Proceedings of the First Tanzania Cheetah Conservation Action Plan Workshop

Tanzania Wildlife Research Institute (TAWIRI)

15th September 2005, Tanzania Carnivore Unit, TAWIRI, Arusha, Tanzania

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Proceedings of the first Tanzania Cheetah Conservation Action Plan workshop

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1. Agenda

Day One

Time	Event	Responsible
8.30 - 8.45	Registration	Flora Kipuyo
8.45 - 9.00	Official opening	Dr. G. A. Sabuni
9.00 - 9.15	Self introduction	Facilitator/All
9.15 - 9.30	Meeting background	Dr. S. Durant
9.30 - 10.00	Agreement on the agenda	Facilitator
10.00-10.15	Group photograph	All
10.15-10.30	*Tea/Coffee break*	All
10.30-12.30	Cheetah distribution and abundance	Mr. A. Lobora
12.30 -1.30	*Lunch*	All
1.30 - 3.00	Conservation threats	All
3.00 - 3.30	*Tea/Coffee*	All
3.30 - 4.30	Conservation threats	All
9.00-10.30	Overall Priority Settings	All
10.30-10.45	*Tea/Coffee*	All
10.45-12.30	Site Based Issues	All
12.30–12.45	Closing	Mr. M. Msuha

2. SUMMARY

This report covers the proceedings of the First Tanzanian Cheetah Workshop held on September 15th 2005. The workshop brought together key stakeholders to assess existing information and establish a consensus on priorities for research and conservation of cheetah *Acinonyx jubatus*. Tanzania holds important populations of cheetah, including one of the world's largest and most famous populations in the Serengeti ecosystem, and is a stronghold for this threatened species. All participants at the workshop recognised Tanzania's importance in the conservation of this species, but agreed that there was an urgent need for better information on the distribution of cheetah across the country, as well as more detailed data in specific regions.

Cheetah are known to occur across the Serengeti ecosystem through to west Kilimanjaro, across the Maasai steppe, Ugalla Game Reserve, Katavi National Park, the Ruaha/Rungwa ecosystem and Rukwa/Lukwati. Their distribution around the Selous ecosystem is unclear as there are no recent documented records of the species in the area. Despite the wide distribution of this species, there are only good up to date estimates of population size and trends in the Serengeti because of the long term study. The group agreed that this study continued to collect important information relevant for cheetah conservation and should be maintained, however they identified clear data needs for other regions. They agreed that information on distribution and trends was a high priority for all regions. Information on density was agreed to be highest priority for the Maasai steppe and the Ruaha/Rungwa ecosystem. Information on survival and reproduction and ranging patterns is extremely difficult to collect therefore, here, the group gave highest priority to representative habitat in the Ruaha/Rungwa ecosystem (other than the Serengeti). The group went on to identify methods currently available for gathering such information, including spoor counts, tourist photos, detection dogs and transects, all of which had potential in certain circumstances. However, only radio collars could be used to collect unambiguous data on ranging patterns and demography – although the use of tourist photographs also showed some potential.

The group discussed potential threats to cheetah conservation and agreed that loss of habitat and land use change, retaliatory killing and unregulated tourism may pose important threats to cheetah conservation, particularly the former. Snaring, death on roads and disease were thought to be less important although more information was needed to determine this. Interspecific killing of cheetah by lions and hyaena, whilst not strictly a threat, as it is a natural component of ecosystems, was an important ecological constraint, as it limits the density of cheetah, ensuring that they occur at lower densities than these other large carnivores. The techniques found to be useful for gathering information on cheetah status could also be used to provide information on threats. Radio collaring, because it allows the following of individual animals, is particularly useful in this, as well as a well designed questionnaire survey. Information needs on threats varied between region. Information on retaliatory killing was agreed to be of the highest priority in the Maasai steppe and the Sonjo area in the northern sector; on habitat loss or land use change in the northern, Maasai steppe and Ruaha/Rungwa regions; on unregulated tourism in the northern area; and on the impacts of interspecific competition on the Maasai steppe. It was agreed that it was important to ensure that incidence reports were made of any cheetah caught in snares or found dead on the road across the country.

Managers need information on the status and threats to cheetah in their areas to plan management activities and to enable cheetah conservation, as well as assess the impact of their activities on cheetah conservation. All participants wished to improve the standards of information on cheetah across the country as, without better information, it is difficult to plan conservation and management for the species. It is hoped that this report provides a first step along this process, and will provide cheetah research and conservation in Tanzania with a new impetus to address the identified priorities hand in hand with training and capacity development.

3. INTRODUCTION

The First Tanzanian Cheetah Workshop was held on 15th September 2005 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 cheetah *Acinonyx jubatus* in Tanzania. The workshop was attended by 14 participants from TAWIRI, Wildlife Division, Tanzania National Parks (TANAPA), Ngorongoro Conservation Area Authority (NCAA) and the Wildlife Conservation Society (WCS, US) (Appendix 1). TAWIRI, through the Tanzania Carnivore Monitoring Project, has been collecting information on all carnivores in Tanzania including cheetah since 2002. This information is intended to be used to help compile an action plan for carnivore conservation across the country. These proceedings form a draft chapter for the cheetah section in this plan. At an international level cheetah are recognised to be threatened and have been the focus of considerable international conservation efforts over the last five years, resulting in a Global Cheetah Conservation Action Plan compiled by the Global Cheetah Forum (Bartels et al. 2001, 2002), an International Cheetah Conservation Monitoring Workshop Report (Bashir *et al*. 2004) as well as a section on cheetah in the IUCN international action plan for wild cats ((Nowell & Jackson 1996) and Appendix 2).

The cheetah is one of the world's most endangered large carnivores. Cheetah present a particular challenge for conservation because they live at low densities and range very widely. These aspects of their ecology and life history mean that populations require vast areas to remain viable in the long term. Tanzania is internationally important for the conservation of the world's remaining cheetah, as it holds approximately 10% of the world's cheetah, including one of the single largest populations in a protected area, within the Serengeti ecosystem. However, despite their international importance, information on cheetah in the country is still very limited, making it difficult to plan for the conservation of this species. This workshop therefore aims to document what we currently know about cheetah status and conservation across the country and to set priorities for future research and conservation.

Fig. 1 Participants at the meeting, from back and starting from left: Rehema Tibanyenda, Jerome Kimaro, Linus Minushi, Lara Foley, Sarah Durant, Anne Hilborn, Novatus Magoma, Ephraim Mwangomo, Maurus Msuha, Charles Foley, Flora Kipuyo, Alexander Lobora, John Shemkunde and Midala B.M.

4. CHEETAH DISTRIBUTION AND ABUNDANCE

The longest ongoing long term study of wild cheetah is sited in Tanzania, in the Serengeti National Park. This study has told us much of what we know about wild cheetah. There are very few in depth studies of cheetah ecology elsewhere, with two notable exceptions at the Cheetah Conservation Fund (CCF) and Okatumba Wildlife Research, both in Namibia. However, there have also been several short term studies of varying depth in South Africa, Zimbabwe and Kenya, and an additional long term conservation project was established in 2003 in Botswana.

The long term study in the Serengeti has shown that cheetah have an unusual social and home range system. Female cheetah are migratory and range across large areas of over 800km^2, following the gazelle migration on and off of the short grass plains from the wet to the dry season. Males can be territorial, holding small territories of around 37km^2, or they can also be migratory like the females, moving across similar areas (Caro 1994). Males are often found in permanent groups known as coalitions, usually of two or three males, although coalitions of up to five have been recorded in the Serengeti. Coalitions are usually, but not always, made up of brothers. Females are either solitary or accompanied by dependent cubs. This combination of male coalition formation and annual female ranging patterns which cover more than 10 times the size of male territories is unique amongst mammals.

Cheetah females reach reproductive age at two years old. After a pregnancy of around three months they give birth to a litter of 2-6 cubs in a den or lair, which is usually in a patch of tall vegetation such as that found in a korongo or kopje (Laurenson 1994). Cheetah cubs suffer very high rates of mortality - only one in twenty cubs born makes it to independence (Laurenson 1995). Over two thirds of cubs die during their first two months when they are confined to the lair (Laurenson 1994). Where the cause of death could be determined, nearly 60% were due to predation, predominantly by lions. Another 26% died from abandonment, a particular problem in a migratory system such as the Serengeti. A cheetah may choose to den in a location with ample prey, but then if the prey move away during the two month denning period she may have to move too far to find food and be forced to abandon her cubs. Other causes of death were fire and exposure. Beyond the denning period it is difficult to determine the cause of death, as carcasses are rarely found, but predation is known to continue to play a role. The oldest cub recorded as being killed by hyaenas was nine weeks old (Laurenson 1994), whilst even adult cheetah have been killed by lions (Durant pers. obs.). Out of the 13 deaths of adult cheetah documented in the Serengeti since 1991, one was due to snaring, two to road kill, four (three females and one male) to lions, three (all male) to other cheetah – probably in male/male territorial disputes, while one (female) died during hunting was after being gored by an adult Grants gazelle, and two (one male and one female) to unknown causes. Whilst three of these deaths were a direct result of human activities (snaring and road kill), they are likely to be disproportionately reported as they are more likely to be detected. For example, whilst we probably find most of the deaths on roads, we probably find a very small proportion of deaths caused by lions.

Because of the impact of other predators on cheetah, as well as their reliance on a healthy prey base, cheetah population ecology is complex, depending on a suite of interacting factors such as rainfall, prey and predator numbers (Durant *et al.* 2004). This means that they are subject to large fluctuations in population size as these factors vary from year to year, and hence demographic parameters such as survival and reproduction are highly variable (Table 1). Modelling of the study population living on the Serengeti plains demonstrates that lions may have real impacts on persistence (Kelly & Durant 2000). Assuming this population is completely isolated (which is not currently the case) the models show that if cheetah recruitment stays at the level recorded when lion numbers are high then the cheetah population is almost certain to go extinct within 40 years, whereas if cheetah recruitment remains at the level recorded when lion numbers are low then it is

extremely likely to go extinct (Kelly & Durant 2000). Fortunately, the Serengeti plains population is not isolated and is unlikely to ever be so in the future if the current borders of the park remain intact and so is not likely to go extinct. However the results have implications for smaller populations elsewhere, and underline the importance of ensuring that corridors between cheetah populations are maintained to ensure that local extinctions are prevented.

Overall, cheetah are limited, not only by prey as with most carnivores, but by the densities of other predators in the ecosystem. This explains why cheetah are usually found at much lower densities than other large carnivores. In the Serengeti ecosystem the estimated cheetah population is around 250 individuals, whereas the estimate for leopard is 800-1000, lions over 3000 and spotted hyaena nearly 8000 (Caro 1994).

a) Females

	Individual rates			Annual rates		
	Mean	Var.	*n*	Mean	Var.	*n*
Adult survival	0.8532[1]	0.1254	797[2]	0.8516[2]	0.00408	18
Adolescent survival (1-2 years)	0.6790[3]	0.2207	81	0.6503[4]	0.08439	15
Recruitment	0.5303	1.0025	437[2]	0.5419[5]	0.08993	18
Minimum age of first reproduction	2.00		88			
Mean age	7.01	12.27	88			
Maximum longevity	11.8*		88			

* Although measured longevity was 13.6, the oldest female seen to produce cubs was 11.8 years.

b) Males

	Individual rates			Annual rates		
	Mean	Var.	*n*	Mean	Var.	*n* (years)
Adult survival	0.7012[1]	0.2101	338	0.6837[2]	0.04550	18
Adolescent survival (1-2 years)	0.3857[3]	0.2404	70	0.3556[6]	0.1336	17
Mean proportion of males recruited to 12 mo.	0.4346	1.0025	214			
Mean age	3.60	1.83	47			
Maximum longevity	7.8		47			

[1]Neglects individuals which were estimated to die in 1978 and 1979 from calculation.
[2]Samples sizes represent the number of cheetah years (number of individual cheetah multiplied by the number of years alive).
[3]Neglects years 1978 and 1979 from calculation
[4]Neglects years 1975, 1978-1980 and 1982 from calculations as there were fewer than 3 adolescents in these years.
[5]Neglects years 1979 and 1980 as the recruitment rates were known for fewer than 5 females in these years
[6]Neglects years 1978-1980 from calculations as there were fewer than 3 adolescents in these years.

Table 1. Demographic rates of Serengeti cheetahs for (a) females and (b) males, showing means and variances for individual and annual rates of survival and recruitment (reproduced from Durant et al. 2004).

Currently, the main threats cheetah face in Tanzania are similar to those of threatened species everywhere: habitat degradation and loss. Persecution is relatively low compared with other countries in Africa, as there are few large scale western ranches, and traditional pastoralists are largely much more tolerant of cheetah. However, conflict is likely to increase over coming years as traditional pastoralists become more sedentary, and hence this is likely to become much more of an issue in the future. Badly managed and insensitive tourism is a potential threat to cheetah, as cheetah are diurnal hunters, and hence are particularly likely to have hunts disrupted by tourists. In addition they are relatively shy and easily scared by large numbers of vehicles. The Serengeti Cheetah Project has documented two cub deaths due to insensitive tourism. However the wildlife authorities are very aware of the potential danger insensitive tourism poses to cheetah, and this is

reflected in tourism management policies such as the zoning within the Serengeti National Park (Serengeti General Management Plan).

4.1 What do we know: Summary of current knowledge.

The Tanzania Carnivore Project has been collecting information on cheetah distribution across the country since 2002 both through its Carnivore Atlas project and its more targeted Cheetah Watch Campaign. This information has been used to generate maps showing a preliminary distribution of cheetah across the country (Fig. 2). The maps also help identify areas where there is no data on cheetah presence. A total of 1750 records of cheetah sightings have been received since 2002 from 104 contributors, however 95% of the sightings are from the northern sector, principally due to the presence of the Serengeti Cheetah Project in the Serengeti, but also due to a bias in coverage due to a higher number of visitors to the region.

The distribution is summarised within the regional sections below. However areas that lack even rudimentary sighting information include:

- The north east
- The southern sector (e.g. Manjesi, Lukwika/Lumesure, Mikumi, Selous)
- Coastal areas
- Tabora-Singida

Whilst distribution information tells us where cheetah are, it does not necessarily inform us about the relative importance of one area over another for cheetah, or even the status of cheetah in an area – such as whether they are increasing, declining or stable. Tanzania still lacks this type of data across much of the cheetah range. The only reliable estimates of density of cheetah in Tanzania are from the Serengeti Cheetah Project where the density is estimated at around 2 adult cheetah/100km^2 (Caro 1994). This density is at the high end of the range recorded elsewhere – commonly, densities of cheetah range between 1-2/100km^2. Information on species density and status are needed for prioritising between different areas and habitats, planning for long-term conservation and assessing the impact of conservation actions.

The following sections summarise what is known about cheetah distribution on a regional basis, approximately aligned to major ecosystems.

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

Cheetah are resident in the Serengeti National Park, Tanzania, the Maasai Mara National Reserve, Kenya and the immediate environs of this ecosystem. The population on the Serengeti plains has been the subject of a long term study conducted by the Serengeti Cheetah Project since 1974 (Caro 1994). This study has shown that cheetah numbers are impacted strongly by lion numbers, since lions kill cheetah cubs and sometimes adult cheetah (Durant et al. 2004). The Serengeti plains population fluctuates between quite wide margins, ranging between 45-77 adults since 1982. This fluctuation is due to a number of environmental factors and their interactions, including rainfall and Thomson's gazelle numbers, the main prey of cheetah, and lion density (Durant et al. 2004). Cheetah numbers are currently in decline from an all time high in the late 1990s, probably due to the recovery of the lion population (Durant unpubl. data). Provided lion numbers have now stabilized, cheetah numbers should stabilize at a slightly lower level than that recorded in the early 90s (45 adults) in the next 2-3 years – in 2004 the population numbered 48 adults. The Ndutu population, in contrast, is doing well, probably due to the lower lion densities in these areas and is thought to be supplementing the Serengeti plains population.

Outside the Serengeti plains, information is limited, but there are some records of cheetah submitted to the cheetah watch campaign from the Lobo area, the western corridor, the LGCA and the NCA. Records tend to be centred around tourist areas such as camps and lodges. From 2000-2005 the campaign received records of 0, 10, 4, 1, 2, 1 cheetah groups in the Lobo area, 3,3,5, 0, 2, 0 in the western corridor, and 1, 3, 1, 0, 0, 3 in the NCA. Several of these cheetah were known from the long term study area on the Serengeti plains, including one male cheetah seen at Naabi and subsequently seen close to Kirawira. The project has also tracked many cheetah from the Serengeti plains in the dry season to the Lemuta area in the NCA in the wet season. Although cheetah are regularly seen in the western corridor and northern Serengeti information is insufficient to determine whether the population is increasing or declining. Cheetah from the Maasai Mara Reserve in Kenya are known to move into the Serengeti Park, as evidenced by the appearance of ear tagged individuals close to Lobo and Kleins. Cheetah are only ear tagged in Kenya – the Serengeti Cheetah Project relies solely on individual spot patterns to recognize individuals and does not place identifying marks on cheetah. A corridor is likely to be open between the crater and Manyara National Park, as a Cheetah Watch sighting from Manyara in 2006 was traced to a cheetah seen on the crater floor in 2005. As we also know that cheetah move from the crater to the Serengeti, this opens the possibility that there is cheetah movement between Serengeti and Manyara.

Cheetah were regularly seen in Ngorongoro Crater in the 1980s, however disappeared from the area in the early 90s, and were not seen again regularly until the late 1990s. The crater population is probably not resident, as information from tourists contributing to the Cheetah Watch Campaign has shown that cheetah seen on the crater floor can move as far as Ndutu, whilst a female who was a long time resident of the plains, dispersed to the crater at quite an old age. Recent regular sightings in the crater demonstrate that the area must have become more attractive to cheetah over recent years. The quality of the photographs submitted to the Cheetah Watch Campaign are often poor, and they vary from year to year, but the campaign has received records for a maximum of three adult cheetah in 2000, eight in 2001, nine in 2002, one in 2003, seven in 2004 and five in 2005. The recovery of the cheetah population in the crater may well be due to a recent decrease in lion and hyaena numbers (Kissui & Packer 2004, Novatus pers. comm.).

Elsewhere information is limited. Mr. Novatus from NCAA felt that the cheetah in the Sonjo area may be decreasing because of hunting by Maasai and Sonjo, but there is no evidence to support this claim. In the Maswa the lion population is thought to be low, which might have positive benefits to cheetah in the region, however there is no data to support this. There are records of cheetah in the Natron area, and resident's of the area report seeing cheetah, however information from local informants, especially morani, suggest that they are seeing cheetah less often.

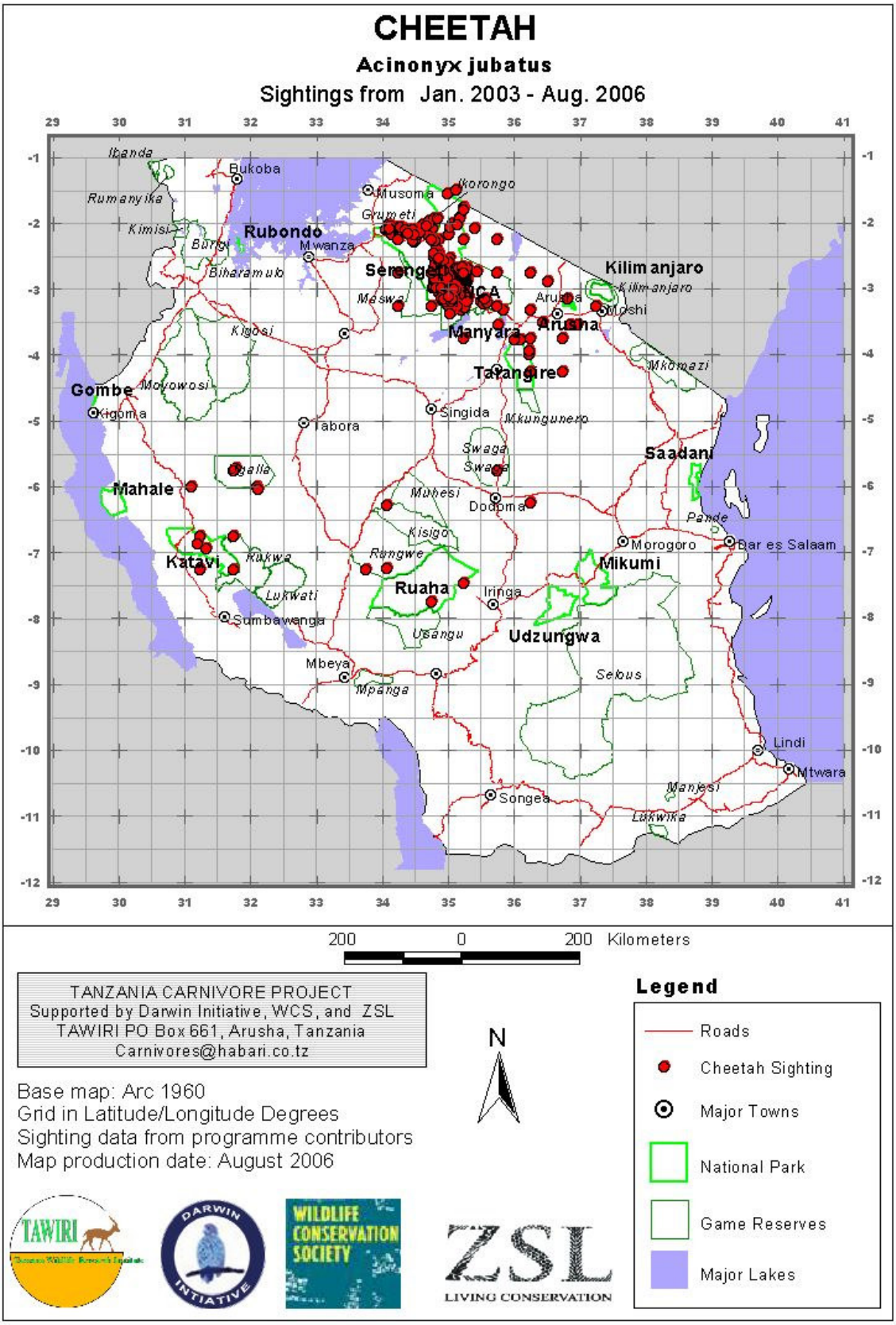

Fig. 2 Map of known sightings of cheetah submitted to the Tanzania Carnivore Project since 2003 up until the time of the workshop. Data submitted is in two forms, either as direct GPS locations, or as a grid square as identified on the map. The former data type are plotted on the map directly, whilst the latter data type are plotted at the centre of the reported grid square.

4.1.2 Maasai Steppe (Tarangire and Manyara National Parks, Simanjiro plains, Mkungunero, Singida, West Kilimanjaro and Mkomazi)

Very little information is available from this region. Cheetah are occasionally seen in Tarangire, however they are seen more commonly in the south than in the more visited areas in the north. They are thought to be nomadic, in that an individual might be seen for a year or so and then disappear. This is illustrated by the records received to the Cheetah Watch Campaign, which received photographs of three different adult cheetah in 2001 and from three groups in 2004: a female with three cubs (probably two sightings of the same group); a female and a single cub and a single cheetah. The cheetah seen in 2004 did not match those in 2001 and no sightings were submitted in 2002, 2003 and 2005. Cheetah are not thought to be resident in the park, but move in and out of the park, ranging across a wider area including the Maasai Steppe. In the early 90s sightings were extremely rare, while they were seen a little more often in the mid-90s, and are currently seen sporadically. It is likely that they move between Tarangire to surrounding areas on the Maasai Steppe such as Simanjiro, Makame and Mkungunero. They are occasionally vagrant in Manyara National Park, and have been seen on Manyara ranch recently. As mentioned in the previous section, a cheetah in Manyara was previously seen in Ngorongoro Crater, showing that there is movement between Ngorongoro and Manyara. It is possible that there is also movement from Manyara up to Natron. Moving further south, cheetah are known to be present in Swaga Swaga, Mkungunero and to the east of Dodoma, but there is no information on density or trends in any of these areas.

Elsewhere in the region, cheetah are known to be present in the west Kilimanjaro region and Mkomazi, although it is likely that densities are very low and the population is widely dispersed. Cheetah in west Kilimanjaro should be able to move to the Longido region and even to Natron, as there is open habitat across this whole area, and they are also likely to move up and down across the border into Kenya. The Mkomazi population should be continuous with the Tsavo population of cheetah in Kenya.

4.1.3 North west and central region (Ugalla, Katavi, Mahale, Lukwati, Lukwa, Moyowosi, Kigosi)

There is very little information on cheetah in this region. Cheetah are known to be present in Ugalla Game Reserve, and it was noted that they were previously not easy to see in this area, but they have been seen more regularly since 2000, most commonly in the short grasslands near the Ugalla river. If the population has increased, then this could be linked to better anti-poaching in the region resulting in less disturbance and an increase in game. An increase in sightings could also be due to increased habituation to people, whereby cheetah are less scared and hence more easily seen – this can occur with no underlying population change and could also result from increased protection and law enforcement.

There is no information on status or trends in any of the other areas in this region. Cheetah are known to be present in Katavi and Lukwati/Lukwa, but there is no information on cheetah in Moyowosi/Kigosii or Mahale. Although the majority of Mahale Mountains National Park is thick forest and hence is unlikely to hold cheetah, it is possible that there are cheetah outside the park where the forest ends and the habitat is dominated by thick bush, but there is no evidence by way of sighting information for cheetah in the area. Outside the protected area there are two anecdotal sightings of cheetah at Nkasi and between Ugalla and Mahale (Davenport pers. comm.) – providing additional evidence that there are likely to be cheetah outside Mahale Mountains National Park.

4.1.4 Ruaha/Rungwa including Katavi National Park and Rukwa- Lukwati ecosystem

There is not much information available for this region. Cheetah are known to be resident within Ruaha National Park, as the Cheetah Watch Campaign have received photographs of two sightings of a female with four large cubs in 2004, close to the river on the Mwagusi side. The campaign has also received photographs of a single cheetah from Katavi in 2003. In addition, a survey of pastoralists in the Lunda-Mkwambi Game Controlled Area to the south east of Ruaha, showed that the majority of interviewees (55% of 67 interviewees) reported seeing cheetah, and the reported high levels of conflict suggest that cheetah are reasonably common in the area (Dickman 2005), although there may be some confusion with leopard (Maddox 2002). Cheetah are known to be present in Muhesi, but there is no information on cheetah from Rukwa-Lukwati, Kigosi or Usango. There is also no information from Manyoni or Itigi thicket to the north east.

There are relatively low numbers of lion and spotted hyenas outside protected areas in this region (see chapter on wild dogs) which are known to impact cheetah. However as with the previous region, the information from this area is extremely limited. This is due to a combination of factors, including thick miombo forest vegetation, making it difficult to see cheetah, a network of swamps which make access to some areas difficult and low number of tourists visiting the region.

4.1.5 Selous - Niassa ecosystem

Cheetah were reported to be present in the Selous in the 80s, possibly up until the early 00s, but sightings were limited to the northern Selous and southern Mikumi region. Sightings were reported in Mikumi sporadically in the 80s, but since then there has been no record of cheetah in the area. The vegetation cover has been increasing making it more difficult to see cheetah. There is very little information on cheetah elsewhere in the region. There are records of cheetah being present in the Selous Game Reserve in the 1980s – Markus Borner records two sightings, one close to Kingupira in the east and one in the north just above Stiegler's gorge (Borner pers. comm.). However game scouts in the region have not recently reported seeing cheetah in the area (Funston pers. comm..). The habitat is quite bushy, and, given the low level of tourism in the region, it is entirely possible that cheetah are present in the area but are simply rarely seen. However more information is needed in order to determine the true suitability of the region for cheetah.

4.1.6 Coast, Mtwara, Saadani ecosystem

There is no information on cheetah from the coast in Tanzania. Cheetah are not listed on the species list for Saadani. Generally this area has less wildlife and prey for cheetah than the interior, however there are a few regions where there might be cheetah, but there are no records. These include Lukwika Lumesare, Liparamba BR southwest of Songea and Kitula/Mpanga. There are historical records (Kingdon 1977), but no recent sightings, from the latter region.

4.1.7 The northwest including Kagera and Bihale/Burigi

Cheetah used to be recorded in Kagera region and Bihale/Burigi, however their current status is unknown as there are no recent records from the area. There is no information on cheetah elsewhere in the region.

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. Key methods appropriate for cheetah 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, tourist photos, working dogs, questionnaires, camera trapping and visual search. Each is discussed below, with a list of their main advantages and disadvantages.

4.2.1 Radio collaring

With this method VHF, GPS or Satellite collars are fitted to a cheetah to enable relocation or recording of position. For most such collars, the collar allows subsequent relocation of the collared cheetah, 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 cheetah, 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 cheetah has to be immobilized, 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 cheetah are often shy and hence are difficult to dart, it is difficult to collar all individuals in a study area and hence these methods are not amenable for density estimation. Alternative capture techniques such as those using trapping, are not much better as, although, unlike darting, they can be used to capture shy cheetah, captures are strongly biased towards males.

Advantages:

- Can provide a huge amount of data on ranging patterns and demographic information including birth and survival rates.
- Relatively low manpower demands except for initial collaring.
- Relatively accurate for estimating ranging patterns and demographic parameters such as birth and survival rates.

Disadvantages:

- Estimation of densities is complicated, because of high overlap in home ranges in cheetah.
- A lot of individuals need to be radio collared to obtain a reliable estimate of density
- Not popular with tourists and hence needs to be combined with good PR in high tourist use areas
- Method involves handling, which carries a risk, and hence should only be used when there are clear data needs
- It is often difficult to find animals sufficiently habituated to get close enough to dart in order to fit a radio-collar
- Satellite and GPS collars are expensive
- Makes use of relatively complicated technology – and hence implementation requires some training

4.2.2 Questionnaires

Questionnaire surveys of residents within a region can be used to collect information on cheetah in two key ways. Firstly, they can be used as a simple presence/absence survey, by gathering information from residents in an area on cheetah 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 cheetah 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:

- It is perhaps the only convenient and feasible method for mapping the distribution of cheetah at a national scale

- It is relatively cheap
- It makes relatively low demands on manpower
- At a basic level, the method can be implemented by relatively unskilled field workers.
- Can provide extra information on potential threats – such as conflict with people
- Potentially, it can provide some information on trends – for example, if interviewees report sudden changes – but these should be interpreted with caution (e.g. animals could become more habituated and hence more easily seen making it appear as if the population has increased, or the habitat could because less or more bushy, making it more or less easy to see cheetah).

Disadvantages:

- Provides only very coarse data, and 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
- Cheetah are often confused with leopards which can make interpretation of questionnaire data difficult.
- Cheetah are often shy and hence are often not seen even if they are in area, this makes it difficult to obtain accurate information on the species through questionnaires alone.

4.2.3 Working dogs

In this method highly trained domestic dogs are used to find cheetah 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.

Advantages:

- Potentially useful outside protected areas
- May provide genetic samples for individual identification of cheetah 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 permission to be used outside protected areas

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

4.2.4 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 cheetah can be used for individual recognition as each cheetah has unique black, white and tan markings. 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 recognized 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). However the method works best in forest and for species with relatively small home ranges.

Advantages:

- Useful in forested areas where visibility is poor and where most of the other methods are difficult to implement
- 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.

Disadvantages

- Method has never been shown to work well for cheetahs in Africa (although it has been trialled in South Africa, Tarangire and Iran).
- Equipment is costly and can only be used in relatively secure areas such as protected areas, otherwise likely to be stolen – particularly as the flash alerts people to the presence of the camera.
- Surveys costly in terms of batteries and films
- Generally works best for species with relatively small range sizes, unlikely it could be effective for a species with such a wide home range as a cheetah
- 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.

4.2.5 Tourist photos

This method relies on encouraging visitors to an area with cheetah to send in photographs that they take of any cheetah that they see. The photographs can then be used to individually identify cheetah 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). The Tanzania Carnivore Project has such a scheme in place – 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 generated very good data for the first two years of operation due to active and direct promotion of the scheme to visitors to the Serengeti by John Shemkunde, who used the technique for his masters thesis (Shemkunde 2004). Of the photos submitted, 80-90% were matchable and could be matched to existing photos in the database. Analysis showed that if photographs for a minimum of 100 sightings of cheetah individuals or groups were obtained in a year, then this would allow monitoring of around 60% of the study population (Fig. 3).

In 2002 the campaign was expanded to a national level taken over by the Tanzania Carnivore Project, however John was posted to head Mikumi National Park and there was no longer any active on-the-ground promotion. As a result, photographic submissions to the campaign dropped until the carnivore project managed to establish an active web site providing frequent feedback to contributors. The method, because it makes use of tourists, can potentially cover large areas of Tanzania, and hence can be useful for tracking individual cheetah across long distances, and hence for establishing the location of dispersal corridors.

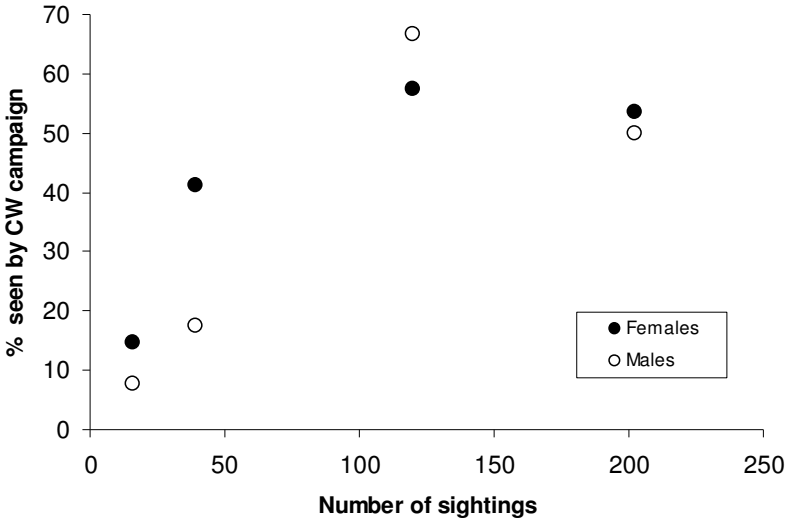

Fig. 3 Percentage of individual adult cheetahs (females & males) seen in the Cheetah Watch Campaign out of those seen by the long term study population plotted against the number of sightings/year. Data from Shemkunde 2004.

Advantages:

- Good for areas well visited by tourists
- Relatively cheap and 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 and updated web site.
- Can be time consuming to implement and requires reasonably well trained manpower
- Will only work in areas where cheetah are habituated.

4.2.6 Visual search

This method relies on an observer finding and following cheetah from a vehicle with no other aids such as radio collars. Since cheetah range so widely and live at such low densities, relying on visual search is unlikely to generate sufficient information for monitoring. Visual search alone has only been effective for monitoring cheetah in open areas and at relatively high densities such as the Serengeti plains, and it is completely ineffective in bushy areas.

Advantages:

- Can provide good information on the population, provided cheetah can be located sufficiently often.
- Minimal disturbance to the animal.

Disadvantages:

- Requires highly skilled personnel able to locate and follow cheetah.
- 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
- Can be difficult to cover all areas in the wet season

4.2.7 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. 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
- Low technology
- Relatively cheap
- Trackers are in most cases available
- Can be used to estimate relative density of other carnivores in the area

Disadvantages:

- A suitable soil substrate is required to enable detection of spoor.
- Relatively poor data quality
- Relies on accurate identification of spoor.
- Relies on a good network of roads for best use.
- Seasonally dependent (as cheetah are diurnal, the rainy season is not good for spoor as rain in the evening will wipe out all spoor for that day by the following morning).
- Cannot be used to compare densities between areas because of differences in substrate and spoor detectability unless calibrated

4.2.8 Driven transects

In this method transects are driven and all individual cheetah 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 cheetah seen from the transect line is recorded. The data can then be analysed with DISTANCE software and used to generate an estimate of overall density. The method relies on a sufficient number of cheetah 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 cheetah are rarely seen or are very shy. In Tanzania its use is probably limited to open areas such as the Serengeti plains.

Advantages:

- Relatively easy to implement
- Relatively cheap
- Can provide other useful data such as density of other carnivores in the area

Disadvantages:

- Will not work in areas where cheetah are shy
- Will only work in open areas – cannot be used in bushy areas where cheetah are difficult to see.
- Requires initial training for carnivore identification, distance estimation and GPS use.
- Analysis using distance based methods is complicated and requires training.

4.3 Status Summary

There is obviously a need to gather information about the status of cheetah across the country. Different regions have different specific needs, depending in part on what information already exists. The Serengeti region is relatively well known, however there is currently not a single region in the country with a good up to date estimate of cheetah population size and trends outside of

the Serengeti plains. 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. 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 summarized in Table 2 according to the types of information they can potentially provide on cheetah 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. No single technique generates good information under all categories. Potentially worthwhile techniques include tourist photo surveys, which can generate good information but are unlikely to be applicable in most areas because of a lack of visitors, and the use of working dogs, which shows much potential but is currently untested in Africa.

	Questionnaire	Spoor	Tourist photos	Working dogs	Camera traps	Radio collars	Driven transects
Distribution	Y	Y	Y[1]	Y	Limited?	Y	Y
Relative abundance	Limited (if similar habitat)	Y	Y[1]	Y	Unlikely	Y	Y
Trends	Limited (requires interpretation)	Y	Y[1]	Y	Unlikely	Y	Y
Density	N	N (but can if calibrated)	Y[2]	Y	Unlikely	Possible with intensive effort	Y
Ranging	N	N	Some info	Some info	Unlikely	Y	N
Demography	N	N	Possible but unlikely	Possible but unlikely	Unlikely	Y	N

[1] With sufficient visitors
[2] With sufficient visitors and provided the extent of the total area covered by visitors is known

Table 2. Data generated by the different methods covered in the sections above. Y indicates that the method could generate appropriate data, N the method could not generate appropriate data, and limited the method might generate some appropriate data, but is open to interpretation. Finally 'unlikely' indicates that whilst the method could theoretically generate the appropriate data, it is unlikely that sufficient data would be collected to fulfil the objectives.

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 cheetah conservation. The group identified the following threats as relevant to cheetah in Tanzania:

- Persecution
- Loss of habitat / land use change (including fragmentation, habitat degradation and prey depletion)
- Ecological constraints - interspecific competition
- Unregulated tourism
- Snaring - by-catch targeted at game
- Road kills
- Disease

Each are discussed in detail below

5.1 Persecution

There is very little information on the importance of persecution as a threat to cheetah conservation. However we know that cheetah do, at least occasionally, kill livestock, and conflict does exist in some areas. However, the degree of conflict varies between different areas and different communities, for example, conflict appears to be much higher in the Ruaha region compared to Serengeti (Dickman 2005, Maddox 2002). Cheetah are known to be occasionally mistaken for leopards (Maddox 2002) which might increase conflict when cheetah are blamed for leopard depredations and attacks. Cheetah are also known to be killed for ceremonial purposes by Sonjo, Maasai, and Sukuma tribes, but it is not known whether this has a significant impact on populations. Movement of cheetah between areas may also be restricted because of persecution in high human use areas. Overall, there is a lack of basic information on the impact and extent of persecution on cheetah.

What more do we need to know?

- How many cheetah are being killed because of genuine livestock loss compared with misidentification? Such information would allow the development of appropriately targeted educational programmes.
- To what extent do cheetah depredate livestock and does this differ from local perceptions?
- What livestock management measures are in place to reduce livestock predation and which are most effective?
- Where and how many cheetah are killed for ceremonial purposes? Is the practice widespread? Are cheetah being killed currently or are old skins reused?
- How do cheetah modify their movements patterns in high human density areas (eg. around settlements, bomas, grazing lands, etc)?

How do we find out?

- Questionnaire surveys can determine perceived levels of persecution, extent of livestock predation, management techniques, and killing for ceremonial purposes.
- Ground verification of reported incidents can show how perceptions differ from actual levels of conflict.
- Radio-collaring can be used to show how cheetah use areas around human settlement, and examine whether cheetah are able to adapt to human activity and, if so, how they do this.
- Working dogs can be used to assess cheetah density in relationship to human presence, and cheetah scat can undergo content analysis to detect livestock remains as alternative method for assessing real levels of livestock depredation.

5.2 Habitat loss / land use change (including fragmentation, habitat degredation and prey depletion)

Habitat loss and land use change pose a threat to wildlife, particularly species like cheetah that live at low densities and range across vast areas. Cheetah do not occur in agricultural landscapes and so agriculture is expected to limit movements to some extent and an increase in agriculture will reduce overall range. Cheetah 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 cheetah movements. Ensuring that sufficient habitat remains and that corridors between protected areas are maintained are high priorities if this threat is to be mitigated. TANAPA and the Wildlife Division are in the process of accumulating information on all wildlife corridors in Tanzania. However, to date, the analysis has largely focused on movements of large ungulates, and needs to address the needs of cheetah. There is currently limited information on cheetah distribution and movement patterns between areas. Without such information it is difficult to develop a comprehensive land use plan that will ensure corridors are maintained for cheetah.

What more do we need to know?

- How does human or agricultural activity influence cheetah distribution and density?
- How does human or agricultural activity affect cheetah movement or dispersal?
- How does loss of prey impact cheetah densities?
- Where are the historical corridors? Do some habitats or land use act as barriers to movement?

How do we find out?

- Radio collaring is probably the best means for investigating individual movement patterns of cheetah. Scat found by working dogs working across a large landscape could also be used, providing DNA is extracted and typed to identify individuals, however interpretation is more problematical than with radio collaring.
- GIS layers covering human and agricultural activity should be accumulated at a national level and used to map against information on cheetah movements
- Night transects using distance to estimate densities of nocturnal prey, day transects to estimate densities of diurnal prey
- Working dogs to estimate actual cheetah density or spoor counts to estimate relative cheetah density.
- Genetic information can be used to map historical corridors - this would require DNA from tissue or faecal samples across a wide geographical area
- A continuation and expansion of the Cheetah Watch Campaign in well visited areas – as this has already shed light on the movements of cheetah between different areas in the northern sector.

Geographical Information Systems (GIS) provide a very useful mechanism for a preliminary review of all corridors and to investigate potential suitability for the movement of cheetah. This method is especially powerful if it can be combined with ranging information on the movements of individual cheetah, such as can be obtained from radio collaring. This combination of techniques can be used to accurately establish the extent to which cheetah make use of corridors and to quantify the degree of agriculture that poses a barrier to cheetah movement.

5.3 Ecological constraints to cheetah conservation

Whilst interspecific competition is a natural and inherent component of functioning ecosystems, it can be a major constraint to the viability of cheetah populations in some areas and hence the effectiveness of conservation measures. Of particular importance to cheetah is the impact of predation and kleptoparasitism from lions and spotted hyaena. Hence the overall density of

cheetah within a protected area is likely to be limited by the density of these species. Lions are thought to pose the biggest threat to cheetah, and have been reported as killing both adult and young cheetah, however the impact of hyaenas on cheetah population dynamics is relatively unknown. In Serengeti National Park predation accounts for over two thirds of known cub deaths in the den (Laurenson 1994) and has been shown to be have an impact on overall population density of cheetah (Kelly & Durant 2000, Durant et al. 2004). Outside protected areas lion and hyaena numbers are often lower than inside, as these species tend to be particular targets of persecution by local communities, usually due to retaliation against livestock attacks. Lower densities of predators in these areas may make them particularly important buffer areas for cheetah conservation.

What more do we need to know?

- Cheetah densities in areas with good prey but no lions and/or hyaenas
- What proportion of the Tanzanian cheetah population occurs outside protected areas?
- How do hyaenas affect cheetah populations?
- How do cheetah densities vary between different habitats? Particularly in Miombo habitat, and on the Maasai Steppe

How do we find out?

- Estimates of cheetah densities in areas where lions/hyaenas are hunted or are known to be at low density (e.g. within the Wakuria area to the north west of the Serengeti) and in representative and potentially important habitats (such as miombo and the Maasai Steppe) are needed. The most appropriate methods for obtaining these estimates are likely to be the use of working dogs or spoor counts.

5.4 Unregulated tourism

Cheetah are particularly vulnerable to the impact of tourism as they hunt during the day. Cubs have been recorded as being killed because they have been separated from their mother due to too many vehicles coming too close to cheetah families, they have also been recorded as being run over or killed by vehicles in the Maasai Mara where the impact of tourism is particularly severe due to a combination of high numbers and poor regulation. Cheetah are also known to modify their hunting behavour in the presence of tourism, tending to hunt when tourists are not around such as lunch time (Burney 1980). The recent decline of cheetah in the Maasai Mara game reserve may be a consequence of unregulated tourism, and suggests that tourist harassment can be sufficiently severe to limit numbers of cheetah.

What more do we need to know?

- Is tourism impacting cheetah cub survival, hunting success, activity patterns and/or reproduction?

How do we find out?

- In depth study of tourist behaviour using unmarked study vehicles.
- Simultaneous study of cheetah behaviour in the presence of high numbers of tourists, again using unmarked study vehicles.

Unmarked vehicles are crucial for the study of the impact of tourism, as TANAPA has strongly enforced regulations which are designed to reduce harassment of animals. Most harassment is likely to be due to individuals breaking park regulations, which is not likely to happen if a parks or research vehicle is clearly present, as they will want to avoid being reported and fined.

5.5 Snaring

Cheetah can be caught in snare lines laid out for game to be used for meat. However, as cheetah do not scavenge, they are not attracted to snare lines, unlike lions and hyaenas – who go to snare lines due to the presence of trapped game. However it is known that cheetah are occasionally caught in snare lines – there are two records from western Serengeti (Campbell & Hofer 1995) - although the impact on snaring at the population level is not well understood. The presence of snares and the species of animals caught in snare lines are recorded during anti-poaching patrols by rangers and game scouts working for TANAPA and WD.

What more do we need to know?

- Not thought to be currently a major problem for cheetah however it should be monitored.

How do we find out?

- Monitor through WD, TANAPA and NCAA incident reports.

5.6 Road kills

Cheetah have rarely reported to be victims of road kills. During 1991-2005 there have been two reports of cheetah being killed on the main road in the Serengeti, one close to Olduvai reported by Reggie Heyworth, and one on the main road from Seronera to Ikoma reported to the TANAPA wildlife veterinary department. Road kills probably currently have limited impact on cheetah populations due to the lack of tarmac or other good roads across the country.

What more do we need to know?

- Not thought to be currently a major problem for cheetah however it should be monitored.

How do we find out?

- Monitor through WD, TANAPA, NCAA and TAWIRI.

5.7 Disease

Disease is not thought to be a threat to wild cheetah populations, however there is little information on its impact. No major die-offs linked to disease have been recorded in areas where cheetah populations have been monitored, with the sole exception of a study in Etosha where a large number of radio collared cheetah died due to an anthrax epidemic (Turnbull et al. 2004). It is worth noting that during the 1994 canine distemper epidemic in the lions in the Serengeti, which killed a third of the lion population, there was no similar die off in the cheetah population (Durant pers. comm..). It is not known whether this was because cheetah rarely caught the disease, perhaps because of low transmission rates, or whether this strain of the disease was not pathogenic to cheetah.

5.8 Other

There is concern in the scientific literature that low levels of genetic diversity documented in the cheetah leads to susceptibility to disease and inbreeding (O'Brien *et al.* 1985; O'Brien *et al.* 1986; O'Brien *et al.* 1983). However, data from the study generating these concerns were from captive cheetah only – wild cheetah have never been shown to experience any difficulties which can be linked to genetic problems (Caro & Laurenson 1994). For example, whilst less than 20% of cheetah females ever reproduce in captivity (Wielebnowski 1996), there are no records of cheetah females failing to reproduce in the wild in the Serengeti (Caro & Laurenson 1994).

5.9 Summary

The group, in general, agreed that persecution and habitat loss/change were the most important factors affecting cheetah conservation in Tanzania. The other potential threats, such as unregulated tourism, road kills, snaring and disease were either thought to be unlikely to be of major significance to cheetah, although there is a need for more information on the impacts of these threats to determine whether this assumption is valid. Ecological constraints, such as competition with lions and hyaenas, has been shown to have an impact on cheetah viability, however these factors are important natural features of functioning ecosystems, and so, whilst they cannot be ignored within a conservation strategy for cheetah, they do not constitute a 'threat' per se, but do make cheetah particularly vulnerable to habitat loss and the resulting fragmentation of their range. Low levels of genetic diversity are not thought to have any impact on cheetah viability in Tanzania.

The techniques discussed in section 4.2 for gathering information on cheetah 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 recognizable 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, persecution, snaring, road kills and even interspecific competition. 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 of cheetah, and hence be used as a tool to inform managers and policy makers about the location and management of key corridors for cheetah movement.

	Questionnaire	Spoor	Tourist photos (in high tourism areas)	Working dogs	Camera Traps	Radio collars
Persecution	Y	N	N	N	N	Possibly - more likely to get direct evidence of deaths
Land use change	Y	N	N	N	N	Y - in combination with in depth study of ranging patterns
Unregulated tourism	Y	N	N	N	N	Y - in combination with in depth study
Snaring	N	N	N	N	N	Unlikely
Road kill	N	N	N	N	N	Unlikely
Disease	N	N	N	N	N	Y - via blood samples and as more likely to find dead individuals
Interspecific Competition	N	Y	N	Y	Y	Y

Table 3. Data on threats and constraints generated by the different methods for investigating cheetah status covered in 4.2. Y indicates that the method could generate appropriate data, N that the method could not generate appropriate data, and possibly that the method might generate appropriate data. Additional conditions on the method to supply appropriate data are listed where necessary.

6. CONSERVATION AND RESEARCH PRIORITIES

In this last part of the meeting the group addressed priorities for cheetah conservation and research in Tanzania. The inputs from the management authorities from WD, TANAPA and NCAA were particularly important for this session. The group agreed that there was currently very little information on cheetah, and that there was an increasingly urgent need to gather data relevant to cheetah conservation across the country. The group also agreed that conservation action should be implemented wherever there are clear indications that such action is necessary. Overall the group identified four key national priorities:

- To obtain baseline information on the distribution of cheetah in Tanzania - additional information on trends and abundance can follow later.
- To provide training in survey techniques to wildlife stakeholders (e.g. game scouts).
- To set priorities for cheetah conservation in the country
- To identify threats

However there were also regional differences in specific information and conservation needs, and the group addressed these needs in detail for each of the major regions in section 4.1. Needs were divided into two sections: status (cheetah distribution, demography, ranging patterns and density – see section 4) and threats (information needs and management priorities – see section 5). Agreed regional priorities are summarized in Table 4 and are described below.

Cheetah status was separated into five components, ranging from broad distribution data, through information on trends and density, to detailed information on demographic parameters (such as survival and reproduction) and ranging patterns. Appropriate methods used to gather this information are covered in section 4.2. All participants felt that information on ranging patterns was particularly useful. Ranging patterns were important to TANAPA to show how often cheetah leave protected areas and how far they travel from them, and to WD and NCAA to alert them to potential conflict situations with local communities. Information on ranging patterns combined with good information on threats can also help identify specific threats cheetah might be exposed over an annual cycle. The only method that can be used to estimate range size is radio collaring (Table 1), and so areas where ranging patterns are deemed as a priority should also regard the implementation of a radio collaring study in these areas as a priority. Other methods, such as spoor counting, can be used to monitor density within areas, but not between areas, and hence can be useful for trends. Photo surveys, which can potentially supply very good information, are unfortunately only effective in areas with a lot of visitors. The use of working dogs can potentially provide good information on distribution, trends, density and demography across a wide range of habitats, but the method is as yet untested in Africa.

Threats represent the main means through which people have an impact on cheetah, and hence also are the main means through which managers can have an impact on cheetah conservation. Their importance should thus be viewed in terms of both gathering information (threats, like cheetah status, should also be monitored), but also in terms of activities that can reduce each threat, such as management, education or policy changes, which can be adapted as more information about each threat is accumulated. Monitoring threats to cheetah were agreed to be as important as monitoring status, and should be a component of any planned survey.

Threats were divided into the six broad headings as outlined in section 5, however threats were further broken down to include specific issues. Persecution was agreed to be a relatively high priority threat as it is known to be an issue wherever it has been investigated, including around the Serengeti ecosystem, the Maasai Steppe and around the Ruaha ecosystem. Management responses to persecution issues depend on the impact of persecution on the population and the reasons for persecution – e.g. livestock predation or a perceived disease threat will require different management responses. In addition, local livestock management practices might

contribute to livestock depredation and hence persecution, and modifications to existing practices should be fully explored. Reports of depredation should also be validated to ascertain whether perceptions reflect reality. Very often perceived depredation by predators is higher than the reality. Persecution issues are probably generally best addressed through outreach and education programmes in problem areas, and through establishing good livestock management practices, the details of which will depend on regional circumstances.

Habitat loss and land use change were seen to be a medium priority threat throughout the country. All regions of the country are affected by these processes which are likely to have an impact on cheetah conservation. The group agreed that the best approach to minimize their impact is the establishment and maintenance of effective corridors between protected areas, and hence recommended a review of the TANAPA/WD/FZS corridor analysis with respect to cheetah, to identify and map corridors for the species. Landscape genetics was seen to be a potentially important tool in this process, as genetic differentiation between different subpopulations of cheetah can demonstrate the extent to which subpopulations mix with each other.

Of the remaining threats, snaring was thought to have limited importance, and then probably only around the Maswa Game Reserve and Ugalla. The group agreed that it was important to review information collected on animals caught in snares collected by game scouts and rangers in routine patrols in these areas. Road kill was deemed to have a relatively low impact everywhere except Mikumi, where there was a need to improve reporting procedures, in order to identify potential trouble spots (see section 5.5). Interspecific competition was judged to be of a low priority.

Conservation and research priorities are reviewed region by region below. It should be remembered that all priorities in Table 4 are based on current information and educated guesswork, and will need to be reviewed and updated as more information is gathered.

6.1 Northern region

This region contains the largest known population of cheetah in Tanzania in the Serengeti ecosystem, which is a globally important population. Therefore monitoring information on distribution, population trends and ranging patterns of cheetah were all agreed to be of a high priority in this region, as was information on density and survival. Of the threats, persecution was deemed to be of a particularly high priority in the Sonjo area and a medium priority elsewhere in the region, whilst habitat loss and land use change was thought to be a high priority threat throughout. Unregulated tourism could have a potential impact in high use areas, and is tourism is expected to increase over the coming years, It is hence deemed to be a high priority threat in high use areas. Snaring and road kills were agreed to be of low priority in this region and elsewhere in the country. The impacts of interspecific competition are known to be high, however it has been the subject of detailed investigation, and hence the group felt it did not need further investigation, but long term monitoring would help understand its impacts elsewhere in Tanzania.

6.2 Maasai Steppe

Information on cheetah in the Maasai Steppe is currently very poor, and hence the group agreed that the first priority for this region should be to gather basic distribution data. Information on ranging patterns were also agreed to be a high priority as the region is largely unprotected. Such information would inform managers of protected areas about where cheetah go when they leave the areas under their jurisdiction. Information on trends were judged to be a medium priority, whilst information on density and survival of a low priority at present. There is currently very little information about threats to cheetah, although there is reasonably good information about other wildlife in Siminjaro. The group felt that of all the threats, persecution is probably of the highest

a) Status	Northern region	Maasai Steppe	Selous/ Niassa	West Ugalla/Mahale etc.	Ruaha Rungwa
Distribution	High	High	High	High	High
Trends	High	High	High	High	High
Density	High	High	Low	Medium	High
Survival and reproduction	High	Medium	Low	Medium	High
Ranging patterns	High	Medium	Low	Low	High

b) Threats and constraints	Northern region	Maasai Steppe	Selous/ Niassa	West Ugalla/Mahale etc.	Ruaha Rungwa
Persecution	High in Sonjo area Medium elsewhere	High	Low	Low	Medium (assess importance)
Habitat loss/land use change	High	High	Low	Low	High
Snaring	Incidence reports throughout				
Road kill	Incidence reports throughout				
Interspecific competition	Medium	High	Low	Low	Medium (assess importance)
Unregulated tourism	High to determine and address	Low	Low	Low	Medium

Other areas	Coastal, Northwest
Distribution	High
Trends	Depends on distribution

Table 4. Information priorities for the major regions for where cheetah are known to occur categorized into low, medium and high priority. The table is divided into two sections according to information needs regarding status and threats. The group prioritized the list of areas at the bottom of the country primarily for obtaining information on distribution as there is currently no information on cheetah in these areas.

priority, whilst disease and habitat loss of medium priority. Snaring, road kill and interspecific competition were relatively low priorities, pending further information, the latter principally due to the low numbers of lions and hyaenas outside the protected areas. The high priority information needs for this area could be addressed by implementing a questionnaire survey combined with a radio collaring study.

6.3 Selous/Niassa

The Selous/Niassa region is an enormous protected area, and yet little is known about cheetah in the region. The group agreed that information on distribution and trends were agreed to be high priorities for the region, until more information is uncovered about the importance of the area for cheetah conservation. Information on ranging patterns, density and survival were deemed to be of relatively low priority. No threats are currently thought to be high priorities, although this might change if an important and significant population of cheetah is found to be resident in the area.

6.4 North west and western central region

This region is very little developed with limited agriculture. There is very little information about cheetah in the region and so, as with the Maasai Steppe, basic information on distribution was agreed to be of the highest priority. Information on trends were also agreed to be of a high priority with information on density and demography a medium priority. Ranging patterns were seen to be less of a priority at present, however this might change if an important population was uncovered in the region, together with evidence of substantial threats such as land use change and persecution. Of the threats, the group thought that this population was probably not greatly threatened by the listed threats. Persecution was deemed to be a low priority in the region. However there was so little known about this region, the region itself should be a priority for a basic survey, and a further refinement of priorities might be necessary pending further information. Distributional data and information on some threats could be addressed through a well designed questionnaire survey throughout the region.

6.5 Ruaha/Rungwa

The group felt that the Ruaha/Rungwa region had great potential for cheetah, possibly second only to the Serengeti in terms of overall importance, but there was a paucity of information from the region. As such the group agreed that this region should be of a particularly high priority, and information on distribution, trends and density of cheetah were all judged to be high priority, as such data would inform the wildlife authorities about the relative national (and global) importance of the region for cheetah. Information on survival and ranging patterns were also agreed to be of high priority, because of recorded levels of conflict outside the protected areas.

Habitat loss and land use change were judged to be high priority threats to cheetah in the region. Persecution was assessed as medium priority, whereby a thorough study is needed prior to any management interventions. Interspecific competition was thought to be of medium priority due to the high densities of other large carnivores in protected areas in the region and the wide extent of these protected areas. Unregulated tourism, whilst not previously a threat, was thought by the group to present a potential medium priority threat to cheetah in the future, particularly in high usage areas around the river. Snaring and road kill were deemed to be of low priority by the group.

6.6 Other areas

There was very little information about the rest of the country, although there were almost certainly cheetah in areas outside the regions outlined above. The group therefore prioritized areas where basic distribution data should be gathered to establish the presence and distribution of cheetah. Priority areas were as follows: Coastal areas, including the Mozambique border,and the north west, including Bihalo Mulo/Burigi and Kagera to establish the northern limit of the western distribution of cheetah. This would be best addressed initially through a series of questionnaire surveys.

7 THE WAY FORWARD

There is an urgent need to get better information on the distribution of cheetah across the country, and TAWIRI, through the activities of the Tanzania Carnivore Project, will continue to gather this information, targeting areas with data deficiencies. There is also a need to gather more detailed data targeted at specific regions. In particular, all the management authorities required information on trends and ranging patterns and potential threats for cheetah in many areas. The priorities listed in Table 4 provide a useful tool for planning specific research and conservation activities on cheetah. High priority activities should focus on those priorities judged as high by the group, and medium priority activities on priorities identified as medium. Tables 2 and 3 list the methods available for obtaining information to address these priorities.

Managers need information on the status and threats to cheetah in their areas to plan management activities and to enable cheetah conservation, as well as assessing the impact of these activities on cheetah conservation. All participants are deeply proud of Tanzania's international status for cheetah conservation, and wish to improve the standards of information on cheetah across the country. The hard work that participants put into this workshop and report reflects this wish, and will hopefully provide cheetah research and conservation with a new impetus, to address the identified priorities hand in hand with training and further capacity development.

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Appendix I

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Glossary

FBD – Forestry and Beekeeping Division
GCA – Game Controlled Area
GIS – Geographic Information System
GPS – Global Positioning System
LGCA – Loliondo Game Controlled Area
MNRT – Ministry of Natural Resources and Tourism
NCA – Ngorongoro Conservation Area
NCAA – Ngorongoro Conservation Area Authority
NGO – Non governmental organisation
PAC – Problem animal control
TANAPA – Tanzania National Parks
TAWIRI – Tanzania Wildlife Research Institute
TCP – Tanzania Carnivore Program
WCS – Wildlife Conservation Society
WD – Wildlife Division
WMA – Wildlife Management Area
ZSL – Zoological Society of London

Endorsements

We hereby declare that we endorse these proceedings and support the listed priorities for cheetah research and conservation

Signature ..... Date .....
Director General
Wildlife Division

Signature ..... Date .....
Director General
TANAPA

Signature ..... Date .....
Director General
TAWIRI

Signature ..... Date .....
Director General
NCAA

Signature ..... Date .....
Director General
FBD