

**International conference on African large carnivores:
impacts on ecosystems and humans**



24th - 27th June 2014

Edited by Titus Adhola

**International conference on African large carnivores:
impacts on ecosystems and humans**

Theme: To develop knowledge on the carnivore evolution
and ecology of predation through modern and fossil
taphonomical studies

Date: 24th - 27th June 2014

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Conference in summary

The *International conference on African large carnivores: impacts on ecosystems and human interaction*, was held at the National Museums of Kenya, Nairobi on 24th - 27th June 2014. The primary aim of the conference was to bring together young and well-seasoned senior researchers, involved in different fields of large carnivore studies, to share existing data and to improve skills and outputs; in order to explore questions related to past and present human-carnivore interactions and conservation. The conference was convened under three sub-themes, namely: human-carnivore interactions and conservation; past and present carnivore biodiversity and environment; and, past and present carnivore taphonomy and eco-ethology.

The conference was attended by 90 participants drawn from 10 countries and representing over 30 institutions. Students, conservation biologists and practitioners, policy makers, and government agencies had the privilege of participating in plenary sessions; presented and listened to findings on country case studies, and engaged in fruitful discussions and deliberations. Two renowned global conservation leaders gave keynote addresses; they highlighted their conservation and research experiences, through the eyes of evolutionary history and transitions of the African carnivores; and, offered possible solutions to some of the challenges faced in carnivore ecology, conservation and biodiversity in Africa.

The conference was graced by the Director Research and Collections, NMK on behalf of the Director General of NMK. The cultural counselor of The French Embassy in Kenya and the eastern Africa regional director of French Institute for Research and Development – *IRD* whose institution partly sponsored this conference were present and gave short speeches. These opening speeches commended the organizers of this conference and reiterated their support for future activities of the carnivore researchers' network.

A total of 23 delegate talks were presented to the audience. Participants proudly confessed they found the opportunity to network with peers and mentors most befitting; and, the re-union with long-lost friends and colleagues most awe-inspiring! The conference received extremely positive feedback from the participants and an overwhelming majority said they would like to see another carnivore conference in the near future. 95% of the delegates reported that the conference had met their expectations. Amidst the keynotes and delegate presentations; five interlinked workshops were convened on the third and fourth day; focusing on carnivore prey base analysis using carnivore scat and prey bone remains. These workshops were equally exciting and clearly demonstrated lack of understanding on how zooarchaeological/taphonomical techniques, contribute to the understanding and resolving of modern ecology and conservations issues. The participants called for more of such workshops to be held in future. A panel discussion on the future of the "*Network of history, biology and conservation of African carnivores*" was convened on the final afternoon of conference. This resulted in very exciting ideas that form the very blueprint of growing and expanding the network, with the view of building the capacity of the next generation of carnivore conservationists in Africa and beyond.

Background of conference

The primary aim of the conference was to bring together young and well-seasoned senior researchers, involved in different fields of large carnivore studies, to share existing data and to improve skills and outputs in the analysis of bone assemblages related to ecology, in order to explore questions related to past and present human-carnivore interactions and conservation. Large carnivores are major components of the ecosystems that regulate herbivore populations, and have cascading influences on the proper functioning of ecosystems. Through analyzing their prey bone accumulations and modification patterns, carnivores can provide useful information necessary for reconstruction of past, present and even predict future ecosystem dynamics. However, negative attitudes and competition for limited space and/or resources has led to a rapid elimination of these carnivores from most of their natural ranges. In Africa, the three large carnivore families: felidae (lion, leopard and cheetah); hyaenidae (spotted, striped and brown hyaenas); and, canidae (wild dogs) pose great conservation challenges due to livestock depredation and pastoralists' negative attitudes towards them. Carnivore ecology and conservation, is thus a complex affair that calls for a firm understanding of the socio-economic and/or cultural values of the pastoralists, as well as past and present ecological dynamics within various ecosystems. To be able to achieve all these requires multidisciplinary expertise. To this end, the goal of this network therefore, is *to develop knowledge on the carnivore evolution and ecology of predation through modern and fossil taphonomical studies*. Neotaphonomical studies can aid in the interpretation of paleontological and archaeological sites formation processes, inferring environmental changes over time, as well as understanding intra and inter-specific competition (especially with prehistoric humans). Such studies need development of a robust methodology that integrates diverse research approaches.



Dr. Lars Werdelin (holding skull) explaining to participants the identification of fossil carnivore remains in NMK paleontology laboratory

Speech by representative of the organizing committee Dr. Ogeto Mwebi



Dr. Ogeto began by welcoming all participants to the inaugural meeting of the African large carnivore conference. “Large carnivores,” he emphasized, “are an exciting and diverse group of predators well distributed in most continents. While they have been literally wiped out in some continents, Africa seems the only major refuge with a high distribution and abundance of carnivores. That notwithstanding, they remain integral components of terrestrial ecosystems, and we look forward to a fruitful debate about them from this very multidisciplinary group of researchers.” He intimated that the long term goal of the African large carnivore project was to form an international team and/or group of both young and seasoned senior researchers, working on diverse aspects of carnivores in the fields of: taphonomy, ethology, ecology, paleontology, biochemical/molecular studies, morphofunction, and conservation with a scientific purpose of linking pleistocenist and holocenist. “One of the key expected outputs of this conference is to help researchers understand the past using the present; and using the past to predict the future.” he explained. He then concluded by acknowledging all sponsors and partners who included: the French embassy in Nairobi; International Union for Quaternary Research (INQUA), Human and Biosphere Commission; *Groupement de Recherche* (GDR) 359 of the French National Centre for Scientific Research (CNRS-INEE); University of Nairobi; Kenya Wildlife Service and National Museums of Kenya as conference host; for their invaluable support.

Speech by the cultural counselor of the French embassy in Nairobi, Mr. Jeremie Blin

He began by emphasizing that it was with great pleasure and privilege for the French embassy in Nairobi to co-sponsor the *International conference on African large carnivores: impacts on ecosystems and human interaction* at the National Museums of Kenya. He intimated that the French embassy in Nairobi has a rich history and long tradition of partnership and cooperation with the NMK. He thanked the organizers for the thoughtful request and invitation to the embassy to send a representative to grace the conference. “The conference theme is very integral and pertinent to contemporary regional and global conservation issues.” he emphasized. He expressed his delight at the diversity of participants present at the conference, drawn from different backgrounds and countries. He indicated that the French Embassy supports research projects in Kenya and will continue doing so. He concluded by wishing everyone fruitful conference deliberations and training.

Opening speech by Dr. Geoffrey Mwachala on behalf of Director General, NMK



“To our esteemed guests, ladies and gentlemen, on behalf of the NMK management, I wish to extend to you our warm welcome and gratitude, for choosing to host this very conference on African large carnivores here at NMK. In case you may have not realized as yet, the Kenyan Court of Arms has diagrammatic representation of two lions in it. Issues dealing with carnivores and ecosystems are succinct and for that very reason, the NMK is profoundly honoured to host the conference. Just at a quick glance at this very audience and the conference programme, I can see a broad representation across countries, continents and cultures. I take this opportunity to thank the French Embassy in Nairobi and all other sponsors for making this event possible. I would also like to thank and urge the French embassy to continue supporting scientists in matters of research and capacity building. I strongly believe that with the diversity of specialist inputs in the form of paleontologists, ecologists, taphonomists, conservation biologists, taxonomists in attendance; this conference marks the dawn of a new beginning that can and should, be able to catalyze and/or initiate development of networks, for enhancing research activities on large carnivores in Africa and beyond. Finally, I would also like to invite all of you to grab the opportunity presented by this conference at NMK to interact with members of the broader NMK community. This conference without any shadow of a doubt is well rounded, and I wish a great success to all participants as you engage, deliberate and interact during the conference and workshops. With those few remarks, it is my great pleasure to officially declare this conference open.”

Keynotes

Below are summaries of the two keynote addresses:

Keynote 1: *Where have all the carnivores gone and why? The carnivore fossil record of Africa* by Dr. Lars Werdelin, Swedish Museum of Natural History



Dr. Lars began his keynote by taking the audience in a trip through the eyes of evolutionary history and transitions of the African carnivore fauna. He gave a list of the fossil records of carnivore families. “The late Miocene saw a transition from archaic hyaenodontids to modern carnivorans. In the late Miocene, a global turnover of carnivorans occurred that strongly affected Africa, consequently, this led to the presence of carnivorans of African origin over large parts of the globe.” The audience was then informed that the past two million years saw a dramatic loss of carnivoran taxonomic and ecological diversity in Africa. Members of mustelidae, the audience learned, were as big as some modern carnivores with extinct giant otters weighing up to 300kg. He explained that the carnivores of the past went through a vigorous transitory process to give rise to the carnivores of today. “Small carnivores were not necessarily always small, some species of small carnivores of today were big enough to be considered large carnivores in the past.” he explained. He elaborated that the felidae were present since the early Miocene and talked in detail about the Sabre-toothed cat and its interaction with prey, the colossal herbivores of the era. The audience was further informed that the hyaenidae came in late after the Miocene. Dr. Lars then concluded his keynote by elaborating the interaction between the carnivores and their prey. He talked about the morphospace within this dramatic history, while attempting to provide an answer to the question of why the modern carnivoran fauna of Africa is a small, endangered remnant of its past diversity.

Keynote 2: *Behavioural ecology of bone-cracking hyaenas* by Prof. Kay Holecamp, Michigan State University



Prof. Kay began by enlightening the audience that over millennia, there have been over eighty hyaena species, and that only four remain extant. They include: Striped hyaena *Hyaena hyaena*; Brown hyaena *Hyaena brunnea*; Spotted hyaena *Crocuta crocuta*; and, Aardwolf *Proteles cristata*. She talked about the ecomorphs that include: mongoose-like and jackal-like hyaenas, cursorial hunting hyaenas, transitional bone-cracking hyaenas, and the advanced bone-cracking hyaenas. She then elaborated the phylogeny and distribution of the four extant hyaenidae, before delving into the details of her decades of research on Spotted hyaena and Striped hyaena in the Masai Mara National Reserve and Shompole areas respectively in Kenya. The audience was enlightened on the similarities and differences in the traits of the extant bone-cracking hyaenas including: skull morphology, ontogeny, social lives including intra and inter specific interactions, foraging strategies and provisioning of cubs at dens. She elaborated on hyaena-human interactions including using extant hyaena species as models for the extinct forms. “Relative to other carnivores, weaning in bone-cracking hyaenas is disproportionately late for their body mass, and cubs develop slowly inside cave and sometimes earthen dens.” she explained. The audience was further enlightened on the trade-offs during hyaena evolution in the time required during ontogeny to develop the skull *vis-à-vis* the robustness of the adult skull to achieve greater bite forces. “Adult Spotted hyaenas” she stressed, “can break open bones up to seven centimetres in diameter!” She then explained that hyaena dung is composed mainly of bone matrix and that the dung fossilizes as coprolites. “*Crocuta spalea*” she explained, “was adapted for scavenging like the modern striped and brown hyaenas, but a reconstruction based on remains found in Italy reveals that it was not adapted to cursorial hunting like the Spotted hyaena.” She then gave reasons why *Crocuta crocuta* is not the best model for extinct bone-cracking hyaenids, including being highly derived with a social life that is totally unique and never leaving Africa. “Anatomical evidence indicates extinct forms were not cursorial hunters.” she explained. She then concluded by stating that *Hyaena brunnea* and *Hyaena hyaena* instead may offer better models for the extinct bone-cracking hyaenids that interacted with our ancestors.

Delegate presentations

The following are the summaries of delegate presentations oscillating under the main conference theme and sub-themes in no particular order:

***Quaternary carnivores: a view from Western Europe and comparison with African carnivores' guild* by Dr. Jean-Philip Brugal, Aix-Marseille Université, CNRS, Aix-en-Provence.**

His talk centered on biodiversity and ecology over past millennia. He elaborated on: the total number of species per family; matrix of occurrence (presence / absence); turnover analysis; diet categories; and, body mass/size. "Viverrids did not occur in Europe, but there existed representatives of the following families: mustelids, ursids, canids, felids and hyenids." he stated. He then gave a broad view from Europe with its rich and diversified carnivore guilds. He explained that periodic turnovers of the carnivores had a relationship with that of herbivore turnovers; highlighting the importance of migrations from Asia and Africa. He noted the relative similarity in terms of species between Western Europe and Africa. He then concluded by stating the need for modern data from Africa to better understand the fossil record; and, the need to incorporate herbivores and their population dynamics.

***Extant African and Extinct European Hyenas: taphonomical characterization of their bone accumulations* by Dr. Jean-Baptiste Fourvel, Université de Toulouse le Mirail.**

He presented the talk on behalf of his research team. He began by briefly stating that large carnivores have mainly been studied in ecological and/or palaeontological purposes. He also stated that hyenas have also been studied for taphonomical purposes. "We examined taphonomic questions arising from modern bone accumulations; then compared the three extant species to establish whether the modern *Crocuta* taphonomic model is appropriate for elucidating behaviour of extinct *Crocuta spp*; or, whether differences found between the extant and extinct *Crocuta spp* are behavioural." he remarked. He concluded by elaborating on the development of taphonomical research on African predators; and mainly because they share the same ecosystems (habitat and prey); predators such as lions, leopard, cheetah and wild dog are the hyenas' main competitor in terms of food access. These very predators are frequently found in association with hyena in modern and fossil contexts.

***Humans and Hyenas: a conflict since the origins* by Prof. Philippe Fosse, Université de Toulouse le Mirail.**

He began by enlightening the audience on the myth of bone accumulating hyaena. He then elaborated on the osteodontokeratic culture of *Australopithecus Prometheus*. He proceeded to give the results of comparative studies between the spotted, brown and striped hyaenas in the light of: *taphonomical data*-faunal lists, toothmarks/bones, skeletal parts/species; *archeological data*- spatial distributions, bone refittings; and, *ecological data*- predator/prey demography, relationships and denning use. "Two categories of sites exist: the open air (fluvial) - single/mass death ungulate sites; and, caves/denning sites." he explained. He then gave a comparison between the canids, hyenids and felids using modern records *vis-à-vis* fossil records. He concluded by expounding on the dynamics of the competition between carnivores and humans for site occupation.

The Science Behind ‘the Man-eaters of Tsavo’; a case study into an infamous incident by Prof. Julian Kerbis, Roosevelt University, Chicago.

He introduced his talk to the audience by showing a landscape view of the study sites through past pictures (1899 by Patterson) and contemporary pictures (1997 by his research team). He then gave a highlight on the possible hypotheses/causes of man-eating behavior that include: abnormally behaving prey, conducive habitat, seasonal circumstances, livestock availability, sex and age profile, bodily injury or dental trauma, depletion of favored prey, and social tradition. Based on a series of research findings shown to the audience, there was found no evidence for: abnormal behavior of victims; impact of rains or any seasonal impact; and, broken tooth hypotheses. However, there was evidence to support the following hypotheses: habitat impact of dense thorny thickets; availability of sick/dead livestock; sex-age profile (young or prime male); depletion of favored prey; and, social traditions. He noted that the Tsavo landscape had already been severely impacted by human activities such as the ivory trade and livestock rearing for over a century. He concluded by emphasizing that man-eating by lions is not hereditary; but an acquired behavioural trait that could easily be passed from parents to their offspring, in addition to the above said conducive environments.

The Potential Distribution of the African Lion in the face of Changing Global Climate by Prof. Julian Kerbis, Roosevelt University, Chicago.

He began the talk by informing the audience that lion populations are presently restricted to protected areas, where their numbers have been somewhat stable over the past 3 decades. Although the species can be protected from direct conflict with humans (with varying levels of efficiency), the potential effects of climate change on its future distribution had not previously been addressed. He talked of his research team using ecological niche models to anticipate future lion distribution. In light of climate change, they evaluated the magnitude of potential changes in the distribution of lion populations over the next 4 decades. Known lion occurrences were integrated with present-day climate data to produce estimates of the lion’s ecological niche. Historical ranges of lions were summarized across Africa, Asia and southern Europe. These were geo-referenced at different levels of precision. The niche models were then integrated with future climate projections from General Circulation Models (GCMs). The results indicated that all temperatures will have a predictable increase but there is much variation in predicted rainfall. “We projected current African distribution models broadly across Asia, Europe and North Africa to investigate the degree to which they could recover broader portions of the historical distributions. These models were successful except for occurrences in the Balkans (perhaps due to cultural icons of lions thought to represent lion distribution)” he stressed. Areas of suitable conditions in southern Africa (Etosha, Kalahari-Gemsbok, Cuvelai Drainage, Kgalagadi) were projected to become less suitable because of climate change (due to increased temperature and decreased rainfall). A broad swath of potential distribution area (West Africa) was anticipated to become less suitable, or even uninhabitable. In the current heart of lion distribution (Kenya and Tanzania) climate change was projected to be more neutral. He concluded by stating that, “Increased temperature and decreased rainfall have secondary effects, by reducing prey availability for lions dependent on migratory prey. This increases cub mortality and starvation of older lions. Further, droughts impact the survival of livestock, making pastoralists less tolerant of lion attacks; thus climate change can increase human-lion conflict.”

***Black-backed Jackals as taphonomic agents: bone accumulations from the Namibian Coast* by Prof. Philippe Fosse (on behalf of Graham Avery, University of Cape Town).**

He began by explaining the primary goal of the study which was, plotting and collecting coastal Jackal bone assemblages for comparison with brown hyaena, palaeontological and archaeological material. He noted that while partially eaten seal limbs were available in kitchen middens of the jackals, these were missing in the Uniab hyaena accumulation. He explained that hyaenas focused on large prey, while Huab Jackals primarily fed on seals and cormorants reflecting most common available prey, away from breeding colonies where prey focus was different. He concluded by stating that, the Huab kitchen middens offered insights into the nature and variability of carnivore assemblages on open coasts; prey reflected available biodiversity; and, such accumulations could (if they were to survive long enough) be fossilized.

***A Brown hyaena (*Hyaena brunnea*) bone accumulation in the Uniab River coastal fan, Skeleton Coast Park, Namibia and taphonomic implications.* by Prof. Philippe Fosse (on behalf of Graham Avery, University of Cape Town).**

He began by explaining the primary goal of the study which was; to plot and collect Brown hyaena den assemblage for comparison with mid-pleistocene fossil dens. He then gave a 25 year history of bone assemblages, due to den abandonments and re-colonizations at distinct timelines, influenced by dune encroachments and flood inundations. He noted that the Uniab hyaenas focussed on springbok, oryx and seals, while jackals primarily taking seals and cormorants. He concluded by stating the following: the Uniab den offered unexpected direct insights into the underlying timing and episodic processes that can contribute to the development of an occurrence, that might (if it were to survive long enough) be preserved and become fossilized; it confirmed the nature and identity of a number of previously putative dens, thereby increasing understanding of this type of fossil occurrence; not all linear occurrences represent burrows; and, prey reflected available biodiversity.

***Determination of ecology, population status and distribution of carnivores on Mt. Mulanje, Malawi* by Wilbert Chitaukali, University of Malawi.**

He began by stating that the biodiversity of Mt. Mulanje was well known except for birds and butterflies. He reported that a number of mammals, reptiles, amphibians and fish species were listed as either rare, endemic, near endemic or isolated. "Medium sized cats had been recently reported on the plateau, hence our study was conducted to identify the cats, their prey; and, distributions through scat analysis." he inferred. He reported that through use of reference hairs, prey species in the scats included: *Tatera*, *Lemniscomys*, *Otomys*, *Rattus*, *Aethomys*, *Pelomys*, *Grammomys*, with *Tatera*, *Lemniscomys* and *Otomys* being dominant. He stated that the study results showed that the cats on Mt. Mulanje predate mainly on *Tatera*, *Lemniscomys*, *Otomys* and *Rattus* species. He concluded by recommending the need for extensive and seasonal sampling in order to answer further ecological questions that would help reveal: the identity of predator species; prey base of the predators; population sizes; demographics; distributions; habitat preferences; possibility of seasonal migration of the predators; and, expansion of the standard hair guide.

Tools for a national cheetah survey 2015-2017 by Dr. Mary Wykstra, Action for Cheetahs in Kenya.

She began by noting cheetah distribution across countries both in the African and Asian continents. “Throughout the cheetah’s home range it is vulnerable to the threats of habitat loss, conflict for resources, indiscriminant killings and illegal trade. While Namibia has the strongest population estimated at around 3000; Kenya is the central population to the whole of Africa. We have estimated the Kenya population to be around 1200-1400 based on studies completed in 2007. The trans-boundary issues with states neighboring Kenya, and land settlement causing fragmentation in Kenya, are critical issues facing the future of the cheetah.” she stated. The audience was enlightened further on the Kenyan cheetah population distribution; which was mainly based on theoretical models, guesstimates made from projections of known cheetah numbers inside parks and reserves; into areas of historic ranges where there were still potential cheetah presence. She then explained, “However, more recent studies show that as much as 80% of cheetahs live outside of protected areas. We also know that carnivore behaviour and social structure are different depending on the level and types of stress (conspecific, human conflict, road network and climate).” She then elaborated in details, an array of activities that will be prioritized during the time schedule 2015 to 2017; with the scope being, identifying conservation status throughout the cheetah range in Kenya. “Two phases have been earmarked”, she said, “Phase 1: Gap Analysis during pre-survey: this will involve fecal detection dog and handler training, literature searches, range wide surveys, fecal analysis, large-scale threat analysis and conflict identification; and, Phase 2: mainly involving actual fieldwork at known sites of cheetah occurrence and their historical ranges.” She then listed the objectives set, which include: evaluating the distribution of cheetahs based on range categories established in the regional and national action plan; determining genetic variation, physiological status, and diet of cheetahs across Kenya; identifying and classifying threats to cheetahs throughout their range; evaluating community perception of cheetahs and distributing materials to encourage positive perceptions/tolerance towards predators; and, working with partners and stakeholders to develop protocols and methods for long-term cheetah conservation efforts. She then stated the methods to be used which include: preliminary evaluation of updated information from ongoing carnivore/cheetah research presence points and Kenya Wildlife Service occurrence data.” She then concluded by stating that, “Fieldwork will involve: Transect data – point data on factors affecting cheetah (prey, livestock, settlement, roads, water); fecal detection dog in areas where no researchers can assist in fecal collection; and, remote sensing to test assumptions of dynamic model and niche evaluation.”

***Cheetahs: losers or survivors?* by Dr. Elena Chelysheva, Mara-Meru Cheetah Project, Kenya.**

She began by noting cheetah adaptations across wide range of habitats and across countries both in the African and Asian continents. “Rivers do not form barriers for the cheetah movement.” she stated. She explained that prey size influenced hunting technique depending on type of habitat and number of hunters. She noted that in all cases, there was full-speed chase of a single hunter and/or co-operative hunt of a group. She enlightened the audience that cheetahs form temporary units (siblings) and permanent units (male coalitions). She then highlighted on the cheetah-human relationships across ages and cultures. She highlighted on the possible reasons for population declines of cheetahs globally, they include: loss of habitat and reduction in prey base, conflicts with people, poaching, illegal trade, disease and disturbance. She then shifted focus to the Mara-Meru Cheetah Project. She explained that the Mara has high tourist activity and relatively low grazing, while Meru has the low tourist visitation and very high grazing. She stated that the main goal of the project was identification of behavioral adaptations, and assessment of impact of social structure on reproductive success and survival of the cheetah in the protected areas under anthropogenic influence. She stated that use of photography helped to: reveal parental relationship between individuals; estimate cheetah lifespan; record personal reproductive history; and, assess survival rate of cubs. “To calculate the effect of tourists on cheetah activity, a table was compiled using the data from the observations (except behavior). Two additional binary variables were entered: 1) whether the animal was active or inactive; 2) whether the subject's behavior had changed or not. The values for activity and behavior changes in the absence of tourists were considered the baseline. Behavior was considered to be changed if there was a shift in the type of behavior pattern from one sample point to the next.” she explained. She then concluded by informing the audience that her team works with the local communities and the Mara driver/tour guides by: giving powerpoint presentations on ecology and behavior of cheetahs in general and Mara cheetahs in particular; and, encouraging local driver/guides to participate in wildlife conservation by awarding certificates signed by the Kenya Wildlife Service and the Narok County Government to exemplary individuals.

***Assessment of cheetah prey base outside protected areas in Salama and Kapiti plains of Southern Kenya* by Noreen Mutoro, University of Nairobi.**

She began by stating that about eighty percent of the Kenyan cheetah population resides outside protected parks in community and private lands. “Conserving these unprotected areas due the high dependency of cheetahs on them is crucial for the cheetah’s long term viability. Understanding of the cheetah’s adaptability is of utmost importance.” she emphasized. The methods she used included: monthly game counts, scat collection and analysis, and Reference Hair Collections. From her study scatology results, the following carnivores were identified: cheetah, blotched genet, caracal, jackal, and serval cat. Prey identified included: steenbok, grants gazelle, bush buck, impala, vervet monkey and baboon. She then concluded by listing the following recommendations: development of a Reference Hair Catalogue for East African mammals; use of detection dogs to find scats in the field; and, use of DNA analysis for carnivore identification.

Comparative bone accumulation and modification patterns of the Spotted hyaena (Crocota crocuta) and the Striped hyaena (Hyaena hyaena) in two pastoralists occupied areas in Kenya
by Dr. Ogeto Mwebi, National Museums of Kenya.

He began by explaining that it has now been well established that hyaenas and other carnivores are prolific bone accumulators in dens; and that, these accumulations were commonly used to reconstruct carnivore feeding ecology and their interaction with hominids in paleontological and zooarchaeological studies. “This relatively inexpensive method has not been used to reconstruct hyaenas’ feeding ecology and their herbivore prey dynamics including their interaction with pastoralists in Kenya.” he observed. He noted with concern that, carnivores in general and hyaenas in particular were highly persecuted for livestock depredation, even when the identity of the ‘culprit’ had not been well established hence the need for documentation to aid mitigation. His study results indicated that: tooth marks were not consistent in distinguishing between the two hyaena species accumulations; and, bone ravaging and element representation was influenced by prey availability. He concluded by stating that: both hyaena species accumulated livestock in relatively high proportions in their dens; the striped hyaenas of Magadi collected more wildlife than livestock, and the Grant’s gazelle was their most important prey; and, Samburu hyaenas accumulated more livestock than wildlife, and large wild ungulates were under-represented probably because they were depleted in the area.

Carnivore diversity and abundance in degraded forest patches in Rumuruti, Laikipia, Kenya
by Bernard Agwanda, National Museums of Kenya.

He began by enlightening the audience that camera-traps have been used in the past decades by many researchers to monitor occurrence of wildlife species. He stated further that majority of past work aimed to detect elusive, cryptic, threatened species that are difficult to study using conventional methods such as sighting, capturing, spoor and track. Study objectives included: rapidly assessing species diversity and abundance of carnivore in Rumuruti, as part of Laikipia conservation area; and, evaluating efficacy of camera-traps as a rapid mammals monitoring tool. “Laikipia is known to hold the largest population of wildlife in privately owned land in Kenya, and some of the commercial livestock ranches have a high tolerance for carnivores and wildlife in general. However, communally owned land is highly degraded and there is low tolerance for carnivores. Bordering community land, Rumuruti forest has suffered degradation due to uncontrolled exploitation.” he explained. A variety of captured images included: primates, ungulates, domestic animals, genets, mongooses, leopard, elephant, serval cat, spotted hyaena and humans. He observed that the smaller carnivore species dominated the larger ones in the frequency of captured images by the camera traps. He noted that the dominance of human activity in the forest was evident from the study results thus far. He concluded by stating that: large carnivores were declining in forests, hence not responsible to livestock and wild herbivores deaths; smaller carnivore species seemed thrive despite the increase in anthropogenic activities; and, use camera traps is an important tool for rapid mammal assessment and monitoring.

***Carnivore population dynamics in the Masai Mara National Reserve in relation to anthropogenic disturbance* by David Green, Michigan State University.**

He began by enlightening the audience on the negative impacts of the increased global human population growth to the conservation of wild carnivores. He outlined the role of large carnivores in maintaining ecological balance, including the cascading effects (mesopredator release) of their removal from an ecosystem. “Countries with large carnivores also derive economic benefits from these species through ecotourism and trophy hunting. However, in many parts of the world, the direct and indirect effects stemming from conflicts with humans over livestock and competition for resources have resulted in widespread declines in carnivore populations. These declines are occurring because of habitat loss, poisoning and persecutions, and prey depletion.” he explained. His research team examined population trends of small and large carnivores based on data collected since 1988 within two areas experiencing different levels of anthropogenic disturbance; the Maasai Mara National Reserve (MMNR) and the Mara Triangle Conservancy. “Maasai Mara National Reserve, which is managed by Narok County Government, is more disturbed since it is not fenced; has more tourist facilities (hotels, lodges and campsites); more human-wildlife conflicts due to Maasai pastoralists grazing in the reserve; the prey population of carnivores has been declining. Mara Triangle Conservancy on the other hand is a privately owned ranch with limited human disturbance, due to fencing and no or limited grazing by cattle. We used both long-term historical and short-term cross-sectional comparisons, to test predictions of hypotheses invoking anthropogenic disturbance and changing ecological conditions to explain changes in carnivore numbers.” he reported. Study results indicated that lions were declining in Talek, an area with high human disturbance; and survivorship of juveniles of the spotted hyaenas was high in the same area. This indicated the competitive effect of the two large predators, and their response to human disturbance. “Hyaenas appeared to be little affected by human disturbance in contrast to lions. In comparison, there were more lions, jackal species, and bat-eared foxes in Mara Triangle, than in Talek. However, the population of the cheetahs was the same both in Mara Triangle and MMNR. These results indicate that all carnivore species are not affected by disturbances in the same way. This raises the need for more research on effects on the effects human disturbance on carnivore species diversity and population, both inside and outside protected areas, in order to understand the drivers of species population declines.” he concluded.

***Effects of predator-proofing homesteads on the socio-economic well-being of pastoralists in Amboseli ecosystem, Kenya* by Iregi Mwenja, Jomo Kenyatta University of Agriculture and Technology.**

His presentation focused on the human-carnivore conflict mitigation in Amboseli ecosystem, a human-carnivore conflict hotspot involving the lion and spotted hyaena. He indicated that lion and spotted hyaena populations in Kenya are increasingly being threatened due to; shrinking habitats, depletion of natural prey and retaliatory killings due to livestock depredation. His study assessed the effects of predator-proofing of domestic animal enclosures on the social and economic well-being of pastoralists. The study results indicated that, predator-proofing of homesteads boosted the beneficiary’s household income through reduced costs of night guarding, and resulting to increase in herd sizes due to reduced depredation. He further noted that predator-proofing of homesteads greatly improved the quality time the family spent together both during the day and at night, since there was no need for overnight sentry. He concluded by stating that, the initiative improved tolerance for predators, due to the socio-economic benefits accrued, thereby considerably reducing the rates of retaliatory killings of large carnivores.

The social economic cost of lion depredation on livestock in the Amboseli Ecosystem, Kenya; and, The cost of livestock lost to lions and other wildlife species in the Amboseli Ecosystem, Kenya: by Margaret Muriuki, Karatina University, Kenya.

She began by stating that the African Lion *Panthera leo* population in Africa is undergoing serious decline; a decline that is largely a consequence of retaliatory killings due to livestock depredation. *She gave two talks that revolved around the same theme hence both talks have been lumped up into one summary.* “Consequently, the value and support which communities place on lions is likely to be a function of costs and benefits.” she emphasized. Her study approach involved a casual comparative research design that was used to compare different causes of livestock loss, and the economic impact they had on livestock keeping. Her key study results indicated that: economic losses caused by lions in the study area were among the highest reported in East Africa compared to other predators; hyenas and leopards kill more livestock compared to the lion, but these are predominantly ‘*shoats*’ (goats and sheep) which have less economic and cultural value compared to cattle; and, there were no husbandry practices in the study area that were effective in protecting livestock against lion attacks. Her key recommendations included: an insurance policy that covers livestock from the risk of wildlife attack; education and training of local communities on better husbandry practices; residents being encouraged to diversify their economic activities to spread risks and cushion themselves against uncertainties associated with pastoralism; and, lion-killing rates being reduced by more effective law enforcement and rigorous prosecutions.

The impact of human land use practices on lion populations in Queen Elizabeth National Park, Uganda by Dr. Charles Twesigye, Kyambogo University, Uganda.

Dr. Twesigye began his talk by highlighting on the challenges of lion conservation in areas with insecurity and political instability. He stated that in the last two decades, serious concerns have been raised over high lion mortality, and prey population declines in the area at the frontier between the Democratic Republic of Congo’s *Parc National des Virunga*, and Uganda’s *Queen Elizabeth National Park*. “However, there is no accurate data on the population status of the lions and their prey given that the available data is from aerial survey estimate (which is known to be inaccurate in detecting lions) conducted a decade ago. The said survey results revealed that the two parks had 221 lion, against their potential of holding 905 lions. The parks in the Albertine Rift are a potential stronghold for the species in East and Central Africa, and immediate conservation intervention for lions and their prey is urgent! This can only be implemented if accurate baseline data on their status is gathered using ground surveys.” he emphasized. After outlining the status and identifying information gaps in lion conservation in Africa, he explained the steps his institution was taking to fill the said knowledge gaps; with a general objective of assessing the impacts of communities neighboring national parks on wildlife in Uganda. “Kyambogo University is documenting the effects pastoralists and fishermen (who have recently settled in the Queen Elizabeth National Park), and farming activities around parks on lion populations. Data collected includes lion genetics, evolution and mortality rates.” he explained. He then concluded this talk by emphasizing that sustainable development could only be achieved, if the economy, social equity and the environment become integrated.

***Supra-occipital craniectomy for treatment of clavial hyperosteosis in lions; and, Can the lion's head jeopardize the lion himself?* by Merav Shamir, The Hebrew University of Jerusalem.**

She began by stating that clavial hyperosteosis has been a common cause of death of captive lions for many years. "Whether the bone pathology is caused by nutritional or genetic reasons or a combination of the two is still not known." she stated. *She gave two talks that revolved around the same theme hence both talks have been lumped up into one summary.* The audience was informed that despite there being about 30 clinical reports describing the disease in more than 100 lions, there was not a single research publication on the same. She reported that stillbirth and death of very young cubs was extremely common in captive lions, in most cases, the cause of death was not known. "However, it was observed that no such instances occurred in the wild populations. Vitamin A deficiency was discovered to be a possible cause of the death in captive lions; even though genetic factors and/or species predisposition could also have played significant roles. Using museum collections enabled us to examine a large number of skulls. However, when looking for clinical relevance of the results, important information such as specific habitat description, exact age, available diet, medical and neurological status, and cause of death was not available." she noted. She concluded by stating the following research findings by her team: a possible predisposition for abnormal bone growth and decreased Foramen Magnum Height (FMH) in skulls of captive lions in comparison to those of wild lions (within-species comparison); possible predisposition in comparison to the tiger, another obligatory carnivore of similar size (across-species comparison); whether this bone pathology is related to insufficient nutrients such as vitamin A or to other environmental and/or to genetic factors in captivity is yet to be determined; it is possible that lions are more sensitive to nutritional constraints than other large cats; and, although the clinical condition was never reported in wild lions population, it does exist in Africa in the semi wild population and may be a risk in the wild populations in future following environmental and/or genetic changes.

***Big cats and the East African palaeoenvironments* by Dr. Carlo Meloro, Liverpool John Moores University (presentation via voice-over powerpoint).**

He began by stating that all felids are hypercarnivores specialized on vertebrate prey. He explained that the aim of his study was to compare humerus functional morphology of extant felids with fragmentary fossil samples from Olduvai Gorge and Koobi Fora. He noted that forelimb is the most important module for the hunting in cats and humerus is highly correlated with supinatory ability as well as body mass. He concluded his talk by highlighting the main result outputs of his study, they include: humerus morphology being discriminated consistently with extant big cats species; fossil specimens clustered within extant species variability although they exhibited certain unique features (e.g. olecranon in *Homotherium*); and, there being a broader diversity of big cats in Koobi Fora rather than in Olduvai supporting a more complex mosaic of palaeoenvironments.

The role of community media in communicating research and policy issues on African large carnivores: impacts on ecosystems and human interactions for sustainable development by Wilson Okaka, Kyambogo University, Uganda.

He began his talk by highlighting on the effectiveness of community media, in disseminating scientific research and policy information, on African large carnivores' impacts on ecosystems and human interactions in Africa. He profiled the prospects and challenges of African large carnivores' conservation; and explained effective research and policy communication strategies necessary for public awareness and understanding of sound science. He then described capacity building initiatives. "The media has a social responsibility to promote and update knowledge. There still exists disconnect between scientific research and policy making, in most African countries where both public awareness and understanding of science, are still making very slow progress. Information and knowledge gaps are rife and there is urgent need for effective training, capacity building, collaborative research, ICT use, infrastructural development, and good governance. This strategy will involve the planned communication component of programmes designed to change the attitudes and behaviour of specific groups of people in specific ways through person-to-person communication, mass media, traditional media and/or community communication." he explained. He further noted that media are agencies of mediation in reporting events and proposing frameworks for their interpretations. "They are part of social reality which shapes our perception." he inferred. He then concluded by stating that, effective public communication campaigns should foster national, regional, and international collaboration among the conservation partners and networks, lack of which has led to: low level of community media and community involvement in natural resources management; low or irregular knowledge on community benefits and ownerships; unresolved land tenure issues; slow or poor implementation of international conservation agreements already ratified by African governments; and, rising large carnivores extinction, threats and dangers.

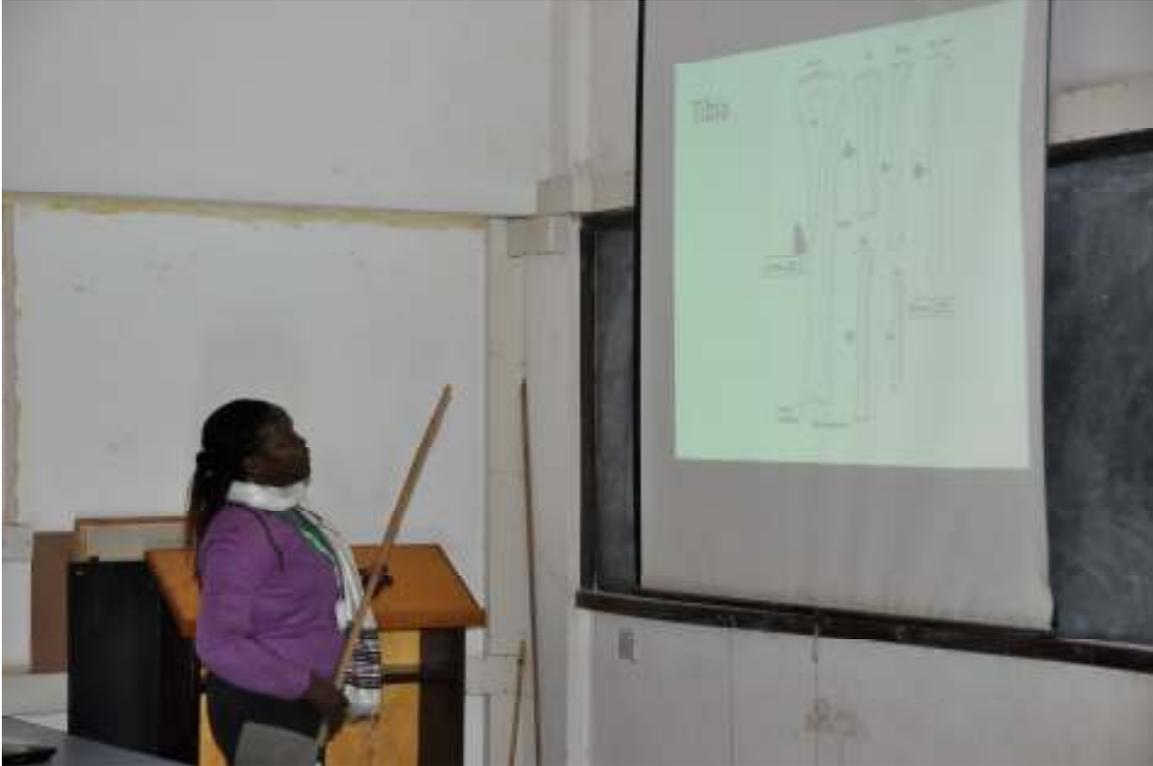
Impact of severe drought and climatic variability on lion population in Amboseli National Park, Kenya by Tuqa Jirmo, Kenya Wildlife Service.

He began by giving a brief summary of his study duration and sites. He elaborated that rainfall variability, prey abundance and human-induced mortality incidences were used to assess lion vulnerability to drought. He noted that escalation of livestock depredation by large carnivores and their retaliatory persecution by pastoralists is of a major conservation concern currently. He observed that among others: increasing human population; water development; shifts in spatial distribution of settlements; and, habitat conversions, were the main contributors to the problem. "We used direct individual identification, radio telemetry and calling stations to estimate lion population densities and social structure in and around Amboseli National Park. This information was used to determine: the lion population densities; pride structure and group size; male and female sex ratio; and, their distribution. We then used rainfall variability, prey abundance and human induced mortality incidents to assess lion vulnerability to drought." he explained. The results of his study indicate that human induced mortality and climatic variability combined have significant effects on lion pride organization and social structure which could threaten their persistence. He concluded by explaining that since more juveniles were observed in Amboseli in the period after the drought, the lion population would ultimately be restored following improved prey numbers.

Workshops

The following are the summaries of the workshops presented:

Workshop 1: *Bone identification* by Dr. Christine Ogola, National Museums of Kenya



She began by reminding the audience that bone identification is a stepwise process that can only be perfected over time. “Dry bones can provide a lot of information to answer important questions in archaeology, geology, forensics, paleontology, physical anthropology, anatomy and conservation biology.” she explained. She then demonstrated various visual skeletal types and elements of mammal, fish and avian specimen. Participants were then enlightened on: symmetry and division of skeletal systems into axial and appendicular skeletons; the skull and its division into cranium and mandible; and, teeth types, structures and orientation for selected animals. Dr. Ogola then concluded the session by emphasizing on the importance of having good reference collections in order to make taxonomic identification of bones a success.

Workshop 2: Taphonomy in paleontology by Dr. Jean-Philip Brugal, Aix-Marseille Université, CNRS, Aix-en-Provence



Dr. Brugal began by explaining that taphonomy refers to the study of bone assemblage and associated processes, i.e. studies about the living animal all the way from time of demise (natural/predation), to being embedded and eventually during excavation. “Most bones are fractured. Type of breakage indicates whether it was natural; with cut marks (hominid activity); or broken by carnivore.” he explained. Dr. Brugal then talked about the ongoing debate by paleontologists about hunting *vis-à-vis* scavenging - “Did hominids take over caves from carnivores or was it vice versa?” He elaborated on the challenges involved in collecting taphonomical data; which is most often fragmented, therefore skill and experience is required to identify which part and/or side of the animal the bone fragment belongs. Is it proximal, dorsal, ventral or distal? He then concluded the session by emphasizing that taphonomy includes all the processes of bone assemblage, and that information on neo-ecology, archaeo-zoology, ethno-archaeology and animal ecology were all crucial in taphonomy.

Workshop 3: *Skeletal preparation: an easy and cost effective methodology using dermestid beetles* by Dr. Job Kibii, University of the Witwatersrand, Johannesburg

Dr. Kibii began by expounding on the existing traditional preparation methods that include boiling and burying. “When boiling skeletons and removing flesh with surgical blades, the bones become degraded and scalpels cause unwanted surface modifications.” he stressed. Participants were informed that the dermestidae family comprises of about 700 - 800 species. “These very species,” he explained, “have a variety of habits and most are xerophilous necrophages.” He then gave the *pros and cons* of using *Dermestes maculatus*. The advantages include: it being a cosmopolitan species; easy availability of comprehensive literature; and, ease of collection and maintenance. The disadvantages include: coastal fish carrion being very unattractive to this species; and, pervasion of a strong stench due to the decaying process of the carcass as the dermestids ‘*have*’ their work in progress! Participants were enlightened on *Dermestes maculatus* identification from larvae to adults; its life cycle and history from the larval to pupae to adult stages. He emphasized that to have optimum action from dermestid colonies; temperature and humidity play the most crucial roles. He then concluded the session by elaborating on the stepwise process of establishing a colony to maximize on productivity, including safety systems and structures that need to be in place to ensure adult dermestid beetles do not escape and wreak havoc on precious collection specimen!



Participants engaging in one of the practical sessions during workshops

Workshop 4: Coprolites by Dr. Jean-Philip Brugal, Aix-Marseille Université, CNRS, Aix-en-Provence



Dr. Brugal began by describing coprolites as fossil faeces that were either dry or mineralised. He then mentioned that their origins could be from marine, terrestrial vertebrates and invertebrates, mostly carnivores and omnivores; and, were used in taxonomy, prey presentation, palynology, parasitology, paleogenetic DNA (phylogeny and prey), isotopes and paleo-environment construction. He stated that their shapes and diameters were characteristically used for identification. Out of the nine groups of coprolites, Dr. Brugal focused his talk on **Group I** which consist of cylindrical faeces which easily fossilize. Finally, he talked about the differences between ingested and digested bones, and how bones become modified after ingestion and/or digestion.

Workshop 5: *Diet investigation by scat analysis: hair identification protocol, the carnivore project* by Nduhiu Gitahi, University of Nairobi



Nduhiu Gitahi (handling microscope) demonstrating to participants the animal hair and/or scat analysis.

He began by enlightening the audience on the difficulty of obtaining lion scat due to its high protein content hence being quickly consumed by other wildlife, particularly scavengers. “Lion scat must therefore be very quickly collected once found or reported.” he stressed. He then elaborated broadly on the methods of scat collection, and the procedures and processes therein. He further talked about Reference Hair Collections (RHC), the procedures and processes therein. He finally wrapped up the session by talking about the challenges encountered during scat and/or hair collection; and, the rigorous and strict procedures that must be followed for effective species identification from the samples collected in the field and/or at livestock depredation sites.

Discussions and way forward

A panel discussion on the future of the “*Network of history, biology and conservation of African carnivores*” was convened on the final afternoon of conference. This resulted in very exciting ideas that form the very blueprint of growing and expanding the network, with the view of building the capacity of the next generation of carnivore conservationists in Africa and beyond.

Key issues raised by participants during panel discussions and deliberations included:

- *Suggested title unanimously agreed upon was: “Network of history, biology and conservation of African carnivores.”*
- Need to have research looking at the communal effects of these large carnivores.
- There is too much focus on the large carnivores, hence need for facilitation to study smaller predators.
- Need to establish a pool of seasoned researchers who can mentor upcoming researchers on funding and fundraising.
- Need to establish projects that focus on taphonomy in addition to the biology and ecology of the large carnivores.
- There exists gaps in geographical studies *i.e.* too much focus on certain geographical areas and/or locations only; need to expand research focus.
- There are great papers on carnivore research, what about implementation of the research findings?
- Need to formalize structure of ‘network’ with a strategic plan and perhaps subsequent meetings, annually or biennially.
- Forum should help in building capacity of members in their respective countries.
- Need to set up a directory of all practicing conservation professionals in carnivore research both regionally and globally; with potential contacts being invited to join network.
- Prospects of using Skype conferencing and social media to meet and/or discuss issues were deliberated.
- Need to establish a secretariat to establish and maintain communications and networks, and subsequent meetings.
- It was deliberated whether the group could niche into INQUA
- Title, theme and scope of conference was deliberated upon; whether scope should be regional or global, or whether theme should focus on general conservation or just a network of researchers.
- It was also debated whether herbivore researchers could be included in the network.
- Members were informed about an annual carnivore conference hosted by the Kenya Wildlife Service.
- Members were informed that a lot of avenues could be exploited, including IUCN specialist groups such as felids specialist group and hyaena specialist group.

- It was noted that geneticists on small carnivores were lacking in Africa.
- It was deliberated whether the carnivore group could marshal resources and representatives to hold a symposium in the next International Mammal Congress which is likely to be held in 2017.
- It was deliberated whether the carnivore group could integrate into current established networks and also have regular meetings and sponsorships for scientists.
- It was agreed that since working groups have broader scope than specialist groups, then it would be prudent to establish *working groups* on certain carnivores.
- Members were informed that the International Union of Biological Sciences (IUBS) has a lot of member states and funds various research initiatives. It was deliberated that IUBS could be sought for sponsorship.
- When the network has been established, an online platform for researchers or naturalists could be set up for online letters (captivating field anecdotes and research findings).
- Collaborations should be kept alive both long term and short term once network is up and running.
- Setting up a facebook page for the network was mooted.
- Need to address challenges that young researchers face in conducting field research, including equipment and how to use them, and possibilities for mentorship was deliberated.
- *The creation of a webpage of the group including setting up a web link within the NMK website was hailed as a welcome idea by all members.*

The organisers thanked participants for their input and fruitful discussions. On behalf of the participants, Prof. Julian Kerbis intimated that all participants were happy and excited to attend meeting, the instructional atmosphere was most excellent, the meals and refreshments great, and thanked sponsors to the conference/workshop including the French government.



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NATIONAL MUSEUMS OF KENYA

WHERE HERITAGE LIVES ON