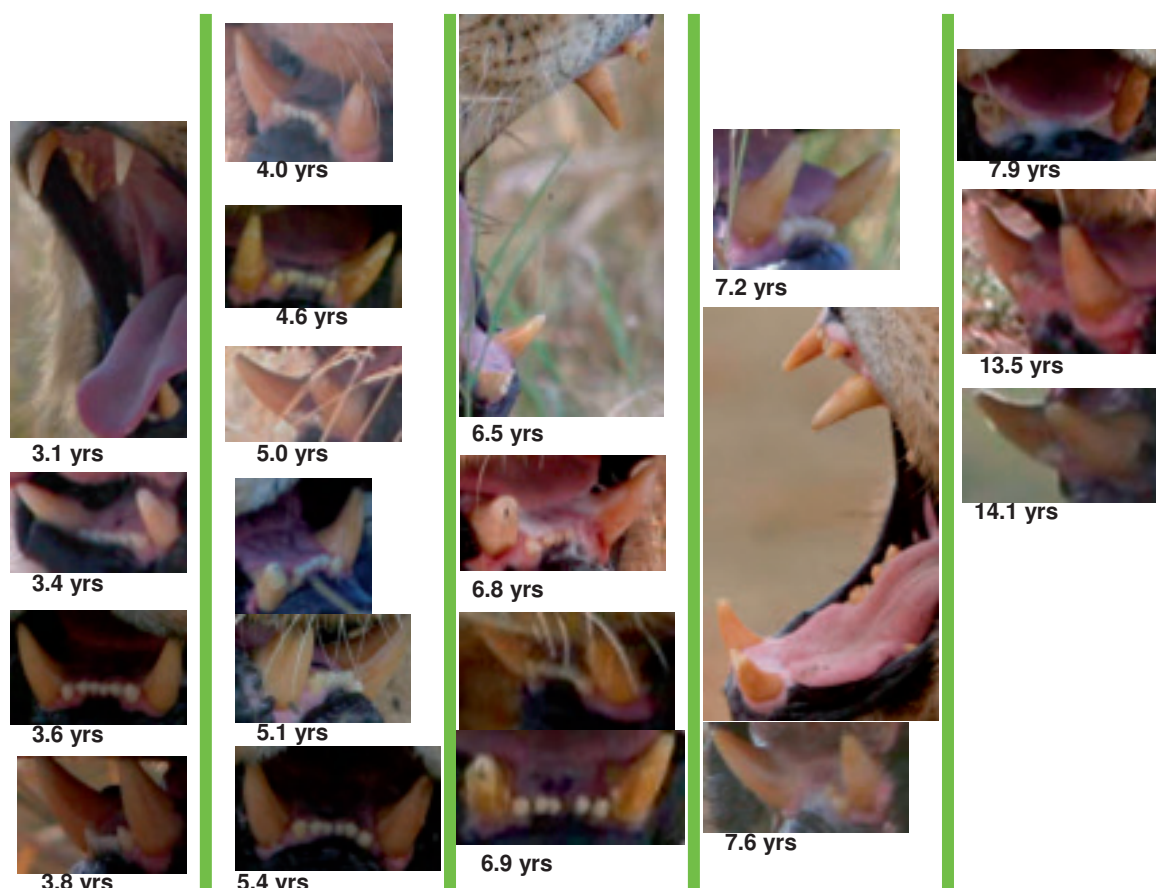
Fig. 5.   Age-estimation for adult lions using nose colouration. A. Identification photograph of a 3 yr old male. B. Excised photo of nose tip. C. GIS rendering of nose colouration. D. Age-change of nose colouration for males and females in two separate populations (Whitman et al. 2004).

Transparency is essential for lion conservation. Even though TAHOA rapidly adopted the 6-yr minimum in June 2004, subsequent internet advertisements by many TAHOA members included numerous photographs of trophy lions shot in 2004 and 2005 that were clearly less than 4 yrs old. Excess offtake of such young males can have catastrophic consequences on entire lion populations (Fig. 1), and professional hunters lack the training to estimate lion age, and though the concept of age-sensitive harvesting has been fundamental to sport hunting of big-horn sheep and other ungulates, it has never before been applied to a carnivore. It is therefore essential to educate PHs, hunting operators and their clients about the need for restraint in shooting young lions, and to implement a reliable mechanism for inspecting lion trophies before they can be exported.

Such a system would require two sets of information. First, methods that can be used to estimate a lion's age before the client is allowed to shoot the animal. Second, post-mortem criteria for evaluating the age of the trophy animal.

Field methods. The most reliable method for estimating lion age is the extent of pigmentation on the tip of the nose (Fig. 5, Whitman 2006): the noses of young lions are pink but become increasingly freckled until turning completely black by the age of 10 yrs. The noses of known-aged lions in the Serengeti and Ngorongoro are 60% black when they are 6 yrs old, and the rate of nose darkening appears to be similar throughout Africa. One research group has claimed that their study lions do not conform to this pattern, but these are the same individuals who wrote the CITES lion proposal on behalf of the Kenyan CITES delegation, and our re-examination of their nose photographs suggests instead that the Okavango lions show a very similar trend in nose darkening as the Serengeti lions.

4.0 yrs

4.6 yrs

3.1 yrs

5.0 yrs

6.5 yrs

7.2 yrs

7.9 yrs

13.5 yrs

3.4 yrs

3.6 yrs

6.8 yrs

14.1 yrs

5.1 yrs

3.8 yrs

5.4 yrs

6.9 yrs

7.6 yrs

Fig. 6   Photograph of known-aged male lions in the Serengeti, either showing the lower incisors + canines or the entire mouth while yawning. The lower teeth are easily observed when the lion is panting. The teeth become increasingly discoloured with age

In addition to nose coloration, an approximate age estimate can be based on tooth colouration (Fig. 6), on coat condition of the lion's face (Fig. 7), and possibly on black colouration on the backs of the males' legs (Whitman & Packer 2007). Although none of these methods is perfect, taken together it should be possible for hunters to make a reasonable estimate of male age before shooting the animal.

PN95
3.9 yrs

CV31
4.1 yrs

PN94
4.3 yrs

PN92
4.9 yrs

PN90
5.1 yrs

BF16
5.3 yrs

PN89
5.4 yrs

MH31
5.7 yrs

SUC
6.2 yrs

PN79
6.8 yrs

NN34
6.9 yrs

NN37
6.9 yrs

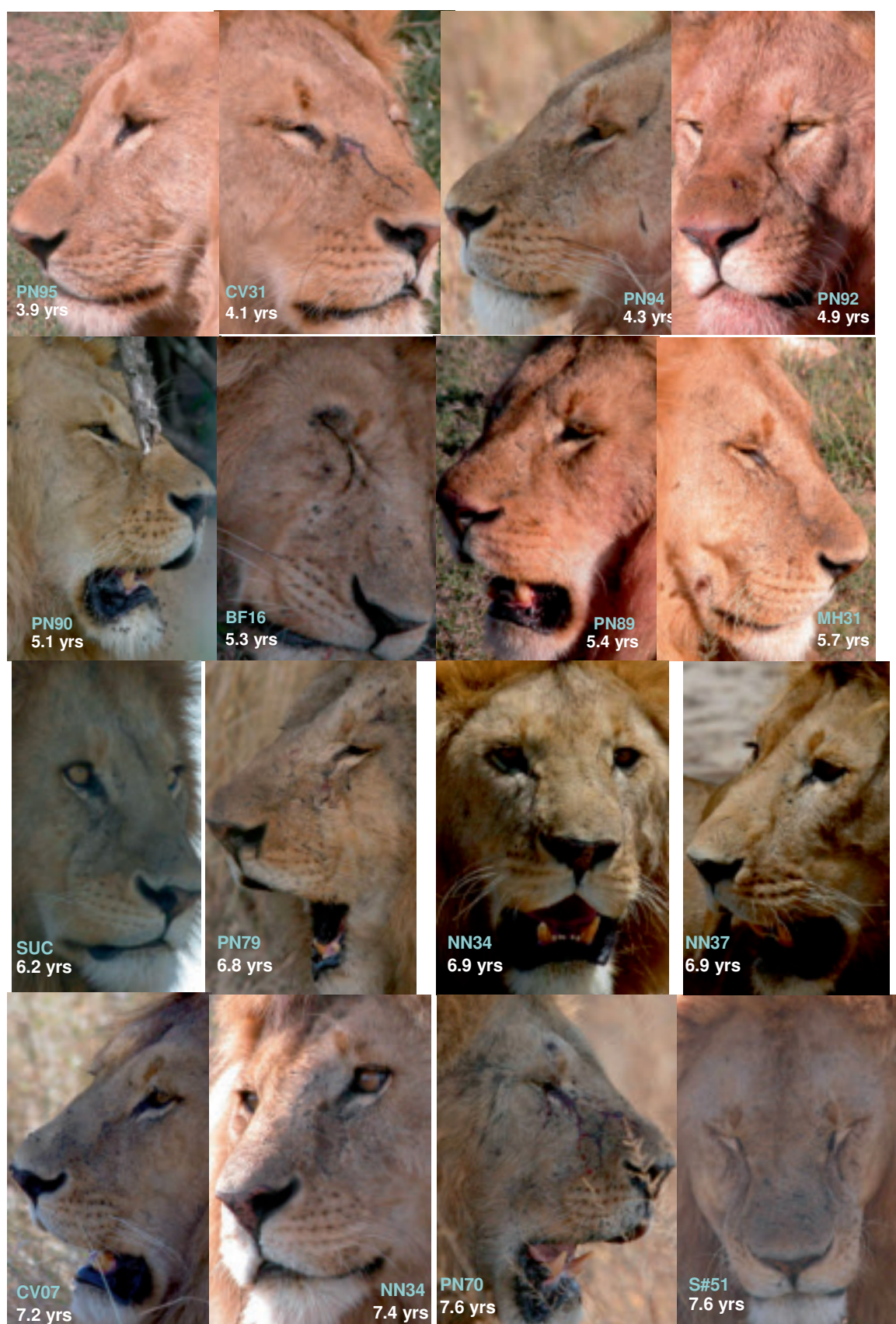CV07
7.2 yrs

NN34
7.4 yrs

PN70
7.6 yrs

S#51
7.6 yrs

Fig. 7   Photos of known-aged Serengeti males. Note the longish fur on the face of the youngest animals, and the increasing "thriftiness" of the fur with age.

Fig. 8   Tooth x-rays for known-aged lions. The pulp cavity is quite wide in lions <2 yrs of age then narrows to adult width by 4.75 yrs.

NOTE: Mane development is NOT a reliable tool for estimating lion age, since the length and colouration of the lion's mane is strongly affected by climatic variation in temperature and humidity. Thus lions in low-altitude ecosystems such as the Selous have much shorter manes than those in the Serengeti or Ngorongoro.
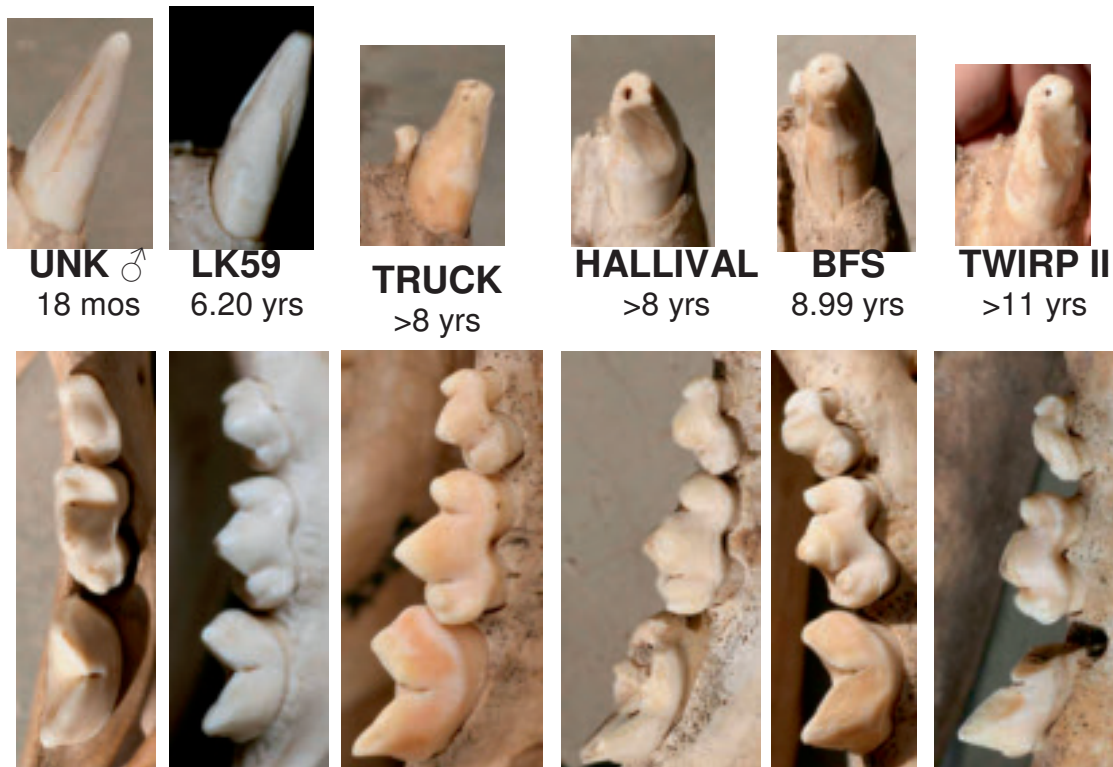

Fig. 9   Canines (top) and cheek teeth (bottom) from the jaws of 6 known-aged lions. The canines develop a conspicuous groove and the carnassial teeth (lowermost) show increasing wear with age.

Post-mortem criteria. After the lion has been shot, the teeth can be analyzed in various ways to estimate age at death (Whitman & Packer 2007). First, x-ray analysis can be used to inspect the extent to which pulp cavities have solidified. In human teeth, the pulp cavity closes off about 3 yrs after eruption of the adult teeth. A similar pattern is apparent in lions, where the pulp cavities are filled in by about 4.75 yrs of age (Fig. 8). For distinguishing ages closer to the 6 yr minimum, tooth-wear patterns will eventually prove useful. We currently have skulls from six known-aged males in the Serengeti, and older males have a conspicuous groove on the back of their lower canines and substantial wear on the outside surface of their lower carnassial teeth (Fig. 9).

Conclusions and Recommendations
An international consensus has been reached that a well-regulated hunting industry can make an essential contribution to lion conservation. The majority of Tanzania's lions reside in hunting concessions, and the hunting companies have a direct financial stake in conserving the species. Lions are essentially impossible to count, so lion quotas could never be scientifically based. Simulation models suggest a straightforward alternative: restrict hunting to males that are at least 6 yrs of age. The hunting industry has been quick to pass resolutions to restrict hunting to the older males, but compliance is an obvious concern. Several Tanzanian operators blatantly advertised "trophy" lions that were far less than 6 yrs of age in 2004 and 2005, and even the most ethical companies have found it difficult to reliably estimate lion ages. In early 2006, we received teeth from trophy lions shot in 2004-5 by four Tanzanian and three Botswana hunting companies. X-rays revealed that about 25% of these trophy lions were less than 5 yrs of age.

Despite the fundamental difficulties of accurately estimating lion age in the field, a mandate by the Tanzanian government to require third-party inspection of lion trophies before export would force the companies and their clients to take adequate care before shooting a lion. Mistakes will no doubt occur, but performance would no doubt improve with experience – especially if companies were penalized for shooting too many under-age lions.

I suggest the following course of action:

1. Require all PH's to receive training in lion age-estimation techniques. This could include spending time in the Serengeti with known-aged lions or receiving instruction at MWEKA.

2. Require inspection of all lion trophies before export. This could be initiated immediately, since TAHOA agreed to the 6 yr minimum in 2004. Inspections would be based on photographs of the lions immediately after death and on teeth x-rays and patterns of tooth wear measured at the company's headquarters.
   A. Prohibit the export of any trophy judged to be less than 4 yrs of age.
   B. Adjust each company's lion quota in 2007 on the proportion of trophies that are less than 5 yrs of age.
   C. As new techniques become available, prohibit export of all trophies less than 5 yrs of age and adjust quotas according to the proportion of trophies less than 6 yrs of age.

All inspections should be performed by a neutral third-party auditor with the scientific qualifications and technical capacity to verify age of offtake. The impact of the age-based harvest system should be directly measured, and, to this end, we have recently initiated a detailed study of the Selous lion population, using radio-telemetry and individual recognition.

3.1.2 The Risk of Living with Lions: Human-Lion Conflict in the Tarangire Ecosystem
Laly Lichtenfeld

Globally, many large carnivore populations are in decline. The persistence of these species is intricately linked to their relationships with humans. However, traditional conservation approaches

focus on the ecological causes and end results of human-carnivore conflicts without considering both the social and ecological forces driving the outcomes.

My research in the Tarangire ecosystem combined both ecological and sociological studies in order to provide a detailed analysis of human-lion relationships and the conflicts existing between people and lions. Working with individuals from the sport hunting and photographic tourism industries as well as local Maasai communities, I examined the following three questions:

(1) How do individuals from Maasai communities, the professional sport hunting industry, and the photographic tourism industry perceive lions? What are the similarities and differences in these stakeholders' attitudes toward lions?
(2) How does the ecological reality of daily cohabitation with lions affect the Maasai in both a physical and psychological sense? More specifically, how do both actual interactions with lions and the sheer possibility of lion encounters, or the perception of risk, influence Maasai – lion conflicts and their overall tolerance of lions?
(3) How do lion populations compare throughout a mosaic of protected, village, and professional sport hunting lands? Do lion densities differ in areas where they interact with different stakeholders? If so, how do the densities change in terms of the attitudes expressed toward lions?

Essentially, I found that the stakeholders, despite coming from widely different backgrounds, had strikingly similar values of lions. For example, most individuals revered the lion as a symbol of bravery or wildness. Only the Maasai held negative perceptions of lions, stemming from the danger these animals pose to their livelihoods and the conflicts resulting from livestock predation and land use issues.

Indeed, among Maasai communities, lions were the most feared of all large carnivores. Those individuals who felt the risk of living with lions was high were more likely to support a reduction in the lion population in the next ten years. Individuals with higher risk perceptions tended to be women, wealthier, and/or Maasai (as opposed to Waarusha). However, those individuals who benefited from photographic tourism or professional sport hunting were significantly more likely to support an increase in the lion population. These individuals tended to be Waarusha and/or male.

Ecological studies were carried out to determine how lion populations differed within sport hunting areas, village communities, and the national park. Given the shy and secretive nature of lions outside the park, I used spoor counts to estimate lion densities by calibrating counts conducted in the park against the density of lions established in the same study area via individual identification. In order to identify large carnivore spoor, and in the case of lions, to determine their age group and sex, I worked with skilled Hadzabe trackers who proved to be both consistent and accurate.

Overall spoor densities were greatest in the park followed by the sport hunting area (Kikoti) and then the village study area (Loibor Serrit). However, significant changes occurred based on seasonality – park spoor densities were greatest during the dry season when wildlife concentrates along the Tarangire River. Outside the park, spoor densities increased in the wet season in Kikoti suggesting the movement of park lions outside the park boundary during the rainy season. Indeed, lions individually identified in the park were sighted outside of the park during this time. However, I also found resident lion prides outside of the park. While lion population structure was similar between the park and sport hunting area, near the village, a greater proportion of subadult animals were recorded. This has important implications for conservation given that these individuals are often the culprits of livestock predation.

Densities of lions in the three study areas (excluding juveniles, annual averages and 95% confidence intervals) were as follows:

Park - 0.12 lions/km^2 (0.068–0.16 lions/km^2)

Kikoti - 0.052 lions/km^2 (0.025–0.078 lions/km^2),

Loibor Serrit - 0.038 lions/km^2 (0.028–0.049 lions/km^2).

A conservative estimate of lion population size in the Tarangire ecosystem (12,000 km^2) is approximately 600 adult and subadult animals.

In addition, I found that the Maasai kill on average 39.9 lions/year in 7 villages resulting in 6.4% to 8.8% annual lion mortality (based on indiscriminate killing of males, females and all age groups). Using an estimated quota of 15 males/year in four hunting blocks within the study area, sport hunting of lions results in 7.4% to 10.1% annual lion mortality (based on hunting of adult males only).

Several recommendations were made to improve human-lion relationships including local community engagement in the conservation and monitoring of lions, large carnivore education programs, participatory livestock predation monitoring programs and the development of socially appropriate solutions to conflicts, and collaborative forums to engage all stakeholders in carnivore conservation.

For more information or a PDF copy of Dr. Lichtenfeld's dissertation, "Our Shared Kingdom at Risk: Human-Lion Relationships in the 21st Century," contact Lichtenfeld@people-predators.org

4. Distribution and abundance

The country was divided up into different areas and information about lion and leopard distribution was assessed region by region. In each region data on lions was better than the data on leopards.

4.1 What do we know: Summary of current knowledge.

The Tanzania Carnivore Project has been collecting information on lion and leopard distribution across the country since 2002 through its Carnivore Atlas project. The majority of the information contributed is from the northern sector, principally due to the better infrastructure and higher number of visitors in the region; whereas, data from the south, west and central regions are limited. The group agreed on the following regions to form the basis for regional analysis:

Northern – Serengeti/Ngorongoro
Maasai Steppe –Tarangire and West Kili/Mkomazi/Arusha; Natron
Southern – Selous/Mikumi; Selous-Niassa corridor and coastal districts
Central/Western – Ruaha complex; Katavi/Rukwa/Ugalla/Mahale complex; Moyowosi/Kigosi
North west – Ibanda/Burigi/Kagera/Buramulo
Other – Tabora; Dodoma –Singida; Northern coast – Saadani; Southern Highlands; Zanzibar
These regions roughly correspond with those in previous reports.

Lions appear to be fairly well distributed across the protected areas within Tanzania (Fig. 10). The data are biased towards the north, where most visitors go, yet reports of lions also exist in most other large protected areas in Tanzania. Chardonnet (2002) estimated Tanzania to hold 14,432 lions in total, whilst Bauer & Van Der Merwe (2004) gave an estimate of 7,073. The latter estimate, however, neglected many areas, including one of the largest protected area complexes in Tanzania – the Ruaha region – and hence must be a marked underestimate. The WCS analysis of range wide distribution and numbers identified 18 major sub populations in east Africa, 3 of the most important of which were centred in Tanzania (IUCN Cat Specialist Group 2006). Four out of 16 priority sub-populations in their analysis occurred in Tanzania. Lion densities have been calculated in some regions, and they range from 0.01 lions per km^2 on the southern plains of the Serengeti to 0.38 lions per km^2 in Manyara national Park and the long grass plains of the Serengeti (Table 1).

Fig. 10 Map of known sightings of lion submitted to the Tanzania Carnivore Project since 2003 up until the time of the workshop. Data submitted is in two forms, either as direct GPS locations, or as a grid square as identified on the map. The former data type are plotted on the map directly, whilst the latter data type are plotted at the centre of the reported grid square.
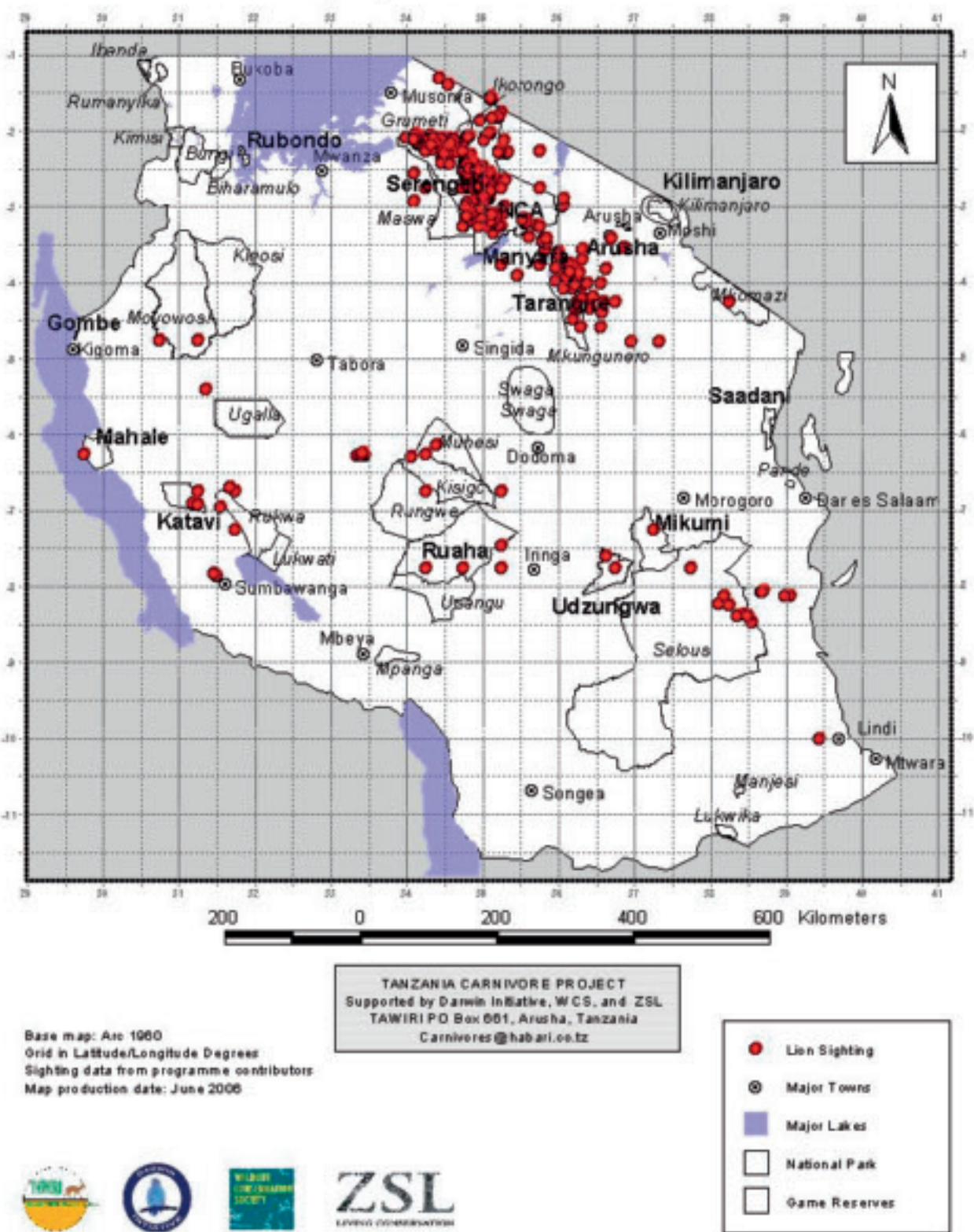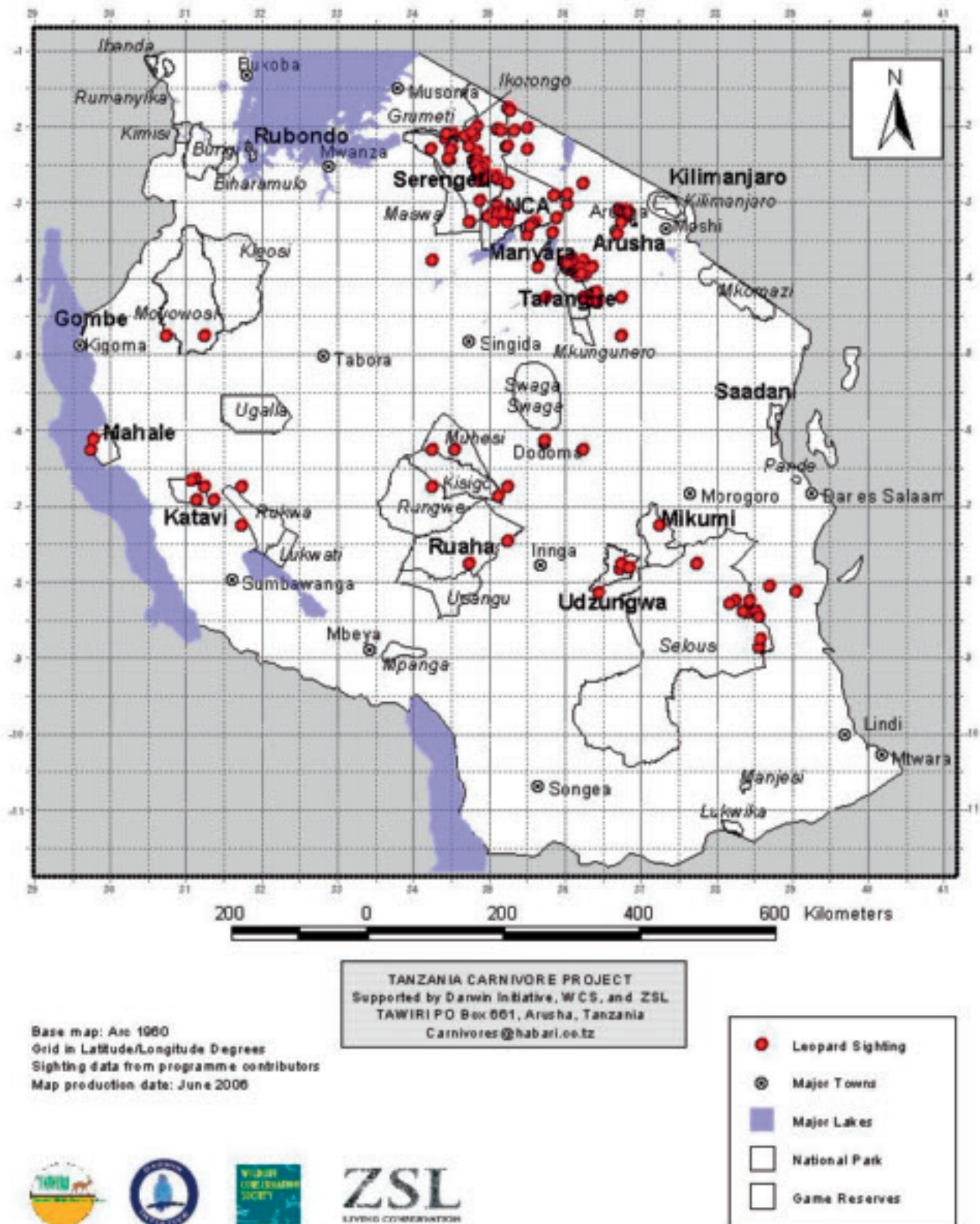
Fig. 11 Map of known sightings of leopard submitted to the Tanzania Carnivore Project since 2003 up until the time of the workshop. Data submitted is in two forms, either as direct GPS locations, or as a grid square as identified on the map. The former data type are plotted on the map directly, whilst the latter data type are plotted at the centre of the reported grid square.

Leopards are also widespread across the country. As with lions, reports are concentrated in the north, largely due to the greater number of visitors to this area and leopards appear to occur in all the large protected areas in the country (Fig. 11). The data on leopard numbers and distribution are extremely limited and there are very few estimates of density.

The following sections summarise in detail what is known about lion and leopard distribution on a regional basis.

Region	Year	Density (lions/km^2)	Method	Source
Katavi Game Controlled Area		0		Caro 1999b
Masai Steppe		0.003		Lamprey 1964
Serengeti short grass plains	1977 dry	0.01	Transect	SRI 1977, quoted in Hofer & East 1995
Total Serengeti plains	1977 dry	0.03	Transect	SRI 1977, quoted in Hofer & East 1995
Katavi NP		0.07		Caro 1999a
Serengeti short grass plains	1986 wet	0.08	Transect	Campbell & Borner 1986
Total Serengeti plains	1986 wet	0.08	Transect	Campbell & Borner 1986
Serengeti (whole)		0.08-0.09		Schaller 1972
Serengeti long grass plains	1986 wet	0.1	Transect	Campbell & Borner 1986
Serengeti long grass plains	1977 dry	0.12	Transect	SRI 1977, quoted in Hofer & East 1995
Serengeti short grass plains	1977 wet	0.17	Transect	SRI 1977, quoted in Hofer & East 1995
Ngorongoro plains	1999-2001	0.21 (0.10-0.29)	Call-ins	Maddox 2002
Total Serengeti plains	1977 wet	0.22	Transect	Hofer & East 1995
Ngorongoro Crater		0.27	Transect	Schaller 1972
Serengeti plains	1999-2001	0.28 (0.09-0.55)	Call-ins	Maddox 2002
Serengeti long grass plains	1977 wet	0.38	Transect	SRI 1977, quoted in Hofer & East 1995
Loliondo plains	1999-2001	0.37 (0.12-0.87)	Call-ins	Maddox 2002
Manyara NP		0.38		Schaller 1972

Table 1   Estimates of lion densities in areas of Tanzania (in order of density), reproduced from Maddox 2002.

4.1.1   Northern Region (Serengeti National Park, Maswa Game Reserve, Ngorongoro Conservation Area, Loliondo Game Controlled Area, Natron)

Lion

Lions are well distributed across the Serengeti ecosystem (Fig. 10). The Serengeti Lion Project estimates around 3500 individual lions (juveniles and adults) resident in the Serengeti National Park, Ngorongoro Conservation Area and the Maasai Mara Game reserve in Kenya. This is made up of an estimated 65 individuals in Ngorongoro crater, 70 in the wider Ngorongoro Conservation Area, and 400 in the Mara, with the remainder, the bulk of the population, around 3000 individuals, resident in the national park. Monitoring by the Serengeti Lion Project shows that the park lion population has been increasing over the last 40 years due to the recovery of ungulate populations after rinderpest was eradicated from the Serengeti in the early 1960s. The relatively small NCA populations inside and outside the crater are thought to be stable, but vulnerable to human persecution and disease.

There is probably also a significant population immediately adjacent to the National Park in Loliondo Game Controlled Area (LGCA) where trophy hunting is permitted, however the total number of lions in that area is unknown. A roar survey performed in 1990 found very few lions in the LGCA adjacent to the park (Packer 1990). More recent surveys between 1999-2001 using call-in playbacks showed that responses from lions in the population immediately adjacent to the park were not significantly different to responses within the park (Maddox 2002). In these surveys mean densities (and 95% confidence intervals) in the LGCA were estimated as 0.37(0.12-0.87)/km^2, in the NCA 0.21(0.10-0.29)/km^2 and on the Serengeti plains 0.28(0.09-0.55)/km^2. However, call-ins are not an entirely reliable means of estimating density, especially when they are not calibrated for individual responses (see 4.2.9). Lions within the Maswa Game Reserve have historically had much lower concentrations than in the neighbouring Serengeti, most likely in response to large scale poaching that has taken place in the area (Schaller 1972). The population within the reserve is thought to be currently stable with an estimated density of adult lions (>2

yrs) of 0.04/km^2 based on lion response to call-ins and individual counts (Whitman 2006). However the population remains vulnerable to over-hunting of immature males (<5 yrs) by trophy hunters and indiscriminate poaching by means of long-line snares (Whitman 2006).

In the smaller game reserves, Grumeti and Ikorongo, adjacent to the park, numbers are suspected to be increasing, mainly due to higher levels of protection. Records outside the park, aside from those from the LGCA discussed above, are sparse, however there are a few records to the west – close to the Maasai Mara Game Reserve in the north, and to the west of Maswa Game Reserve to the south.

Leopard
Information on leopards in the area is much more limited than that on lions. Leopards are able to hide from people more effectively than lions, and their preference for thick bush and forest makes them difficult to find, whilst their broader diet enables them to survive on a variety of prey (Mizutani 1999; Norton et al. 1986), including domestic dogs in some areas (Edgaonkar & Chellam 2002). Therefore the species is likely to be reasonably widely distributed across the region throughout suitable habitat. The Tanzania Carnivore Program has records of leopards from across the Serengeti complex, including Serengeti National Park, Ngorongoro Conservation Area, Maswa, Grumeti and Ikorongo Game Reserves as well as areas outside these protected areas such as Loliondo Game Controlled Area to the north east, and areas to the north east and south of the NCA. There are no records of leopard sightings outside the protected areas to the west of the Serengeti ecosystem (Fig 11).

Studies on leopards in the region are limited. A study of 3 radio collared leopards in the Lobo area in the Serengeti estimated a home range of around 16km^2 for an adult female (Bertram 1982). Assuming leopard territories are exclusive, then this provides a provisional estimate of 570 adult females. Using a published sex ratio estimate of 1 female to 0.75 males (Stander 1998), this would mean a total of 760 males, giving a very approximate population estimate of 1,330 in the entire park. This estimate neglects the plains areas which are unsuitable habitat for leopards and which comprise around one third of the park (Sinclair 1979). Densities in Ngorongoro are unknown, but leopards are seen frequently on the crater rim and on the crater floor, and are probably present across all wooded habitats in the NCA. NCAA reported that ranger patrols have also sighted a good number of leopards all across the northern highland forest. Photo trapping surveys in the region have shown leopard to be widespread, being photographed in 24% of camera locations, despite quite a short trapping period (a mean of 19.9 days per location). They were also recorded throughout the western portion of the LGCA (Maddox 2002), and are known to be present in Maswa Game Reserve (Whitman 2006), but there is no information on density or trends in either region.

Leopards do come into conflict with people in the region, and the NCAA reported that leopards have been recorded as attacking cattle between Endulen, Kakesho and Ndutu. Questionnaire surveys in the LGCA and NCA in 1999-2001 demonstrated that leopards were perceived to be a significant threat to both livestock and people (Maddox 2002). In summary, leopards are probably abundant in suitable habitat across the region, but there is no information on trends.

4.1.2 Maasai Steppe (Tarangire, Arusha, Kilimanjaro and Manyara National Parks, Simanjiro, Mkungunero, West Kilimanjaro; Natron; Mkomazi)

Lion
Lions are distributed across the Maasai steppe, with many records in Tarangire National Park, Manyara National Park and some records of lions seen over 100km to the east of Tarangire. The People and Predators project has been using calibrated spoor counts and individual identification to monitor lions in and outside Tarangire National Park, mainly to the east. Lichtenfeld (2005) estimates the mean density (and 95% confidence intervals) of lions in the north of Tarangire National Park to be 0.12 lions/km2 (0.068 – 0.16 lions/km2; juveniles excluded). Using

conservative estimates of lion density in several land use types (i.e. national park, sport hunting land, village land), a population of between 450 and 625 lions (excluding juveniles) is calculated for the Tarangire ecosystem, measuring 12,000 km^2 (Lichtenfeld 2005). Threats to lions in the Tarangire ecosystem include local retaliation against livestock-raiders, where 40 lions per year are estimated to be killed by the Maasai in seven villages outside the eastern boundary of Tarangire National Park, and the negative effects of shooting immature males by trophy hunters (Lichtenfeld 2005). The Serengeti Lion project reported that Lake Manyara has 25 individual lions and noted that the population has been stable since the 1960s. Elsewhere information is sparse. Lions are known to be present around Lake Natron, West Kilimanjaro, and Mkomazi, but no information is available on densities or trends. They are no longer present in Arusha National Park, but are probably present in the savannah areas to the north.

Leopard

There is very little information on leopard from this region. Spoor counts of leopards conducted by the People & Predators project in Tarangire National Park, sport hunting and village land to the east of the park resulted in the following spoor density estimates (# of spoor/km; mean and standard error): 0.030 ± 0.0091, 0.039 ± 0.0086, and 0.041 ± 0.0065, respectively. No difference in the relative abundance of leopards throughout these three study areas was noted (p>0.05; Lichtenfeld 2005).The Tanzania Carnivore Program (TCP) has received sighting records of leopard from Tarangire, Manyara and Arusha national parks, and a few records to the north and east of Tarangire National Park. The TCP has also photographed leopards in all three national parks during camera trapping surveys in 2004-2006. Leopards are thought to be present in Kilimanjaro National Park, but were not photographed there in a recent TCP camera trap survey (1001 camera trap days over 37 locations), although leopard sign was found on the plateau close to the access road when the TCP were setting up camera traps. There is no information on densities or numbers in the region except from Tarangire, where a camera trapping survey in December 2004 – February 2005 estimated densities at between 9.9-33.5/100km^2 (Kelly et al. unpublished data). These densities are markedly higher than those estimated through spoor by the People & Predators project (Lichtenfeld 2005). Trapping rates varied between 0.0043 in Tarangire National Park (1169 camera trap days), 0.0130 (in Arusha National Park (1073 camera trap days), 0.0135 in Manyara National Park (74 camera trap days), and 0.0306 in Ngorongoro Conservation Area (915 camera trap days). Suggesting that the Ngorongoro area is particularly good for leopards.

4.1.3 Central and western region (Ruaha complex, including Rungwa and Rukwa-Lukwati ecosystem; Ugalla; Katavi; Mahale; Moyowosi; Kigosi)

Lion

Lions are probably well distributed in this region, however the area receives few visitors and so records are sparse (Fig. 9). The Tanzania Carnivore Program has records of sightings of lions in the Ruaha complex, including Muhesi, Kisigo, Rungwe and Usangu game reserves as well as Ruaha National Park, Ugalla, Moyowosi, Mahale, Katavi and Rukwe, as well as some evidence of lions outside these areas to the north west and south east of the Ruaha complex; to the south west of Rukwe near Sumba wanga; and to the north west of Ugalla (Fig. 10).

There is some information on density and status in the region. Chardonnet (2002) provides an estimate of 3,360 individual lions in the Ruaha complex. However there is no information about how this figure was derived. An estimate of 185 lions was obtained through call-in playbacks in Katavi National Park, giving a density estimate of 0.043(0.02 – 0.11)/km^2 (Kiffner 2006). Chardonnet (2002) estimates 600 lions in the entire Rukwa complex, including outside the Katavi National Park, and Rukwa/Lukwati Game Reserve, suggesting that 400 lions live outside Katavi. Lions are known to be present in Mahale to the east and to the north and south, but are probably not in the steep forest close to the lake shore. They were not found in an intensive camera trap survey in the park in 2005 (no photographs in 653 camera trap days. Lions are also known to be present in the corridors between Rungwa and Rukwa and between Rukwa and Mahale, but it is

unknown whether these populations are stable, increasing or declining. Chardonnet (2002) estimates 280 lions in Ugalla Game Reserve however the derivation of this estimate and its current status is not clear, although some participants felt that the population may be increasing, but there was no evidence for this. A call-in survey conducted within the Reserve in 1998 estimated a density of 0.02 lions (>2 yrs)/ km^2 (Whitman 2006). An estimate of 91 lions was made for the southern region of Moyowosi around Njingwei using playback call ins (Viljoen et al. 2004) or approximately 2.9 (lions (>2 yrs)/km^2 (Whitman 2006, but see Viljoen et al. 2004), and an estimated total 483 lions in the entire Moyowosi complex, including Kigosi Game Reserve (Chardonnet 2002). This population is thought to be declining but it should be noted that there is little accurate information on the status of lions anywhere within this region.

Leopard
Leopards are known to be present throughout this region, however there is very little precise information. The Tanzania Carnivore Program has records of leopards in Muhesi, Kisigo, Rungwe and Ruaha, as well as Katavi National Park, Rukwa Game Reserve, Mahale National Park and Moyowosi Game Reserve. A camera trap survey of Mahale National Park in 2005 photographed leopard in 13% of 67 location, averaging 19.2 days at each location. The overall trapping rate was 0.0214, suggesting a reasonably high density in the area. Elsewhere in the region, a study of radio collared leopards was conducted in Piti Game Reserve established male home ranges as 136km^2 (n=3) and females as 25 km^2 (n=4) (Caso 2002), suggesting leopard densities are slightly lower than in the Serengeti in this region, but which are still reasonably high. There is no other information on density and no information on trends in any part of this region.

4.1.4   Southern – Selous/Mikumi; Udzungwas; Selous- Niassa corridor and coastal districts

Lion
Lions are distributed across the Selous Game Reserve, Mikumi National Park and Kilombero Game Controlled Area. Lion attacks are also reported from across the region suggesting that they are present outside the protected areas. Attacks have been reported as far south and east as Linde. A study in the Selous in the 1990s estimated densities of 0.08-0.13 lions (adults plus subadults) per km2, giving an estimate of 7425 lions in the Selous Game Reserve, Mikumi National Park and Kilombero. Lions in the Selous Niassa corridor and coastal districts were estimated to number around 1,800 (Baldus 2004). Lions are present in Udzungwa National Park, however their density is unknown. Wildlife Division reported that trophy quotas are met in the entire Selous Game Reserve, suggesting that the population is probably stable. If quotas were not being met over a long period, then the population would most likely be declining. A previous report from the indicated that only 50% of quotas were fulfilled between 1988-1992 (Creel & Creel 1997). The status of the lion population outside the protected area system is unknown, however a large number of attacks on people and livestock have been reported across the region, suggesting a high potential for conflict between lions and people (Packer et al. 2005).

Leopard
There is very little information on leopards from the region. The Tanzania Carnivore Program has received reports of leopards from the Udzungwa and Mikumi National Parks, and the Selous Game Reserve, and a few sightings to the east of the Selous. There is no information from elsewhere in this region and no information on densities or trends. Wildlife Division reported that trophy quotas are being met across the entire area, and leopards are certainly present in the Selous and Mikumi, and likely to be present outside the protected areas provided sufficient habitat exists, but there is little specific information on this species.

4.1.5   The northwest – Ibanda; Burigi; Kagera; Buramulo

Lion
The Tanzania Carnivore Program has no records of sightings of lion in this area. However lions are known to be present in the Kagera complex, but the population is likely to be low, estimated at around 177 (Chardonnet 2002), with an estimated 57 lions in Biharamulo and Burigi Game Reserves, 20 lions in Ibanda and Rumanyika Game Reserves, and 100 lions in the surrounding area. The status of lions in this area is unknown.

Leopard
Leopards are present in the area in suitable habitat, as Wildlife Division reported that hunting quotas were being met, but their distribution and status is unknown.

4.1.6   Other – Tabora; Dodoma; Northern coast – Saadani; Southern Highlands; Zanzibar

Lion
Lions are known to be present around Dodoma and Swaga Swaga Game Reserve (Fig. 9). The area to the south of Dodoma and Swaga Swaga also has some potential for lions, although we have no records of sightings in the area. Lion are also likely to be present around Tabora, particularly around Itigi thicket. Along the northern coast, lions are present in Saadani National Park, however they are not present in the Pare or Usambara mountains. Their presence in the Ulugurus and southern highlands is unknown. The status of lions in any of these areas is unknown.

Leopard
Leopards are present around Dodoma and Swaga Swaga, also around Tabora in the vicinity of Itigi thicket (Fig. 10). They are present along the northern coast in Saadani National Park, Udzugnwa National Park, the Ulugurus, but are thought not be to present in the Pare and Usambara mountains. In the southern highlands their distribution is unclear, however they are known to be present in Mpanga-Kipengere Game Reserve. Unfortunately, there is no evidence that the leopard population in Zanzibar is still extant. There is no detailed information on numbers or trends of leopards in any of these areas.

4.2 How to get information on status: Available methods

There are several methods that can be used to survey large carnivores. Which method is selected for use depends on the questions that need to be addressed and the suitability of that method for a particular region (Norton-Griffiths 1978). Key methods appropriate for lion and leopard surveys identified in this workshop follow those identified by the International Cheetah Monitoring Workshop held in Tanzania in June 2004 (Bashir et al. 2004). They include spoor counts, radio collaring, line transect surveys, tourist photos, detection dogs, questionnaires, camera trapping and visual search. Additional methods relevant for lions and leopards are call-in playbacks, official records of attacks, trophy hunting records, baiting, and roar counts. Each was discussed as below, and a list of their main advantages and disadvantages compiled.

4.2.1 Questionnaires

Questionnaire surveys of residents within a region can be used to collect information on lion or leopard in two key ways. Firstly, they can be used as a simple presence/absence survey, by gathering information from residents in an area on sightings. Secondly, they can be used as an in depth survey to not only gather information on distribution, but also to assess levels of conflict with people, threats and attitudes of residents to lions and/or leopards in their area. All data gathered through questionnaire surveys needs to be interpreted with caution, as interviewees will not necessarily respond honestly and openly to questions.

Advantages
- Perhaps the only feasible method for mapping distribution at a national scale
- Relatively cheap
- Relatively low manpower demands
- Can be implemented by relatively unskilled field workers.
- Can provide extra information on potential threats – such as conflict with people and good local areas for lions.

Disadvantages
- Provides only very coarse data – cannot detect local changes in population density.
- Provides no information on other potentially important factors such as demographics, ranging patterns and disease.
- Requires highly skilled labour when combined within a GIS framework.

4.2.2 Spoor counts

In this method a vehicle is driven at a slow speed along existing tracks with a dusty or sandy covering that has a good potential to show spoor or tracks or a lion or leopard. The vehicle should be mounted with a specially modified chair on which a skilled tracker can be seated. The tracker should record all spoor that is fresh (less than 24 hours old) seen on the track. This information is then used to generate a spoor frequency, i.e. the number of kilometres travelled per spoor detected (Stander 1998), which can then be used as an index of density.

Advantages
- Relatively easy to implement
- Can provide presence/absence data, relative abundance providing soil substrate and habitat similar, trends, and density if calibrated against a known density
- Low technology
- Relatively cheap
- Trackers are in most cases available
- Can provide information about other carnivores in the area
- Can be used in areas where animals are shy and hard to locate
- Can be used at all times of year

Disadvantages
- A suitable soil substrate required in order to detect spoor
- Relies on accurate identification of spoor
- Relies on a good network of roads or trails
- Relies on highly skilled trackers
- Time intensive

4.2.3 Driven or walked transects

In this method transects are driven and all individual lions and leopard seen are counted along the transect line. For optimum effectiveness distance based methods should be used (Buckland et al. 1993) whereby the distance of each individual or group seen from the transect line is recorded. The data can then be analysed with DISTANCE software (Buckland et al. 1993) and used to generate an estimate of overall density. The method relies on a sufficient number of lion or leopard groups to be seen and recorded – generally a minimum of 30 groups are needed for a reasonably accurate estimate of density. This makes it unsuitable for use in areas where lion and leopard are rarely seen or are very shy. In Tanzania its use is probably limited to open areas such as the Serengeti plains, and hence is unlikely to be suitable for leopards as they are not found in open habitat.

Advantages
- Relatively easy to implement
- Relatively cheap

- Can provide other useful data such as densities of other carnivores in the area

Disadvantages
- Will not work in areas where animals are very shy
- Will only work in open areas – cannot be used in bushy areas where animals are difficult to see – hence useless for leopards
- Distribution of lions is very clumped resulting in high variances

4.2.4 Detection dogs

In this method highly trained domestic dogs are used to find lion and/or leopard scat, in much the same way as dogs are used by the police to find narcotics. Scat can either be counted in much the same way as spoor counts (see below) to give a density estimate, or DNA can be extracted and typed to provide a unique genotype that can then be used in a mark-recapture analysis framework to provide a more accurate estimate of density. The method has been used successfully in the US to estimate population densities of several carnivore species, including kit foxes and grizzly bears (Smith et al. 2003; Wasser et al. 2004), however, aside from a training program conducted by the Serengeti Cheetah Project in Laikipia in July 2004, the method is largely untested in Africa. The training program demonstrated that it is possible to train Kenyan dogs to locate and distinguish wild dog and cheetah scat from other scat such as that from jackals, it is unlikely that lion or leopard scat would present a problem.

Advantages
- Potentially useful outside protected areas
- Can provide genetic samples for individual identification and hence accurate monitoring
- Genetic samples can provide extra information – such as population structure
- Scat samples can provide extra information on diet
- Relatively cheap to implement (except when using DNA analysis).

Disadvantages
- Method untested in Africa
- Requires training of both dogs and handlers
- DNA analyses currently expensive and labour intensive
- Would require a change in permit regulations to be used inside protected areas
- Requires good veterinary care

Requirements
- Requires good safety protocols and pre planning
- Dogs require frequent breaks when working
- Dog needs to be bonded with handler

Proviso – working dogs must be vaccinated, dewormed and certified disease-free to prevent introduction of diseases.

4.2.5 Camera traps

For this method cameras are positioned along animal trails which show active use, and linked to a beam that detects any changes in infrared in front of the camera, such as that which occurs when an animal moves along the trail. Whenever such a change is detected the camera takes a photograph, hence the expression 'camera trap', and in so doing produces photographic evidence of the carnivore community in an area. Photographs of leopards can be used for individual recognition as each leopard has unique markings; lions are more difficult to recognise by photographs as they are usually recognised through whisker spot patterns and these are not always photographed in camera traps. Once they are put in place, the cameras are generally left undisturbed for a minimum of two months, except for battery checks and changing film. Individual animals are recognised from their photographs and a library established of individuals within an area. Mark recapture analysis is then used to estimate population size. The technique has been

very effective for surveying tigers and jaguars (Karanth & Nichols 1998; Silver et al. 2004). The method works best in forest and for species with relatively small home ranges.

Advantages
- Useful in forested and bushy areas where visibility is poor and most of the other methods difficult to implement and where there are good trails
- Can provide accurate density estimates when using individual recognition.
- Can provide useful other additional information such as the carnivore and prey community in an area
- Proven to work for leopards in Africa in Gabon and possibly Tarangire

Disadvantages
- Method has never been shown to work well for lions
- Set up equipment is costly and can only be used in relatively secure areas, otherwise likely to be stolen.
- Works best for species with relatively small home ranges.

In savannah habitats, congregations of ungulates, birds or primates can trigger the camera and result in an entire film being taken in a matter of hours – this will not be a problem if digital cameras are used.

4.2.6 Tourist photos

This method relies on encouraging visitors to an area with lions and leopards to send in photographs that they take of any individual animals that they see. The photographs can then be used to individually identify lions and leopards and build up a profile of population size and structure. Such a scheme has been shown to have potential for monitoring cheetah in highly visited areas such as the Serengeti plains (Shemkunde 2004) and for uncovering the history of the Ngorongoro Crater lion population (Packer & Pusey 1987). The Tanzania Carnivore Project has such a scheme in place for cheetah – the Cheetah Watch Campaign, which is receiving photos in increasing numbers. The method was originally initiated at the end of 2000 in the Serengeti region only and has generated data sufficient for monitoring. The method, because it makes use of tourists, can potentially cover large areas of Tanzania, and hence can be useful for tracking individual animals across long distances, and hence for establishing the location of dispersal corridors.

Advantages
- Good for areas well visited by tourists
- Relatively easy to implement, provided an infrastructure exists.
- Has potential to provide good information on population size and demography.

Disadvantages
- Not suitable for areas seldom visited by tourists
- Depends on promotion by tourism industry to be successful
- Requires active promotion e.g. production of promotional materials such as leaflets
- Can be time consuming to implement and requires reasonably well trained manpower and technical infrastructure (storing, library etc.).
- Tricky to use for lions as identification depends on good photos of whisker spots
- Works less well in areas with low domestic tourism

4.2.7 Visual search

This method relies on an observer locating lion or leopard from a vehicle without using aids such as radio collars but by relying entirely on visual cues such as via binoculars or spoor. Since lion and leopard range widely and are largely nocturnal, relying on visual search is unlikely to generate sufficient information for monitoring.

Advantages
- Can provide good information on the population

Disadvantages
- Will not work in areas where lions or leopards are shy
- Unlikely to work at all for leopards
- Requires highly skilled personnel able to locate and follow lions and leopards – particularly the latter
- Extremely expensive in terms of money and manpower for relatively poor information reward
- Very time consuming
- Highly labour intensive
- Unlikely to generate sufficient information for monitoring outside the Serengeti Plains

4.2.8 Radio collaring

With this method VHF, GPS or satellite collars are fitted to a lion or leopard to enable relocation or recording of position. For most such collars, the collar allows subsequent relocation of the collared animal, due to a signal transmitted from the collar, either to a VHF receiver, or via a satellite. Some GPS collars do not transmit a constant signal, but store GPS reference points visited by the animal, at a set rate (once, twice or several times a day) and transmit a signal only when they drop off after a set time, to allow them to be located and the data retrieved and downloaded to a computer. In order to fit the collar the lion or leopard has to be immobilised, usually by darting. The method allows the collection of accurate data on ranging patterns that are not biased by habitat visibility, unlike methods relying on visual relocation. However because lions and leopard are often shy and hence are difficult to dart, it is not always possible to collar all individuals in a study area and hence these methods are not amenable for total counts. Instead density can be estimated using a generally held assumption of territoriality and from estimates of territory size and extent of overlap. Alternative capture techniques such as those using leg hold traps, are better as, although, unlike darting, they can be used to capture shy animals. Using playbacks of species specific female calls/roars to targeted individuals (i.e. within a radius of 100 m to 1000 m) have been used to facilitate darting attempts of shy animals since they will lure resident leopards/lions to the speaker (Whitman, pers. comm.). It is worth noting that for some GPS collars, the collar must be removed from the individual to be downloaded — thus making collar retrieval critical. Placing such GPS collars on lions or leopards which are likely to be killed by humans risks losing all data that the collar may have recorded.

Advantages
- Can provide a huge amount of data, not only on population size, but also on disease monitoring, ranging patterns, identification of threats to the population and demographic information including birth and survival rates
- Relatively low manpower demands
- Very accurate for territorial species as establishes density through home range size
- Gives good information on movements including habitat use, avoidance/attraction to people/livestock etc., particularly when used in a GIS framework

Disadvantages – general
- Requires a well-trained veterinarian to minimise any potential risks of immobilisation
- Not popular with tourists unless accompanied by good PR

Disadvantages – for satellite and GPS collars only
- Satellite and GPS collars are expensive
- Relatively expensive
- Some satellite/GPS collars may require substantial support from manufacturers including further costs for data downloads
- Makes use of relatively complicated technology – and hence implementation requires some training.

Requirement
- Collar should be as small and light as possible

4.2.9 Call in playbacks

In this method a sound of a kill – an animal dying or hyaenas at a kill - is played at a loud volume, usually between 110-120DB, for a standardised time, usually one hour, and the numbers of individuals attracted to the sound are individually identified when possible and counted. Lions often scavenge kills from other predators, and hence can be attracted by the sound of kills. Although leopards have been known to respond to hyena call-ins on occasion (Maddox 2002, Whitman 2006), they are unlikely to be attracted to lion or hyena kills thus generally limiting the use of such call-ins to lions. However resident adult leopards of both sexes will readily respond to call-ins of female leopard roars when played within close proximity (<500 km radius) (Whitman, unpublished data).

Advantages
- Relatively easy to implement
- Relatively cheap
- Provides data on presence

Disadvantages
- Open to interpretation and bias – e.g. lions with young cubs won't come in, and lions in different habitats respond in different ways to different calls (for a thorough discussion see Whitman 2006).
- Depends on hunger level and prey availability
- Does not provide much other useful information.
- Will not work for leopards – lions only.
- Lions do not respond to playbacks in areas where they are persecuted
- There is a problem with habituation after repeated surveys

4.2.10 Hunting records

Official records are kept by hunting companies and Wildlife Division (WD) on trophies in each concession. The government requires information on trophy size, and, more recently, age. Whilst information on trophies needs to be interpreted with caution, it can be used to assess age structure and potentially past trends.

Advantages
- Indicates presence
- Consistent information on trophy age and size can be used to indicate population trends
- Good central record keeping by WD
- Historical measurements of trophies exist which may be useful for evaluating past trends
- Low cost – information already present
- WD has independent measurements of trophy size for leopards

Disadvantages
- Age has not been recorded until recently
- Inconsistent trophy measurement methods and record keeping by hunting operators
- Stored as paper copy, not electronically

Comment – access to data is granted through an approved government procedures

4.2.11 Records of attack

Records are kept by Wildlife Division in Dar and at district level on any reports of attacks on people and livestock. The main problem with these records is that reporting is seldom consistent between and within regions, especially for livestock attacks.

Advantages
- Indicate presence
- Indicate conflict hotspots
- Centralised record keeping

- Data are available at WD and district offices
- Records for man eating very reliable over most of the country

Disadvantages
- Records of livestock attacks are under reported and inconsistent.
- There are cultural variations in reporting (e.g. Maasai under report attacks).
- Records available only as paper copy – there is no centralised electronic database.

4.2.12 Baiting

This technique uses bait to attract lions and leopards to an area for research and information - not for hunting. A well designed baiting survey in an area where animals are attracted to bait can yield information on numbers and density if combined with individual recognition of the animals coming to bait and a total count. It can also yield information on presence when not used in a rigorous design or without individual recognition.

Advantages
- Establishes presence
- Repeated baiting in an area over several sites can provide information on trends and allow monitoring of individuals
- May attract other carnivores which can provide useful information about predator community

Disadvantages
- Labour intensive
- Cost of providing bait
- Most appropriate for leopard – not as effective for lion
- There are potential consequences of conflict for local people if not planned carefully
- Ineffective in many areas, particularly with a history of poisoning

4.2.13 Roar counts

In this technique observers are stationed across a site over night and count roars through the night.

Advantages
- Indicates presence
- Can provide a crude estimate of density if calibrated against a population of known density at the same time

Disadvantages
- Only useful for extrapolating densities around known populations
- Not good in areas of high conflict where lions are known to roar less frequently
- Cannot show absence

4.3 Status Summary

The group agreed that there was a need for more information on the status of lions and, particularly, leopard across the country. Different regions are likely to have different specific needs, depending, in part, on what information already exists. Overall, status information needs can be broken into different levels depending on the quality of the data required: distribution, population trends, density, demographic parameters such as survival and reproduction and ranging patterns. Sex ratio is also a useful measure for managers of hunted species – as males are hunted and females are not. Different areas are likely to require data of different quality depending on what data already exists and likely threats. The methods available to gather relevant data on status are listed above and are summarised in Table 2 according to the types of information they can potentially provide on lion and leopard status. Not all methods will work in all

areas, for example photo surveys can only work in an area which is regularly visited by tourists and spoor surveys in areas with sufficient tracks and suitable substrate.

a) Lion

	Distribution	Relative Abundance	Sex ratio	Age structure	Trends	Density	Ranging	Demography
Questionnaires	Y	Y (qualitative information only)	N	N	Y (qualitative information only)	N	N	N
Spoor (where substrate suitable)	Y	Y (in similar habitat and soils	Y	Possible (for adult lions with good tracker)	Y	Y (if calibrated)	N	N
Hunting records	Y	Y	N	N	Y (see notes)	crude	N	N
Records of attacks	Y	N	N	N	N	N	N	N
Baiting (where animals respond to bait)	Y	Y	Y	Y	Y	Y (using individual recognition)	N	Possible (using individual recognition)
Roar surveys (lions only)	Y	N	N	N	N	N	N	N
Call-in playbacks	Y	crude	crude	N	crude	crude	N	N
Tourist photos (where sufficient visitors)	Y	Y	Y	Y	Y	Y	Y	Y
Working dogs	Y	Y	Y	crude	Y	Y	Y	N
Camera Traps	Y	possible but crude	possible but crude	possible but crude	Y	N	N	N
Radio Collars	Y	Y	Y	Y	Y	Y	Y	Y

b) Leopard

	Distribution	Relative Abundance	Sex ratio	Age structure	Trends	Density	Ranging	Demography
Questionnaire	Y	Y (qualitative information only)	N	N	Y (qualitative information only)	N	N	N
Spoor (where substrate suitable)	Y	Y (in similar habitat and soils	unverified	unverified	Y	Y (if calibrated)	N	N
Hunting records	Y	Y	N	N	Y (see notes)	crude only	N	N
Records of attacks	sparse	N	N	N	N	N	N	N
Baiting (where animals respond to bait)	Y	Y	Y	Y	Y	Y (using individual recognition)	N	Possible (using individual recognition)
Roar surveys (lions only)	NA	NA	NA	NA	NA	NA	NA	NA
Call-in playbacks	NA	NA	NA	NA	NA	NA	NA	NA
Tourist photos (only where sufficient tourists)*	Y	Y	Y	Y	Y	Y	Y	Y
Working dogs	Y	Y	Y	crude	Y	Y	Y	N
Camera Traps	Y	Y	Y	crude	Y	Y	crude	Y (adults and over multiyear survey)
Radio Collars	Y	Y	Y	Y	Y	Y	Y	Y

* assumes leopards are habituated

Table 2. **Data generated by the different methods covered in the sections above for a) Lions and b) Leopards. In each table Y indicates that the method could generate appropriate data, N the method could not generate appropriate data, 'crude' the method might generate some appropriate data, but it will be crude and open to interpretation and 'possible' indicates that whilst the method could theoretically generate the appropriate data, it is unlikely that sufficient data would be collected to fulfil the objectives. NR indicates the method is not applicable.**

No single technique generates good information under all categories. Potentially worthwhile techniques able to generate the full data requirements for lions include tourist photo surveys (but these are unlikely to be applicable in most areas because of a lack of visitors) and detection dogs, which shows much potential but is currently untested in Africa (Table 2a). The only technique which is tested and is known to generate the full range of data is radio collaring. However

managers and policy makers don't always require such detailed data, but may require more crude data across a wider area. In these situations official hunting records and records of attacks are particularly useful, as the data are already in existence, and merely needs to be collated. It is worth noting that all the experts in the group felt that call in playbacks, a technique used extensively, were likely to generate unreliable data which is difficult to interpret. This is because lion responses to call-ins varies greatly between regions, between individuals, and researchers often use different or inconsistent techniques for both the call-ins and in analysis (cf. Whitman 2006). For example lions are much less likely to approach call-in playbacks in areas with a lot of human/lion conflict as they are much shyer in these areas, whilst females with cubs are much less likely to approach call-ins (Whitman 2006).

Each method's relevance for gathering data on leopards is similar to that for lions. Again the best method to reliably assess all the elements of leopard status from ranging patterns through to demography is probably radio collaring, however tourist photos and detection dogs also show potential (Table 2b). Tourist photos are much less reliable for leopards than for lions as leopards are harder to find and tend to be much less habituated to people. Also, although, as with lions, official records are potentially useful for providing broad brush information on distribution, leopards attack people less frequently than lions, and so this information is not likely to be as useful for this species as for lions. Questionnaires and spoor counts can also provide broad sweep information, and whilst baiting can provide a lot of useful information, it only attracts one individual at a time and is therefore is less productive at generating data than for lions.

5. CONSERVATION THREATS

After a thorough discussion of distribution and abundance, together with available methods for gaining more information, the group moved on to examine potential threats to lion and leopard conservation in Tanzania. The group identified the following threats as relevant to both species falling under 5 key categories – (1) prey; (2) land use change; (3) anthropogenic killing; (4) inadequate management; and (5) disease:

Prey availability
* Overall loss
* Change in prey - to livestock
Land use/cover change
* Habitat conversion
* Resource extraction
* Fragmentation
Anthropogenic killing
* Retaliatory
* Snaring
* Road kills (leopards only)
* Cultural
* Illegal international trade (leopards only)
Inadequate management
* Lack of a clear legal framework in GCAs and open areas
* Outdated Laws
* Inadequate resources, personnel and data
Disease

Each are discussed in detail below

5.1   Prey availability

If lions and leopards are able to remain in an area there needs to be a sufficient prey base. This is particularly true for lions, as they are more selective in their prey than leopards. Leopards can survive on a wide variety of prey ranging from very large prey such as zebra and buffalo through to very small prey such as birds and hares, and, in human modified landscapes, leopards are even able to subsist on a diet of domestic dogs (Edgaonkar & Chellam 1998). Natural prey can be lost from habitats due to overall loss, perhaps because of poaching or habitat destruction, or because of grazing competition with livestock, leading to their replacement by livestock. Regardless of the mechanism of loss of prey, a reduction in lion and leopard numbers is likely to result. However where wild ungulates are replaced by livestock, increased conflict with people is likely to result, as lions and leopards are more likely to switch to livestock when their natural prey declines.

5.2   Land use/cover change

Habitat loss and land use change pose a threat to wildlife, particularly large carnivores which live at relatively low densities and range across large areas. Lions and leopards do not occur in wholly agricultural landscapes and so agriculture is expected to limit movements to some extent and an increase in agriculture will reduce overall range. Both species are likely to be able to pass through limited and patchy agriculture, but unlikely to be able to pass through dense areas of crops. Therefore the intensity of agriculture is likely to have an impact on movements, particularly of lions, as they pass through patchy agricultural landscapes less easily than leopards because of their larger size and greater visibility. Ensuring that sufficient habitat remains for both species are high priorities if this threat is to be mitigated.

5.3   Anthropogenic killing

Across communites lions and leopards are perceived as posing the greatest threat to both people and wildlife (Maddox 2002). Both lions and leopards may attack livestock opportunistically, particularly when natural prey has been depleted and when livestock is insufficiently protected especially at night (Hemson 2003, Ogada et al. 2003). When this happens it often elicits an aggressive response from people, who will often hunt down, snare, or poison a lion or a leopard after an attack. Very often, if an animal is killed in response, it is not necessarily the individual responsible for the original attack, particularly if indiscriminate methods are used such as poisoned bait. Studies have shown that once predators start attacking livestock they are much more likely to do so again (Woodroffe & Frank 2005). Therefore whilst lethal control of a livestock predator may be the most appropriate option, if the wrong predator is killed in response, then this risks decreasing the non-livestock killers in a community, whilst the livestock killers are unaffected, and possibly reproducing. Thus if a retaliatory killing is to occur after a livestock attack, it should be a targeted response rather than indiscriminate, to lessen the likelihood of exacerbating the situation.

Lions and leopards do not just attack livestock, but may also attack and kill people. In Loliondo Game Controlled Area, Ngorongoro Conservation Area, Simanjiro and Ruaha region lions consistently rank as the most fearful and potentially harmful predator (Lichtensten 2005, Maddox 2002, Dickman 2005).The extent of lion attacks on people was documented by Packer et al. (2005) and has resulted in more than 560 lethal attacks reported since 1990. Leopards are less likely to attack people, however they do still present a threat. Retaliatory killing is frequent after attacks on people, and the authorities will try and kill a man eater, however, as with livestock attacks it is important that the target individual is removed and not a relatively benign individual which may be keeping other, more dangerous, predators out. It is important to maintain good records on problem animal control.

Whilst retaliatory killing is likely to be one of the biggest threats to lions and leopards, other forms of anthropogenic killing are also significant threats. Both species are attracted to animals caught in snare lines and hence can get caught in snares themselves, although the impact of snares at the population level is not known. Cultural killing can also have an impact. For example, Maasai morani, gain considerable respect in the community as well as valuable gifts, such as cows if they are the first to put their spear into a lion. Other groups may kill leopards for their skins. These activities are not thought to have a major impact on the population at present, and may even be positive in that the cultural groups concerned are likely to value lions and leopards because of these benefits and hence may be more likely to aid their long term survival. However it needs to be monitored and assessed. For example, around Tarangire, lions receive the brunt of Maasai aggression against livestock-raiding carnivores (e.g. 82% of lion attacks on cattle result in Maasai retaliation, usually via spearing, versus 67% of leopard attacks and 9.5% of hyena attacks; Lichtenfeld 2005).

Leopards appear to be more likely to be killed on roads than lions, and their silky and patterned fur makes them more vulnerable to resumption in international trade. However neither of these threats are thought to have a major impact on the population at present. Fast tarmac road coverage is limited in Tanzania, whilst wild cat fur is currently not popular in the international community. The possibility of an extension of the Chinese medicine trade to include these species remains a possibility that should be monitored.

Although there have been previous reports that trophy hunting could have a negative impact on lion and leopard populations (Creel & Creel 1997), the participants did not raise this issue as posing a current threat. The targeting of immature lions (<5yrs) by hunters has the greatest impact on populations (Whitman et al. 2002, in press).

5.4 Inadequate management

Many of the threats to lions and leopards, including those listed above, can be linked to issues to do with management. For example, indiscriminate retaliatory killing, such as poisoning, might result because the local district office has not responded sufficiently rapidly to a request for problem animal control. Another example is that the lack of a clear legal framework outside protected areas and outdated laws leaves communities with little say in the way wildlife resources are used in their areas, and little clear benefits. Whilst these are being addressed through the Wildlife Management Area (WMA) framework, few WMAs have yet received formal approval. Many aspects of inadequate management often results from a lack of resources and personnel, as well as insufficient information, such as can be gained by monitoring. There are also often problems of access, particularly to remote areas in the wet season.

5.5 Disease

Disease has been shown to impact lion populations, when canine distemper virus decreased the population of lions in the Serengeti National Park by up to one third in 1994. However, to date, it has not resulted in the extinction of a lion population, and its impacts on leopards are unknown.

5.6 Summary

The group, in general, agreed that retaliatory killing, land use/cover change and the problems resulting from inadequate management were the most important factors affecting lion and leopard conservation in Tanzania. Other potential threats, such as road kills, snaring and disease were either thought to be unlikely to be of major significance, although there is a need for more information on the impacts of these threats to determine whether this assumption is valid.

	Prey Availability		Land use/cover change			Anthropogenic Killing					Inadequate management			Disease
	Overall loss	Change in prey to livestock	Habitat conversion	Resource extraction	Fragmentation	Retaliatory	Snaring	Road kill	Cultural	Illegal trade	Lack of a clear legal framework in LGCAs and open areas	Outdated Laws	Inadequate resources, personnel and data	
Questionnaires	Y	Y	Y	Y	Y	Y	Y	Y	Difficult	Difficult	Y	Y	Y	Difficult
Spoor (where substrate suitable)	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
Hunting records	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Records of attacks	N	Y (if reported)	N	N	N	Y	N	N	N	N	N	N	N	N
Baiting (in areas where animals respond to bait)	N	N	N	N	N	N	Limited	N	N	N	N	N	N	N
Roar surveys (lions only)	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Call-in playbacks (lions only)	N	N	N	N	N	N	Limited	N	N	N	N	N	N	N
Tourist photos (where sufficient visitors)	N	N	Limited	N	N	N	Limited	Limited	N	N	N	N	N	Limited
Detection dogs	N	Possible	N	N	N	Possible (poisoning only)	N	N	N	N	N	N	N	Y
Camera Traps	Y	Y	N	N	N	N	Limited	N	N	N	N	N	N	N
Radio Collars	N	Y	N	N	Y	Y	Y	Y	Limited	N	N	N	N	Y

Table 3. Data on threats and constraints generated by the different methods for investigating lion and leopard status covered in 4.2. Y indicates that the method could generate appropriate data, N that the method could not generate appropriate data, 'limited' that the method is likely to generate some appropriate data and 'possibly' that the method might generate appropriate data but is as yet untested. Additional conditions on the method to supply appropriate data are listed where necessary.

The techniques discussed in section 4.2 for gathering information on lion and leopard distribution and status are potentially also useful for collecting information about threats (Table 3), and hence the choice of a particular technique might depend on what other information the technique might additionally provide. For example a questionnaire survey could potentially provide information on persecution and land use change, and even on some easily recognisable diseases such as rabies, whilst spoor surveys, working dogs and camera traps could provide information on the other predators (and prey) in the ecosystem. Radio collaring, because it involves handling, has the potential to provide good information on many diseases if a blood sample is collected, and because it is easier to monitor individuals, information on deaths due to disease, anthropogenic killing, snaring and road kills. It can also be used to locate individuals for in depth behavioural observation which might provide additional information about the impacts of interspecific competition. Finally, although radio collaring itself is not appropriate for assessing the direct consequences of land use change, it can provide information about how this threat affects ranging patterns, and hence be used as a tool to inform managers and policy makers about the management of land adjacent to protected areas.

6   Conservation and Research Priorities

In this last part of the meeting the group addressed priorities for lion and leopard conservation and research in Tanzania. The inputs from the management authorities from WD, TANAPA and NCAA were particularly important for this session. The group used the log frame generated by the southern and east African international lion workshop to guide this discussion. In this meeting experts in lion conservation and protected area management, including representatives from all national wildlife authorities from each range state, identified the main problems affecting lions, which broadly overlap with the conservation threats facing lions and leopards in Tanzania as identified in section 5, a set of targets to address these problems, and a suite of activities to address each target. Five of the participants in the regional workshop, proposed to use this plan, and this was approved by all participants. In this process the log frame from the regional workshop was used to guide recommendations for Tanzania activities to address the identified international goals. Although the log frame was devised for lions, it was also broadly applicable to the leopard, as both species face similar threats.

Overall, Tanzania already has many activities in place, as recommended in the log frame. These include the trial establishments of WMAs, which, provided they are approved, will address many of the socio-economic factors listed in the plan. The Tanzania Carnivore Program, under TAWIRI and WD are addressing many of the data gathering requirements. For lions specifically, there are two active lion conservation and research projects, which are addressing more specific community issues at a local level, however there is as yet, no project specifically addressing leopards. Two students operating under the Tanzania Carnivore Program are investigating conflict and land use issues for all carnivores in Ruaha and Simanjiro. A number of international priorities were not seen as particularly relevant for Tanzania to address at a national level. Specifically, some of the international activities under policy and land use and politics, whilst Tanzania already maintains its protected areas well, and hence sees no need to markedly increase protection for these areas as part of this plan.

The group agreed on the following key immediate information needs for **lions and leopards**:

1.   Information on anthropogenic threats targeting conflict hotspots (Craig Packer to provide map of conflict hotspots, Alex Lobora to provide last of the wild map for Tanzania)
2.   Research on effectiveness of existing and development of new mitigation strategies (protection against man eaters and livestock killers and reducing dependence on local natural resources)
3.   Information needed on status in representative areas

4.   Addressing gaps in knowledge of distribution
5.   Movement of leopards and lions between NCA and surrounding game reserves and GCAs
6.   Within National parks information needed on status and movements of lions on small parks (Manyara, Mikumi, Tarangire, Arusha) and where there is human/lion conflict.
7.   Central GIS resource which includes land use, vegetation, land cover, human population, hydrology, rainfall, altitude

Recommendations:
To require hunting operators to provide GPS locations of where each trophy was shot to WD.
To require game scouts within Game reserves and pilot WMAs to provide GPS locations of lion sightings to WD.

Lion – information needs:

1.   Information needed on status and threats in west Tanzania – between Ruaha and Kigoma
2.   Address information gaps on status and threats
3.   Information needed on density

Leopard - Information needs:

1.   Establish a good map of conflict hotspots
2.   Information on anthropogenic threats targeting conflict hotspots (CP to include map of conflict hotspots, AL to include last of the wild map for Tz)
3.   Research on effectiveness of existing and development of new mitigation strategies (protection against man eaters and livestock killers and reducing dependence on local natural resources)
4.   Information needed on status in representative areas
5.   Addressing gaps in knowledge of distribution
6.   Movement of leopards and lions between NCA and surrounding game reserves and GCAs
7.   Within National parks information needed on status and movements of leopards in small parks (Manyara, Mikumi, Tarangire, Arusha) and where there is human/leopard conflict.
8.   Central GIS resource which includes land use, vegetation, land cover, human population, hydrology, rainfall, altitude
9.   Information on the threats posed by international and local trade in skins/parts

6.1 The Way Forward

Managers need information on the status and threats to lions and leopards in their areas to plan management activities and to enable lion and leopard conservation, as well as assessing the impact of these activities on their conservation. All participants are proud of Tanzania's international status for lion and leopard conservation, and wish to maintain this reputation. The hard work that participants put into this workshop and report reflects this wish, and will hopefully lead to a more effective lion and leopard monitoring and management programme, with sustainable hunting for the foreseeable future, hand in hand with training and capacity building.

Acknowledgements

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Appendix I

Participants

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Appendix II

Logical Framework for the strategic plan

Objective	Target	Activity	Focus	Tanzania Action	Responsible
MANAGEMENT: To ensure effective conservation and management of lions/leopards, their habitats and wild prey	Monitoring and survey programs for effective and adaptive lion/leopard conservation established throughout the lion/leopard range within 3 years	Develop and set up monitoring programs	National	Improve and maintain national hunting records	WD
			National	Improve and maintain national human-lion/leopard conflict reports	WD
			National	Improve and maintain national Tanzania carnivore program database	TCP at TAWIRI
			Regional	Maintain long term monitoring of lions in the Serengeti	Serengeti Lion Project
			National	Standardize reporting systems	WD
			Regional	Develop monitoring programs surrounding protected areas	PPF
			Regional	Improve and maintain regional human-lion/leopard conflict reports	WD
			Regional	Maintain long term monitoring of lions in Tarangire	Tarangire Lion Project, PPF
			Regional	Establish a monitoring program for lions in the Selous Game Reserve	Serengeti Lion Project
		Identify and procure appropriate equipment	National	provide internet, e-mail, computers to allow data to be reported and disseminated	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
		Identify key areas for data collection: ecological data, trade data, socio-economic data, etc.	National	Continue to Develop TSED at National Level to develop poverty map	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Develop National GIS Databases	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	NORAD MNRT Program	
			Regional	Look at each regional area to prioritise data collection	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Train personnel in data capture, management and analysis	National	Savannahs Forever staff	Savannahs Forever
			National	Carnivore Centre staff	TAWIRI, ZSL and WCS
			National	Improve training at colleges & universities	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	TANAPA, NCAA, WD staff	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Identify regional stakeholders who have capacity to provide training	David Erickson through TNRF
			Regional	Establish regional training programs	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Improve systems for carrying out collaborative surveys across borders with shared lion/leopard populations	Regional	Selous-Niassa	WD, FBD and TAWIRI to co-ordinate with Direcçao Nacional das Areas de Conservaçao in Mozambique, PPF to provide support.
			Regional	Serengeti-Mara	TANAPA, WD, FBD, NCAA and TAWIRI to co- ordinate with KWS in Kenya
			Regional	Western Kilimanjaro - Amboseli	TANAPA, WD, FBD and TAWIRI to co-ordinate with KWS in Kenya
			Regional	Tsavo-Mkomazi	TANAPA, WD, FBD and TAWIRI to co-ordinate with KWS in Kenya
			Regional	Akagera-Ibanda-Burigi	TANAPA, WD, FBD and TAWIRI to co-ordinate with UWA and Office Rwandais du Tourisme et des Parcs Nationaux
		Carry out national lion/leopard surveys	National	Improve and expand on-going surveys	NGOs[1] with TANAPA, WD and TAWIRI
		Develop and maintain harmonized data bases at National and Regional levels	National	Modify existing lion & leopard databases to meet IUCN CSG standards	NGOs[1] with TANAPA, WD and TAWIRI

[1] NGOs with representatives at this workshop were PPF, Savannahs Forever, TNRF, WCS and ZSL

Objective	Target	Activity	Focus	Tanzania Action	Responsible
	Targeted research on ecology manage-ment and mitigation of conflict initiated in representative priority areas in each range state within 2 years	Disseminate information as appropriate	National	Carnivore Program newsletters to be maintained and translated into Swahili & web site maintained	TCP at TAWIRI
			National	Press releases for national press, other newsletters & publications	TCP at TAWIRI
			National	Disseminate relevant lion & leopard news clippings & video	Swara, kakakuona, miombo, hunting in-sight, national geographic to be disseminated by TCP at TAWIRI
			National	e-mail discussion groups	TCP at TAWIRI
			National	Improve WD public relations	WD
			National	Conduct regular conservation organisation stakeholder meetings	TANAPA, WD, FBD, NCAA and TAWIRI
			National	Disseminate reports from research to TAWIRI/WD/TANAPA/NCAA	TCP at TAWIRI
			National	Put the TAWIRI Carnivore Centre Library on-line	TCP at TAWIRI
		Identify and prioritize biological and socio-ecological research needs	National/Regional	TAWIRI Framework for stakeholder input	TAWIRI
		Standardize methodology where collaborative research is needed	NR	Already identified	NR
		Develop and carry out research projects in identified areas and aspects	National/Regional	Facilitate research projects in priority areas	Reports from research to TAWIRI/WD/TANAPA/NCAA
	Capacity building programs for lion/leopard conservation where possible in tandem with research and monitoring, established in 0% of the extant lion/leopard range within 5 years	Identify national and regional training needs	National	Increase training in graphic design and visual communication for use in outreach.	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National/Regional	Increased training for database design and management	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Increased training for GIS and remote sensing	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Increased training for web site development and management	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			Regional	Training in data collection and entry (to enable standardised data to be input into national database)	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Increased training for grant and proposal writing	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
		Identify and procure appropriate equipment and funding	Regional	Procurement of GPS/digital cameras etc	TANAPA, WD, NCAA, TAWIRI and NGOs[1]
			National	Wildlife authorities to identify equipment needs in terms of gaps in existing programs	TANAPA, WD, FBD, NCAA and TAWIRI
		Identify regional centres of excellence for regional training		Field based training programs for staff developed	TANAPA, WD, NCAA, TAWIRI, PPF and other NGOs[1]
		Develop and implement capacity building programs for lion/leopard conservation	National	Conservation organisations to assist in developing & implementing staff training programs at wildlife authority level	NGO[1]'s
			National	TAWIRI to maintain & improve existing programs	TAWIRI
			Regional	WD to continue & improve district game officer training	WD
			Regional	Community level training to be provided by all stakeholders	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
			Regional	Improve collaboration between stakeholders for training at local level	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]

Objective	Target	Activity	Focus	Tanzania Action	Responsible
MITIGATION: To minimise and, where possible, eliminate human-lion/leopard related conflicts	Considering local ecological conditions, best management standards and practices identified and implemented in all trophy hunted lion/leopard populations within 3 years	Identify best practice trophy hunting practices that are acceptable in various areas	National	Stakeholders to maintain and improve standards	TANAPA, WD, TAWIRI and NGOs[1]
		Implement best trophy hunting practices	National	WD to continue, improve, & develop verification mechanisms	WD
			National	3rd party stakeholders to assist & verify implementation	TANAPA, WD, TAWIRI and NGOs[1]
	National lion/leopard management plans developed in 90% of the extant lion/leopard range within 5 years	Develop national lion/leopard management plans in accordance with this Conservation Strategy	National	This document	TAWIRI
		Advocate for adoption by relevant authorities and implementation of national lion/leopard management plans	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
	Database on human-lion/leopard conflict and PAC established in each range state within 3 years	Develop human-lion/leopard conflict databases in all lion/leopard range states	National	Maintain & improve existing databases	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Participatory planning on how to mitigate lion/leopard attacks on humans in at least 3 known hotspots	National/ Regional	on-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
	Incidents of human-lion/leopard conflict reduced by at least 30% within 5 years while also reducing retaliatory killing	Develop and implement country specific awareness and education package on lion/leopard conservation and management	National/ Regional	Improve and maintain on-going programs	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
		Develop mechanisms with the livestock sector to reduce livestock predation by lions/leopards	National	NGO's on-going	All NGOs[1]
			National	Government on-going	TANAPA, WD, NCAA, TAWIRI
	Number of lions/ leopards killed through indiscriminate killings reduced by at least 30% within 5 years after establish- ment of a baseline.	Develop and implement country specific awareness and education package on lion/leopard conservation and management	National/ Regional	Improve and maintain on-going programs	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Develop incentives for communities to use legal PAC in three identified hotspots	Regional	improve capacity and support at district game offices	WD
			National	Maintain and improve PAC Program including enhanced coordination (all levels) and rapid response to deal with problem lion & leopard	WD

Objective	Target	Activity	Focus	Tanzania Action	Responsible
	Well staffed unit established in each range state to conduct rapid response, restrained and precisely targeted PAC within 5 years	Assess needs and management capacity for effective PAC Units in lion/leopard Range States within 2 years	National/Regional	Follows from above	WD
		Build capacity for effective PAC Units in each lion/leopard range state in accordance with the needs assessment	National/Regional	Follows from above	WD
	Incidences of lion/leopard attacks on humans reduced by at least 30% from current levels within 5 years	Develop and implement collaborative and effective PAC techniques		On-going	WD
SOCIO-ECONOMICS: To equitably distribute the costs and benefits of long-term lion/leopard management	Inventory of stakeholders directly affected by lion/leopard conservation completed in each range state within 2 years	Identify stakeholders groups (e.g. local communities, hunting groups, tourism groups) at the appropriate scale	National/Regional	Maintain & update stakeholder groups (e.g. local communities, hunting groups, tourism groups) at the appropriate scale	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
			National	Develop & maintain meta-database	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Identify impacts on each stakeholder group	Local	WD in collaboration with stakeholders at local level	WD
		Determine extent/magnitude of impacts	Local	WD in collaboration with stakeholders at local level	WD
		Prioritize groups for intervention based on extent/magnitude of impacts	Local	WD in collaboration with stakeholders at local level	WD
	Appropriate training and capacity building delivered to prioritized stakeholders in at least 50 gender- and age-representative groups to assist them to manage lion/leopard conservation more effectively	Identify training needs in consultation with identified stakeholders	Local	Improved collaboration between stakeholders	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
			Local	Link in with on-going government reform processes	WD
		Develop and implement training materials and programs	Local	Link in with on-going government reform processes	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
		Review effectiveness of training materials and programs in consultation with identified stakeholders	Local	Link in with on-going government reform processes	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]
		Implement adaptive program across lion/leopard range	National	as follows from above	TANAPA, WD, NCAA, FBD, TAWIRI, PPF and other NGOs[1]

Objective	Target	Activity	Focus	Tanzania Action	Responsible
	Collaboratively developed and area-specific lion/leopard management plans agreed and implemented with at least 50 identified stakeholder groups in each range state within 5 years	Consult identified stakeholders	National	On-going within WMA Process	WD
		Determine the scope and scale of the key activities of the management plan	National	On-going within WMA Process	WD
		Identify and integrate 'best practices', making provisions for, amongst others: • Ownership issues • Zoning for wildlife • Mutually binding agreement • Verifiable compliance • Suitable wildlife utilization plan (e.g. tourism, trophy hunting) • Income flows and cost distribution (including rainy-day funds to anticipate uncertainties in tourist revenues) • Appropriate husbandry techniques • Conflict-mitigation measures • Regulation of human immigration • Adequate wildlife and conflict monitoring • Annual environmental audits	National	On-going within WMA Process	WD
		Implement management plan	Regional	On-going	WD
		Review plan annually and amend where necessary	Local	On-going	WD
	Transparent mechanisms for equitable distribution of lion/leopard-related/generated income to identified stakeholders implemented in at least 50 representative groups in each range state within 5 years	Identify income generated from wildlife	National	PER	
		Distribute generated income according to intensity of lion/leopard impact	National	On-going within national policy & WMA process	WD
		Provide appropriate incentives for people in high conflict areas to relocate to low conflict areas	National	On-going w/in National wildlife Policy & WMA Process	WD
			National	Changes in national wildlife policy under review to ensure that villages not qualifying for WMA will still receive benefits from wildlife	WD
			National	MKUKUTA	MNRT
		Provide appropriate incentives to discourage immigration into lion/leopard range	National	On-going w/in National Policy & WMA Process	WD

Objective	Target	Activity	Focus	Tanzania Action	Responsible
POLICY AND LAND USE: To develop and implement harmonious comprehensive legal and institutional frame works that provide for the expansion of wildlife integrated land-use, lion/leopard conservation and associated socio-economic benefits in current and potential lion/leopard range	Within 5 years, to have at least one new wildlife-integrated land-use plan that secures an existing, or establishes a potentially viable lion/leopard population in all range states	NR for Tanzania		NR	NR
	Legal frameworks that provide for integrated lion/leopard conservation and associated socio-economic benefits developed, applied and regionally harmonized within 10 years across 80% of the lion/leopard range states	Develop regional guidelines to assist harmonization of lion/leopard range states legislation for wildlife integrated land use, lion/leopard conservation and associated socio-economic benefits	National	Enhance on-going	WD
		Advocate for adoption of the guidelines by SADC	National	Enhance on-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Advocate for ratification of the guidelines by all range states	National	Enhance on-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Advocate for adoption of the guidelines by EAC			TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Advocate for adoption of the guidelines by African Union Parliament	National	Enhance on-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Make a checklist of relevant legislation in all range states		NR	NR
		Identify weaknesses and gaps		NR	NR
		Agree on a statutory code of practice in each signatory country for wildlife integrated land-use, lion/leopard conservation and associated socio-economic benefits		NR	NR
		Develop and implement appropriate institutional frameworks in lion/leopard range states as necessary		NR	NR
	At least 50% of protected and other defined wildlife areas within the lion/leopard range are effectively and adaptively managed within 5 years	NR for Tanzania – as already protects a substantial proportion of the lion/leopard range		NR	NR
	Legal and institutional frameworks providing for integrated lion/ leopard conservation and associated socio-economic benefits developed and applied nationally by 80% of the lion/ leopard range states within 5 years	NR – international			NR

Objective	Target	Activity	Focus	Tanzania Action	Responsible
POLITICS: To ensure that global policies better reflect the will and intent of regional and national sustainable use policies and practices	Global policies, agreements, conventions, and other instruments relevant to lion/leopard conservation, that are not conflicting with national/regional policies of lion/leopard Range States are encouraged within the two CoP cycles of CITES, CBD and CMS and thereafter	Make databases on lion/leopard numbers in each range state available to all decision makers	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Promote consensus amongst range states for categorisation of the African lion/leopard at the CMS and CITES conventions	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Advocate for support for listings of the African lion/leopard consistent with the aspirations of this conservation strategy.	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Attend CITES, CBD and CMS COPS to ensure decisions are consistent t with the aspirations of this conservation strategy	National	On-going	TANAPA, WD, TAWIRI and NGOs[1]
	Accommodation of this conservation strategy by world wide domestic policies and measures promoted during the next 10 years	Distribute this conservation strategy	National	TAWIRI to disseminate once fully endorsed by all participants	TAWIRI
		Secure funding for the implementation of workshops, dialogue sessions and meetings	National	Raised for first workshop, subsequent workshops and meetings - ongoing	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Appoint a facilitator (IUCN) for the dialogue sessions		Not necessary	NR
		Appoint a mediator (IUCN) between range states and non-range states which have policies that conflict with this conservation strategy		NR as yet	NR
		Maintain on-going dialogue with non - range states to get their co-operation and funding support	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
TRADE: To prevent illegal trade in lions and lion products while promoting and safeguarding sustainable legal trade	Existing legislation and regulations reviewed, where necessary amended, and enforced, to ensure that all trade in lions/leopards and lion/leopard parts and derivatives are comprehensively covered in all range states within 5 years	Train and coordinate law enforcement officers (wildlife immigration, customs, police) to identify lion/leopard products	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Review and amend relevant legislation and policies (including prohibiting trade in lion/leopard bones)	National	On-going	WD
		Prepare identification toolbox of lion/leopard products	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Share information with other range states	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Put up awareness posters at border (exit and entry points)	National	WD to liaise with relevant conservation organizations	WD

Objective	Target	Activity	Focus	Tanzania Action	Responsible
	Sound non-detriment findings made and all CITES requirements fulfilled by all range state CITES parties within 5 years	Review relevant data on offtake and population status	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Domesticate CITES into national laws	National	Done	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Consult and coordinate at national and regional levels and with trading partners on non- detriment findings	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Conduct training at regional level targeting scientific authority staff	National	On-going through TAWIRI	TAWIRI
	Regional consensus on sustainable utilization of lions/leopards achieved within 5 years	Conduct awareness on lion/leopard use among decision makers at national and regional levels	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Advocate for wildlife use to be an agenda item at regional meetings (SADC, EAC, COMESA) that are relevant to national economies	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Collect and analyse relevant information on sustainable use	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Conduct training at regional level on sustainable lion/leopard utilization			TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Formulate agreements at regional or bilateral level on sustainable lion/leopard use	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]
		Consult consider and reference the convention on biodiversity principles and guidelines for sustainable use as a guide in monitoring sustainable use and trade	National	On-going	TANAPA, WD, NCAA, FBD, TAWIRI and NGOs[1]