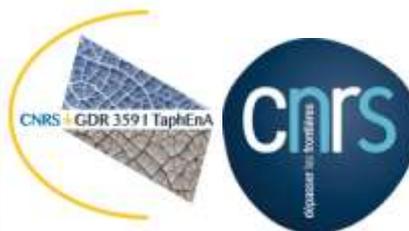




African Large Carnivores: Impacts on Ecosystems and Humans Interactions

*Conference & Workshop at National Museums of Kenya
Louis Leakey Auditorium*

24TH - 27TH JUNE 2014



Ogeto Mwebi & Jean-Philip Brugal (orgs)

WELCOME

We wish to welcome you all to this first meeting of the African Large Carnivores researchers' project. Large carnivores are exciting diverse predator groups, which were well distributed in all continents. While they are mostly extinct in the other continents, Africa has still a high number of them extant. They are important components of the terrestrial ecosystems and we look forward to a fruitful debate about them in this multidisciplinary group of researchers. The long term goal of this project will be to form an international carnivore researchers' group that will bring together young and senior researchers working on diverse aspects of the carnivore studies both in modern and fossil record including: taphonomy, ethology, ecology, paleontology, biochemical/molecular biological studies, morphofunction, and conservation with a scientific purpose of linking pleistocenist and holocenist.

We will to acknowledge and appreciate all sponsors and partners for their invaluable support: the International Union for Quaternary Research (INQUA) - Human and Biosphere commission, the National Museum of Kenya (the host of this meeting), the French Embassy in Kenya's Cooperation and Cultural Affairs Department, the French Research Group (Groupement de Recherche, GDR) GDR 3591 of the Centre National de la Recherche Scientifique (CNRS-INEE), the University of Nairobi, and the Kenya Wildlife Service (KWS).

Finally we warmly welcome and thank the key note speakers and all the other participants for coming and making this conference a success.

BACKGROUND

The primary aim of the project is to bring together young and senior researchers involved in different fields of large carnivore studies to share existing data and to improve skills and results 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 functioning of the biosphere. By analysis of their prey bone accumulations and modifications patterns, carnivores can provide useful information necessary for the reconstruction of past, present and even predict future ecosystem dynamics. However, negative attitudes and competition for limited space/resources has led to rapid elimination of these carnivores from most of their natural ranges; the consequence of their ecological role and their current elimination is little known. In Africa, the three large carnivores' families: *Felidae* (lion, leopard and cheetah), *Hyaenidae* (spotted, striped and brown hyenas) and *Canidae* (wild dogs) pose great conservation challenges due to their livestock predation behavior and pastoralists' negative attitudes towards them.

Thus carnivore ecology and conservation is a complex affair that calls for understanding of the socio-economic/cultural values of the pastoralists as well as past and present ecological dynamics within various ecosystems. To achieve this will require multi-disciplinary expertise. Therefore, the goal of this project will be 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 as well as in inferring environmental changes through time plus understanding intra- and inter-specific competitions (especially with prehistoric humans). Such studies need development of a robust methodology that integrates diverse research approaches.

Scientific Committee

Ogeto Mwebi
Zoology Dpt, NMK

Christine Ogola
Earth Sciences Dpt, NMK

William Ogara
University of Nairobi, Kenya

Jean-Philip Brugal
CNRS, Aix-Marseille Université, Aix-en-Provence, France

Bernard Agwanda
Zoology Dpt, NMK

Local Organizers

Ogeto Mwebi
Zoology, NMK

Christine Ogola
Earth Sciences Dpt, NMK

Bernard Agwanda
Zoology Dpt, NMK

Ben Nyakundi
Zoology Dpt, NMK

Esther Nguta
Zoology Dpt, NMK

Nduhiu Gitahi
University of Nairobi

Nelson Owange
University of Nairobi

PROGRAMME

A two-day's meeting would be devoted to different presentations within three sessions:

- * S1 - HUMAN-CARNIVORE INTERACTIONS & CONSERVATION**
- * S2 -BIODIVERSITY & ENVIRONMENT (past-present)**
- * S3 - TAPHONOMY & ECO-ETHOLOGY (past-present)**

It would be followed by a two-day's workshop (26-27th, June) around questions/training:

- * STUDIES OF BONE-ASSEMBLAGES MADE BY CARNIVORES**
- * CARNIVORE SCAT ANALYSIS**

24th June, 2014

Louis Leakey Auditorium

8.30- 9.00

Registration

9.00 – 9.20

Welcome address (organizing committee)

9.20-9.40

Message from sponsors (HaBCOM/French Embassy)

9.40 – 10.00

Director NMK Opening address

10.00-10.30

Key-note speaker /Start of Conference:

Lars Werdelin

Where have all the carnivores gone – and why? The carnivore fossil record of africa

S1 - HUMAN-CARNIVORE INTERACTIONS & CONSERVATION

10.30-10.50

David S. Green et al - Carnivore Population Dynamics in the Maasai Mara National Reserve in Relation to Anthropogenic Disturbance

10.50-11.20

Tea Break

11.20-11.40

Iregi Mwenja - Effects of Predator-Proofing Homesteads on the Socio-Economic Well-Being of Pastoralists in Amboseli Ecosystem Kenya

11.40-12.00

Margaret Muriuki et al - The Social Economic cost of Lion depredation on livestock in the Amboseli Ecosystem, Kenya

12.00-12.20

Charles K.Twesigye - The impact of human land use practices on lion (*Panthera leo*) populations in Queen Elizabeth National Park Uganda

12.20 – 12.40

Bernard Agwanda –Documenting Diversity of Carnivores through Camera trapping

12.40-13.00

Short Discussion

13.00 -14.00

LUNCH Break

14.00-14.20

Margaret Muriuki et al - The Cost of Livestock Lost to Lions and Other Wildlife Species in the Amboseli Ecosystem, Kenya

14.20-14.40

Wilson Okaka - The Role of Community Media in Communicating Research and Policy Issues on African Large Carnivores' Impacts on Ecosystems and Human Interactions for Sustainable Development

14.40-15.00

Noreen Mutoro - Assessment of Cheetah Prey Base Outside Protected Areas in Salama and Kapiti Plains of Southern Kenya

15.00-15.20

Mary Wyskyra - National Cheetah (*Acinonyx jubatus*) Survey : Tools for a Range Wide Analyses of Cheetah Distribution

15.20 – 15.40

Merav H Shamir et al- Supra-occipital Craniectomy for Treatment of Clavarial Hyperostosis in Lions (*Panthera leo*)

15.40 – 16.00

Tea Break

S2 -CARNIVORE BIODIVERSITY & ENVIRONMENT (past-present)

16.00 – 16.20

Tuqa Jirmo - Impact of Severe Climate Variability on Lion Population Structure in the Amboseli Ecosystem Kenya

16.20-16.40

W.N. Chitaukali - Determination of Ecology Population status and Distribution of carnivores on Mt. Mulanje, Malawi

16.40-17.00

Short discussion and end of the day session

25th June, 2014

Louis Leakey Auditorium

9.00-9.20

Carlo Meloro- Big Cats And The East African Palaeo-Environments

9.20-9.40

Julian Kerbis Peterhans - Potential Effects of Climate Change On Lion Distribution

9.40-10.00

Jean-Philip Brugal - Quaternary' Carnivores: A View From Western Europe In Comparison With African Carnivores' Guild

10.00-10.20

Short discussion

10.20-10.40

Tea break

S3 - TAPHONOMY & ECO-ETHOLOGY (past-present)

10.40-11.10

Keynote speakers :

Kay Holekamp - Behavioral Ecology of Bone-Cracking Hyenas

11.10-11.30

Joseph Saragusty et al- Comparative skull analysis suggests species-specific captivity-related malformation in lions (*Panthera leo*)

11.30-11.50

Graham Avery - Black-backed jackals (*Canis mesomelas*) as taphonomic agents: bone accumulations from the namibian coast

11.50-12.10

Jean-Baptiste Fourvel et al -Extant african and extinct european hyenas: taphonomical characterization of their bone accumulations

12.10-12.30

Ogeto Mwebi - Comparative bone accumulation and modification patterns of the spotted (*Crocuta crocuta*) and striped (*Hyaena hyaena*) hyaenas in two pastoralist occupied areas in Kenya

12.30-14.00

Lunch Break

14.00-14.20

Philip Fosse - Humans and Hyaenas: in conflict since their origins

14.20-14.40

Graham Avery- A modern brown hyaena (*Parahyaena brunnea*) bone accumulation in the Uniab River coastal fan, Skeleton Coast Park, Namibia and taphonomic implications

14.40-15.00

Julian Kerbis Peterhans - The circumstances of man-eating in lions

15.00-16.00

General discussions : Focus Group Matters

16.00-16.30

Tea Break

16.30-17.00

Movie, presented by J. **Kerbis Peterhans** : "*Entering a modern lions cave (Western Uganda)*" JC Kerbis Peterhans (Roosevelt University and FMNH), TP Gnoske (FMNH), RM Kityo (Makerere Univ)

17.00-17.15

Closing Ceremony

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TRAINING WORKSHOP 26th and 27th June

At Osteology Department, NMK

26th, June

**STUDIES OF BONE-ASSEMBLAGES MADE BY
CARNIVORES**

9.30-10.30

**Presentation ppt about bone identification, taphonomical
studies**

10.30-11.00 = Tea Break

11.00-12.30

**Visit at the Palaeontology Dpt, NMK : fossil carnivores & look
on the Amboseli den bone collection**

12.30-13.30 = Lunch break

13.30-16.30

**Lab. Practices = Training on bone collection from Kenyan
hyenid dens**

27th, June, 9.00-12.30

CARNIVORE SCAT ANALYSIS

**Presentation ppt on scat analysis procedure, coprolites'
(fossil and modern)**

10.30-11.00 = Tea Break

11.00-12.30

Lab. Practices

12.30-13.30 = Lunch break

14.00-15.30

Discussion and Evaluation

ABSTRACTS

Key-note speaker /Start of Conference:

WHERE HAVE ALL THE CARNIVORES GONE – AND WHY? THE CARNIVORE FOSSIL RECORD OF AFRICA

Lars Werdelin

Department of Palaeobiology

Swedish Museum of Natural History

lars.werdelin@nrm.se

The African carnivore fauna has undergone several revolutions in the past 25 million years, from its origin some 27 million years ago. The Middle Miocene (ca 16-13.5 million years ago) saw a transition from archaic hyaenodontids to modern carnivorans. In the Late Miocene (ca 7-5 million years ago) a global turnover of carnivorans occurred that strongly affected Africa. From ca 4 million years ago, an endemic carnivoran fauna arose in Africa that ultimately led to the presence of carnivorans of African origin over large parts of the globe. The past 2 million years have seen a dramatic loss of carnivoran taxonomic and ecological diversity in Africa. In this talk I will discuss some aspects of this dramatic history and attempt to provide an answer to the question of why the modern carnivoran fauna of Africa is a small, endangered remnant of its past diversity.

S1- HUMAN-CARNIVORE INTERACTIONS & CONSERVATION

CARNIVORE POPULATION DYNAMICS IN THE MASAI MARA NATIONAL RESERVE IN RELATION TO ANTHROPOGENIC DISTURBANCE

David S. Green, Lily Johnson-Ulrich, Hadley E. Couraud, Adam Hoffhines, Brian R.

Heath, Kay E. Holekamp

Michigan State University, USA

Global human population growth has become a major threat to the conservation of wild carnivore populations. 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. In southwestern Kenya, the Masai Mara National Reserve has historically supported abundant carnivore populations year-round; these carnivores represent a

major attraction for foreign tourists and thus an important driver of foreign exchange for the Kenyan economy. However, exponential human population growth outside Reserve boundaries may be affecting carnivore population sizes within the Reserve. In the current study, we examined population trends of small and large carnivores within the Reserve in two areas experiencing different levels of anthropogenic disturbance. Using both long-term historical and short-term cross-sectional comparisons, we tested predictions of hypotheses invoking anthropogenic disturbance and changing ecological conditions to explain changes in carnivore numbers.

EFFECTS OF PREDATOR-PROOFING HOMESTEADS ON THE SOCIO-ECONOMIC WELL-BEING OF PASTORALISTS IN AMBOSELI ECOSYSTEM, KENYA

Iregi Mwenja

Jomo Kenyatta University of Agriculture and Technology , iregim@gmail.com

Lion (*Panthera leo*) and spotted hyaena (*Crocuta crocuta*) populations in Kenya are becoming increasingly threatened. In the Amboseli ecosystem, a human-carnivore conflict hotspot, the most immediate and serious threat to these species is conflict with humans. Shrinking habitats and reducing numbers of natural prey (due to drought and poaching for the illegal bushmeat trade) has resulted in increasing numbers of livestock being preyed upon by lions and hyenas. The consequence of such livestock predation is retaliatory killing by local community. As a result, predator numbers have fallen dramatically. The majority of attacks by predators on livestock are at night-time, when livestock are enclosed in traditional ‘bomas’ (night-time enclosures made of a ring of cut thorns, approximately 1.5m high). Predators find these bomas easy to penetrate, and livestock housed in the traditional bomas are therefore an easy target. Conservation organizations are predator-proofing these homesteads to protect livelihoods and enhance social interactions of the households in Olgulului Group Ranch in Amboseli ecosystem. My study investigated the effects of this project on the social and economic well-being of these pastoralists in the group ranch. Findings of the study reveals that predator-proofing of homesteads in the group ranch boosted the beneficiary’s household income through reduced costs of night guarding and resulting increase in herd sizes due to reduced depredation; the time the family spent together both during the day and at night was improved as there was no longer the need for overnight sentry; and lastly, the initiative improved tolerance to predators due to the socio-economic benefits accrued thereby considerably reducing their propensity to retaliatory killings.

Keywords: Predators, Amboseli, predator-proof Bomas, human-carnivore conflict, Pastoralists, Maasai.

THE SOCIAL ECONOMIC COST OF LION DEPREDATION ON LIVESTOCK IN THE AMBOSELI ECOSYSTEM, KENYA

Margaret W. Muriuki (1), Hellen Ipara (2), John W. Kiringe (3)

1) Department of Tourism and Hospitality Management, Karatina University, Kenya

2) Department of Wildlife Management, Eldoret University , Kenya

3) School of Field Studies, Center for Wildlife Management Studies, Kenya

The African lion population in the Amboseli ecosystem of Kenya has been on the decline in recent years, a trend largely attributed to retaliatory killing by the Maasai due to livestock predation. The local people incur a lot of financial costs due to predation of livestock by lions, but little is known about the extent of this loss. This study was carried out in the Olgulului Group Ranch (OGR) located adjacent to Amboseli National Park in June 2009. The main objective of the study was to assess the economic cost of livestock predation by lions in Amboseli ecosystem. Specific objectives of the study were: to determine the cost of livestock predation by lions in the Amboseli ecosystem, to compare the cost of livestock predation by lions relative to other large predators, to assess whether killing of livestock by lions and other wildlife results in the highest loss of livestock compared to diseases, drought and theft, and to investigate the husbandry practices used in the study area to minimize livestock attacks and determine their effectiveness against the attacks. Questionnaires, focus group discussions, key informants interviews with officials from OGR, KWS and compensation scheme organizations were the methods used to collect information. Cluster and systematic sampling techniques were used to select a sample of 200 respondents from OGR. Lions were blamed for 40.2% (US\$ 374,603) of the total cost of livestock lost to wildlife between 2008 and June 2009, and represent an economic concern for livestock owners. The differences between the mean costs incurred due to losses attributed to lion US\$374,603, hyena US\$276,321, and leopard US\$117115 were significant ($F=34.297$, $df=2$, 1782 , $p=0.00$). The costs of livestock lost to hyena and the lion were not significantly different ($q=0.24$, $p=0.968$), while the economic losses of livestock to drought US\$1,334,718, wildlife US\$946673 and diseases US\$370813 were significantly different ($F=61.484$, $df=2$, 1782 , $p=0.00$). Lions caused greater economic damage compared to hyenas because they attacked cattle which had high economic value. Although the mitigation measures including well built livestock enclosures and use of dogs, used against livestock attack were successful in deterring other wildlife species, none of them deterred attacks of livestock by lions. Addressing human-lion conflict adequately calls for an improvement in livestock husbandry practices in order to minimize problems facing livestock production systems in the study area.

THE IMPACT OF HUMAN LAND USE PRACTICES ON LION(*PANTHERA LEO*) POPULATIONS IN QUEEN ELIZABETH NATIONAL PARK, UGANDA

Charles K.Twesigye

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During the last two decades there have been raising concerns over high lion *Panthera leo* mortality and prey population declines in the area at the frontier between the Democratic Republic of Congo and Uganda. To determine the causes and severity of these population changes requires extensive surveys on the ground because aerial detection of lions is inaccurate. It has been difficult to conduct ground surveys over large areas due to political instability in the area. The available data is based on aerial surveys of medium- to large-bodied ungulate prey to estimate lion abundance in two adjoining parks: Queen Elizabeth National Park, Uganda, and Parc National des Virunga, Democratic Republic of Congo. The most recent studies predict the two national parks together could have held 221 lions in 2004 and they have the potential to hold 905 lions if prey recover and lion-specific mortality is curbed. This makes the Albertine Rift a potential stronghold for the species in East and Central Africa. However, a recent one third decline in lion numbers in Queen Elizabeth National Park and pervasive threats to the Congolese Park calls for immediate conservation intervention for lions and their prey. There is urgent need for focused action to protect lions from poaching and retaliation by the surrounding communities. The situation is further complicated by recent discoveries of oil in the region, and the Basongora cattle keepers who recently settled in some parts of the park, as well as the fishing villages which use the park for grazing cattle and as a source of firewood for smoking fish. General enforcement of wildlife protection and a ground-based survey for lions are needed. Intervention measures are proposed and discussed.

Keywords: Albertine Rift, Carnivore, fishing villages, *Panthera leo*, Poaching, wildlife

DOCUMENTING DIVERSITY OF CARNIVORES THROUGH CAMERA TRAPPING

Bernard Agwanda

National Museum, Nairobi

(not arrived)

THE COST OF LIVESTOCK LOST TO LIONS AND OTHER WILDLIFE SPECIES IN THE AMBOSELI ECOSYSTEM, KENYA.

Margaret W. Muriuki (1), Hellen Ipara (2), John W. Kiringe (3)

1) Department of Tourism and Hospitality Management, Karatina University, Kenya

2) Department of Wildlife Management, Eldoret University , Kenya

Though retaliatory lion (*Panthera leo*) killing as a result of livestock predation in the Maasai group ranches between the Tsavo NPs and Amboseli is remarkably high, other wildlife species are known to kill livestock. This study was carried out in the Olgulului Group Ranch (OGR) located adjacent to Amboseli National Park in June 2009. The cost of livestock killed by each of these species including lion, hyena (*Crocuta crocuta*), cheetah (*Acynonyx jubatus*), leopard (*Panthera pardus*), olive baboons (*Papio cynocephalus*), black-backed jackal (*Canis mesomelas*) and the African elephant (*Loxodonta africana*) is unknown. This study investigated the cost of livestock killed by lions compared to the cost of livestock killed by the species mentioned above. Questionnaires, focus group discussions, key informants interviews with officials from OGR, KWS and compensation scheme organizations were the methods used to collect information. Cluster and systematic sampling techniques were used to select a sample of 200 respondents from OGR. Lions were blamed for 40.2% (US\$ 374,603) of the total cost of livestock lost to wildlife between 2008 and June 2009, and represent an economic concern for livestock owners. The differences between the mean costs incurred due to losses attributed to lion US\$374,603, hyena US\$276,321, and leopard US\$117115 were significant ($F=34.297$, $df=2$, 1782 , $p=0.00$). The costs of livestock lost to hyena and the lion were not significantly different ($q=0.24$, $p=0.968$). Although hyenas killed more livestock compared to the lions the economic damage between the two was not significantly different because lions attacked cattle which had high economic value. Cattle also hold important cultural value to the Maasai community. Conservation of lions will be increasingly difficult if the current levels of predation particularly on cattle are not reduced to economically and socially acceptable levels.

THE ROLE OF COMMUNITY MEDIA IS VITAL IN COMMUNICATING RESEARCH AND POLICY ISSUES ON AFRICAN LARGE CARNIVORES' IMPACTS ON ECOSYSTEMS AND HUMAN INTERACTIONS FOR SUSTAINABLE DEVELOPMENT IN AFRICA.

Wilson Okaka

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The main objectives are to: (1) discuss the effectiveness of community media in disseminating scientific, research, and policy information on African large carnivores' impacts on ecosystems and human interactions in Africa, (2) profile the prospects and challenges of African large carnivores' impacts on ecosystems and human interactions in Africa, (3) explain effective research and policy communication strategy for public awareness and understanding of science, and (4) describe capacity building issues, interdisciplinary, university curricula, and international (North-South) research collaboration approaches. This review shows that the media has a social responsibility to promote and update knowledge. There is still a 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. There is urgent need for effective training, capacity building, North–South collaborative research, ICT use, infrastructure development, and good governance based on gender equality. Development communication is one of the best ways to go in developing eco-tourism in Africa. This strategy involves 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 or community communication. It aims at the delivery of services and the interface between service deliverers and beneficiaries where people are empowered to by informed choice, education, motivation and facilitation effecting the expected changes. The media are agencies of mediation in that in reporting events they propose certain frameworks for their interpretations. They are part of social reality which shapes our perception. An effective public communication campaign fosters national, regional, and international collaboration among the ecosystems conservation partners like: researchers, private sector, civil society, policy makers, the media, and communities. Effective policy legislations are critical for ensuring sustainable conservation development of large carnivores' ecosystems and human interactions in Africa.

Key words: Africa, carnivores, communication, ecosystems, media, policy, research collaboration

ASSESSMENT OF CHEETAH PREY BASE OUTSIDE PROTECTED AREAS IN SALAMA AND KAPITI PLAINS OF SOUTHERN KENYA

Noreen Mutoro

University of Nairobi, Kenya

Over 80% of Kenya's cheetah (*Acinonyx jubatus*) population range falls outside protected areas, in community and private land. Majority of their historical geographical ranges which have been converted in to farmlands have lost their natural ecological systems. Understanding the conservation biology and natural ecosystem functioning on farmlands is therefore critical for their conservation outside protected areas. This ongoing study was carried out in Salama and

Kapiti areas of Southern Kenya to assess the potential and/or actual wild cheetah prey and their importance in the cheetah diet through faecal hair analysis. Monthly game counts were conducted in the study area for 8 consecutive months using point and line transects to determine the cheetah's actual and/ or potential prey species. Over 250 scat samples were collected in the study areas from 2012 to 2014. Distance 6.0 sampling software will be used to derive density and spatial distribution of the prey species in the study area. Prey hair found in scats will be expressed as frequency of occurrence of the different prey classes and the percentage biomass of each prey will be determined to show their importance in the cheetah's diet.

Key Words: *Acinonyx jubatus*, scats, prey base, faecal hair analysis.

SUPRA-OCCIPITAL CRANIECTOMY FOR TREATMENT OF CLAVARIAL HYPEROSTEOSIS IN LIONS (PANTERA LEO)

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3) Pittsburgh Veterinary Specialty & emergency center, Pittsburgh PA., USA

Clavarial hyperostosis mainly of bones surrounding the caudal fossa is a well described abnormality causing neurological malfunctioning in young lions. (BARTSCH et al., 1975; CHANDRA et al., 1999; HARTLEY et al., 2005). The condition is believed for years to be caused by vitamin A deficiency in captive lions although the precise mechanism is not clear (CHANDRA et al., 1999). Clinical signs are usually related to compression of the cerebellum and caudal brain stem and include incoordination, ataxia, opisthotonus, and head tilt (MC CAIN et al., 2008; SHAMIR et al., 2008). Death can occur as the disease progresses and affected animals are often euthanized due to progressive neurological deterioration. Diagnosis is typically made at necropsy by identifying thickening of the skull with secondary compression of the cerebellum, with or without herniation. In the last ten years CT and MRI are used more often hence enabling antemortem diagnosis of the pathology (HARTLEY et al., 2005; GROSS-TSUBERI et al., 2010). The early diagnosis encouraged veterinarian to try treating this disease with vitamin A supplementation. Even though it is not known at what stage is the vitamin crucial for normal development of the skull in the growing lion, in some less severe cases, excessive supplementation with vitamin A resulted in resolving of clinical signs. No imaging is available to show an actual reduction in the size of the thickened occipital bone or widening the narrowed foramen magnum following the medical treatment in these cases (HARTLY et al., 2005). When conservative treatment fails, surgical decompression should be attempted (DEWEY et al., 2005; MC CAIN et al., 2008; SHAMIR et al., 2008). Surgical procedure consisting removal of the supra-occipital bone for decompression of the caudal fossa and widening the foramen magnum was performed in 5 lions in the past 6 years. We present the clinical signs on presentation, skull

and brain imaging, surgical approach, rate of recovery; outcome and long term follow up of these lions. All lions recovered well from the procedure and were back to normal few weeks following the surgery. No deterioration of the clinical signs was noted in these lions in a post –op period of 6 months to 6 years. Vitamin A supplementation at this stage did not seem to alter the outcome. We conclude that surgical correction of the bone abnormality is warranted in captive lions whenever conservative treatment fails and until more information is available on ways to prevent this devastating and often fatal disease.

S2 -CARNIVORE BIODIVERSITY & ENVIRONMENT (past-present)

IMPACT OF SEVERE CLIMATE VARIABILITY ON LION POPULATION STRUCTURE IN THE AMBOSELI ECOSYSTEM, KENYA

Tuqa Jirmo

Leiden University, Institute of Environmental Sciences Department of Conservation Biology,
The Netherlands & Kenya Wildlife Service

This study covers the impact of severe drought on lion population density and social structure in Amboseli National Park. We studied lion population density and social structure during 2007 – 2012, three years before/during and three years after a severe drought in 2009. We used rainfall variability, prey abundance and human induced mortality incidents to assess lion vulnerability to drought. The drought serenity index was highest for 2009 as compared to any other year in the last 35 years. Lion vulnerability was however, higher during (2010 – 2012) after the drought. We found lion population showed a significant increase in male to female sex ratio a decline in adult group size and decline in juvenile to adult ratio after the drought. We also witnessed 28 lions killed around Amboseli National Park during 2010 - 2012 post drought periods as compared to 12 before/during the drought (2007 – 2009). All these changes are attributed to lion vulnerability to severe drought as a result of a decline in wild prey because of mass death during the drought and human induced mortality of lions (retaliatory killing) that followed due to intense livestock predation in the period that followed drought. Although female lions were also killed during this period male lions were targeted more than females by Maasai warriors (Moran) due to cultural practice (use of manes, claws and hide). The removal of pride males affects survival rate of cubs due to pride take over as a result of territorial vacuum while reduced group size is perceived as disturbed social structure is also lion drought coping mechanism during drought lean period.

DETERMINATION OF ECOLOGY, POPULATION STATUS AND DISTRIBUTION OF CARNIVORES ON MT. MULANJE - MALAWI.

W.N. Chitaukali (1), Ulemu Sitaubi (2), David Nangoma (2)

1) Department of Biological Sciences, Chancellor College, P.O. Box 280 Zomba , Malawi

2) Mulanje Mountain Conservation Trust, P.O. Box 139, Mulanje

A study was conducted to determine the type, distribution and prey base for cats that exist on Mount Mulanje. Mount Mulanje, with the highest peak at 3002 metres above sea level. The plateau covers an area of about 640,000 hectares and has a forest reserve with a diverse range of ecological zones ranging from rainforest to alpine, woodland to grasslands and a very rich range of habitat of rare, endemic, near endemic or endemic plants and animal life. Collection of scats was made through transect walks made across the plateau, focusing mainly at Lichenya, Sombani, Thuchira, Madzeka and Chinzama basins. Four hundred thirty four scats were collected, so far 54 scats have been analysed. A total of 2700 hairs were mounted on 540 slides, 10 slides for each scat with 5 hairs on each slide. Using reference hairs, prey species in the scats included *Tatera*, *Lemniscomys*, *Otomys*, *Rattus*, *Aethomys*, *Pelomys*, *Grammomys*, with *Tatera*, *Lemniscomys* and *Otomys* being dominant.

BIG CATS AND THE EAST AFRICAN PALAEO-ENVIRONMENTS

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Ecomorphological studies of extant large felids support strong association between their forelimb morphology and habitat adaptations. This relationship can be used to infer palaeo-environments from ancient fossil sites. I provide data on humerus morphology to compare the big cat fossil record from hominin fossil sites of Olduvai Gorge and Koobi Fora. Distal epiphyses were the most abundant elements and their morphological variation partially clusters within the morphospace area identified by extant large *Panthera* species. No significant differences occur between fossil lions from Olduvai Gorge and extant specimens. *Dinofelis* specimens from Olduvai are larger and cluster closer to modern jaguar and lion while those from Koobi Fora suggest stronger similarities with extant leopards. The large *Homotherium* specimens from Koobi Fora occupy a unique area of the morphospace supporting a strong differentiation in functional morphology of this saber cat. A mosaic of habitats was probably present in the hominin fossil sites of East Africa to suite different hunting and killing behavioural strategies of fossil big cats. A trend towards opening of landscape from older to younger stratigraphic intervals seems to be supported by felid long bone ecomorphology for Olduvai Gorge but not for Koobi Fora.

POTENTIAL EFFECTS OF CLIMATE CHANGE ON LION DISTRIBUTION

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The objective of this study is to estimate possible impacts of global climate change on the geographical distribution of the African lion *Panthera leo* in the coming decades. Current lion population occurrence data across Africa and distributions of lions in historical times (6,000–100 years before present) were obtained from the literature and integrated with data on present-day climates to generate ecological niche models. Models based on distributions of African lions were tested for predictive ability based on various subsetting approaches and were projected across Asia, Africa and Europe, to retrodict the distribution of the species for the past 6,000 years. These models were highly accurate, giving confidence in future projections. Future potential distributions were predicted by projecting ecological niche models onto three climate scenarios of future greenhouse gas emissions based on eight climate models for the years 2040–2070. The prediction was regarding relative range stability into the future: few new areas were identified as becoming suitable for the species but large areas of southern Africa and West Africa are expected to become less suitable. Predictions of effects of climate change on potential distributions of lions may assist conservation efforts by clarifying options for mitigation and response.

QUATERNARY' CARNIVORES: A VIEW FROM WESTERN EUROPE IN COMPARISON WITH AFRICAN CARNIVORES' GUILD

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Five carnivore families (Ursidae, Felidae, Hyaenidae, Canidae, Mustelidae) are present in Western Europe during the Quaternary, and are contemporaneous of Palaeolithic hunter-gatherer groups. Carnivores cover a large range of body-size and diet classes as well as a wide range of biological requirements which imply potential intra- or inter-specific competition for their subsistence, shelter or reproductive factors. Most of these species still exist nowadays, especially in Africa, and some of their morphological and eco-ethological features are useful for the reconstruction of the past carnivore communities. A general overview of chronological and taxonomical, as well as eco-ethological characteristics of carnivores in Western Europe is proposed as an attempt to evaluate the dynamic of the guilds during the Pleistocene. The ecological structure of the carnivore community remained stable during the Late Pliocene –

Early Pleistocene period and does not reveal the influence of climate change over the community structure. Important structural changes started during the transition between Early and Middle Pleistocene, marked by extinction of solitary hypercarnivores and increase of collective hunters. During the Middle Pleistocene, the community of carnivores was dominated by large social predators (*Panthera leo*, *Crocuta crocuta*, *Canis lupus*) that were perfectly adapted to open landscapes and large-sized herbivores. A comparative essay would be made with past and present carnivore guilds from Africa, especially on Felids, Canids and Hyenids.

Key-words : Quaternary, Carnivores, Western Europe, Africa

S3 - TAPHONOMY & ECO-ETHOLOGY (past-present)

Keynote speakers :

BEHAVIORAL ECOLOGY OF BONE-CRACKING HYENAS

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COMPARATIVE SKULL ANALYSIS SUGGESTS SPECIES-SPECIFIC CAPTIVITY-RELATED MALFORMATION IN LIONS (*PANTHERA LEO*)

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Lion (*Panthera leo*) populations have dramatically decreased worldwide with a surviving population estimated at 32,000 across the African savannah. Lions have been kept in captivity for centuries and, although they reproduce well, high rates of stillbirths as well as morbidity and mortality of neonate and young lions are reported. Many of these cases are associated with bone malformations, including foramen magnum (FM) stenosis and thickened tentorium cerebelli. The precise causes of these malformations and whether they are unique to captive lions remain unclear. To test whether captivity is associated with FM stenosis, we evaluated 575 lion skulls of wild ($N = 512$) and captive ($N = 63$) origin. Tiger skulls ($N = 276$; 56 captive, 220 wild) were

measured for comparison. While no differences were found between males and females or between sub-adults and adults in FM height (FMH), FMH of captive lions (17.36 ± 3.20 mm) was significantly smaller and with greater variability when compared to that in wild lions (19.77 ± 2.11 mm). There was no difference between wild (18.47 ± 1.26 mm) and captive (18.56 ± 1.64 mm) tigers in FMH. Birth origin (wild vs. captive) as a factor for FMH remained significant in lions even after controlling for age and sex. Whereas only 20/473 wild lions (4.2%) had FMH equal to or smaller than the 5th percentile of the wild population (16.60 mm), this was evident in 40.4 % (23/57) of captive lion skulls. Similar comparison for tigers found no differences between the captive and wild populations. Lions with FMH equal to or smaller than the 5th percentile had wider skulls with smaller cranial volume. Cranial volume remained smaller in both male and female captive lions even when controlled for skull size. These findings suggest species- and captivity-related predisposition for the pathology in lions.

BLACK-BACKED JACKALS (*CANIS MESOMELAS*) AS TAPHONOMIC AGENTS: BONE ACCUMULATIONS FROM THE NAMIBIAN COAST

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Samples from coastal Namibian jackal kitchen middens and a breeding den slightly further inland are used to illustrate that black-backed Jackals can be significant accumulators of bones. The accumulations are described and distinguishing characteristics of remnants are identified. The aim is to develop a model for the recognition of accumulations made by this canid size-class and to demonstrate their potential presence in palaeontological and archaeological assemblages. This interest arose specifically from the need to establish the roles of carnivores in the seal assemblage from Langebaanweg, which includes damage by large and smaller carnivores, including juveniles.

Jackal prey composition closely matches that of brown hyaenas *Parahyaena brunnea* on this coast, since each has access to an essentially similar resource base; species-richness in the jackal assemblages is greater and the composition of the residues, damage and degree of damage differ from those of brown hyaenas, however. Damage to flippers, for instance, tends to be peripheral on phalanges and metapodials, reflecting the bite limitations of jackals; hyaenas leave fewer and different remains. Seabird remains are common in the jackal assemblages along with seals and fish; in hyaena accumulations, particularly near breeding colonies, frequencies reflect availability but are underrepresented elsewhere due to almost-complete consumption and the availability of other resources; there is a degree of overlap in the preservation of some elements, but the jackal accumulations remain distinct from those of brown hyaenas. Once buried, however, long-term

preservation of at-coast accumulations would be dependent on protection from sea level change and would favour localities beyond such effects.

Scats were absent at the jackal accumulations studied, whereas they are a distinctive feature at hyaena nursery dens. Interactions between jackals and hyaenas at hyaena dens and jackals with other predators at carcasses can affect the nature of assemblages; this undoubtedly included interactions with hominins/humans in the past and present.

EXTANT AFRICAN AND EXTINCT EUROPEAN HYENAS: TAPHONOMICAL CHARACTERIZATION OF THEIR BONE ACCUMULATIONS

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Because of its recurring presence in the Pleistocene paleontological setting in whole Europe, the cave hyena (*Crocota crocuta spelaea* GOLDFUSS) is a carnivore particularly studied in taphonomy. The recognition of the role played by the (cave) hyena, in bone assemblage formation, allowed to precise main ecological and evolutionary trends of these carnivores (cave occupation, consumption of bones, predation vs scavenging, interspecific competition, Humans-Carnivores interaction). The behavior of the fossil spotted hyena (accumulator of bones, osteophagy) is mainly based on the development of the ecological and neotaphonomic works since the 1970s. The present work concerns a taphonomic survey of Modern (6 dens) and Pleistocene Hyenids (5 dens). Modern samples come from different ecological and geographical contexts (Republic of Djibuti, Namibia). Dens are as follows : *Crocota* : Dumali (Ungulate NISP = 421), Heraide (Ungulate NISP = 216), Yangula Ari (Ungulate NISP = 133), Oboley (Ungulate NISP = 259) ; *Hyaena* : Datagabou (Ungulate NISP = 352) ; *Parahyaena* : Uniab (Ungulate NISP = 568).

The taphonomic analysis of these bone samples allows to characterize modifications produced by modern Hyenids. This model is then taken into account in the study of 5 unpublished fossil spotted hyena dens of : Artenac c10 (MIS 5c ; Ungulate NISP = 1301), Peyre (MIS 5e ; Ungulate NISP = 2815), Grotte aux Pucés, réseau supérieur (100ka ; Ungulate NISP = 2360), Fouvent (MIS 3 ; Ungulate NISP = 3347) and Conives (MIS 3 ; 1717).

It seems that Extant and Extinct Carnivores share common taphonomic characteristics (e.g. morphotypes of consumption, skeletal parts of preys). On the other hand, the fossil hyena osteophagic behavior distinguishes itself from that of the modern species by: an important production of shaft fragments, the recurring presence of coprolithes and finally a high number of ingested bones.

Keywords: Taphonomy, Extant Hyenas, Pleistocene Hyenas, Bone accumulations, Bone consumption, Africa, Europe.

COMPARATIVE BONE ACCUMULATION AND MODIFICATION PATTERNS OF THE SPOTTED (*CROCUTA CROCUTA*) AND STRIPED (*HYAENA HYAENA*) HYAENAS IN TWO PASTORALIST OCCUPIED AREAS IN KENYA

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Data gathered from two rock-shelter dens bone assemblages of each of the two bone accumulating hyaena species (*Crocota crocuta* and *Hyaena hyaena*) in Kenya was compared. The study aimed at ascertaining unique bone collecting behaviour of the two hyaena species in two (Magadi and Samburu in southern and northern Kenya respectively) pastoralists' areas. The diversity of species representation in the two dens was very similar (26 species of 12 families of 78 minimum number of individuals for the Samburu den and 28 identified species of 14 families of 79 minimum number individuals for the Magadi den. However, the ungulates representation proportions per size class differences were statistically highly significant indicating that the striped hyaena accumulation was dominated by size class I&II ungulates while size class III ungulates were more in that of the spotted hyaena. Skeletal element representations were similar in both dens. While tooth mark sizes patterns were similar, their location patterns differed in the proportions of those marked on the near distal and near proximal portions of the bone elements. The striped hyaena assemblage had a higher proportion of the elements marked near distal locations which probably reflects hunting vs. scavenging behaviour of the two species. The spotted hyaena den had more of its species skeletal remains (both juvenile and adult) that were mostly complete while the striped hyaena had just a fragment of its bones suggesting that they scavenge more on their own species than the spotted hyaenas do. In general this study's results are consistent with previous studies that indicate hyaena den collection reflect the species dynamics of the den sites.

Key words: Kenya, Magadi, Samburu, tooth marks, *Crocota crocuta*, *Hyaena hyaena*

HUMANS AND HYAENAS: IN CONFLICT SINCE THEIR ORIGINS

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From the earliest evidence for hominids in the Old World (~2.5 Ma in Africa, 1.8 Ma in Asia, 1.4 Ma in Europe) to the Late Pleistocene mammalian extinctions of the large predators (MIS 2 in Western Europe, ~30 000 ky), interactions between human groups and large carnivores are common in archaeological deposits. These illustrate inter-specific competition between predators/scavengers for food resources and access to living sites. Examples of bone modification by hyaenids observed in European deposits dating to the last million years are presented. Between 1 million and 500 000 ky, the giant short-faced hyaena (*Pachycrocuta brevirostris*) occurs in open air deposits, in association with large felids. This scavenger specialized in the consumption of macro-herbivore carcasses abandoned by large predators, particularly *Megantereon*. From 500 000 ky remnants of the activities of the extinct spotted or cave hyaena (*Crocuta crocuta spelaea*) are found in many deposits; they comprise palaeontological remains of the hyaena (teeth, postcranial elements, coprolites) and bones of macro- and mega-herbivores (cervids, bovids, rhinocerotids, proboscideans and, sometimes, hominids), with characteristic modification (gnaw marks, digested bones). Data from open air sites (mass death sites, scavenging sites) and caves (hyaena dens) have enabled us to develop a taphonomic signature for *Crocuta crocuta spelaea* and to reconstruct its behaviour through different climatic periods of the Pleistocene.

A MODERN BROWN HYAENA (*PARAHYAENA BRUNNEA*) BONE ACCUMULATION IN THE UNIAB RIVER COASTAL FAN, SKELETON COAST PARK, NAMIBIA AND TAPHONOMIC IMPLICATIONS

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A recently-abandoned Brown Hyaena *Parahyaena brunnea* nursery den in the Uniab coastal fan, Skeleton Coast Park, Namibia is described. Observations provide insights into the taxa and rate of accumulation at the den and interactions with *Canis mesomelas* Black-backed Jackals. Prey comprise several terrestrial and marine species, the most common of which were *Antidorcas marsupialis* Springbok, *Oryx gazella* Gemsbok, *Canis mesomelas* Black-backed Jackal and *Arctocephalus pusillus* Cape Fur Seal; seabirds, cetaceans (whale and dolphin), fish and !Narra skins were present. Damage to the bones is typical of that recorded for other recent hyaena accumulations elsewhere. We note a significant bias regarding the under-representation of osteological remains of Springbok. Periodic flooding has contributed to site formation. Excepting the marine element, the occurrence exhibits strong similarities to assemblages excavated from Middle Pleistocene Elandsfontein and Swartklip (amongst others), in South Africa and Middle and Later Pleistocene palaeontological and archaeological *Crocota spelaea* Cave Hyaena occurrences in France.

THE CIRCUMSTANCES OF MAN-EATING IN LIONS

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The story of the "Man-eaters of Tsavo" has been retold through script, cinema, and oral tradition in the 100+ years since their infamous 'reign of terror'. Despite their predictably broad popular appeal, the details pertaining to the natural history of these lions have never been reviewed. The skulls and skins of these lions have resided at the Field Museum of Natural History (Chicago) for over 75 years. An analysis of the skull of the primary culprit displays a traumatic injury that may have limited his predatory ability in subduing 'normal' prey. A sample of hairs, reflecting the diet of both man-eaters, is preserved in the broken and exposed cavities of their canines. Various additional circumstances likely contributed to their man-eating habit. The Tsavo incident closely followed the debut of rinderpest on the continent, which devastated cattle and buffalo, the primary prey of the Tsavo lion. The Tsavo 'nyika' consists of a dense thorn scrub thicket limiting visibility and passage, representing an ideal habitat for an "ambush predator". Finally, historical review of the literature reveals that 'man-eating' was not an isolated incident at Tsavo. This behaviour was well established in the vicinity of the railway bridge well before these infamous lions appeared, and continued well after their demise, suggesting a recurring opportunity, which may have evolved into a local behavioural tradition. In sum, virtually all of the recognised preconditions for man-eating outbreaks to occur were in effect at Tsavo in the 1890's.