TANZANIA WALDLIFE RESEARCH INSTITUTE (TAWIRI)

THE 10th TAWIRI BIENNUAL SCIENTIFIC CONFERENCE

2nd – 4th December 2015

NAURA SPRINGS HOTEL

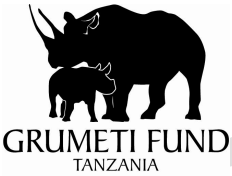
PROGRAMME

CONFERENCE THEME

"The future of Wildlife Conservation in the face of Increasing Anthropogenic Demands"

CONFERENCE SPONSORS

Wildlife Divisiobn



MESSAGE FROM THE ORGANIZING COMMITTEE

TAWIRI Scientific Conferences are Biennial events taking place after every one year. This year, we are marking the 10th TAWIRI Scientific Conference since we started in 2000. The 10th TAWIRI Scientific Conference under the Theme: ***"The future of Wildlife Conservation in the face of Increasing Anthropogenic Demands"*** aims at contributing to the global efforts on the long term sustainable wildlife conservation. It brings together, scientists, policy markers, conservesionists, NGOs representatives and Civil Society representatives from all over the world to present their findings, knowledge and get informed on the current knowledge, shortcomings and challenges facing wildlife resources in Tanzania and Africa at large. The conference will also highlight the links and challenges of the increased demands and overexploitation of wildlife resources and the future of wildlife conservation in Tanzania.

In all three conference days there will be scientific oral and poster presentations as well as seminars which aim at addressing the major conference theme. The Conference is expected to bring together about 300 participants from all over the world with diverse knowledge on wildlife conservation. The conference is a forum for dissemination of scientific information generated from various research studies whose aim is to provide ecological implication on wildlife conservation. It is expected that the recommendations generated from this conference will not only improve and safeguard our wildlife resources within the current increasing antropogenic demands over wildlife resources but also devise a way on how better communities can sustainably utilize the ecosystem services.

On behalf of the TAWIRI Management, the Organizing Committee of the 10th TAWIRI Scientific Conference is honoured and pleased to invite all scientists, conserversionists, government officials and representatives of NGOs and Civils Societies organizations to this important forum.

ORGANIZING COMMITTEE MEMBERS

1. Dr. Maurus Msuha — Chairman
2. Dr. Janemary Ntalwila — Secretary
3. Dr. Stephen Nindi — Deputy Secretary
4. Dr. Victor Kakengi — Member
5. Dr. Devolent Mtui — Member
6. Mr. Mwita Machoke — Member
7. Mr. Daniel Wanna — Member
8. Ms. Ritha Billy — Member
9. Ms. Cecilia Leweri — Member
10. Ms. Kezia Oola — Member

GENERAL INFORMATION

Venue and Dates
The 10th TAWIRI Scientific Conference takes place at Naura Spring Hotel in Arusha, Tanzania along the East African Road, from 2nd – 4th December 2015.

Contact Address
Tanzania Wildlife Research Institute
Njiro, Arusha.
Phone: +255 (27) 2509571/2548240
Fax: +255 (27) 2548240
Email: info@tawiri.or.tz
Website: http://www.tawiri.or.tz

Mobile Phone Policy
Delegates are advised that, mobile phones should either be in silent mode or switched off during the Conference session hours.

Language
The official language of the Conference is English.

Conference opening hours:
Tues day, 01st Dec. 2015: 15:00 - 18:30
Wednesday 02nd Dec.2015: 07:30 – 18:30
Thursday 3rd Dec.2015: 07:30 – 18:30
Friday 4th Dec 2015: 07:30 – 18:00

Cloakroom
A cloakroom will be open throughout the conference. It will be possible to store luggage in this cloakroom area.

Lost and Found
For lost and found personal belongings, please contact the Information Desk at the registration area.

Name badge
Your personal name badge is your entrance ticket to all sessions. Please, remember always to wear your badge during conference hours. Participants without a badge will be denied access to conference rooms/sessions. If you lose your badge, a new one will be given against proof of your original registration.

First Aid
In case of emergency, contact the information desk.

Lunch and Coffee Breaks
Lunch and coffee/tea is included in the registration fee and will be served daily in the conference area.

Climate and Dress
The weather in Arusha at this time of the year is usually sunny with temperatures around 22-28^{o}C. An umbrella might be useful as showers can occur. Dressing will be informal throughout the conference.

Time Zone
The time zone in Arusha is GMT +3 Hours.

Banks and Post Office
Most banks open at 08:30am and close around 15:00 Monday through Friday while on Saturdays they are open till mid-noon. A number of Bureau de Changes and ATM machines are available in Arusha. Post offices are generally open between 08:00 and 16:00.

Electricity
The voltage in Arusha is 220/240V.

GENERAL PROGRAMME FOR THE CONFERENCE FROM 01st - 04th DECEMBER 2015

TIME	DATES			
	01st Dec	**02nd Dec**	**03rd Dec**	**04th Dec**
16:00-18:30	Registration and other logistics-	-	-	-
7:30 – 8:30		Registration/ Introductory remarks/House keeping	Registration/ remarks/House keeping	Registration/ remarks/House keeping
8:30- 10:30		OPENING CEREMONY	Paper presentations and seminar talks	Paper Presentations and seminar talks
10:30-11:00	**Health Break**			
11:00-13:00		Paper presentations	Paper presentations and seminar talks	Paper presentations
13:00-14:00	**Lunch**			
14:00-15:30		Paper presentations and seminar talks	Paper presentations and seminar talks	Paper presentations
15:30-16:00	**Health Break**			
16:00-17:30		Paper presentations and seminar talks	Paper presentations and seminar talks	**Closing remarks**
17:30-17:40		**Announcements**	**Announcements**	**Announcements**
18:30-20:00		Cocktail party celebrating the 10th Anniversary of TAWIRI Conference	-	-

DAILY PROGRAMME

Tuesday 1st December 2015

Time	Activity and Location	Responsible
10:00 – 18:30	Delegates arriving	Organizing Committee
10:00 - 18:30	Registration	Organizing Committee

DAY ONE WEDNESDAY 2nd DECEMBER 2015

EVENTS/PRESENTATIONS: KILIMANJARO CONFERENCE HALL				
S/N	**Time**	**Event/Paper**	**Responsible**	**Chairperson**
i)	07:30 – 08:30	Registration & Logistics	Organizing Committee (OC)	Chairman - OC
ii)	08:30 – 08:40	Introductory remarks/House keeping	Chairman - OC	MC
iii)	08:40 -09:00	Welcome note	Director General TAWIRI	MC
iv)	09:00-09:40	Opening Speech by the Guest of Honor	Minister - MNRT	MC
v)	09:40-10:00	Group Photo	Organizing Committee (OC)	**MC**
	10:01 – 10:30	**TEA/COFFEE BREAK**	**All**	**MC**
KEY NOTE PAPER PRESENTATION No. 1-PLENARY SESSION				
S/N	**Time**	**Event/Paper**	**Responsible/Presenter**	**Chairperson**
1	10:30 – 11:10	Long-term field experiments: what do we learn and when do we learn it?	Mick Crawley	Inyasi Lejora
PARALLEL SESSION 1 DAY ONE: KILIMANJARO CONFERENCE HALL **SUB-THEME: WILDLIFE ECOLOGY AND ECOLOGICAL INTERACTIONS**				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
2	11:20– 11:40	Wildlife monitoring: are ground surveys necessary?	Tim Caro	Kideghesho
3	11:40– 12:00	Challenging co-existence; lion habitat use and movement patterns in Ngorongoro's multiple-use landscape.	Ingela Jansson *et al*.	
4	12:00-12:20	Movement pattern and home range sizes of the reintroduced wild dog packs in the Serengeti National Park, revealed by the GPS satellite collars.	Eblate E. Mjingo *et al.*	

5	12:20 - 12:40	Inventory of the Tanzanian Orthoptera fauna and scientific applications	Claudia Hemp	
6	12:40 - 13:00	Using remote sensing to investigate patterns and drivers of vegetation change in the Serengeti ecosystem from 1984 to 2011	Anna B. Estes, *et al.*	Kideghesho
	13:01– 14:00	**LUNCH**		
7	14:00 - 14:20	Body size and age in elephants of Mikumi National Park: Jaw measures indicate smaller size	Fredrick Mofulu, *et al.*	William Mwakilema
8	14:20 - 14:40	Recruitment and survivorship of the Kihansi Spray Toad (*Nectophrynoides asperginis*) in captivity	Nahonyo, C. L. and Goboro, M. E.	
9	14:40 - 15:00	Vulture monitoring program in Southern Tanzania	Corinne Kendall, *et al.*	
10	15:00 -15:20	Butterfly species and their relevance to conservation in Wildlife Management Areas of Ruvuma Landscape, southern Tanzania	Ally Nkwabi *et al.*	
11	15:20 - 15:40	Understanding the drivers of wildebeest movement	Elaine Ferguson	
	15:41 – 16:00	**HEALTH BREAK**		
12	16:00 - 16:20	Studying collective animal behavior from aerial and space-based platforms.	Mutayoba, B and Lacey Hughey	Tim Caro
13	16:20 - 16:40	Investigating the 'smaller majority' of the Udzungwa Mountains for larger questions and wider applications	Jagoba Malumbres Olarte	
14	16:40 - 17:00	Dash and Dine: quantifying individual variability in prey handling times in wild cheetahs	Anne Hilborn*, et al.*	
15	17:00 -17:20	Activity Patterns of Black-and-White Colobus Monkey *(Colobus guereza caudatus)* in Rau Forest Reserve, Tanzania	Abraham Eustace, *et al.*	

PARALLEL SESSION 2 DAY ONE: VENUE-KITULO CONFERENCE HALL

S/N	**Time**	**Event/Paper**	**Responsible/Presenter**	**Chairperson**
16	11:21 - 11:40	Spatial distribution of mitochondrial lineages of Tanzanian baboons	Zinner, D. *et al.*	Thomas Morrison
17	11:41- 12:00	Butterflies of Kihansi Gorge Forest in Tanzania	Devolent Mtui, *et al.*	
18	12:01 - 12:20	Masai giraffe demography in the Fragmented Tarangire Ecosystem"	Derek E. Lee, *et al.*	
19	12:21 - 12:40	Dramatic Population Decline of Ashy Red Colobus Monkeys (*Piliocolobus*	Mohamed Kibaja	

		tephrosceles) in Mbuzi Forest, Rukwa Region, Tanzania		
20	12:41-13:00	Sex-specific survival of juveniles of black coucal and white-browed coucalinthe Usangu plains of Southwestern Tanzania: preliminary findings	Ignas Safari and Wolfgang Goymann	
	13:00 – 14:00	**LUNCH**		
21	14:00 – 14:20	A Holistic Indicator Selection Protocol for Identifying Measures of Conservation Success Using Conceptual Models	Andrew R. Marshall and Fadhili M. Njilima,	Anna Czupryna
22	14:20 - 14:40	Vultures – a conservation challenge for Africa	P. Kariuki Ndang'ang'a and Julius Arinaitwe	
23	14:40 - 15:00	Insights into long-distance dispersal by African wild dogs (*Lycaon pictus*) in East Africa	Emmanuel H. Masenga, *et al*	
24	15:00 -15:20	Assessment of diets taken by frogs around Mazimbu Campus, Morogoro	Ndibalema V.G. and Elisante, A	
25	15:20 - 15:40	Effect of Land Cover–Land use Change on Abundance of Large Herbivores in the National Parks in Tanzania	Devolent Mtui and Christopher Lepczyk	
	15:41 – 16:00	**HEALTH BREAK**		
26	16:00 – 16:20	Using Camera Traps to Infer the Numbers and Habits of Crop-raiding Elephants in Udzungwa Mountains National Park, Tanzania	Josephine Smit, *et al.*	Andrew Marshall
27	16:20 – 16:40	The Udzungwa Red Colobus (*Procolobus badius gordonorum*) in highly modifies habitat of Kalunga rubber plantation Morogoro Tanzania	Samuel Mtoka *et al.*	
28	16:40 – 17:00	Diet composition of golden jackal, *Canis aureus* in the Ngorongoro Crater, Ngorongoro Conservation Area, Tanzania	Temu, S. *et al.*	
E N D O F D AY ONE				
18:30 - 20:30 COCKTAIL --- PARTY				

DAY TWO: THURSDAY 03rd DECEMBER 2015

A. PAPER PRESENTATIONS				
SUB-THEME: HUMAN – WLDLIFE INTERACTION				
KEY NOTE PAPER PRESENTATION No. 2: KILIMANJARO CONFERENCE HALL				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
29	8:30 – 9:10	Political Ecology of Wildlife Conservation	Hussein Sosovele	Han Olff
PARALLE SESSION 1 DAY TWO: KILIMANJARO CONFERENCE HALL				
30	9:10 – 9:30	Scaling up of chili based techniques and validation of phantom drones for mitigation of crop raiding elephants in Tanzania (MICRET)	David Olson, *et al.*	Dennis Rentsch
31	09:30 – 9:50	Impacts of Tanzania's Wildlife Management Areas	J. Bluwstein, *et al.*	
32	9:50 – 10:10	Human wildlife interaction: Impacts to conservation and livelihood at Saadan National Park	Monica Shilereyo	
33	10:10 – 10:30	The Last Linkage: a forgotten Wildlife Management Area and the final connection between northern and southern Tanzania	Jasson Riggio and Tim Caro	
	10:31 – 11:00	**HEALTH BREAK**		
34	11:00-11:20	Man-eating behavior manifestation and consequences for lion, leopard and hyena conservation in Tanzania	Ikanda, D., and Kissui, B.	Alfred Kikoti
35	11:20 – 11:40	The human dimension of blockage of wildlife corridors in the Tarangire-Manyara ecosystem	James V Wakibara and Gladys Ngumbi	
36	11:40 – 12:00	Effects of Poaching on Elephant Demography, Behaviour and Tusklessness in Ruaha-Rungwa	Trevor Jones *et al.*	
37	12:00-12:20	Assessment of livestock loss due to spotted hyena (*Crocuta crocuta*) in selected villages of Rorya District, Tanzania	Mrimi D. *et al.*	
38	12:20-12:40	Knowledge and attitudes of communities on small mammalian carnivores in MBOMIPA wildlife management area, Iringa, Tanzania	Alphonce M. Msigwa, *et al.*	

39	12:40 – 13:00	Enhancing Tourist Opportunities to View Spotted-Necked Otters (*Lutra maculicollis*) at Rubondo Island National Park: Can the apriori Location of Latrines Simplify Identifying Best Viewing Areas	Bridget Amulike, *et al.*	
	13:01- 14:00	**LUNCH**		
40	14:00 – 14:20	Tanzania and the natural world heritage designation: Does it matter?	James V. Wakibara and Beatrice M. Kessy	Martin Nielsen
41	14:20 – 14:40	Reversing the trend of Wildlife crime in Tanzania: Challenges and Opportunities	Jafari R. Kideghesho	
42	14:40 – 15:00	The impact of over-speeding on vertebrates' road kill in the Serengeti ecosystem, Tanzania	Richard D. Lyamuya, *et al.*	
43	15:00 – 15:20	Local people knowledge and perception towards African wild dogs (*Lycaon pictus*) release in the Western part of the Serengeti ecosystem, Tanzania	Emmanuel H. Masenga, *et al.*	
44	15:20 – 15:40	Use of ostrich (*Struthio camelus*) products: exploring the potential of improving rural livelihood	Flora Magige and Eivin Røskaft	
	15:41- 16:00	**HEALTH BREAK**		
SUB-THEME: WATER RESOURCES AND WETLAND CONSERVATION KILIMANJARO CONFERENCE HALL				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
45	16:00 – 16:20	The water catchment values of Loliondo Game Controlled Area: Implications for the conservation of Serengeti National Park	James Wakibara, *et al.*	Claudia Hemp
46	16:20 – 16:40	Can Water Resources Lead to Pro-Poor Growth?: A Comparative Study on Lake Victoria and Lake Tanganyika Fisheries in Tanzania	Odass Bilame and Janemary Ntalwila	
47	16:40 – 17:00	Assessment of Surface Water Quality along the Loliondo Game Controlled area segment of the Proposed Highway through Serengeti National Park, Tanzania	Kaswamila, A. L., *et al*.	
48	17:00 – 17:20	The role of Usangu wetlands in biodiversity, ecosystem services and socio-economical development of the people in Tanzania	Banga Paul	

PARALLE SESSION 2 DAY TWO: PAPER PRESENTATIONS KITULO CONFERENCE HALL SUB-THEME: HUMAN – WILDLIFE INTERACTION				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
49	9:10 – 9:30	Spotted-necked Otters and Rubondo Island National Park, Tanzania: The Process of Developing an Ecotourism Flagship	Tom Serfass and Sadie Stevens	Paul Ndang'ang'a
50	09:30 – 9:50	Predicting factors contributing to crop raids by elephants in Amboseli ecosystem, Kenya	Kenneth Kimitei, *et al.*	
51	9:50 – 10:10	The effect of quarry mining on the diversity of invertebrates in peri-urban Dar es Salaam.	Upendo Richard	
52	10:10 – 10:30	Influence of Human-induced Habitat on Avifauna Diversity and Abundance around Lake Jipe Wetlands	Christina Daniel Kibwe and Alex W. Kisingo	
	10:30 – 11:00	**HEALTH BREAK**		
53	11:00-11:20	Examination of Typologies of Human – Wildlife Interaction in the Grassroots' Governance of Wildlife Resources in Tanzania	Montanus C.Milanzi	Ingela Jansson
54	11:20 – 11:40	Poaching mortality, trophy harvest mortality and spatial displacement and the decline in Elephant *Loxidonta Africana* population of the eastern Selous Game Reserve, Tanzania.	Ikanda, D.K. *et al*.	
55	11:40 – 12:00	Status and economic value of livestock-wildlife conflict in West Kilimanjaro, Tanzania	Joyce E. Kombe' *et al.*	
56	12:00-12:20	Does seasonal variation affect tropical forest mammals' occupancy and detectability by camera traps? Case study from the Udzungwa Mountains, Tanzania	Emanuel H. Martin, *et al.*	
57	12:20-12:40	Modeling Past, Present and Future Ecosystem, Climate and Human Interactions in East Africa Savannahs	Rebecca Kariuki, *et al.*	
58	12:20 – 13:00	Illegal activities contribute to significant biodiversity decline in protected areas across the globe: a review	Alfan A. Rija, *et al.*	
	13:00- 14:00	**LUNCH**		

SUB-THEME: CLIMATE CHANGE KITULO CONFERENCE HALL				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
59	14:00 – 14:20	Kilimanjaro under Global Change	Andreas Hemp	Joseph Ogutu
60	14:20 – 14:40	Impact of climate change and land use on local butterfly pollinators: A Case of Dar es Salaam City, Tanzania	Adelaide Sallema	
61	**14:40 – 15:40**	**Poster presentations**		
	15:40- 16:00	**HEALTH BREAK**		
	16:00 – 17:00	**Seminar Presentations Continues**		
END OF DAY TWO				

B. SEMINAR PRESENTATIONS: GOMBE CONFERENCE HALL

TIME: 9:10 -13:00: Chairpersons: Eivin Røskaft

S/N	Time	Title	Presenter
	9:10 – 9:30	A brief introduction to AfricanBioServices	Eivin Røskaft
62	09:30 – 09:50	Modeling how population growth affects biodiversity and ecosystem function through land use changes and infrastructure development	Bente Jessen Graae
63	9:50 – 10:10	Modeling effects of climate change on biodiversity and ecosystem dynamics	Joseph Ogutu
64	10:10 – 10:30	How biodiversity enables different ecosystem services along landscape gradients	Han Olff
	10:30 – 11:00	**HEALTH BREAK**	
65	11:00-11:20	How AfricanBioServices will contribute to establish better strategies challenges related to conservation of the Serengeti Ecosystem	William Mwakilema
66	11:20 – 11:40	Household welfare dependence on ecosystem services	Martin Reinhardt Nielssen
67	11:40 – 12:00	How AfricanBioServices will contribute to develop better strategies related to conservation of protected areas in Tanzania	Jafari Kideghesho
68	12:00- 13:00	General Discussion	Benard Bett
	13:00- 14:00	**LUNCH**	

B2. FIRE IN THE SAVANNA ECOSYSTEMS: GOMBE CONFERENCE HALL

TIME: 14:00 -17:00: Chairpersons: Colin Beale

S/N	Time	Title	Presenter
69	14:00 – 14:20	Fire regimes impact tropical montane forest composition during periods of rapid climate change	Colin J. Courtney Mustaphi *et al.*
70	14:20 – 14:40	Modeling the interactive dynamics of grass, trees, fire and wildebeest in the Serengeti ecosystem	Andy Dobson
71	14:40 – 15:00	Environment, humans and scale as determinants of biodiversity patterns across Africa	Gareth Hempson
72	15:00 – 15:20	Savannah bird community change and fire management	Colin M Beale and Elliot Kinsey
73	15:20 – 15:40	Characteristics and interactions of fire in the Serengeti ecosystem	James Probert *et al.*
	15:40- 16:00	**HEALTH BREAK**	
74	16:00 – 16:20	What controls seedling survival in savannas? Experimental tests of water limitation, herbivory and fire in Serengeti	Thomas A. Morrison
	16:20 – 17:00	Discussion	

C. POSTER PRESENTATION

S/N	Title	Presenter (s)
75	Environmental awareness and beekeeping in selected villages at Malagarasi-Muyovozi ramsar site	Jasson John, *et al.*
76	Effect of land use and elevation gradient on soil aggregate fractionation on Kilimanjaro ecosystems	Emanueli Ndossi
77	Can rhino ranching reduce its poaching in Tanzania?	Emmanuel Chacha Matiko
78	Considerations of West Usambara colobus monkeys : A documentation of conservation activities and their impacts on colobus monkeys around Magamba Nature Reserve	Mwihomeke Mickfanaka *et al.*
79	Wilderness and road networks in protected areas	Ragnvald Larsen, *et al.*
80	Mapping chimpanzee artifacts: What can they reveal about hominin evolution?	Alejandra Pascual-Garrido
81	A changing climate in the rangelands of Northern Tanzania: effects on people and their ecosystem services	Silvia L. Ceppi, *et al.*

82	Human – wildlife, interaction around selous game reserve in Tanzania	Twaha Twaibu
83	Raw material procurement for termite fishing tools in wild chimpanzees	Katarina Almeida-Warren and Alejandra Pascual-Garrido
84	Simian strains of the bacterium *T. pallidum*: A missing link to understand syphilis's evolution?	Chuma, I. S. *et al.*
85	Population health parameters in olive baboons (*Papio anubis*)	Lipende, I. F. *et al.*
86	Behavioral determinants and consequences of the natural spread of a sexually transmitted disease in wild olive baboons (*Papio anubis*)	Paciência, F. *et al.*
87	Integrating indigenous knowledge and science in wildlife management	Obeid Mahenya
88	The use of sleeping tree refuges by yellow baboons in Mikumi National Park	Samuel Mtoka and Guy W Norton
89	Can Geographical Indication labeled honey address the local pollinators decline in Tanzania?	Godfrey Nyunza
90	Implications of land cover changes on community's livelihoods along the slopes of Mt. Kilimanjaro in the changing climate	Hawa K. Mushi
91	Soil Erosion under Different Vegetation Cover and Land-use: Experience from Cultural Landscape of Mt. Kilimanjaro, Tanzania	Jerome Kimaro, *et al.*
92	The influence of microcredit-funded businesses on human welfare and bushmeat consumption among communities in serengeti, Tanzania	Lowasssa, A., *et al.*
93	GIS platform; connecting land, people, and biodiversity	Samuel Kimani
94	Evaluating techniques to estimate lion abundance	Jerrold l. Belant, *et al.*
END OF DAY TWO		

DAY THREE: FRIDAY 04th DECEMBER 2015

A. PAPER PRESENTATIONS				
KEY NOTE PAPER PRESENTATION No. 3: KILIMANJARO CONFERENCE HALL				
S/N	**Time**	**Paper**	**Presenter**	**Chairperson**
95	8:30 – 9:10	Livestock-Wildlife-Human Interactions: Challenges for control of zoonoses and emerging infectious disease	Julius Keyyu	Han Olff
PARALLE SESSION 1 DAY THREE: KILIMANJARO CONFERENCE HALL				
SUB-THEME: WILDLIFE DISEASES AND ECOSYSTEM HEALTH				
S/N	**Time**	**Event/Paper**	**Presenter**	**Chairperson**
96	09:10 – 09:30	Malignant catarrhal fever: a field trial of a novel vaccine strategy	Felix J. Lankester, *et al*.	Robert Fyumagwa
97	09:30 – 09:50	Neglected tropical diseases: One health and the role of nonhuman primates	Knauf, S. *et al*.	
98	09:50 – 10:10	Genetic and ecological drivers of tuberculosis at human-livestock-wildlife interface of the Serengeti ecosystem, Tanzania	Bugwesa Z. Katale *et al.*	
99	10:10 – 10:30	Free-roaming domestic dog demography and vaccination near Serengeti National Park in Tanzania	Anna Czupryna, *et al.*	
	10:30 – 11:00	**HEALTH BREAK**		
100	11:00-11:20	Causes of mortality in baboons at Gombe National Park: the role of intrinsic factors, predation, disease, and conflict with humans.	A. Collins, *et al.*	Knauf, S.
101	11:20 – 11:40	Health and demographics of African buffalo (*Syncerus caffer*) in Ruaha National Park, Tanzania	Epaphras A. Muse, *et al.*	
102	11:40 – 12:00	Systematic surveillance and capacity strengthening to detect emerging viral zoonoses of wildlife origin in Tanzania	Zikankuba Sijali, *et al*.	
103	12:00-12:20	Free from the cold-chain? A rabies vaccine thermo-stability trial	Felix J. Lankester, *et al.*	
104	12:20-12:40	Seroprevalence of tuberculosis in domesticated elk (*Cervuscanadensis*) in Korea	Shin-Seok Kang, *et al.*	
105	12:40 – 13:00	Preliminary field and laboratory observations of the effects of handling	Ray Shoo and Reginald Mwaya	

		stress of natural populations of the pancake tortoise (*Malacochersus tornieri*)		
	13:00- 14:00	**LUNCH**		
106	14:00 – 14:20	Detection of arenaviruses in rodent and shrews from selected wildlife-human interfaces in Tanzania	Ruth Maganga, *et al.*	Christian Kiffner
107	14:0 – 14:40	Sero-prevalence and spatial distribution of Rift Valley Fever in humans residing in agro-pastoral and pastoral communities during inter-epidemic period in the Serengeti ecosystem, northern Tanzania	Jabir Makame, *et al.*	
SUB-THEME: BEEKEEPING, BEE ECOLOGY, BEE PRODUCTS AND POLLINATION SERVICES: KILIMANJARO CONFERENCE HALL				
108	14:40 – 15:00	Challenges and opportunities for sustainable beekeeping livelihoods in Miombo wooland of Mlele District western Tanzania	Janemary Ntalwila, and Angela Mwakatobe	Jasson John
109	15:00 – 15:20	Current challenges of beekeeping sector in Tanzania	Mumbi, C.T., *et al.*	
SUB-THEME: NATURAL RESOURCES GOVERNANCE AND INFRASTRUCTURE DEVELOPMENT: KILIMANJARO CONFERENCE HALL				
110	15:20 – 15:40	Impacts of the Tanzania - Zambia tarmac road on wildlife road kills and waste in Mikumi national park	Julius Keyyu, *et al.*	Christian Kiffner
111	16:40 – 16:00	The impact of the Tanzam highway on diet, ranging and foraging behaviour of yellow baboons in Mikumi national park	Amani Kitegile, *et al*.	
	16:00- 16:20	**Research Directorate – communication/ update**	**Dr. Julius Keyyu**	
	16:20- 16:40	**HEALTH BREAK**		
	16:40 - 17:10	**Closing Remarks – End of the 10th TAWIRI Scientific Conference**		
PARALLE SESSION 2 DAY THREE: KITULO CONFERENCE HALL				
SUB-THEME: NATURAL RESOURCES GOVERNANCE AND INFRASTRUCTURE DEVELOPMENT				
112	9:10 – 9:30	Performance of wildlife conservation approaches in Northern Tanzania	Christian Kiffner	Stephen Nindi
113	09:50- 10:10	Perceptions of the Maasai inhabiting the	Steria Ndaga,*et al.*	

		Loliondo District of Tanzania Regarding Agencies involved in the Process of Conservation-based Land-use Planning		
114	10:10 – 10:30	Natural Resources governance in a multiple use protected area, Mlele Beekeeping Zone – Katavi Region	Napoleon Frank, *et al.*	
	10:30 – 11:00	**HEALTH BREAK**		
115	11:00-11:20	Indigenous Knowledge Utilization and Land Use in Tanzania: The case of Usambara Mountains	Fadhili Bwagalilo, *et al.*	Felix J. Lankester
116	11:20 – 11:40	An overview of environmental data and data owners in the Coastal area of Tanzania-an emerging environmental spatial data infrastructure.	Christopher Muhando, *et al.*	
117	11:40 – 12:00	Avian Flight Heights across Power lines in Dar es Salaam	Joinse Tuyishime and Jasson John	
SUB-THEME ETHNO-BOTANY AND VEGETATION ECOLOGY:KITULO CONFERENCE HALL				
118	12:00-12:20	Drivers of tree community composition and seed demography in Serengeti.	Deusdedith Rugemalila, *et al.*	Ndibalema V.G.
119	12:20- 12:40	How to live with invasive? Positive environmental and climate mitigation effects of *Prosopis juliflora* in Ethiopian rangelands	Anna C. Treydte, *et al.*	
120	12:40-13:00	Phylogenetic diversity of plant communities at Mt Kilimanjaro in relation to elevation and human impact	Neduvoto Piniel Mollel, *et al.*	
	13:00- 14:00	**LUNCH**		
121	14:00 – 14:20	The importance of ethno-medicinal plants amongst the Iraqw in the Karatu District: Cultural and Conservation implication	John Mwamhanga *et al*.	Deusdedith Rugemalila
122	14:20 – 14:40	Forest edge effects for the three glade types in Mount Meru Game Reserve	Ladislaus W. Kahana, *et al.*	
123	14:40 – 15:00	The Distribution and causes of alien plant species in Serengeti National Park	John Bukombe, *et al.*	
124	15:00 – 15:20	Projected Population Growth and Deforestation in the Serengeti Ecosystem	Aine Seitz McCarthy, *et al.*	
	16:00- 16:20	**Research Directorate communication**	**Dr. Julius Keyyu**	
	16:20- 16:40	**H EALTH BREAK**		
	16:40 - 17:10	**CLOSING REMARKS**		

END OF DAY THREE – END OF THE 10TH TAWIRI SCIENTIFIC CONFERENCE
THANK YOU ALL FO MAKING THIS EVENT ONE OF THE SUCCESS CONFERENCES

DAY THREE SEMINAR PRESENTATION: GOMBE CONFERENCE HALL

WHAT HAS SCIENCE EVER DONE FOR LAW ENFORCEMENT

TIME: 9:10 – 13:00: Chairpersons: Howard Frederick

S/N	Time	Title	Presenter
125	09:10 – 10:00	Large mammals census methods and recent census results in Tanzania	Edward Kohi
126	10:00 – 10:40	Lessons learned by advanced spatial methods: how can this science help management authorities in sustainable conservation?	Colin Beale
	10:40- 11:00	HEALTH BREAK	
127	11:00 – 12:00	Can cheaper and more frequent surveys better inform law enforcement and management? What data are worthwhile now, and what could CIMU improve upon?	Howard Frederick
	12:00 – 13:00	Discussion	Howard Frederick and Edward Kohi
	13:00 – 14:00	**LUNCH**	

ABSTRACTS

DAY ONE: Wednesday 2nd December 2015

SUB-THEME: WILDLIFE ECOLOGY AND ECOLOGICAL INTERACTION

KEY NOTE PAPER;

LONG-TERM FIELD EXPERIMENTS: WHAT DO WE LEARN AND WHEN DO WE LEARN IT?

Mick Crawley

WILDLIFE MONITORING: ARE GROUND SURVEYS NECESSARY?

Tim Caro*

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In Tanzania long term wildlife monitoring is seen as important for the wildlife sector. Most monitoring is restricted to aerial censuses conducted by TAWIRI and there are only very few ground based long-term surveys operating in Tanzania's protected areas. This is because they are costly in terms of manpower and funding. This raises the question of whether ground-based monitoring needs to be conducted at all and if so, how frequently? The survey aimed at assessing the need for annual herbivore counts and comparing 20 years of vehicle censuses and more than 35 years of aerial censuses in the Katavi ecosystem on a species-by-species basis. Main research questions that were addressed were; (i) what information do vehicle transects surveys add over and above that obtained from aerial censuses? (ii) Should ground monitoring efforts be targeted at a few specific vulnerable species rather than all large and medium-sized mammals? (iii) Can some species act as indicator species for the whole large mammal community? (iv) Can we reduce survey effort by conducting ground-based surveys every decade rather than annually?. In brief, aerial censuses perform better than other methods for most large mammal species. Frequency of ground based wildlife monitoring can be reduced considerably. Species cannot act as indicators for population trends in other species. Conclusions: wildlife monitoring can be made more efficient in Tanzania.

Key words: Censuses, large mammals, monitoring, surveys

CHALLENGING CO-EXISTENCE; LION HABITAT USE AND MOVEMENT PATTERNS IN NGORONGORO'S MULTIPLE-USE LANDSCAPE.

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Abundant wildlife coexists with a traditional pastoralist population and their livestock in the Ngorongoro Conservation Area (NCA), an essential part of the greater Serengeti ecosystem. A rapid human population growth has increased competition for natural resources and intensified human – wildlife conflict (HWC). Most vulnerable to HWC in NCA is the lion (Pantheraleo), and theirnumbers and distribution have declined substantially in recent decades. The long-term viability of the iconic lion population in the Ngorongoro Crater iscompromised by a growing isolation, as any dispersing lion from the nearby Serengeti population must cross an increasingly challenging matrix to reach the Crater. This has led to a long history of close inbreeding in the Crater population. Our overall goal is to develop sustainable model for coexistence in this landscape. A primary objective is to describe existinginteraction patterns between people, livestock and large predators in the NCA. Here we explore the lions' potential as well aschallengesto adept and coexist in this landscape. We describe contemporary patterns of lion movement, habitat-use, and distribution,as revealed bysix GPS-collared individuals, with additional location data from opportunistic observations. These data are combined with spatio-temporal and contextual parameters from depredation events, andmap-layers of relevant landscape features and landmarks (e.g. homesteads, water-points, no-grazing zones) to explore factors affecting livestock/predator vulnerability and risks of attack.The results characterize distributions of key resources, land-use patterns of people, livestock and wildlife, conflict hot-spots, and contextual risks for conflict. Based on these results we have developed a friction map identifying priority areas for conflict mitigation efforts and potential lion dispersal and stepping stones areas.

MOVEMENT PATTERN AND HOME RANGE SIZES OF THE REINTRODUCED WILD DOG PACKS IN THE SERENGETI NATIONAL PARK, REVEALED BY THE GPS SATELLITE COLLARS.

Eblate E. Mjingo and Emanuel H. Masenga

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Global Positioning system (GPS) technology prove to be advantageous in tracking movements as well as areas utilized by wild animals compared to physical tracking in that they have the ability to gather large quantities of spacio-temporal data that are accessed remotely. We report movements and areas utilized by African wild dog packs that have been reintroduced and released into the Serengeti National Park (SNP) since 2012, following local disappearance from SNP in 1990s mainly due to diseases. Conservation initiative was designed to save the species by

establishing viable population within SNP - a safe place away from human influences. Five packs of 10 to 14 individuals were captured using combination of both physical and chemical methods. Packs were kept in holding facility and managed for a period not exceeding 6 months before their release into the wild. In each pack, one or two individuals were fitted with GPS satellite collar which were set to give eight readings per day for monitoring. Result revealed thatone pack showed long movement pattern, utilizing extensive area of the Serengeti ecosystem and finally one individual settling in Kenya. The rest 4 packs showed confinement movement pattern with overlapping home ranges, while each pack utilizing selected potential areas within SNP, Maswa Game Reserve and Ngorongoro Conservation Area. These results provide very important information in the conservation history in Tanzania and the world regarding free range carnivores reintroduction.

INVENTORY OF THE TANZANIAN ORTHOPTERA FAUNA AND SCIENTIFIC APPLICATIONS

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First inventories of the whole flora and fauna of northern Tanzania also including Orthoptera were made over one hundred years ago (1905-1906) by an expedition led by the Swedish scientist YngweSjöstedt. 34 bushcricket and 71 grasshopper and locust species were identified and partly newly described for Kilimanjaro, Mt Meru and parts of the Usambara and Pare Mountains. The sampled material was transferred to the Natural History Museum Stockholm where it can still be studied today. During colonial times more sampling was conducted and new species described especially from the Usambara Mountains (Amani, Lushoto) and first entomological collections established in Tanzania. After the first world war when Tanganyika became British protectorate most collections were transferred to Nairobi where a major part of Tanzanian Orthoptera material is still preserved. Up to now not much effort was made again establishing a national entomological collection in Tanzania. An intensive inventory of the Orthoptera fauna of East Africa with focus on Tanzania was started in 1996 by our own working group. About 80 grasshopper, locust and bush cricket species and subspecies, 8 new genera and a subtribe were erected and newly described for East Africa, mainly from Tanzania around Mt Kilimanjaro and the Eastern Arc Mountains highlighting the high biodiversity and degree of endemism found in Orthoptera in Tanzania and East Africa. These basic data may be used to investigate mechanisms behind the present biogeographical patterns of Orhtoptera taxa, to understand times and modes of speciation patterns and with it the vegetation history of the area. The data set also serves to recognize areas of biodiversity and to outline centers boosting speciation in East Africa.

USING REMOTE SENSING TO INVESTIGATE PATTERNS AND DRIVERS OF VEGETATION CHANGE IN THE SERENGETI ECOSYSTEM FROM 1984 TO 2011

Anna B. Estes, A.B. Massada, T. Kuemmerle, H.H. Shugart and V.C. Radeloff

Managing ecosystems for biodiversity conservation requires understanding the processes that shape them at multiple scales. Remotely-sensed data allow analysis of ecosystem changes over long periods of time and across broad spatial scales. This can help contextualize smaller-scale changes that are observable in the field, and upon which conservation decisions are often based. The Serengeti ecosystem in Tanzania is an area of global biodiversity importance, and changes in woody vegetation cover have long been a concern to managers and conservationists. We used time series of Landsat imagery to analyze long-term vegetation change in the Serengeti at a spatially-continuous landscape scale. We identified shifts between woodland and grassland in three periods between 1984 and 2011 and compared these to known drivers of change in savanna ecosystems, namely elephant numbers and fire frequencies derived from the MODIS burned area product. We found frequent, small-scale increases and decreases in woody vegetation cover occurring simultaneously in all time periods, with over half of the woodlands and grasslands transitioning between states at least once between 1984 and 2011. But despite these small-scale, highly-dynamic vegetation changes, the magnitude of change aggregated over the entire ecosystem was relatively minor. At the ecosystem scale, we observed an increase in woody cover between 1984 and 1995 and consistent but moderate declines in woodland extent thereafter, from 62.5%in 1995 to 57.5% in 2011. While these changes coincide with changes in elephant numbers, our results suggest that fire frequency played a larger role in woodland declines in Serengeti than currently assumed. Some areas experienced as many as 20 fires in 10 years, and areas showing declines in woodland in the past decade had a higher mean number of fires. This indicates that management interventions to control woody vegetation loss could be targeted at reducing the number of human-caused fires.

BODY SIZE AND AGE IN ELEPHANTS OF MIKUMI NATIONAL PARK: JAW MEASURES INDICATE SMALLER SIZE

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The elephant in Mikumi National Park have been reported to be small in size by both casual and experienced observers for at least the past 40 years. Other experienced observers have suggested that Mikumi elephant are not small relative to age but appear small overall as a consequence of being a population dominated by younger animals. Measurements of molar teeth and lower jaws from the skulls of elephant of known age in Amboseli National Park, Kenya has shown that jaw size is correlated with age. We determined the sex and age of 108 elephant skulls collected in Mikumi. We used the same jaw size measures as used in Amboseli. We found that the size of

jaws relative to age was considerably smaller then the size/age relationshipin Amboseli. This provides the first quantitative evidence for small size relative to age in Mikumi elephants. We evaluate the likely causes of smaller body size in Mikumi elephant. Resource limitations that inhibit or limit growth appears to be one factor. Because small body size has been reported for Mikumi elephant for many decades, stress and acute mortality due to poaching seems unlikely as an explanation. But, we consider the patterns of poaching related mortality and change over the long-term in Mikumi in relation to the causes of small body size.

RECRUITMENT AND SURVIVORSHIP OF THE KIHANSI SPRAY TOAD (*NECTOPHRYNOIDES ASPERGINIS*) IN CAPTIVITY

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In this study we document the recruitment and survivorship of the extinct in the wild (EW) Kihansi Spray Toad (KST) in captivity. Five breeding pairs were put in separate terraria and observed for 14 months and fed by normal diet used for other toads in the biosecure captive facility. We examined the life span, fecundity, recruitment, weight development and survivorship of the KSTs. The females visibly showed eggs through their transparent bellies at the age of eight to nine months since birth. Gestation period of the KST from the moment eggs were fertilized to delivery ranged between one and two months. There was a high survivorship of toadlets born; numbering 1 to 10 per birth than toadlets born numbering 11 to 20 per birth. We found that juveniles attained full yellow color with dark striping at the age of five months and became adults at the age of seven months. Within a year a female KST normally gave birth three times, with 8 to 20 toadlets for the first birth and not more than 8 toadlets for the next births. When adult, a female KST on average weighed 0.770g and 0.558 for an adult male respectively. The highest number of toadlets born per year from one female was 25 and the lowest was 3. These results suggest that the KST has a relatively good recruitment rate and high offspring survivorship which is an important attribute for the successful reintroduction process of the toad to its native habitat.

Keywords: recruitment, fecundity; survivorship; captive breeding; Kihansi spray toad

VULTURE MONITORING PROGRAM IN SOUTHERN TANZANIA

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Vultures play a key role in disease control and waste removal. African vultures have declined dramatically in recent years, mostly due to poisoning. In many cases, vulture declines have occurred over short time periods and population monitoring is thus critical for vulture conservation. Prior to 2013, no systematic surveys had been done on vultures in southern Tanzania. Beginning in 2013, North Carolina Zoo and the Wildlife Conservation Society in partnership with TANAPA began conducting roadside counts of vultures in Ruaha and Katavi National Parks. In 2015, surveys were conducted in both dry and wet seasons. Preliminary results suggest that the vulture population is stable and that numbers are comparable to other parts of East Africa. However, surveys with rangers and other key stakeholders demonstrate that there are several potential threats, including poisoning. Building on this initial work, WCS and NC Zoo plan to use satellite telemetry to understand vulture movement and ranging patterns in Southern Tanzania to inform the surveys being conducted. Our goal is to establish a long-term population monitoring program for African vultures in Ruaha and Katavi National Parks. Because ecology and conservation needs of vultures overlap closely with other species, on-going monitoring of vultures will be important for assessing the health of these ecosystems and many other species, including carnivores and elephants that inhabit them.

BUTTERFLY SPECIES AND THEIR RELEVANCE TO CONSERVATION IN RUVUMA WILDLIFE MANAGEMENT AREAS

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Butterfly sampling was conducted in Ruvuma WMAs in order to determine butterfly communities and to assess the influence of disturbance on number of individual butterflies, species richness and composition. The sampling was done from September to November, 2014 by means of sweep nets and visual observations. Results show that a total of 545 butterfly individuals belonging to 6 families, 41 genera and 90 species were recorded in the study area.

Kruskal-Wallis test revealed no significant variation in number of butterfly individuals across the WMAs. Among five WMAs studied, Butterfly species richness was highest in Mbarang'andu WMA (28.7±0.81) and lowest in Kimbanda WMA (2.2±0.29). Mean number of individuals butterfly was slightly higher (3.1±0.26) in the miombo woodland compared to the riverine forest (2.9±0.37) but were not statistically different between the two vegetation types (W = 3988, P = 0.678) when tested by using Wilcoxon rank sum test. Even though there is some degree of environmental destruction caused by adjacent communities to the WMAs, there is a correspondingly high diversity of plants to support identified butterfly species. However, further destruction of the forest could affect the species richness and abundance of both flora and fauna within a study area. Hence we recommend that more resources and effort should be put to safe guard these WMAs for the benefit of present and future generation.

Keywords: Butterfly, richness, disturbance, Conservation, Ruvuma Wildlife Management Areas,

UNDERSTANDING THE DRIVERS OF WILDEBEEST MOVEMENT

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The annual migration of the 1.2 million wildebeest in the Serengeti is hugely influential in driving the dynamics of the entire ecosystem. Understanding the factors driving this mass movement of animals iscritical in identifying risks to its continuanceand developing strategies for managing these risks. We are currently developing population-based models of wildebeest movement that we plan to fit to monthly wildebeest distribution data to investigate how movement is influenced by different mechanisms, including environmental gradients (e.g. in rainfall, soil nutrients or human disturbance), local depletion of resources, and social interactions between individuals within the herd. By incorporating all of these mechanisms within the same modelling framework, we hope to explain wildebeest distribution patterns more fully than has previously been possibleand more accurately predict how the migration may respond to changes in climate or human-wildlife conflict. In addition to this ecosystem-scale analysis of wildebeest distribution patterns, we intend to use individual-based models of collective movement toexamine the social interactions between wildebeest at a fine scale, using aerial video footage of the herds collected under various scenarios (e.g. when the herd is grazing, marching or responding to a predator threat). The effect of social behaviour on movement has seldom been explored in wildebeest, largely due to a lack of suitable data. Bycapturing the movement paths of hundreds of individuals relative to each other, our new aerial video data offers a unique opportunity to analyse how individuals use social cues from their neighbours to inform their movement decisions. This analysis will provide new insights on how information (e.g. on environmental gradients or predator presence) is transmitted through the herd, allowing the animals to more efficiently exploit their ecosystem.

STUDYING COLLECTIVE ANIMAL BEHAVIOR FROM AERIAL AND SPACE-BASED PLATFORMS.

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Predation risk can influence animal behavior, trophic interactions, and community processes at multiple scales. Thus, understanding the behavioral responses of prey in the presence of risk is an essential component of understanding the dynamics of populations and entire ecosystems. Until now, researchers investigating the consequences of risk-induced behavioral shifts in aggregating animals have been largely limited to laboratory experiments and computer simulations of small-bodied organisms (e.g. ants, minnows) interacting with predators on small spatial scales. This project took advantage of recent advances in remote sensing technology to empirically study the spatial ecology of risk in large animal aggregations at multiple scales. Specifically, we used high-definition video obtained from unmanned aerial vehicles (UAVs) and high-resolution satellite imagery to identify rules of social interaction that govern group movements of migratory wildebeest (*Connochaetes taurinus*) in response to predation risk at local (1 km^2) and landscape (100 km^2) scales in Serengeti National Park.

INVESTIGATING THE 'SMALLER MAJORITY' OF THE UDZUNGWA MOUNTAINS FOR LARGER QUESTIONS AND WIDER APPLICATIONS

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[2] Zoological Museum, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; [3] Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland.

Here we will present our ongoing research project in the forests of the Udzungwa Mountains National Park, in the Eastern Arc Mountains. Our focus is the 'smaller majority'of these mountains – the arthropod communities – which have remained largely unknown. Our aims are: to describe and explain the spatial and temporal variation in the abundance patterns of arthropod communities; to develop protocols for efficient and informative field-data collecting; to provide information and tools for conservationfocused ecological monitoring; and to document the arthropod fauna and to generate occurance data for them. We will provide preliminary results in relation to our four aims; however, we will focus on our sampling protocols and their applicability to other taxa and biomes. Maximising resources is important when collecting field-data, but it is critical when it comes to sampling communities of mega-diverse taxa, such as orthropods in ecosystems like tropical forests. Indeed, the design of sampling protocols depends on the specific objectives of the study – ad hoc protocols may hinder re-using the data for other purposes. Conversely, standardised designs can allow comparability and generate data for wider use. We have developed a protocol for sampling spider communities in tropical forests that

combines samples of different methods, and provides the best feasible picture of the community and allows for comparison across sites. Therefore, the resulting data may be used as biodiversity surveys for conservation purposes or for understanding community patterns and processes.

DASH AND DINE: QUANTIFYING INDIVIDUAL VARIABILITY IN PREY HANDLING TIMES IN WILD CHEETAHS

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Functional response models are central to our understanding of predator prey interactions. However, field studies on functional response are rare; assessments of whether model assumptions are met even rarer. In addition, we still lack an understanding of how the functional response of mesopredators is affected by the presence of apex predators. The purpose of the study was to test whether the assumption of constant handling time adequately describes the predation behavior of a wild mesopredator, and to determine what factors influence handling time duration. We considered data collected between 1980 and 2014 on observed hunts by wild cheetahs (*Acinonyx jubatus*) in the Serengeti National Park. We used mixed effects models to determine whether factors such as cheetah identity, age, sex, social grouping, short term hunger, prey size, and whether the kill was stolen by other predators affected handling times for this mesopredator. Observed handling time varied from 9 minutes to over 8 hours. The duration was impacted by the amount of meat available per cheetah, cheetah social grouping, and whether the kill was stolen or not. These effects accounted for 38% of the variability in handling time; cheetah ID accounted for a further 11%. Our results show that the assumption of constant handling time in Holling's functional response models do not hold for cheetahs. We also demonstrate how apex predators can impact the functional response of mesopredators, and how incorporating a third trophic level in functional response models can help us understand a wider variety of predation dynamics.

ACTIVITY PATTERNS OF BLACK-AND-WHITE COLOBUS MONKEY (COLOBUS GUEREZA CAUDATUS) IN RAU FOREST RESERVE, TANZANIA

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This study on black-and-white colobus monkey (*Colobus guereza caudatus*) was conducted in Rau Forest Reserve, Moshi, Tanzania investigating overall activities and activity across age and sex groups. We used scan sampling to record overall activities. We used focal animal sampling

to record activities across age and sex groups. Colobus monkeys in Rau Forest Reserve spent much time resting (57.7%), followed by feeding (27.7%) and less time on moving (10.8%) and social activities contribute only (3.8%). Across age groups, adults spent 60.7% of their time resting while juveniles and infants spent only 50% and 46.1% respectively. Furthermore, adults spent 21% of their time feeding, followed by juveniles 27.9% and infants 16.9%. Movements were more similar across ages (10.5-13.1%). Time engaged in social activities varied strongly among ages (adults 7.8%, juveniles 10.8%, and infants 23.8%). Sexes differed slightly in their activities, most notably with females spending almost twice as much time in social activities as males (8.0% vs. 4.3%). This difference seems to be dictated by the availability of social partners. Resting time in colobus monkeys is a strategy for energy conservation, although socialization is also particularly important for infants.

SPATIAL DISTRIBUTION OF MITOCHONDRIAL LINEAGES OF TANZANIAN BABOONS

Zinner, D.[1], Keller, C.[1], Nyahongo, J.W.[4], Knauf, S.[3], Roos, C.[2]

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Tanzania plays a key role in understanding distribution patterns of savanna mammals, because for several of the species or genera it constitutes the boundary between species of the southern and northern savanna belt. Previous molecular studies, based on mitochondrial sequence data of baboons (*Papio*sp.), showed that a sharp boundary between southern and northern baboon lineages occurs in central Tanzania. The aim of our study was an analysis of the distribution pattern of mitochondrial lineages within East Africa, with a special focus on Tanzania. We collected non-invasively baboon fecal samples in different regions of Tanzania. Based on complete cytochrome *b* sequences, we identified severalhaplogroups within yellow (*P. cynocephalus*) and olive baboons (*P. anubis*). Our analysis revealed that the border between southern and northern lineages did not correspond to taxonomy, but divided yellow baboons in southern and northern lineages. The border between the lineages cuts through the range of yellow baboons causing the mitochondria of yellow baboons from southern Tanzania to be closer related to those of chacma baboons (*P. ursinus*) than to the mitochondria of their conspecifics from northern Tanzania. Interestingly, one of the oldest baboons lineages was detected in the Mahale Mountains area, where yellow baboons occur sharing some morphological characteristics with Kinda baboons (*P. kindae*) from Zambia. The contemporary distribution of baboon mitochondrial lineages in Tanzania might be a result of a recurrent extension and retractionof the savanna biome due to climate changes during the Pleistocene, giving way to the survival of ancient lineages in savanna refugia during unsuitable climate periods and secondary contact with gene flow and introgressive hybridization in periods of suitable climate conditions. In order to protect primate, in this case baboon genetic diversity, our study identifies and locates particular genetic linages, which might correspond to previously described, but subsequently synonymized taxa.

BUTTERFLIES OF KIHANSI GORGE FOREST IN TANZANIA

Devolent Mtui, Edward Kohi, Cecilia M. Leweri and Steven Liseki

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Butterflies are sensitive to changes in geographic and ecological conditions, and are therefore potential indicators of habitat quality and biodiversity change. Kihansi Gorge forest (20km^2), which is part of the Eastern Arc Forest Mountains in Tanzania, provides important habitats for a number of endangered and endemic plant and animal species, including the Kihansi spray toad (*Nectophrynoides asperginis*) and *Coffea kihansiensis*. Since 1999, the Kihansi gorge forest has experienced ecological changes as a result of diversion of Kihansi River for hydropower generation. This study aimed at documenting species diversity of butterflies in the gorge that can serve as baseline information for monitoring of Kihansi ecosystem. Surveys were conducted for 24 months, between March 2005 and March 2007, by sampling along transects with sweep nets and Malaise traps. Two hundred and six butterfly species were recorded, among the following families: Nymphalidae (34% of all species), Lycaenidae (18.4%), Hesperiidae (18%), Acraeidae (7.8%), Pieridae (7.3%), Papilionidae (5.3%), Satyridae (5.3%), Danaidae (3.4%), and Riodinidae (0.5%). Among these one species is new to science: *Charaxes* sp. nov. (Kihansi Charaxes) (Nymphalidae). These results provide baseline data to help monitoring the health of Kihansi Gorge forest.

MASAI GIRAFFE DEMOGRAPHY IN THE FRAGMENTED TARANGIRE ECOSYSTEM

Derek E. Lee[1,2], Douglas T. Bolger[1], Bernard Kissui[3], YustinaKiwango[4]

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This study examined how demography of giraffe was affected by spatial variation in natural and anthropogenic factors. Giraffe are believed to have declined, astheir habitat throughout Africa has been lost and fragmented, and thus the fragmented Tarangire Ecosystem in Tanzania was representative of much of the remaining landscape for these iconic megaherbivores. We used data from 1,857 individual giraffe at5 sites to estimate population sizes, probabilities of reproduction, calf survival, adult survival, movements, and source-sink statistics to understand asuspected declining overall population trend. We examined how differences in spatial covariates of land management, giraffe density, lion predation, and illegal hunting affecteddemographic components. Adult female survival, reproduction, and movements varied significantly by site, but only variability in adult survival was significantly correlated with a spatial covariate. Adult female survival was positively correlated with anti-poaching patrol intensity. Population growth rate also varied significantly by site. A decreasing metapopulation($\lambda^M \approx 0.99$) was estimated by two methods of computing the metapopulation

growth rate. TarangireNP was identified as the dominant engine of metapopulation growth, but movement of individuals out of TarangireNP and into "attractive sink" sites was the most likely explanation for the shrinking metapopulation. However, these movements were also responsible for preventing extirpation of giraffe sub-populations in the non-Tarangire NP sites.

DRAMATIC POPULATION DECLINE OF ASHY RED COLOBUS MONKEYS (*PILIOCOLOBUS TEPHROSCELES)* IN MBUZI FOREST, RUKWA REGION, TANZANIA

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Monitoring endangered primate populations and their habitats is critical for deploying effective conservation and management strategies. However, primate populations in non-protected, remote habitats are typically given very low priority in conservation efforts. The population of the endangered Ashy monkey (*Piliocolobus tephrosceles*) in Mbuzi Forest, Tanzania, was discovered only in 2006. Since then we have monitored the status of this population by conducting surveys using complete counts. In 2014, the population size was 35 individuals and mean group size was 7±1.23 individuals. In comparison with the 2006 survey, population size and mean group sizes had sharply declined by 74% and 80%, respectively. We attribute this decline to unprecedented habitat loss due to conversion of forest into farms and hunting of the monkeys. However, we argue that the current poor status of the forest should not impede decisions to protect it and restore it. Restoration of the Mbuzi Forest is crucial to conserve wildlife, maintain the forest as a water catchment site and make human activities in the forest sustainable. We make recommendations for the immediate conservation of the Mbuzi Forest. Finally, we discuss the implications that our results have for the protection of this endangered primate thorough its range**.**

Keywords: Primate Conservation, red colobus, population status, complete counts, Ufipa, Nkasi District.

SEX-SPECIFIC SURVIVAL OF JUVENILES OFBLACK COUCAL AND WHITE-BROWED COUCALINTHE USANGU PLAINS OF SOUTHWESTERN TANZANIA: PRELIMINARY FINDINGS

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Population dynamics of a species is regulated by the rate of birth and death of individuals. Predation of eggs and young in birds is a strong force that affects recruitment of juveniles to the adult population and can have impact on population growth and species survival. We studied breeding effort and sex-specific juvenilesurvival ina population of black coucal *(Centropusgrillii)* and white-browed coucal*(Centropus supercilious)*that live sympatricallyin the Usangu plains.Black coucal is a polyandrous bird species and it is only males that incubate and take care of young while white-browed coucal is a socially monogamous species and male and female cooperate in incubation and caring of young. During the 2015 breeding seasonwe monitored 41 nests of black coucal containing a total of 140 eggs and 30 nests of white-browed coucal containing a total of 96 eggs andwe established the fate of each nest and egg. Only 36.6% of the black coucalnests and 30.0% of the white-browed nests fledged at least one young, the rest got predated, destroyed or abandoned before fledgingany young. Using lightweight radio-telemetry senders (<1.5g) we tagged, followed and recorded post-fledging survival of 37black coucal and 30 white-browed juveniles that successfully fledgedfrom the focal nests. Over 48.7% of the juvenilesof black coucaland 56.7% of the juveniles of white-browed coucalgot predated early before theycould grow to adult stage. We are currentlyconducting genetic sexing to find out whether male and female fledglingsof each species had equal predation rate. Bothcoucal specieshad quick nest replacement ability, a strategy that possibly helps themto compensate for the high predation pressure of their young.

A HOLISTIC INDICATOR SELECTION PROTOCOL FOR IDENTIFYING MEASURES OF CONSERVATION SUCCESS USING CONCEPTUAL MODELS

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Measures of conservation success are usuallynot selected systematically, and are biased towards management or donor interests and expertise. Subsequently, indicators rarely representoverall biodiversity, normanagement, policy, orlocal livelihoods on which the ecosystem depends. Here we present a Holistic Indicator Selection Protocol (HISP) for rankingpotentialindicators,using lowland forest in Tanzania as a case study. The HISP is a simple site-specific index comprising the number of threats that an indicator represents, and the indicator proximity to biodiversity targets, both derived fromaconceptual model (CM). The index also incorporates expert and local stakeholder opinion, as well as expected donor appeal. Indicator ranksvaried between biologists, social scientists, managers and villagers, but were mostly inter-correlated. These opinions and HISP indices produced very similar mean ranks across biological, social, economic, policy, and cross-cutting indicators. Indicator ranks among four alternative HISPindices were highly correlated with expert opinion, but allowed for more fine-scale ranking. All fourindices ranked biomass, habitat extent, and local knowledge among the top five indicators, with village natural resource deficit, threatened monkey numbers, and bushfire damage consistently in the top ten. A modification of the basic HISP removingCM proximity to the biodiversity target ("objective" O-HISP) reduced biological bias,leading toincreasedweightof economic and cross-cutting indicators, while a second modification removing donor appeal ("practical" P-HISP) led to increased weight of biological indicators. Overall we intend for the HISP to be applicable to conservation projects in any ecosystem and welcome further trials of its use.

VULTURES – A CONSERVATION CHALLENGE FOR AFRICA

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Africa supports 11 vulture species, eight confined to the continent. Vultures are a distinctive, iconic and charismatic component of Africa's wildlife. As nature's most successful scavengers, they keep habitats free of carcasses and contain the spread of diseases. However, the decline of vulture populations in Africa is catastrophic, with four species listed as Critically Endangered in the 2015 IUCN Red List, and there being a steady and continuing deterioration in the status of

Africa's vultures between 1988 and 2012. Ecological consequences of these declines include changes in community composition of scavengers at carcasses and an increased potential for disease transmission between mammalian scavengers at carcasses. This could have negative implications for human, livestock and wildlife health. We propose that evidence-based solutions for vulture conservation in Africa are developed, trialed and implemented through multi-disciplinary partnerships at local, national and regional scales. Science, capacity building and enhancement of policies are important ingredients to these solutions. We present some of the work being undertaken by the BirdLife Partnership, and encourage both conservation and non-conservation stakeholders in Tanzania to increase focus on addressing threats facing eight vulture species found in the country.

Key words: Africa, Declines, Health, Vultures, Solutions

INSIGHTS INTO LONG-DISTANCE DISPERSAL BY AFRICAN WILD DOGS (*LYCAON PICTUS*) IN EAST AFRICA

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Modern anthropogenic activities have resulted in extensive habitat transformation and loss, isolating wildlife populations from each other. Understanding how wild animals negotiate human-dominated landscapes is required to ensure that connectivity between populations is maintained. Previous studies have shown that African wild dogs typically disperse as single-sex groups and are capable of covering hundreds of kilometres in search of mates. However, only three wild dog dispersal events further than 300 km were reported, all of which lacked satellite GPS collar data. Here we report on two long-distance wild dog dispersals events from the Serengeti Ecosystem which, for the first time, was documented in detail through the use of satellite GPS collar data. To assess how wild dogs moved in relation to human-modified landscapes, we used a land cover map which classified land cover as either predominantly natural (>50% natural vegetation) or predominantly anthropogenic (>50% anthropogenically converted to agriculture, settlements and mines). Our results revealed that the cumulative distances between consecutive GPS locations for each group were 1642.0 and 3892.3 km (mean = 13.9 and 14.9 km per day) respectively. Furthermore, straight-line distances between the two farthest most locations for each group were 202.4 km and 520.4 km respectively. Both male and females dispersed over long distances and human dominated land cover was strongly avoided.

Group 1 moved from Serengeti National Park through Loliondo Game Controlled Area (LGCA) and Maasai Mara ranches, and settled south of Narok town in Kenya. Group 2 moved from LGCA through Mount Suswa Conservancy, Loitokitok Forest Reserve, Longonot, Hell's Gate, Tsavo West and Chyulu Hills National Parks in Kenya, and Kilimanjaro and Mkomazi National Parks in Tanzania. Our results represent the longest recorded dispersal distance and the need for strengthening cross-border conservation collaboration and management strategies for this endangered carnivore.

ASSESSMENT OF DIETS TAKEN BY FROGS AROUND MAZIMBU CAMPUS, MOROGORO.

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Foraging strategies and type of food used by amphibians tend to vary depending on surrounding physical environment, animal's morphological characteristics and feeding behavior patterns as influenced by human activities. A total of 110 anurans frogs were collected haphazardly between December 2013 and February 2014 dissected and the gut contents instantaneously analyzed for identification of prey species taken near three ponds found around Mazimbu campus. The main purpose was to assess diversity and identify prey species based on profitability. About 141 prey species were identified and grouped accordingly into eleven orders to include; Araneae (7.09%), Hymenoptera (19.15%), Coleoptera (11.35%), Orthoptera (14.89%), Dermaptera (0.71%), Collembola (1.42%), Odonata (7.09%), Diptera (4.26%), Hygrophila (1.42%), Spirobolida (21.99%), Megadrilacea (3.55%), pupa (0.71%) found into class Insecta (67.36%), Diplopoda (21.99%), Arachnida (7.09%), Oligochaeta (3.55%) and Gastropoda (1.42%). In addition, plant material from tree family Fabaceae (Tamarindus indica) (6.38%) were observed. These results suggest that frogs feed unselectively on a variety of ground insects, flies and litter dwelling forms. Other important food materials in small proportions include diplopods, oligochaeta, gastropoda and the arachnids. The intake of plant leaves was perhaps due to chance during feeding. The millipedes formed larger part of diet in pond C, ants and wasp formed the larger portion of diet from pond A and B and appeared to undergo little digestion, but their exoskeleton was recovered intact in rectum. Whereas in snail, grasshopper and beetles only head capsule and shells remained in rectum, the rest was completely digested. Soft bodied animals also occurred in large numbers in stomach and were completely digested. This finding suggests that Anuran frogs are generalist feeder and feed opportunistically on different diet breadth.

USING CAMERA TRAPS TO INFER THE NUMBERS AND HABITS OF CROP-RAIDING ELEPHANTS IN UDZUNGWA MOUNTAINS NATIONAL PARK, TANZANIA

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Crop-raiding is a primary cause of human-elephant conflict (HEC), and mitigation methods can be informed by a better understanding of the biological drivers of crop-raiding behaviour in elephants. We trialed camera traps as a tool for estimating numbers and demography of crop-raiding elephants along the eastern boundary of Udzungwa Mountains National Park, Tanzania. A total of 443 photographs were taken over 5314 trap nights between October 2010 and August 2014. This corresponded to 336 events, of which 37% (n=126) were suitable for individual identification. A minimum of 49 bulls were identified. Of these, 34 were one-off raiders (captured once on camera traps), and 15 were repeat raiders (2 or more captures) responsible for at least 26% of events. Of these repeat raiders, seven were captured 2-3 times, and seven were captured 4-7 times. One individual (tuskless) was captured 34 times over 4 years, and was responsible for a minimum 10% of events. Among repeat raiders, 25-40 year olds made up the greatest proportion of identifiable events (53%). Time between successive captures of repeat raiders was variable (range 0-681 days, median 13.5 days), but 24% of re-captures occurred on two consecutive days, and 43% of re-captures occurred within 7 days. The majority of bulls were captured heading towards farms from 19:00-22:00, and returning to the National Park from 04:00-06:00. The demography of crop raiders shown here is similar to that found in Amboseli, Kenya, and suggests that crop raiding may be initiated when male elephants leave their mother-calf groups, and linked to increasing energetic demands associated with life history milestones. Similar to the results in Amboseli, we find evidence for a few repeat raiders and a large pool of occasional raiders that casts doubt on the effectiveness of mitigating HEC through Problem Animal Control.

THE UDZUNGWA RED COLOBUS (*Procolobus badius gordonorum*) IN HIGHLY MODIFIED HABITAT OF KALUNGA RUBBER PLANTATION, MOROGORO, TANZANIA

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Habitat destruction and degradation are among major challenges facing biodiversity conservation in Tanzania. Widespread conversion of forests to agricultural land in the Kilombero valley, Morogoro region has led to significant decline in the population of the endemic Udzungwa red colobus monkey. Beginning 2008, the Kalunga Forest Reserve was heavily cleared for rice farming forcing the few primates to move to the nearby Kalunga rubber plantation. This study examined the adaptability of the Udzungwa red colobus in the rubber plantation focusing on aspects of population and feeding behaviours. We used line transects and on-foot tracking to collect data on the abundance of the monkeys and their activity budget, respectively. Habitat quality was assessed using vegetation quadrat method. We found a decline in the number of Udzungwa red colobus and other primates in Kalunga rubber plantation and this is probably linked to the deteriorating habitat We also found that the Udzungwa red colobus mostly used ground patches in the plantation as opposed to foraging in tree canopies This indicates possible adaptation to optimise foraging. A monitoring plan was suggested to continue tracking Udzungwa red colobus in the plantation and to add ecotourism value in order to sustain the monkeys' conservation.

DIET COMPOSITION OF GOLDEN JACKAL, *CANIS AUREUS* IN THE NGORONGORO CRATER, NGORONGORO CONSERVATION AREA, TANZANIA

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The Ngorongoro crater is known for having the highest density of carnivores in the world. In the past, research has been focused on large carnivores such as lions and spotted hyenas. Medium sized carnivores such as jackals have received very little attention and the information on these carnivores is limited. Diet composition of golden jackal, C. aureus was studied in the Ngorongoro crater from July 2014 to May 2015 covering both dry and wet seasons using focal animal observation (direct method) and collection of faecal/scat samples from known individuals in the field (indirect method). In both seasons, insects (mostly dung beetles, family Scarabaeidae) formed the largest percentage of food items consumed (100% of scat samples analyzed). The frequency of occurrence of rodents was higher in dry season (58%) than in wet

season (28%), Mann Whitney U test, $p<0.05$). Additionally, 25% and 39% of scat samples contained plant materials of the family Cucurbitaceae in dry and wet seasons respectively. The animals also fed on carrion of large herbivores (mainly wildebeest and buffaloes). Seasonal variation in types of food was noted; in wet season, the jackals also consumed birds (Abdim's storks), medium sized mammals (Thomson's gazelle fawns) and in one incidence, three individuals were observed to hunt and feed on adult Thomson's gazelle. The results suggest that the golden jackal are omnivorous and opportunistic in their feeding. Dietary studies are very important in mammalian ecology given that food availability influences population size, social organization and interspecific relationships.

Key Words: Diet composition, golden jackal, dry season, Ngorongoro Crater, wet season.

DAY TWO: THURSDAY 3rd DECEMBER 2015

SUB-THEME: HUMAN – WLDLIFE INTERACTION

Key note paper. "Political Ecology of Wildlife Conservation":
Hussein Sosovele

SCALING UP OF CHILI BASED TECHNIQUES AND VALIDATION OF PHANTOM DRONES FOR MITIGATION OF CROP RAIDING ELEPHANTS IN TANZANIA (MICRET).

Julius D. Keyyu, Donald G. Mpanduji, Lucas T. Malugu, Alex F. Chang'a, Angela Mwakatobe, Nadia deSouza, Jonathan Konuche, Nathan Hahn, Sue Palminteri, Marc Goss, David Olson

Diminishing human-elephant conflicts is a key element of protecting elephants in Africa. Here we test the efficacy of small quadcopters (unmanned aerial vehicles [UAVs] or drones) as a mitigation tool for wildlife managers responding to incursions of wild elephants into farmlands and communities. We have found that wild elephants react quickly and decisively to the presence of small UAVs and that this makes moving them out of high conflict areas easier and safer for rangers, farmers, and elephants. We have trained 20 wildlife managers in the piloting, field tactics, maintenance, and repair of small UAVs to be used as part of their toolkit for responding to and diminishing human-elephant conflict (HEC). The daily use of UAVs by wildlife managers this past harvest season in northern Tanzania has provided evidence that the UAVs are highly effective at deterring elephants from crop raiding, are a useful tool within the standard operating procedures of the rangers, and are sufficiently tough to last several seasons. Presently, after a year of testing, there is no evidence of elephant habituation to the UAVs, and no evidence that the animals circle back to the fields the same night after being moved by the UAVs. Rangers have been trained in the use of aerial deployment of diffuse clouds of chilli powder for stubborn bulls that may eventually habituate to UAVs, although the use of chilli has not been needed up to this point. The rangers now only deploy the UAVs to move elephants, no longer having to get dangerously close, throw chili bombs, or chase them in vehicles. We are evaluating how best to scale-up the use of UAVs by wildlife managers in HEC hotspots throughout Tanzania.

Key Words: Human-Elephant Conflict (HEC), UAV, mitigation, crop raiding

IMPACTS OF TANZANIA'S WILDLIFE MANAGEMENT AREAS

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In many parts of the developing world, community-based conservation projects (CBC) shape the rules governing local people's ability to access, and benefit from, natural resources. Tanzania's Wildlife Management Areas (WMAs) are a prominent example. WMAs aim to promote wildlife conservation and benefit local communities through the creation of sustainable wildlife-based revenues. Since 2007 the WMA model has spread from the initial sixteen pilot sites and there are now 38 WMAs in various stages of development, due to cover some 64,000 km^2 and 7% of national land surface area, representing a major influence on local livelihoods and land use.
Here we report preliminary outcomes of a large scale, quasi-experimental impact evaluation carried out in six of the pilot WMAs and matched control areas spanning the northern rangelands to the southern miombo woodlands. We report on a nested data set collected across 42 villages with wealth data from ~13,500 households generated through participatory wealth ranking exercises at village level and livelihoods and income data from 1,920 households and 940 women spouses generated through structured interviews. On wealth, our findings suggest that there has been relatively little change in wealth ranking from 2007 to 2014, but that WMAs may have played a role in driving some change. Further, there seems to be a disparate pattern between the Northern WMAs where 2 out of 3 studied have been generating substantial revenues from tourism, where wealthier households and those in leadership positions appear to have benefitted from WMA membership, and the South where effects are less pronounced. Findings suggest that WMAs have the potential to intensify human-wildlife conflict (HWC) and restrict access to natural resources and land for farming and grazing. The women spouses survey indicates that WMAs generate differentiated impacts for women as opposed to men, and for wealthier as opposed to poorer women.

HUMAN WILDLIFE INTERACTION: IMPACTS TO CONSERVATION AND LIVELIHOOD AT SAADAN NATIONAL PARK

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The study was conducted at Saadani National Park with special focus on the impacts of wild animals to communities' livelihood, benefits accrued from this Park to the communities as well as the community's attitudes towards conservation given the increase of problem animals. Questionnaires, Focus group Discussions and physical observations were used to collect data in 100 households that were randomly selected in three study villages. Results revealed that over

85% of the local communities found to have negatively impacted by wild animals in both crops and livestock with little benefits accrues from wildlife conservation. Animals like warthogs, baboons, elephants were mentioned as the main crop raider in the area while lion was for livestock and some areas baboon was mentioned to have fed on chicken. The impacts were accelerated by the death of a villager from lion attack in October 2014, followed by kill of 50 goats in November 2014 at Saadan Village (not paid until the time of this study) which make them think that the lions were "trans located" purposely by TANAPA to evict them strategically. SANAPA was found to have negative consequences to the agro-pastoralists and community whose livelihoods depended on land that lack clear boundary until today. Communities had a feel that that eradication of the park could bring them peace that they had when the area was Game Reserve. The challenges such as low community involvement in pre and post establishment of the park, boundary conflicts, and untimely condolences were the reason of negative attitude. However, given the potential of this park to biodiversity and economy, community awareness should be raised on the difference between National park and Game reserve, fairly and timely condolences and were possible the government in collaboration with donors may adopt insurance scheme to reduce this burden of crop and livestock damages.
Key words: Human wildlife interaction, crop damage, livestock depredation, local community

THE LAST LINKAGE: A FORGOTTEN WILDLIFE MANAGEMENT AREA AND THE FINAL CONNECTION BETWEEN NORTHERN AND SOUTHERN TANZANIA

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Conservation science dictates that thelong-term viability of wildlife populations relies on maintaining connectivity between protected areas. In Tanzania, Wildlife Management Areas (WMAs) and Game Controlled Areas (GCAs) may act as linkages between National Parks (NPs) and Game Reserves (GRs). The Tanzanian Wildlife Research Institute (TAWIRI) identified Wami-Mbiki WMA as a potential corridor hub connecting Mikumi, Mkomazi and Saadani NPs and Selous GR. This WMA is the last remaining link between wildlife populations in northern and southern Tanzania. I used high-resolution satellite imagery and interviews in 65 villages to confirm the presence of corridors surrounding Wami-Mbiki and to determine which, if any, have been severed by land conversion. Four out of five potential corridors through Wami-Mbiki still remain open to wildlife movement, but both the satellite imagery analysis and interviews indicate that the corridor north from the WMA may be blocked by agriculture. Without formal protection, Tanzania risks losing the remaining four corridors to farms and charcoal production. I also conducted 31 walking transects in 2014 within the WMA to survey large mammal presence and relative abundance. This survey illustrates the bleak situation facing Wami-Mbiki. Livestock and pastoralists have invaded the WMA. Not surprisingly, observations of livestock outnumbered wild animals by a disparaging ratio of nearly 28 to 1. And while mammal diversity still remains high (26 species noted during this study), all species barring cape hare and baboon were encountered significantly less frequently than in a prior walking transect survey conducted by TAWIRI in 2009. However, it is not too late to protect this irreplaceable corridor hub and its

diverse cohort of large mammals. I present five major social and ecological reasons why this reserve should be upgraded to a higher form of protection.

Key words: Corridor, Land use change, Wambi

MAN-EATING BEHAVIOR MANIFESTATION AND CONSEQUENCES FOR LION, LEOPARD AND HYENA CONSERVATION IN TANZANIA.

Ikanda, D., and Kissui, B.

Large carnivores have the innate ability to prey on humans and throughout history demonstrate atypical predation behavior while attacking human repeatedly in time and space. Understanding predation behavior on humans as prey is often compounded with lack of empirical data; with the characteristic similarity and difference of the behavior among the key large carnivores largely going unnoticed. In Tanzania, African carnivore's lions, leopards and hyenas have systemically attacked people and thorough records maintained in the last 30 yrs. Though records indicate that attacks have been persistent in time, no assessment on the extent of predation on humans that has likely occurred in the course of attacks has been made. We examine empirical records of attacks by lions, leopards and hyenas on humans to show manifestations of man-eating behavior, analyze similarity and differences among the carnivores, and link the behavior with lethal control in order to highlight the implication for large carnivore conservation in Tanzania. Results indicate lions largely expressed full man-eating, leopards opportunistic man-eating and hyenas partial man-eating behaviors in the course of attacks in Tanzania. Mortality to lethal control is proportionate with full and opportunistic man-eating in the lion and leopard respectively, but highly disproportionate with partial man-eating in the hyena. As such, man-eating behavior carries substantial consequences for large carnivores in Tanzania through lethal control and seriously undermines conservation efforts at human-wildlife interfaces.

Key words: Man-eating, lion, leopard and hyena

THE HUMAN DIMENSION OF BLOCKAGE OF WILDLIFE CORRIDORS IN THE TARANGIRE-MANYARA ECOSYSTEM

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This paper dwells with the human-mediated destruction of wildlife corridors in the Tarangire-Manyara ecosystem in North-Eastern Tanzania from a social-economic perspective in a study that took place from October 2013-July 2014. A standard detailed questionnaire involving 112 respondents was used to contrast the 20 year (1984 and 2004) changes in livelihood conditions perceived by the local residents within three sample corridors. To supplement these data, physical blockage of wildlife corridors by human artifacts within the corridors were counted

through systematic aerial flights, and agricultural expansion through analysis of contrasting satellite imageries. Major shifts in human factors that promotes blockage of corridors were found in particular: high immigration into the area, a radical change from pastoralism to both agriculture and pastoralism as a major livelihood means and a stabilizing land tenure system. Remote sensing data re-confirmed expansion of agriculture by a larger margin. Human artifacts such as iron roofed houses were common-place, especially in Mswakini corridor. Overall, 87.4% of respondents admitted major livelihood changes to have taken place within the ecosystem, and indicated that deteriorating climate conditions were leading to increasingly frequent famine conditions. The provision of social services in the corridors has also stabilized over the contrasted years apparently spearheaded by the government initiatives. Given these findings, options to safeguard the last wildlife corridors movements are proposed.

Key words: Human dimension, blockage, wildlife corridors, Tarangire-Manyara ecosystem

EFFECTS OF POACHING ON ELEPHANT DEMOGRAPHY, BEHAVIOUR AND TUSKLESSNESS IN RUAHA-RUNGWA

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Southern Tanzania is the most important area for elephants in East Africa, but is also where they have been hardest hit by poaching for ivory over the last decade. Recognizing the need to better understand and protect the region's key elephant populations, we have begun a long-term elephant monitoring program in Ruaha National Park to understand the demography, ecology and behaviour of elephants in the Ruaha-Rungwa ecosystem, and to document how these are being affected by poaching. We collected demographic, behavioral and distribution data using a combination of vehicle-based transects, aerial transects, camera-trapping, and opportunistic demographic sampling. Each month we are expanding an ID database of individually identified elephants, which currently comprises 108 cow-calf groups and over 150 bulls, amounting to about 900 individuals. This ID database is used to document re-sightings of known elephants, and lays the groundwork for research into elephant home ranges, habitat use, seasonal movements, social behaviour, and the behavioural and ecological implications of tusklessness. In Rungwa, Kizigo and Muhezi Game Reserves, direct observations are extremely difficult, and dung surveys instead offer the best chance of trend assessment. Analysis of the current demography and behaviour of the Ruaha elephant population is ongoing, based on our ID database of known individuals. To establish up-to-date changes and trends, we will compare 2015 demographic (including tusklessness) and behavioural (particularly flight distance as indicator of stress) parameters from Ruaha plus results of a 2015 dung survey in Rungwa-Kizigo-Muhezi Game Reserves, with the results of demographic assessments undertaken in 2009 and 2013. We also present preliminary data on seasonal elephant movements and distribution, and their relation to poaching activity as well as water availability and other ecological factors.

Finally, we discuss how these results and the monitoring program can make a meaningful contribution to long-term protection of this critical elephant population.

Key words: Elephant, Poaching, Demography, Tusklessness elephant, Ruaha-Rungwa

ASSESSMENT OF LIVESTOCK LOSS DUE TO SPOTTED HYENA (*CROCUTA CROCUTA*) IN SELECTED VILLAGES OF RORYA DISTRICT, TANZANIA

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This study was conducted to assess the loss of livestock due to depredation by spotted hyena in three villages, Chereche, Kowak and Omuga surrounding the Rorya hills in Rorya District, Tanzania. The study involved 194 respondents from the three selected villages. The tools for data collection were standardised questionnaires and interviews conducted in households that claimed to be affected by hyenas. Information gathered was stored in an electronic data base and data were analysed using descriptive statistics and non-parametric tests in the Statistic Packages for Social Sciences (SPSS). Results suggested that contrary to our expectation, livestock depredation was similar among the surveyed villages along a distance gradient leading away from Rorya hills for all livestock species with exception of cows. Diseases were found to be the major cause of loss compared to depredation in cows while for goats and sheep depredation caused more losses. The majority of farmers in the study area did not have either predator proof bomas or defined places for household waste disposal. Moreover, the results from the current study revealed that a relatively low number of people practise bushmeat hunting in the surveyed villages, probably due to low densities of bushmeat species in surrounding areas. To minimize the level of depredation farmers should be encouraged to build predator proof bomas, disposal of household waste should be improved as this attracts spotted hyenas to forage in villages thereby increasing the chance that livestock will be taken and bushmeat hunting minimised to increase wild ungulate prey for wild carnivores. Lastly, improvement of veterinary services could assist farmers to manage diseases thereby improving the availability of meat and income in villages by curtailing the substantial loss of livestock due to diseases.

Key words: livestock loss, spotted hyena, Rorya District

KNOWLEDGE AND ATTITUDES OF COMMUNITIES ON SMALL MAMMALIAN CARNIVORES IN MBOMIPA WILDLIFE MANAGEMENT AREA, IRINGA, TANZANIA

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The term Wildlife Management Area (WMA) refers to an area set aside by village governments and gazetted by the Government for the purpose of conserving natural resources, improving the life standard of communities and alleviating poverty across rural areas in Tanzania. With an area of 771 km^2, MBOMIPA is among the three WMA's bordering Ruaha National Park in Iringa region with large number of animals. However, little has been documented on small mammalian carnivores (SMC) in the area. This study was therefore designed to assess communities' knowledge and attitudes on trends and threats of SMC in the area. Structured questionnaires were used for collecting information from village game scouts, local tourist hunters (campsite attendants, hunters guide, drivers and tour guides). Eleven SMC species were reported in the current study, viz. Black backed jackal, Aardwolf, Bat eared Fox, Zorilla, Cape clawless otter, Striped weasel, African civet, Wild cat, Caracal, Honey badger, and Banded mongoose. Eighteen respondents reported an increase of SMC despite presence of many threats against their survival. Competition (20.8%) and fire (16.5%) were reported to be the leading factors threatening the SMC in the area. Information gathered from this study was considered important for wildlife managers when implementing conservation activities and future research on SMC.

Keywords: Attitudes, carnivores, conservation, community, knowledge

ENHANCING TOURIST OPPORTUNITIES TO VIEW SPOTTED-NECKED OTTERS (*LUTRA MACULICOLLIS*) AT RUBONDO ISLAND NATIONAL PARK: CAN THE *APRIORI* LOCATION OF LATRINES SIMPLIFY IDENTIFYING BEST VIEWING AREAS?

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We observed spotted-necked otters (*Lutra maculicollis*) along a 5.17 km section of shoreline at Rubondo Island National Park, Tanzania, during May 2008 and February, June–August 2009 to determine if their activity areas were associated with latrines sites (places along the shoreline where spotted-necked otters scent-mark by depositing scats and urine) as part of an assessment to determine how tourists or researchers can best view the species. For this assessment, we compared the distance of spotted-necked otters sightings associated with the shoreline (n = 207) to the distance between an equal number of GIS-generated random points to the nearest latrine for each of the respective points. The mean distances for locations of spotted-necked otter sightings to the nearest latrine differed from the mean distance of random points to latrines (171.94 [SE = 11.30] and 66.13 [SE = 8.16], respectively; t = -9.23, df = 412, $P < 0.001$). Sightings also were much (2.6 times) closer to latrines that occurred in groups than those that were isolated (single). Establishing viewing sites at or near latrines (particularly those occurring in clusters) would thus seem an effective way to maximize opportunities to see spotted-necked otters.

Key words: ecotourism, flagship species, latrines, *Lutra maculicollis,* Rubondo Island National Park, spotted- necked otter, Tanzania, wildlife viewing

TANZANIA AND THE NATURAL WORLD HERITAGE DESIGNATION: DOES IT MATTER?

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Tanzania ratified the UNESCO's 1972 Convention Concerning the Preservation of Cultural and Natural World Heritage sites in 1977. Currently, there are 1007 sites from 161 State Parties inscribed on the world heritage list worldwide including seven sites from Tanzania. Five other Tanzanian sites are on the tentative list for possible inscription in future. From a natural resources governance perspective, this is a step in the right direction. However, it is important to have an in-depth grasp of the implications of this designation for the country as a whole and for the inscribed sites in particular. This paper explores the world-iconic and prestigious word

heritage designation for the natural sites in Tanzania from both a local and global perspective. The inherent complexities, and the benefits and challenges related to such inscriptions are explored in detail so as to feedback on the current Tanzania's conservation policies and practices.

Key words: Tanzania, Natural world Heritage, Designation, Policy

REVERSING THE TREND OF WILDLIFE CRIME IN TANZANIA: CHALLENGES AND OPPORTUNITIES

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Marked with negative consequences on ecological, economic, political and security aspects, wildlife crime has remained a sad reality in Tanzania. This scenario provides sufficient rationale for reconsidering and intensifying efforts to combat the problem. However, these efforts are compromised by a number of challenges, though opportunities for success exist. This paper presents some of these challenges and opportunities for reversing the trend of wildlife crime in Tanzania. The paper starts with a brief review of the ecological, economic and security implications of wildlife crime followed by an overview of wildlife resources, status and trend of this crime in Tanzania. In conclusion, the paper underscores the gravity of the problem and its implications and offers some recommendations for improving the situation.

Key words: Wildlife crime, poaching, challenges, opportunities, Tanzania.

THE IMPACT OF OVER-SPEEDING ON VERTEBRATES' ROAD KILL IN THE SERENGETI ECOSYSTEM, TANZANIA

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Information on road kills in protected areas is more available in developed countries. Despite of its important in world conservation significance, information on road kill is scanty in the Serengeti Ecosystem. Road kill survey on terrestrial vertebrates for the wet-low tourists season in the Serengeti Ecosystem was conducted between March and April 2015 covering a total transect length of 720km. Direct observation method was employed to detect live animals, killed or injured found on the road transect including mammals, avifauna, amphibians and reptiles. The

results revealed a total of 19 road kills, from 16 species. On average the road kill rate was 0.0132 individuals / km / day, equivalent to one killed vertebrate per 40km per day. More mammals were found killed in the area than birds. Road kills were more sighted on the Fort-Ikoma and Naabi One (1) transects compared to others. These transects are on open and wooded grassland with good terrain and visibility suggesting that over-speeding and traffic volume were probably the main predisposing factors. More fresh carcasses were observed during the morning session suggesting that more road kills occur in late evening, at night and early in the morning. More adult animals were killed in the area, out of those, males were more than females. This study recommends for strengthening of fines, vehicle speed limit check points and installation of speed limit devices (e.g. solar powered cameras). Therefore, to further the study, it calls for more funds and collaboration from donors.

LOCAL PEOPLE KNOWLEDGE AND PERCEPTION TOWARDS AFRICAN WILD DOGS (*LYCAON PICTUS*) RELEASE IN THE WESTERN PART OF THE SERENGETI ECOSYSTEM, TANZANIA

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The Serengeti ecosystem (SE) harbours unique diversity of wildlife and is famous for its migratory ungulates and associated mammalian carnivores. Thus the area attracts many tourists from different parts of the world for game viewing. This study assessed the knowledge and perception of local people towards African wild dogs released in the Western part of the SE. A randomised face to face interview was employed using semi-structured questionnaire to acquire information on wild dogs' conservation from respondents in six selected villages. Our results revealed that more males than females identified correctly wild dogs from different carnivore photos IDs. In addition, many livestock keepers recognized wild dogs as a bad animal due to the past experience on their livestock depredation. Education level was the main factor contributing to the respondent's knowledge of identifying wild dogs. Furthermore, educated respondents reported that retaliatory killing was the main cause for wild dogs' population decline. Generally, more males than females expressed negative attitudes towards wild dogs' presence in their area. Therefore, this study recommends that the information obtained should be included in the management and conservation plans of the species in the area.

Keywords: Wild dog knowledge

USE OF OSTRICH (*STRUTHIO CAMELUS*) PRODUCTS: EXPLORING THE POTENTIAL OF IMPROVING RURAL LIVELIHOOD

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Ostrich (*Struthio camelus*) products have been used since time immemorial. In the recent years the number of slaughter ostriches has been increasing around the world. Over the last decade there was a growing interest in ostrich farming. The objective of this study was to determine the use of ostrich products by local people adjacent the Serengeti National Park and Ngorongoro Conservation Area (NCA) in northern Tanzania. Comparison in terms of utilisation was made between tribes with long hunting traditions (e.g. Ikoma and Kurya) on the western side of the national park with the largely pastoral Maasai living on the eastern side. A total of 115 respondents were interviewed through questionnaires in June-July 2006. Respondents in the western Serengeti (202%) admitted that ostriches were hunted illegally for meat, eggs and feathers, whereas villagers in NCA (193%) only collected eggs and feathers. The products were mainly for subsistence, ornamental, medicinal and economic purposes. Ostrich products were sold to the villagers themselves and sometimes to the tourist hotels. The ostrich products fetched reasonable prices for which if the market is legally established it could improve the livelihood of the local people. Awareness and education programmes on ostrich farming are recommended to the villagers residing adjacent protected areas and other Tanzanians in general.

Key words: Ostrich Products

SPOTTED-NECKED OTTERS AND RUBONDO ISLAND NATIONAL PARK, TANZANIA: THE PROCESS OF DEVELOPING AN ECOTOURISM FLAGSHIP

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To most North Americans and Europeans otters are highly esteemed for intelligence, playfulness, and attractiveness. In fact, otters are regarded by many conservationists from these regions as key indicators of the health of aquatic and wetland ecosystems. Additionally, the playful behavior and appearance of otters make them particularly appealing to many people with a recreational interest in viewing wildlife. Consequently, in addition to their potential value as 'bio-indicators' in aquatic environments, otters also possess characteristics that make them excellent candidates for use in promoting wildlife tourism in landscapes dominated by aquatic environments. Unfortunately, otters have received little conservation and research attention in most areas of the world outside of North America and Europe - especially in Africa. During 2007-2008 we conducted human dimensions and ecological studies at Rubondo Island

National Park to evaluate the potential of spotted-necked otters (*Lutra maculicollis*) inhabiting the Island to serve as flagships for promoting tourism to the area. Human dimension studies focused on assessing attitudes and knowledge of local people about otters, the interest of tour operators in taking clients to Rubondo to view otters, and the interest of tourists in visiting Rubondo for otter-viewing opportunities. Ecological studies focused on assessing where, when, and how to best view otters at Rubondo by assessing habitat preferences, activity patterns, and behavioral responses to the presence of people. Generally, the otter was not well known among various stakeholders, indicating a need to implement education programs at all levels (from residents living near the Park to international tourists). However, otters were easily viewed and closely associated and created latrines (marking areas) near specific shoreline features (e.g., forested areas with large rocks). Opportunities to view otters were twice as likely near latrines than at random shoreline sites. We discuss these and outcomes of the investigations, how these outcomes can be integrated and applied by the Park for promoting otter-based tourism, and both challenges and opportunities for using the otter as a tourism flagship.

Key words: Ecotourism; *Lutra maculicollis*; Rubondo Island National Park; spotted-necked otter.

PREDICTING FACTORS CONTRIBUTING TO CROP RAIDS BY ELEPHANTS IN AMBOSELI ECOSYSTEM, KENYA

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Amboseli ecosystem host about 1400 elephants most of which roam outside the national park. Elephant conservation faces pressure due to human population growth and changes in land use. Rainfall patterns in the ecosystem do not support farming. Most of the farming is done in the wetland areas under irrigation. This scenario has led to increasing crop raids by elephants which threatens local community economic status as well as elephant populations through retaliatory attacks. This study used crop raiding data, geographical information system and remote sensing to identify features contributing to crop raid occurrences by elephant. Binary logistic regression model was developed using crop raids by elephants collected by scouts between January 2013 and April 2015. Only georeferenced data were used. A convex hull for presence data was created and an area within it was excluded when generating absence data. The absence data was randomly distributed two kilometers outside the convex hull but within the six targeted Amboseli group ranches. Qualitative feature shape files were converted to distance data. Results showed that crop raiding was determined by water surface points, distribution of settlements, soils types, electric fences and distance to national parks, wildlife management areas, forest reserve, game controlled areas and woodlands. Receiver operating curve (ROC) plots confirmed that the models fitted well with the data (AUC>0.9). Sustainable mitigation of crop raids by elephants can be achieved via long-term strategies that include proper land use planning where all stakeholders are fully involved. Also local communities should be supported and or encouraged to engage in alternative livelihoods which include ecotourism activities, which are conservation friendly.

Key words: Amboseli, Elephant, crop raiding

THE EFFECT OF QUARRY MINING ON THE DIVERSITY OF INVERTEBRATES IN PERI-URBAN, DAR ES SALAAM.

Upendo Richard

The present paper pertains to address the effect of mining activities on the diversity of invertebrates in the mining site of Kitonga. Kitonga is in Temeke Municipal, 28km from Dar es Salaam city centre. The site was divided into two areas; the mined area and the adjacent unmanned areas. In each of the two areas, three sampling plots were established, in which collection of invertebrates was carried out using three methods: pitfall traps, timed hand collection and sweep nets. A total of 2,288 specimens comprising 197 species were captured. Of these 1,520 specimens where collected on mined area and 768 on unmined area. The most abundant species include *P. tarsata*, *Trigonopus sp*, *C. solenopsis*, *C. marshalli*, *P. caffra*, *L.rostratus*, *B. anvarata, A. eponina*, *Anoplolepsis sp*. and *Anostostomidae sp.* The difference in abundance was significant with mined area having higher abundance than unmined area. However the higher abundance of invertebrates in mined area than unmined area was highly contributed by one species, *Camponotus solenopsis* with abundance of 1,101 in the mined area. Omitting *C. solenopsis,* unmined area had higher abundance than the mined area. Species richness on the unmined area was higher than the mined area and the diversity between mined and unmined areas did not scientifically differ. It was concluded that the mining activities had negative effect on invertebrate's diversity. Given recommendations on the actions to be taken include; all mining activities should adhere to country laws and regulations for environmental protection and conservation, also the need to improve taxonomic infrastructures which will help in identifying species to lower level and to know conservation status of the species. Study also recommends the use of invertebrates as biodiversity monitoring.

Key words: Diversity, Invertebrates, Peri-urban Quarry mining

INFLUENCE OF HUMAN-INDUCED HABITAT ON AVIFAUNA DIVERSITY AND ABUNDANCE AROUND LAKE JIPE WETLANDS

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The study of birds responded to the environmental factors will contribute to the understanding of habitat selection and biodiversity conservation. Lake Jipe is among the important site for migratory birds. The survey covers village around the wetland which was Jipe, Kambi ya Simba and Butu village. The aim of the study were: (1) to compare avifauna diversity and abundance in areas agriculture, settlement and grazing area around Lake Jipe; (2) to trace changes in avifauna diversity across land uses overtime from 2008 to 2015. Line transect method was used where nine permanent transects, each 900 m long were established in each habitat. For the 2015 survey 755 individual birds were observed in 63 families. These results differ from the 2008 survey where 414 individual birds were observed in 52 families. Analysis of variance for diversity and abundance revealed a significant difference between the different sub-habitats $F(2,272) = 7.17$, p

= 0.0005. The result shows significantly higher abundance of avifauna in grazing areas and lowest in agricultural areas but higher diversity in agriculture than grazing area. The study recorded expansion of settlements, agriculture and livestock grazing as the main human-induced threats to the survival of birds in and around Lake Jipe.

Keywords: Abundance, avifauna, diversity Lake Jipe, wetland

EXAMINATION OF TYPOLOGIES OF HUMAN – WILDLIFE INTERACTION IN THE GRASSROOTS' GOVERNANCE OF WILDLIFE RESOURCES IN TANZANIA

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The main aim of this article is to provide an in depth examination on the typologies of human – wildlife interaction that are in existence in Tanzania. It is the interaction that dwells at the grassroots' governance and management of wildlife resources within local government authorities. The test for the participative typology is questioned by the centrally based administration and institutions in favour of the strengthened non decentralized and non devolved structures that ignore the primary beneficiaries that exist at the grassroots namely the villages, communities and respective local government authorities. The two typologies produce different reactions by the people. This article examines the inherent human – wildlife management models in the local governance of wildlife resources in Tanzania. It is in favour of the devolved system of human – wildlife interaction. It is the system or the model which seems to dissipate in terms of policies, laws and wildlife management practices.

Key words: Governance, Wildlife management areas.

POACHING MORTALITY, TROPHY HARVEST MORTALITY AND SPATIAL DISPLACEMENT AND THE DECLINE IN ELEPHANT *LOXIDONTA AFRICANA* POPULATION OF THE EASTERN SELOUS GAME RESERVE, TANZANIA.

Ikanda, D.K., Kyando, M. and Mtoka, S.

African elephants are in continuous decline throughout their eastern and central African geographical range. Exploitation by Illegal killings for ivory, trophy harvests together with spatial displacement resulting from the landscape of fear are the known causes for the decline. In eastern Selous Game Reserve, elephant numbers have plummeted in the course of the last five years and all of the above parameters are integral to the population's decline. Although poaching mortality has likely impacted the population heavily, empirical data on retrieved elephant skulls and tusks assessments can show the actual magnitude and possible additive effects of harvest

mortality and spatial displacement in the overall decline. We use field data to reconstruct the population's historical abundance, make meaningful inferences on mortality patterns due to natural, harvest and poaching and evaluate the magnitude of decline that is due to poaching mortality and spatial displacement. Elephant field count data for 1960-90s was reviewed and abundance estimates made in order to obtain the historical population level. Skulls and tusks from recent poaching incidences and trophy harvests were examined and measurements on length and height of various parameters used to infer the age-sex of killed elephants. Inferences of age-sex measurements we used to construct patterns of exploitive mortality and evaluate the magnitude of decline that is specifically due to poaching mortality. Historical population records indicate a substantial overall decline in elephant numbers, where poaching mortality is overall significant, with males suffering most at juvenile ages where as females at sub adulthood and trophy harvest has a significant additive effect on adult male mortality. Patterns of poaching and harvest mortality indicate significant segment of the population to have survived recent poaching, but are likely displaced adjacently or distantly from the Selous ecosystem in attribute to fear. Reducing the landscape of fear by controlling poaching and continued regulation of trophy harvests offers the best management option for the recovery of the elephant population in eastern Selous Game Reserve.

LIVESTOCK-WILDLIFE CONFLICT IN WEST KILIMANJARO, TANZANIA: STATUS AND ECONOMIC VALUE.

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Livestock-wildlife conflict is a common phenomenon in areas where humans, livestock and wildlife share the same landscape and compete for limited space and resources. These conflicts lead to loss for one or both parties. Few studies however, have attempted to calculate the economic value of these losses. We use both qualitative and quantitative methods to assess the status and economic value of these losses in Enduimet Wildlife Management Area in West Kilimanjaro, Tanzania for the period of five years. The findings revealed that four mammal carnivore species spearheaded the livestock-wildlife conflict, resulting to cost either way. While pastoralists experienced direct loss of their livestock through depredation by large carnivores, wildlife sector equally suffer direct cost from retaliatory killings of the carnivores as result of negative attitude towards conservation borne by the pastoralists. Apparently, the loss of livestock to predators represented an estimated cost of around USD 139, 974 for the past five years, whereas the cost of wildlife killed by local communities in retaliation amounted to USD 105,403 in the same period. On the other hand, the hidden costs of the conflict include social unrest among local community members, loss of time used in care and treatment of the casualties, waste of time spent hunting predators and risk of zoonotic diseases such as rabies and brucellosis

from wildlife. Overall, the direct and indirect cost of the conflict is enormous suggesting the urgency with which to address the issue in the region. Raising conservation awareness and use of effective preventive measures such as predator-proof fences around livestock penal together with consolation payment and benefit sharing may help in managing the livestock-wildlife conflict in the area.

Key words: Carnivores; economic valuation; livestock depredation; wildlife-human conflict; Enduimet Wildlife Management Area

DOES SEASONAL VARIATION AFFECT TROPICAL FOREST MAMMALS' OCCUPANCY AND DETECTABILITY BY CAMERA TRAPS? CASE STUDY FROM THE UDZUNGWA MOUNTAINS, TANZANIA

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The increasing use of camera trapping coupled to occupancy analysis to study terrestrial mammals has opened the way to inferential studies that besides estimating the probability of presence explicitly consider detectability. This in turn allows considering factors that can potentially confound the estimation of occupancy and detection probability, including seasonal variations. To address this, we conducted a systematic camera trapping survey in the Udzungwa Mountains of Tanzania by deploying 20 camera traps for 30 days in dry and wet seasons, and used dynamic occupancy modelling to determine the effect of season on estimated occupancy and detectability for species with > 10 capture events. The sampling yielded 7,657 and 6,015 images in dry and wet seasons, respectively, belonging to 21 mammal species. Models with no season-dependency and with season-dependent detectability were best supported, indicating that neither colonization nor extinction varied with seasons, and that occupancy too did not vary. Only bush pig (*Potamochoerus larvatus*) showed a significant decrease in detectability from dry to wet seasons. Our study indicates that seasonal variation may have limited effect on occupancy and detectability of resident mammals in tropical forests, however it remains a factor to consider when designing camera trapping studies.

MODELLING PAST, PRESENT AND FUTURE ECOSYSTEM, CLIMATE AND HUMAN INTERACTIONS IN EAST AFRICA SAVANNAHS.

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Savannahs are tropical and subtropical biomes characterized by varying proportions of woody plants and grasses. In East Africa, they are home to humans and they support large biomass of livestock and wildlife. They also provide numerous ecosystem services to a wide range of people and biodiversity. Savannahs in East Africa have been modified greatly by human activities and are further shaped by rainfall, fire, nutrients and herbivores. Since they occupy more than 60% of the land surface in East Africa, it is important to understand the transient changes in their interactions with human activities and climate. This paper assess the spatial and temporal changes in the interactions between savannah ecosystems, climate and societies using a dynamic global vegetation model, an agent based model and a grazing model. It looks into the interactions between ecosystems, climate and society that happened in the past and that is currently happening and uses these interactions to inform future predictions. Specifically, the paper assesses the changes in grazing and sedentarization in relation to climate change and human activities. The response of vegetation structure and distribution to climate change, land use change and socio-economic development are also assessed and projected into the future. Pollen, field and remote sensed data were used to calibrate and validate the output from the model. This paper unveils the impacts of grazing and sedentarization on vegetation structure and distribution of East African savannahs. Further, it produces predictive scenarios for forecasting future environmental, climatic and socio-economic changes. Ultimately, this paper unveils the resilience of East African savannahs across time and space in relation to the main drivers of vegetation structure and composition

ILLEGAL ACTIVITIES CONTRIBUTE TO SIGNIFICANT BIODIVERSITY DECLINE IN PROTECTED AREAS ACROSS THE GLOBE: A REVIEW

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Illegal activities are a persistent problem in protected areas across the globe. How big the problem is and its impact on broader spatial and temporal scales is unclear. We review the last 35 years of research on the impact of illegal harvesting on population decline. From 93 papers reporting 1048 species/site combinations, more than 350 species comprising mammals, reptiles, birds, fishes and molluscs were reportedly extracted illegally from 146 protected areas across four continents. The majority of research was based in Africa and was carried out in strictly

protected areas. Population declines of >75 % were most frequent where there was commercial poaching as opposed to subsistence hunting alone, in countries with a low human development index and for species with a large body mass over 100 kg. In addition, at least 80% of species decline was more likely to occur in countries experiencing high habitat loss and in the least enforced protected areas particularly in Asia and Africa. Overall, we found strong evidence that large mammal species had a high probability of experiencing declines in protected areas faced with threats of illegal activities. Given the mounting pressures of illegal activities, additional conservation effort is required to stop the activities and to improve biodiversity conservation within existing protected areas.

Keywords: human development index, illegal harvest, land use change index, poaching, population decline, protected areas

SUB-THEME WATER RESOURCES AND WETLAND CONSERVATION

CATCHMENT VALUES OF LOLIONDO GAME CONTROLLED AREA: IMPLICATIONS FOR THE CONSERVATION OF SERENGETI NATIONAL PARK

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The water catchment values of the Loliondo Game Controlled Area (LGCA) for Serengeti National Park in Northern Tanzania were evaluated using multiple approaches in February 2015 with a view toward the long-term conservation of the larger Serengeti Ecosystem. The focus was on extent and intactness of natural catchment forests. Remote sensing analysis was applied to determine the extent of water catchment as well as changes in catchment forest cover for the years 2001-2013. Targeted ground and aerial surveys were conducted to ground-truth the catchment forest conditions. Data on key human socio-economic parameters were also gathered to assess the current and likely future human livelihood and land-use trends. Key stakeholder consultations were also undertaken to supplement empirical information thus gathered. LGCA was confirmed a major water catchment for the Grumeti River-the most dominant that drains 47.8% of the Parks area. Although overall the catchment values in LCGA appear relatively undisturbed, they are clearly threatened by rapid agricultural expansion as well as overgrazing. Options for a better management of LGCA are discussed in view of the socio-political and livelihood tensions prevailing in the area.

CAN WATER RESOURCES LEAD TO PRO-POOR GROWTH?: A COMPARATIVE STUDY ON LAKE VICTORIA AND LAKE TANGANYIKA FISHERIES IN TANZANIA

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Fish resources have direct link to fishers' incomes. However, majority of fishers in developing countries who are involved in fishing and related activities have remained poor. This study, using Participatory Rural Appraisal (PRA) methodology has assessed the extent to which fisheries in Lake Tanganyika and Lake Victoria is for Pro-poor growth by focusing on the distribution of incomes between fishers and fishing gear owners. With respect to Lake Tanganyika fisheries, the net monthly income accruing to fishers and fishing gear owners during high catch season (October-March) was relatively higher compared to the net monthly income accruing to Lake Victoria fishers and fishing gear owners during high catch season (May-November). With Lake Tanganyika fisheries, fishing gear owners took the lion's share of the net income that was generated, but still fishers also netted relatively higher incomes during high catch season. A fisher who earned the highest monthly income netted $ 3,400 while one with lowest netted $ 600. The majority of fishers (17 fishers out of 35 fishers) each netted between $ 1875 and $ 3750. With respect to fishing gear owners, the highest monthly income earner netted $ 13,750 while the lowest income earner netted $ 1500. However, net monthly income earned by both fishers and gear owners during low catch season (April-September) were low. With respect to Lake Victoria fisheries, the majority of fishers (35 fishers out of 53 fishers), each generated net monthly income that ranged between US$ 161-480 during high catch season. And during low catch season (December-April), out of 53 fishers, 46 fishers each generated net monthly income of US$ 40. Fishing gear owners were relatively far better in both seasons.

Key words: Water resources, Pro-poor growth, Lake Victoria, Lake Tanganyika

ASSESSMENT OF SURFACE WATER QUALITY ALONG THE LOLIONDO GAME CONTROLLED AREA SEGMENT OF THE PROPOSED HIGHWAY THROUGH SERENGETI NATIONAL PARK, TANZANIA

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Water quality assessment was carried on several rivers and streams along the proposed Serengeti-Mto wa Mbu tarmac highway from Digodigo village to Klien's Gate, between December 2012 and May 2013 during the dry and wet seasons. Water samples were collected using a standard vertical water sampler by dipping it, just below the surface at the center of the river. The physico-chemical analysis of water was carried out following standard methods mainly TZS 574:2002 method of test, for the quality of drinking water. The physico-chemical parameters determined were flow rate, turbidity, pH, alkalinity, temperature, conductivity, total dissolved solids (TDS), hardness, nitrate, fluoride and chloride levels as well as several heavy metals. The results indicated that the waters from the natural surface sources were normal, safe and acceptable for human and animal use. However, the waters need to be treated before use, particularly for humans, in order to improve water clarity.

THE ROLE OF USANGU WETLANDS IN BIODIVERSITY, ECOSYSTEM SERVICES AND SOCIO-ECONOMICAL DEVELOPMENT OF THE PEOPLE IN TANZANIA

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The development of water resources in the local semi-arid region of Tanzania is the most multifaceted issue due to the intricate relationship among several actors in the very fertile and highly productive ecosystems like the Usangu basin including poor people, small-scale farmers, pastoralists and large scale investors. The wetlands ecosystems are highly sensitive to changes in water levels, variations in climatic variables that influence wetlands hydrology. The net outcome is the unprecedented negative impacts on the social, ecological and economic values associated with wetlands since they provide vital tangible and intangible ecosystem goods and services for human livelihood. These ecosystems are rapidly degraded and even destroyed from land use changes including irrigation projects. The Usangu wetland in particular has been facing serious

management challenges for over two decades till to date. This has caused the drying up of the Great Ruaha River that flows through Ruaha National Park since 1993. The cease flow period in the recent years has reached 4-5 months in the National Park. The peak water level in 2013 as measured by automated HOBO data loggers was only 0.27 m, which is the smallest value since 2008; the peak was 1.3 m in 2009 and 2010, and the smallest value was 0.6 m in 2011. Thus the peak water level in 2013 was only 45% the value in 2011. The Great Ruaha River drying up has severely impacted the Parks biodiversity and Hydropower production in Mtera and Kidatu hydro-power plants the trend that has caused power rationing and increased production and supply costs from alternative sources of energy. This is mainly due to the lack of water governance upstream of Usangu wetlands and ever increasing unplanned irrigation schemes from 50000ha in 1990s to approximately 130000ha to date. The assessment of water quality in Usangu basin has revealed that it is a very powerful filter of water pollutants. In order to address these challenges political will, proper planning of irrigation projects in Usangu basin coupled with increased water use efficiency and comprehensive sectoral linkages are essential steps while options for augmenting dry season water supply to wild animals in Ruaha National Park is recommended.

Key Words: Wetlands, Usangu, Ruaha National Park, Great Ruaha River, Irrigation.

SUB-THEME: CLIMATE CHANGE AND ECOSYSTEM DYNAMICS (IMPACTS, MITIGATION AND ADAPTATIONS).

KILIMANJARO UNDER GLOBAL CHANGE

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Changing weather conditions, large-scale habitat conversion, agricultural intensification and rapid human population growth have reached a critical stage at Kilimanjaro. Decreasing precipitation is the main driver for increasing forest fires in combination with illegal logging activities affecting e.g. fog water collecting capacity and with this, the water balance of the whole mountain. This endangers its function as water tower for northern Tanzania, on which nearly 10 million people depend on. The Amboseli National Park on Kilimanjaro's northern foothills has experienced sweeping climate and habitat changes. This has caused an increasing migration of elephants from the Amboseli ecosystem into the forests of Kilimanjaro with negative consequences for forest cover. In contrast to the alpine flora, which migrates downslope due to climate change impacts on Kilimanjaro, savanna grasshoppers are spreading from lower elevations to the submontane, montane and even afroalpine zone due anthropogenic opening of the closed forest and a warmer microclimate. Natural savanna vegetation is increasingly converted into cultivated fields. As a result Kilimanjaro is becoming an island surrounded nearly entirely by cultivation. In the past, a corridor of sub-montane forest vegetation linking Kilimanjaro with Mount Meru facilitated the dispersal of forest animals. Today such movement

has been curtailed. Kilimanjaro's ecosystems will be subject to significant further climate changes, enhancing the above threats. However, this direct impact of land use change and intensification on biodiversity, ecosystem functioning and livelihood can be assumed to be even stronger than future effects of climate change.

IMPACT OF CLIMATE CHANGE AND LAND USE ON LOCAL BUTTERFLY POLLINATORS: A CASE OF DAR ES SALAAM CITY, TANZANIA

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Butterflies were used as indicator species because of their high sensitivity in ecosystems alteration. It is expected that changes in land use and climate will greatly change the butterfly fauna in Dar es Salaam. Assessment of the abundance and presence of butterfly pollinators in Dar es Salaam was carried out by comparing recent data (2008 to 2009) with previous data (1977 to 1978) from the same sites. The total number of species and individuals in both set of data were identified by classifying the butterflies to species level using identification guide. The expected changes on abundance of butterfly pollinators in previous and recent studies were documented using ranking method or t-test. Using the same data, the effects of climate change and land use on abundance of butterflies were identified using Fisher test. Comparison in the value of species in past and recent data was done using correlation analysis. Findings show that there are 54 species of butterflies identified; 32 species from the previous data and 22 from recent data. Abundance changes of butterfly pollinators between the two sets of data were significantly correlated. There is decrease of species in recent data as compared to previous data. However, the species show great abundance in previous data as compared to recent data. This change is consistent with previous studies that changes in abundance of butterfly pollinators can be caused by changes in climate and land use together with interactive effect of environmental changes. The study recommends more researches to be done on the impact of climate change and land use on pollinator species to trace trend of butterflies in Tanzania. Re-vegetation of the area can be used as remedial measures to attract back the migrated species.

Keywords: Climate change; Impact**;** Land use; butterfly pollinators; Dar es Salaam City

DAY TWO: SEMINAR PRESENTATIONS

LINKING BIODIVERSITY, ECOSYSTEM FUNCTIONS AND SERVICES IN THE GREAT SERENGETI-MARA ECOSYSTEM (GSME) - DRIVERS OF CHANGE, CAUSALITIES AND SUSTAINABLE MANAGEMENT STRATEGIES (AFRICANBIOSERVICES)

Chairpersons: Eivin Roskaft and Robert Fyumagwa

Humans derive a large number of important benefits from natural ecosystems and their associated biodiversity. Such ecosystems services include both direct benefits such as food from agriculture or fishing, inspiration and improved mental well-being, income from recreation, and indirect benefits as flood and disease regulation. Human dependence on ecosystems services is tightest in developing regions of sub-Sahara Africa, where poverty reduces people's capacity to capitalize on national resources other than those they can acquire from their direct surroundings. The reciprocal relations between human well-being and the state and diversity of ecosystems have been identified and discussed extensively at the global scale in the Millennium Ecosystem Assessment (MA 2005). However, innovative and practical (on the ground) solutions for the continued delivery of ecosystem services now requires focussed attention at the regional level. This requires the unravelling of region-specific complex relations between population growth, land use and climate change, biodiversity changes, changes in ecosystem services and changes in human well-being, and the separation between external and internal drivers of change. ***AfricanBioServices*** focus on the Serengeti-Mara Ecosystem and associated agricultural areas in East Africa; a region that encompasses parts of Kenya and Tanzania. In this project, internationally leading researchers from Norway, the Netherlands, Scotland, Denmark and Germany are teaming up with strong local partners in Tanzania and Kenya. The consortium brings together a uniquely equipped group of researchers with complementary skills in human welfare, socio-economics, ecology, biodiversity, climate change, and ecosystem services with key research institutes, management authorities and policy makers from developing countries. Most notably, this interdisciplinary consortium includes strong internationalization, and committed transcontinental (Europe-Africa) and transboundary (Tanzania-Kenya) cooperation and coordination. Furthermore, it provisions extensive and novel training opportunities both in Europe and in Africa, as well as a strong knowledge dissemination program aimed both at regional stakeholders and other areas with similar problems worldwide. A***fricanBioServices*** foster a new generation of researchers and policy makers with a novel understanding of the complex linkages between human well-being and the state and biodiversity of ecosystems. The research is organised in seven interlinked work packages (WPs). ***AfricanBioServices*** will quantify the connections between human population growth, land use change and biodiversity changes. In this special workshop ***AfricanBioServices*** will present and discuss 1) how we will quantify the connections between human population growth, land use change and biodiversity changes, 2), how we will analyse the consequences of climate change for key aspects of biodiversity in the region, 3) how we will empirically test the links between biodiversity and the core ecosystem services on which people in the region depend, and 4) how we will quantify the

dependence of human livelihoods on these ecosystem services. We have invited two key Tanzanian speakers to discuss how ***AfricanBioServices*** might help develop better conservation strategies both locally (Serengeti) and at a national level.

Presenters

1.	**Eivin Røskaf**	A brief introduction to AfricanBioServices
2.	**Bente Jessen Graae**:	Modelling how population growth affects biodiversity and ecosystem function through land use changes and infrastructure development
3.	**Joseph Ogutu**	Modelling effects of climate change on biodiversity and ecosystem dynamics
4.	**Han Olff**	How biodiversity enables different ecosystem services along landscape gradients
5.	**Martin R. Nielssen**	Household welfare dependence on ecosystem services
6.	**William Mwakilema**	How AfricanBioServices will contribute to establish better strategies challenges related to conservation of the Serengeti Ecosystem
7.	**Jafari Kideghesho**	How AfricanBioServices will contribute to develop better strategies related to conservation of protected areas in Tanzania
8.	**Bernard Bett**	Roundtable Discussion - Management Policy Platform

FIRE IN THE SAVANNA ECOSYSTEMS

Chairpersons: Colin Beale and Andy Dobson

Fire is one of the few active management activities carried out in east African protected areas. This side event explores the ecological role of fire within the savannah biome. Talks in the session cover research into the history of fire in East African ecosystems, the dynamics of fire itself and the impacts of fire on biodiversity at continental and local scales. It will provide a broad introduction to a range of problems in fire ecology that will be of interest to ecologists and land managers together.

FIRE REGIMES IMPACT TROPICAL MONTANE FOREST COMPOSITION DURING PERIODS OF RAPID CLIMATE CHANGE

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Detailed empirical records of periods of abrupt climate change are crucial given the rapidity of global environmental changes presently underway and the high relative importance of anthropogenic pressures on the future of land cover and fire regimes. East African ecosystems underwent important transitions from the Last Glacial Maximum (LGM, ~23000-19000 yr BP) to the interglacial as temperatures increased and the amount, distribution and seasonality of rainfall was altered by circulation changes that influenced the positioning of the intertropical convergence zone (ITCZ). These climate changes produced drastic changes to broad-scale vegetation distributions. Patterns of change were broadly coherent spatially across eastern Africa, although heterogeneity between major watersheds and with elevation was evident due to variability in precipitation-evapotranspiration budgets. The role of fire has not been examined in high temporal resolution over this period of abrupt and significant environmental change. There is a paucity of fire return interval estimates in moist montane forests and the controls of fire-vegetation interactions are poorly constrained. To understand these processes, we used the sediments from Rumuiku Swamp, Mount Kenya (2160 m asl), which provides an unprecedented millennial-to-decadal scale resolution record of fire activity in the local moist montane forest. Sediment pollen analysis shows that montane forest compositions were slowly changing at millennial scales and an abrupt change toward increased *Hagenia* abundances occurred at 21000 yr BP. Macroscopic charcoal (>125 μm) analysis suggested, a proxy for fire activity, suggests that this forest compositional shift was associated with changes to the fire regime of the watershed. The results show that variability in fire frequency produced significant changes to

forest compositions through Marine Isotope Stage II and that changes to the fire regime during a period of rapid climate change can result in important changes in species assemblages.

MODELLING THE INTERACTIVE DYNAMICS OF GRASS, TREES, FIRE AND WILDEBEEST IN THE SERENGETI ECOSYSTEM

Andy Dobson and cast of 1000's

Long term studies of wildebeest abundance, fire and tree abundance suggest that the interactions between these species are central to the observed temporal and spatial transitions between grassland and woodland in the Serengeti and other East African Savanna ecosystems. In this talk we present results from a mathematical model that is parameterized for different regions of the Serengeti region. The analysis suggests that wildebeest play a crucial role in suppressing fire, and allowing trees to establish in regions where rainfall and soil allow tree recruitment, this is potentially offset by wildebeest trampling seedlings that reduces rates of tree recruitment. The model also considers seasonal patterns the of rainfall and wildebeest abundance for different regions of Serengeti; different patterns of seasonality lead to different levels of fire potential and whence tree recruitment. We conclude by discussing the implications of the work for the management of fire frequency in the Serengeti ecosystem.

ENVIRONMENT, HUMANS AND SCALE AS DETERMINANTS OF PYRODIVERSITY PATTERNS ACROSS AFRICA

Gareth Hempson

Fire frequency, intensity, size and seasonality vary considerably in response to climate, vegetation, herbivory and human activities, yet global scale fire regimes nonetheless emerge due to underlying environmental constraints on these different fire traits. Pyrodiversity is a measure of how the bounds on fire traits themselves vary, and thus describes how variable fires are within a landscape or region. However, the fundamental drivers and continental-scale patterns of pyrodiversity have not yet been explored, and, by capturing the full regional spectrum of fire contingencies, may provide new insights into the role of fire as an evolutionary driver and in Earth system feedbacks. Here we present a pyrodiversity index developed using MODIS-fire imagery data for individual fires across sub-Saharan Africa from 2000 to 2010. We then use this index to explore how environmental conditions and human influences shape pyrodiversity across Africa, and how different fire traits (fire return interval, fire size, fire radiative power and fire season length) contribute to generating pyrodiversity under different ecological and human land-use contexts. The scale-dependency of pyrodiversity is examined both inside and outside of protected areas, while accounting for the principal environmental drivers of pyrodiversity. Our overall intention is to develop an understanding of the factors critical to generating pyrodiversity in a landscape, and thus to provide a new lens through which to explore fire as an ecological phenomenon and management tool.

SAVANNAH BIRD COMMUNITY CHANGE AND FIRE MANAGEMENT

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Climate change threatens biodiversity yet we know least about its impacts in high biodiversity tropical regions. The Serengeti has shown recent large-scale climate-related changes in bird communities, yet it seems unlikely the impacts of climate is direct. Instead, we hypothesise changes are mediated through changes in invertebrate populations which, in turn, are impacted by climate-driven changes in plant nutrition and defence. Realistic management changes to adapt to the impact of climate change in large protected areas such as Serengeti can only be addressed through altering fire management. Consequently, we assessed the impacts of recent fire history on the bird communities of Serengeti. Bird communities responded most to vegetation structure, which proved remarkably resilient to fire history. Ultimately, changing fire management alone may prove too blunt an instrument to actively adapt to climate driven changes in savannah ecosystems.

CHARACTERISTICS AND INTERACTIONS OF FIRE IN THE SERENGETI ECOSYSTEM

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Fire is a ubiquitous element of African savannah ecology, one of the most common management activities undertaken and a key factor in determining vegetation structure, community composition and herbivore distribution. However, despite its importance fire is understudied and little is known about the complex interactions it has with climate, edaphic factors and vegetation. The Serengeti ecosystem is large and complex, encompassing multiple habitats, management regimes and land use types. We examine the characteristics which define fire in the Serengeti and compare these to the fire regimes of other African savannahs, investigate the interactions between fire regime, environmental and biotic variables and also examine recent changes in the management of some areas of the Serengeti, the effect these have had on the ecology and fire regime of these areas and discuss the potential of management to manipulate the natural fire regime of the Serengeti.

WHAT CONTROLS SEEDLING SURVIVAL IN SAVANNAS? EXPERIMENTAL TESTS OF WATER LIMITATION, HERBIVORY AND FIRE IN SERENGETI

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One of the striking features of tropical savannas – defined as a continuous C4 grass layer underlying a discontinuous tree canopy layer – is the wide range of environmental conditions over which they occur. Savannas span large rainfall gradients, occur in areas with and without vertebrate herbivores and persist where vegetation burns at various intervals, from multi-annually to multi-decadally. While savanna tree communities are highly dynamic over space and time, they are also resilient to disturbance and have a strong propensity to re-sprout following damage. Arguably the key demographic stage for savanna trees is seedling establishment (i.e. first-year survival), when environment forces shape the emergent composition, structure and functioning of the woody cover. In the woodlands of Serengeti National Park, tree cover has substantially increased over the last 30-35 years, prompting interest by both managers and ecologist. We experimentally assessed the effects of grass competition, herbivory and fire on seedling survival of the two most dominant tree species – Acacia robusta and A. tortilis – using a

seedling transplant approach spanning the Serengeti rainfall gradient. We germinated 760 seedlings in a nursery for approximately six weeks and transplanted them to 38 plots across Serengeti. Grass removal had the strongest effect on seedling survival, while herbivory and fire had weaker (but significant) negative effects. The survival effect of grass removal appears to be due to increased soil moisture, particularly during the early dry season. A. tortilis was more tolerant of dry soils than A. robusta and had higher first-year survival (13.7% SE=1.7%) than A. robusta (7.6% SE=1.3%). Both species had surviving individuals in plots outside their current ranges, suggesting seed dispersal and germination may constrain their range limits, rather than just seedling survival. Our results show the significant role that soil moisture plays in shaping savannah tree recruitment.

Key-words: Acacia robusta, A. tortilis, environmental gradient plant-available soil moisture, Serengeti Nattional Park

DAY TWO: POSTER PRESENTATION

ENVIRONMENTAL AWARENESS AND BEEKEEPING IN SELECTED VILLAGES ATMALAGARASI-MUYOVOZIRAMSAR SITE

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In developing countries where resources are limited and especially in Ramsar sites which are guided by 'wise use' principle, engaging local communities is the best way of managing resources therein.Changes in climate, human population, and dynamism of the society require new measures to sustainably manage the natural resources.Environmental awareness and environmentally friendly income generating activities are some of the measures. From July 2014 to June 2015, a project was implemented in three villages surrounding Malagarasi wetlandsin Uvinza (Chagu and Kasisi Villages) and Kaliua (Lumbe Village) Districts.Forty eight adults (29% females) mostly representatives of different committees from each village attended environmental awareness workshops.About 146(32% female) primary school and 53 (43% female) secondary pupils were also reached. A pilot project for beekeeping has been established at Kasisi Village (Magwemagwe Group), Uvinza District. Twenty beehives and all necessary accessories for harvesting and processing honey have been provided to the group. Beehives were hanged in a village forests near the wetland in April 2015 and all colonised. The hanging of beehives were preceded by a beekeeping seminar held at Nguruka, Uvinza where at least 5 members from each of the three villages attended. Moreover, the project supported representatives from target villages to participate in the first Apimondia Symposium on African Bees and Beekeeping held in November 2014 at Arusha International Conference Centre.Additionally, at least 3 people from each of the village and the Uvinza District Natural

Resource Officervisited Lake Tlawi inMbuluDistrict to learn the integration of beekeeping and wetland management. Magwemagwe group expect to earn about 2.4 million Tshsper year. Other villages are in the process of establishing similar projects. Apart from income to the groups, the village forests used for beekeeping will be protected from livestock grazing, charcoal burning and frequent fires.

EFFECT OF LAND USE AND ELEVATION GRADIENT ON SOIL AGGREGATE FRACTIONATION ON KILIMANJARO ECOSYSTEMS

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Kilimanjaro ecosystems under global change: Linking biodiversity, biotic interactions and biogeochemical ecosystem processes.

Soil aggregate size fraction plays a major role in soil characteristics and productivity of the land under different uses. The study to analyze the impact of land use on the soil aggregation along land use pattern of Southern slopes of Mt. Kilimanjaro ecosystem in Tanzania was undertaken. We hypothesized that soil aggregates size and distribution is influenced by land use and elevation gradient. Through using particle sizes analyzer vibro shaker (Retsch), it was found that along land use gradient, tilling the land have major impacts on soil aggregate size as well as type of crops grown. Practices by farmers like tilling intervenes the roots and microbe activities which produces binding materials for aggregates stabilization. The Chagga Home Gardens (HOM) plots soils indicates more stable macro aggregates due to mixed agriculture and less or no application of chemical fertilizers .Tilling practices inhibit generation of Soil Organic Matters (SOM) and disturbs microbial condition in the soil ultimately influencing aggregate size distribution. On Coffee plots (COF), micro aggregates fractions (<2mm) was about 70% suggesting that the soil is unstable, vulnerable to erosion with limited microbial activities which can increase the risk of soil degradation.At the Forest Lower Montane (FLM) plots, macro aggregates size fractions of 5mm increases subsequently correspond to elevation slightly from Ocotea forest (FOC-3.6%), Podocarpus (FPO-4.3%), Erica Forest (FER-8.7%) towards Helichrysum (HEL-8.7%). For micro aggregates sizes (2mm, 1mm, 0.25mm and less than 0.25mm) increases from lower to higher elevations with exception of Savannah (SAV) and Lower Mountainous forest (FLM) which doesn't increasing along the land use gradient. It is therefore evident that the land use type influences the aggregate size distribution unevenly across land use and elevation gradients but along less utilized ecosystems the soil particle sizes are evenly distributed.

CAN RHINO RANCHING REDUCE ITS POACHING IN TANZANIA?

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Conservation has been and still contributing in maintaining ecosystem healthy and to the economy of various nations and World at large. Some countries have been sticking to centralized modal of conservation while some have moved to private ownership modal of conservation to a greater extent. In either ways, illegal poachers have been striking in making sure that they stick on their guns, to a greater extent the major focus has been of rare and endangered animal species. This paper aims at reviewing various practices towards conserving rhinos in some of SADC countries (i.e. South Africa, Zimbabwe, Botswana, Zambia and Tanzania). The major focus is made on assessing different approaches through literature review. In countries where they involve private organs to conserve rhinos in conservancies or ranches, the number of rhinos has been increasing by making rhinos save themselves. This has been possible through creating a broad and safe environment for the rhinos to breed in a rate that exceed the rate of poaching. Recently trade has also become an important key factor that determines the trend of rhino poaching in Africa. In some countries, South Africa in particular, the burning of both legal and illegal trade of rhino horns has triggered more poaching of rhinos. This is due to the fact that when you burn and dry completely trophy`s trade you automatically trigger both demand and price figure. Consequently, more people become motivated to engage themselves in illegal poaching and trading. Despite of scant information, Tanzania has been experiencing some incidences on rhino poaching indicating that Tanzanian`s rhinos are also in a danger. This paper concludes that the use of bullets in intensified patrols, monitoring and involving communities alone cannot solve the problem of rhino poaching in Tanzania and elsewhere. It needs a combination of approaches including adoption of private ownership modal (in ranches and conservancies) that will increase conservation and production base of rhinos in line with thinking of controlled market as well.

Key words: Conservation, Ranch, poaching, Rhino, Private Ownership Model

CONSIDERATIONS OF WEST USAMBARACOLOBUSMONKEYS : A DOCUMENTATION OF CONSERVATION ACTIVITIES AND THEIR IMPACTS ON COLOBUS MONKEYS AROUND MAGAMBA NATURE RESERVE.

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Magamba nature reserve have been for many years the range land of unique primates that is Colobus monkey (*Colobusangorensis*), understanding currently conservation activities and their impacts is vital for strengthening conservation activities and revamp future considerations towards Colobus monkeys at Magamba nature reserve . This study was dedicated in assessing challenges towards conservation of Colobus monkey around Magamba nature reserve, covering three sub hamlets of Magamba village in Lushoto district. Both purposively and simple random sampling were used under both primary and secondary data to collect the sample with the sample size of 60 respondents from three villages by interview and check list. Data collected were analyzed by the software known as Statistical Package for Social Science (SPSS). Results indicate that 100% of the respondents are aware about Colobus monkey availability and their ecological strengths in Magamba nature reserve (MNR). 86.67% of the Respondents indicated that currently there have been an increase of these primates population trend, this is succeed by different conservations strategies imposed by Magamba nature reserve (MNR). Regarding to this study findings, worldwide primates have been reported to have decrease in population of which is contrary to this study findings about the population of primates around Magamba nature reserve, such made more scientific curiosities that a study of the like or conservation projects should as well consider documenting population size and at different years in order to have a critically comprehension on population trends of Colobus monkeys around Magamba nature reserve.

Key word: *Colobus monkey, conservation, challenges, Magamba Nature Reserve*

WILDERNESS AND ROAD NETWORKS IN PROTECTED AREAS

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The continuing loss of wilderness areas around the globe remains a challenge for the protection of endangered species. Through the convention for Biological Diversity, Tanzania and many other countries have committed to slowing down or stopping the fragmentation of natural habitats. To reduce or stop the loss of biodiversity and manage the remaining wilderness areas in the best way possible it is important to provide methods and tools to visualize this challenge.
The main objective of this study was to provide an objective method for evaluating wilderness in a Tanzanian context. Wilderness is in this context defined as areas without infrastructural development through measuring distance to human infrastructure. GIS tools to support the method was been developed as part of this work have been made freely available. We provide two examples where we test the method; an analysis of wilderness areas in Ruaha National park and an area in the eastern part of Selous Game Reserve. Our key findings are that it is possible to establish an objective measure of wilderness and change in wilderness status. Challenges and opportunities with the method in a Tanzanian context are explored through statistics and methods discussion.

MAPPING CHIMPANZEE ARTEFACTS: WHAT CAN THEY REVEAL ABOUT HOMININ EVOLUTION?

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Material culture is a hallmark of human evolution. But when, why and how did technology come about? Archaeological records of stone tool use date back to about three million years. However, this evidence suffers from significant gaps. Firstly, scientists will never be able to observe the actual behaviour of early humans. Secondly, much if not most tool use left no traces, as implements were made from perishable plant material. Thirdly, the traditional anthropocentric perspective of *Homo faber* as a unique product of evolution has been increasingly challenged through recent field studies of non-human primates; these revealed that not only apes, but also old and new world monkeys are capable to use lithic as well as non-lithic tools. Consequently, the emerging paradigm of "Primate Archaeology" aims to compare the varied material cultures of non-human primates, to then design models about evolutionary trajectories that will allow us to better reconstruct the information contained in early archaeological sites. My research focuses on the use of tools made from perishable raw material such as barksand twigs associated with the

exploitation of termite mounds by our closest living relates, chimpanzees (*Pan troglodytes*). For this, I study three populations that live in environments equivalent to early human habitats: woodland-savannah (Ugalla / Tanzania), woodland (Gombe / Tanzania) and mixed forest (Mahale / Tanzania). I use traditional archaeological methods to map how tools discarded by the apes distribute and accumulate across sites and how their initial deposition pattern changes over time. I aim to understand whether or not this cumulative deposition of discarded plant probes across the landscape creates recognizable patterns ('signatures'), and if so, how do they compare with tool assemblages of early humans. Such "archaeology of the perishable" may equip us to better understand the mechanisms behind tool assemblages of Plio-Pleistocene hominids.

A CHANGING CLIMATE IN THE RANGELANDS OF NORTHERN TANZANIA: EFFECTS ON PEOPLE AND THEIR ECOSYSTEM SERVICES

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Climate change effects include unpredictable rainfall patterns and long periods of drought that drive water scarcity and erosion of topsoil, both conducive to economical and food insecurity. The target research area lies in the Southern Acacia-Commiphora bush lands and thickets eco-region, which interspersed with patches of Serengeti Volcanic Grasslands, covers more than 20% of Tanzania's land and focuses on the rangelands bordering the slopes of the West side of the Mount Meru. Here, Maasai subsistence pastoralists entirely depend for their survival on the ecosystem services provided by the Acacia-commiphora bushlands, and they have a reduced capacity to endure stochastic environmental changes. A contraction of available and good quality grazing lands exacerbated by climate change and population growth has forced pastoralists to revert to unsustainable practices as exit strategies to reduce their economical insecurity. These include migration, charcoal production and livestock destocking below the market price. This paper presents the preliminary results of an analysis of current livelihood strategies, the perception of climate change, and the coping mechanisms adopted by selected representatives of the Maasai communities both at household and community levels, thus contributing to the understanding facilitating the design of appropriate and effective response mechanisms to alleviate people and ecosystems' vulnerabilities.

Key words: Climate change, rangeland, grazing land, pastoralism, Maasai, coping strategies.

HUMAN – WILDLIFE INTERACTION AROUND SELOUS GAME RESERVE IN TANZANIA.

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Selous Game Reserve (SGR), covering an area of 50,000 km2 is one of the largest protected areas in the world and by far one of the global outstanding ecological entities. Its history is shaped by various forms of human-wildlife interactions. This paper highlights the genesis of wildlife conservation in the SGR and different forms in which wildlife interacts with adjacent local communities and possible solutions as way forward. The socio-economic status of the communities bordering the SGR, one of the major determinants of human-wildlife interaction in Tanzania. For instance, poverty prompts people to poach in order to survive. Human-wildlife interaction have two scenarios. One being positive, in the sense that, interactions involves the use of wildlife for food, medicines, spiritual purposes etc. The other scenario is negative where interaction is defined by numerous costs associated with wildlife such as crop damage, livestock depredation, killing/ injury to people and wildlife, diseases transmission, destruction of habitat and resources. This paper is framed around the following questions; (i) which are the different forms and how do humans interact with wildlife in SGR?; (ii) How do different people perceive different forms of human-wildlife interaction (positive against negative); (iii) which are the different strategies/ solutions employed in addressing the negative forms of human-wildlife conflicts?; and (iv) what are the implications of these interactions on wildlife conservationist?
I conclusion, paper recommends that, the policy makers and Protected Area Managers should address the needs of local people in order to minimize the prevailing conflicts resulting from negative interactions and promote harmonious coexistence between humans and wildlife. As many large carnivore species are endangered or threatened with extinction, the best we can do is to promote good will towards wildlife. This will only be possible when attacks on people are mitigated through sound management practice.

RAW MATERIAL PROCUREMENT FOR TERMITE FISHING TOOLS IN WILD CHIMPANZEES

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Chimpanzee termite fishing has been studied for decades. However, we still know little about how raw material for the extraction of tools is obtained. This is particularly true for potential selection criteria and what these imply for underlying cognitive mechanisms, such as forward

planning. We employed traditional archaeological methods while studying termite fishing in two different habitats in Tanzania, i.e., in the woodlands of Gombe and a more open woodland-savannah at Issa. Results suggest that chimpanzees select particular species as tool sources, many of which are also food plants. Chimpanzees at both sites chose three identical species, perhaps for their especially suitable physical properties, like bark that is easy to peel off. At both sites, chimpanzees used plants close to termite mounds, but also from further away (up to 35 m), indicating a mixed strategy of opportunism and forward thinking. The populations also differed, in that Issa chimpanzees clearly preferred bark as raw material, while Gombe chimpanzees also used twigs and grass. Moreover, a quarter of sourced plants at Issa was not visible from the mound, and, compared to Gombe, on average 5 m further away. These disparities are likely caused by environmental differences, in that the more open and drier habitat at Issa might necessitate a higher degree of planning.

Keywords: Chimpanzee archaeology, termite fishing, plant tools, raw material procurement

POPULATION HEALTH PARAMETERS IN OLIVE BABOONS (*PAPIO ANUBIS*)

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A potential cost of living in highly social, promiscuous groups, such as in olive baboons (*Papio anubis*), is the elevated risk of acquiring diseases. Infection with *Treponema pallidum* was reported from olive baboons at Gombe Stream, Lake Manyara (LMNP), and Serengeti National Park as well as Ngorongoro Conservation Area in Tanzania, but has until to date not been documented in adjacent National Parks such as Tarangire National Park (TNP),which is less than 50 km fromLMNP. The pathogen is most likely transmitted by sexual contacts and the infection is clinically associated with severe genital ulceration. Our understanding of disease spread and ecology within defined ecosystems is scarce and factors that might influence disease susceptibility are important considerations for disease control or elimination. It is hypothesized that baboons in areas of high simian *T. pallidum* infection are exposed to factors such as (co-)infections that make animals more susceptible for infection with the spirochete *T. pallidum*. We predict that baboon populations with high *T. pallidum* infection rates have a higher population density, a higher endoparasite burden and richness as well as virus infections that may influence immune-competence. The objective of the study is to understand factors that influence disease susceptibility through (i) assessment of risk factors (ii) assessment of the confounding factors; (iii) assessment of the role played by immune status. Our ongoing comparative study is conducted at LMNP utilizing a heavily infected baboon population at LMNP and, as a control, clinically healthy baboons at TNP. Infected and healthy baboons at LMNP are additionally used to assess intra-population differences. While samples that can be obtained noninvasively (e.g., fecal samples) are taken from an adequate sample size throughout both conservation areas, invasive sampling is performed in a smaller subset of animals (N=30 per national park). However, invasive sampling in immobilized baboons will facilitate the analysis of (1) blood,(2)

fecal,(3) vaginal, bucal, and pharyngeal swab samples for the detection of pathogens as well as to assess general immuno-competence (e.g., WBC counts and differential).

BEHAVIORAL DETERMINANTS AND CONSEQUENCES OF THE NATURAL SPREAD OF A SEXUALLY TRANSMITTED DISEASE IN WILD OLIVE BABOONS (*PAPIOANUBIS*)

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Diseases may influence the behavior of both infected and healthy individuals, leading to changes in social and mating systems of populations. Sexually transmitted diseases (STDs) could be one of such cases. However, for nonhuman primates it is still largely unknown whether individuals are able to develop adaptive behavioral counter-strategies in response to possible STD acquisition. The aim of this study is to investigate whether baboons vary their behavior in response to mating partners clearly infected by a disease that causes severe genital ulceration.
The study will be conducted at Lake Manyara National Park (LMNP) Tanzania taking advantage of a population of *Treponema pallidum* infected and thus genital ulcerated olive baboons (*Papio anubis*). Due to the clinical manifestations, the bacterium is most likely transmitted by sexual contacts and in a later stage the disease can be easily detected by visible ulcerations on infected individuals. Olive baboons show a promiscuous mating behavior and can therefore be considered as one of the species with increased risk of STD acquisition, which makes this species an ideal model to test behavioral defense hypotheses such as mate choice and post-copulatory self-cleaning. Mating behavior (e.g., number of mating partners, number of sexual contacts), post-coital self-grooming and post-copulatory urination, will be quantitatively analyzed to assess whether visible signs of infection in mating partners have any effect on mate choice and mating behavior. Additionally, co-factors as dominance rank, age and reproductive state will be taken into account due to their influence on mating strategies. By combining the data obtained during fieldwork, in a mating network, an individual-based epidemiological model will be generated in order to understand the routes of pathogen transmission and its impacts on the population. This will further facilitate testing disease management options for National Parks in theory before practical interventions cause unpredictable expenditures.

INTEGRATING INDIGENEOUS KNOWLEDGE AND SCIENCE IN WILDLIFE MANAGEMENT

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Indigenous knowledge should be considered as complementary to science in wildlife conservation as it sets a building block for problem-solving strategies for local communities. I examined indigenous knowledge by identifying its applicability through literature survey and by drawing examples from various parts of the world where indigenous knowledge has really been applied successfully. Major indigenous knowledge contributions in wildlife management identified included; wildlife population monitoring, total protection of use of resources such as rivers, ponds and forests, rotational resource use, prohibition of killing certain species, wildlife habitat management through use of fire and agroforestry farming practices. Although, it was found that indigenous knowledge had some limitations such as slow pace in coping with changes, vulnerability to data loss and external pressures, the benefits outweighed the risks.

Key words: *Indigenous knowledge, institutions, taboos, wildlife management*

THE USE OF SLEEPING TREE REFUGES BY YELLOW BABOONS IN MIKUMI NATIONAL PARK

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Yellow Baboons use large, often-emergent trees, which are usually in clumps or groves, as nocturnal refugia. In Mikumi National Park, the distribution of appropriate sleeping tree sites is along watercourses [korongos] that flow into the central Mkata floodplain. This permits the baboons in Mikumi to be non-central place foragers able to move in multiple directions and a wide range of habitats without returning to a single or a few locations. Most sleeping sites are used repeatedly and the pattern of sleeping site use reflects habitat selection and use and can be related to foraging effort. The use of sleeping sites by the Viramba troops in Mikumi has been recorded and monitored on a daily basis for the past 40 years. Over 225 sleeping tree sites have been recorded and mapped. Sleeping Site use varies with season and resource or habitat use. Sleeping Sites used by the study troops has changed over time and patterns of change indicate changes in range and resource use and may be linked to habitat change. We evaluate the use of sleeping sites in relation to: baboon population patterns and change; known and observed

patterns of habitat change; and features of the landscape both natural (e.g. topography) and anthropogenic (e.g. roads)

CAN GEOGRAPHICAL INDICATION LABELLED HONEY ADDRESS THE LOCAL POLLINATORS? DECLINE IN TANZANIA?

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A study was carried in two villages of Aghonde and Sanjaranda of Manyoni District, central Tanzania. Specifically, the study aimed to (i) investigate factors contributing to the pollinator decline (ii)identify criteria used to make up GI honey (iii) determine potential GI honey qualities (vi)examine the potential influence of GI honeys in reducing pollinator decline. Both Secondary and primary data were used. Primary data were obtained using various research approaches including, survey questionnaires, interviews, focus group discussion and observation. Purposive sampling was employed to collect data for this study. In each village a sample size of 10% of experienced beekeepers practicing beekeeping was interviewed. Descriptive and quantitative analyses were used to determine the results. For quantitative means, percentages, ranges and other summary statistics the excel sheet was used. The preliminary findings showed that beekeepers perceived the decline of pollinators specifically honey bees caused by climate change, varroa mites and environmental fragmentation. Reviews results indicated that natural link, human link, domestic reputations, honey specificities, safety qualities, standards and legislation in quality and roles played by associations were basis for forming GI honey. Further, preliminary results analyses indicated that natural link (thicket vegetation and soils), honey specifications (nang'ana honey with sweet-sour taste), human link (methods of production), hygiene, organic and use of traditional hives were found to comply with prior GI standards. Nevertheless further studies are required. The use of potential GI labelling honey was found to address environmental fragmentation and likely to the impacts of climate change and nothing to do with varroa mites. The study concluded that areas identified with potential GI honey would form basis towards conservation practices in beekeeping areas and hence reduce honey bee pollinator decline through incentives gained from premium prices of GI honey.

. **Key words:** Geographical indications, Origin products, honey, Pollinator decline, Tanzania

IMPLICATIONS OF LAND COVER CHANGES ON COMMUNITY'S LIVELIHOODS ALONG THE SLOPES OF MT. KILIMANJARO IN THE CHANGING CLIMATE

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The Mount Kilimanjaro vegetation cover has not only changed but has also been diminishing year after year due to frequent occurrence of fires, such that the Montane type of forest which disappeared in year 2000. This has un-doubtfully significantly affected the ecosystem services for the people's livelihood along the slopes of Mt. Kilimanjaro. The study was undertaken along two transects on the slopes of Mt. Kilimanjaro covering different ecological zones (from the upper settled landscape to the lower landscapes).It aimed at establishing how communities on the slopes of Mt. Kilimanjaro depend on the natural ecosystems for their livelihoods and their response to the changing climate. It also unveiled various communities' climate change adaptation strategies in these different ecological zones along the transects. A total of six villages (two villages per transect) were selected through which a study sample was chosen. Random sampling technique was used to select the households to be involved for the study. As a multidisciplinary research, both qualitative and quantitative methods of data were used through field work (survey) and extensive literature reviews. Major changes in land use/cover have occurred on the slopes of Mount Kilimanjaro. Some of them being the expansion of cultivation down the slopes and the replacement of natural vegetation by cultivated land. These changes have taken place at different time scales and were driven by variety of processes. In response to these changes, many farmers have diversified their crop production with the youths opting for non-farm activities outside their homes as a livelihood strategy. For the majority, however, the dwindling natural resource base continues to be a major constraint to agricultural expansion, food security and poverty eradication efforts.

Key words: *Climate Change, Land cover changes and Livelihoods*

SOIL EROSION UNDER DIFFERENT VEGETATION COVER AND LAND-USE: EXPERIENCE FROM CULTURAL LANDSCAPE OF MT. KILIMANJARO, TANZANIA

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The study was conducted on the managed ecosystem of the Southern slopes of Mt. Kilimanjaro to determine whether changes in vegetation cover and land use had influenced spatial variability of surface run-off erosion. In carrying out this study, topographic map of Kilimanjaro region and Google earth imagery were initially used to select study sites whereby relief and land use features were analyzed. Thereafter, a baseline survey was conducted to evaluate major vegetation cover types; land use patterns and practices; and the levels of soil conservation status. Field experiments were finally conducted during the long rains started March to June, 2015. Six sets

comprised of surface run-off traps and rainfall collectors were installed in both open and closed farm along three distinct agro-ecological zones within Weruweru River watershed. A half litre sample of sediment load was collected from each trap for oven drying to determine dry weight. Along with this, a measuring cylinder was used to measure the volume of rain water collected in each rain collector station. This paper reveals that more proportion of surface run-off load (67.2%) came from open canopy farms compared to what was quantified in closed canopy farms (32.8%). However, open farms which were under fallow showed more resistance to soil erosion (12.1%) compared to cultivated (tilled) closed farms (17.9%). Further to this, it was noted that lower areas of Mt. Kilimanjaro had more pronounced erosion whereby gullies with depth up to 120 cm, width of 180cm and length of 3000cm had already developed. On other hand, several soil conservation technologies practiced by local farmers were noted. Common one involved contour bunds, vegetative barriers, mulching and agroforestry. Findings of this paper will be useful to several stakeholders including agricultural officers, conservation managers and policy makers.

Key words: Mt. Kilimanjaro, surface run-off, erosion, land use, soil, water

THE INFLUENCE OF MICROCREDIT-FUNDED BUSINESSES ON HUMAN WELFARE AND BUSHMEAT CONSUMPTION AMONG COMMUNITIES IN SERENGETI, TANZANIA

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Bushmeat mostly illegally harvested in western Serengeti, Tanzania, provides cash and protein to households. Recently, microcredit-funded businesses have been initiated in Serengeti as an intervention that integrates conservation aims and human development needs, thus, to curb illegal bushmeat hunting and improve human livelihoods in that order. The credit scheme seeks to facilitate income generation to make local residents less dependent to bushmeat hunting. This study investigated the impact of microcredit-funded businesses on well-being of communities in western Serengeti. This was done through examining the number of bushmeat meals consumed and perceived wellbeing of households. A quasi-experiment was used to compare households from the same villages who had (n=63) and those that had not (n=58) participated in the microcredit scheme.The comparison focused on (a) the sources and amounts of protein consumed, as reported in a dietary recall exercise, and (b) self-reported wellbeing and uses of the loans. Data was collected on a monthly basis over a 10 month-period (which year?).Results suggested that on average, households participating in the microcredit scheme consumed significantly less bushmeat than those not participating. Credit-takers tended to consume more non-bushmeat protein meals (such as beef, fish and/or chicken) than non-credit takers. Loans were found to improve household welfare by covering costs of, for example, medical care, and schooling expensesand improving housing condition. Approximately fifty percent of credit-

takers established a small business, but most of these businesses were not able to sustain themselves due to, not least, the limited credit-size and a short repayment period. It is logic to conclude from these findings that longer runtimes for credits and the provision of accessible advice for credit-takers could increase the sustainability of these businesses. Nonetheless, facilitation of marketing trajectories of the products produced by the communities would raise the impact of the micro-credit scheme, thereby improving both livelihoods and wildlife conservation.

GIS PLATFORM; CONNECTING LAND, PEOPLE AND BIODIVERSITY

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GIS platform solution for natural resource management, inspires and enables people to positively impact the future through a deeper, geographic understanding of the changing world. Our technology enables organizations to create responsible and sustainable solutions to problems at local and global scales. We believe that geography is at the heart of a more resilient and sustainable future. The interactive relationships of species, ecosystems, and genetics weave the tapestry of biodiversity. Likewise, interactive collaboration among stakeholders is essential to conserving biodiversity. Esri makes the dialogue between conservationists, ecologists, government, and business easily understood. Access data from multiple disciplines and layer it onto a map. More readily analyze cause and effect. Use the Esri platform to collaborate and find ways to preserve habitat and species.

Keywords: Platform, Ecosystem, Genetics, Map, Esri

EVALUATING TECHNIQUES TO ESTIMATE LION ABUNDANCE

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Obtaining accurate abundance estimates of lions and other wildlife species is important for effective management and conservation. We evaluated the efficacy of two commonly used techniques, track counts and call-in surveys, to estimate lion abundance in a 1,920 km^2 portion of Serengeti National Park, Tanzania, during September–November 2015. We modified these techniques to allow surveys to be replicated weekly over 7 weeks to explore the suitability of using occupancy and n-mixture models to account for additional sources of variation. Lion population estimates obtained during the first week using earlier models differed by almost 200 individuals between track surveys and call-in surveys. In addition, estimates from track surveys varied by up to 170 individuals across weeks. Estimates derived from track surveys appeared

strongly influenced by the lunar cycle, with estimates greater during weeks with the new moon, and 4-week average estimates likely closer to the true population. Lions also demonstrated habituation to call-in surveys after the first week; we are currently exploring further modifications to call-in surveys to reduce habituation effects. We have demonstrated that the two prevailing survey techniques and associated models used to estimate lion abundance can provide markedly different results. We also have demonstrated that the timing of conduct of these surveys can have a strong effect on abundance estimates. Estimates of lion abundance appear strongly influenced by multiple environmental and detection factors, including lunar cycle, that have not previously been evaluated or integrated into population models. We will continue to analyze our data using occupancy and n-mixture models to develop population estimates and to determine which environmental and detection factors are influential. We suggest that using repeated surveys that account for these factors may offer improvements in our ability to estimate lion abundance.
Key-words: abundance estimation, call-in surveys, lion, Serengeti National Park, track surveys

DAY THREE: FRIDAY 4th DECEMBER 2015

SUB-THEME: WILDLIFE DISEASES AND ECOSYSTEM HEALTH

Key note paper. Livestock-Wildlife-Human Interactions: Challenges for control of zoonoses and emerging infectious disease
Julius Keyyu

MALIGNANT CATARRHAL FEVER: A FIELD TRIAL OF A NOVEL VACCINE STRATEGY

Felix J. Lankester[1,2], Ahmed Lugelo[3], Ahab Ndabigaye[4], Nicholas Mnyambwa[4], Julius Keyyu[5], Rudovick Kazwala[3], Dawn Grant[6], David Haig[7], George C. Russell[6] and Sarah Cleaveland[1]

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A field trial for a vaccine against wildebeest associated malignant catarrhal fever (MCF).
The trial was carried out in a livestock-wildlife grazing area in northern Tanzania. The blinded randomized controlled trial focused on 200 cattle divided equally into (i) a vaccinated group that received a prime and, 4 weeks later, a boost vaccination containing the attenuated MCF virus + adjuvant, and (ii) an unvaccinated group that received an adjuvant only mixture. During the challenge phase the cattle were grazed, in contrast to traditionally managed herds, close to wildebeest calves. Monthly blood and nasal secretion samples were used for serological and PCR analyses. Histopathological analysis was erformed on tissues collected from fatal cases. The vaccine's efficacy (VE) at reducing infection was calculated. The vaccine was well tolerated. The vaccine was effective at eliciting an immune response, with all vaccinated cattle producing detectable MCF-specific and virus neutralizing antibody titres. These titres peaked at 2 months post-primary inoculation after which they decreased to low levels at 6 months. The VE at reducing infection was 56%. Unvaccinated cattle were more than twice as likely to be infected. The vaccine stimulated a virus neutralizing and an MCF-specific antibody response and, as a result, incidence of MCF infection was reduced. The vaccine could benefit herd owners who, because of changes in land tenure, are now unable to move their cattle away from migrating wildebeest and require means to improve the protection of their cattle. The vaccine could also benefit pastoralists using traditional grazing systems by protecting cattle against exposure to virus following inadvertent contact with wildebeest calves. A key question remains however: whether this partial protection is sufficient to support a wholesale change in the traditional

grazing management systems to allow cattle to graze alongside wildebeest calves when pasture quality is highest?

NEGLECTED TROPICAL DISEASES: ONE HEALTH AND THE ROLE OF NONHUMAN PRIMATES

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Neglected tropical diseases (NTDs) disproportionally afflict poor, marginalized human populations in developing regions of sub-Saharan Africa, Asia, and the Americas. Though they receive little attention, collectively NTDs cause an estimated 0.5–1 million deaths annually, a global disease burden equivalent to that of HIV/AIDS. Nonhuman Primates (NHPs) are phylogenetically closely related to and share diseases with humans. Two pathogens, the bacterium *Treponema pallidum* and tape worms*Taenia* sp., may serve as model systems for understanding (1) host-pathogen evolution, (2) the role of NHPs as a potential reservoir for human NTD infection, (3) providing insight into disease ecology, and (4) highlighting the difficulties of diseases control and prevention for National Parks. Though research is on-going, there is compelling evidence that simian and human yaws-causing strains of the *T.pallidum*bacterium are closely related. While Tanzania has no records of human yaws cases since decades, we found at least one simian strain that causes genital ulceration in NHPs, even though it is genetically most closely related to human yaws-causing strains.The identification of NHPs as a reservoir for human yaws infection would be revolutionary and would aid the current WHO yaws-eradication effort. It would however immediately raise the question on how to treat wild NHPs since wildlife and human health is inevitably tangled with each other. *Taenia* is a globally distributed parasite that, depending on the species, causes untold morbidity and mortality in humans. It has been shown that biodiversity impacts pathogen transmission, and NHP societies at the human-livestock-wildlife interface in the Ethiopian Afro-Alpine Highlands provide an exceptional opportunity to study the impact of parasites such as *Taenia* at the individual, population, and community level in primates. In conclusion, NTD investigations in NHPs provide outstanding opportunities to improve human and wildlife health through multidisciplinary, hypothesis-driven research that moves between field and laboratory.

GENETIC AND ECOLOGICAL DRIVERS OF TUBERCULOSIS AT HUMAN-LIVESTOCK-WILDLIFE INTERFACE OF THE SERENGETI ECOSYSTEM, TANZANIA

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Interspecies transmission of tuberculosis is of particular concern, particularly in areas where human, livestock and wildlife live in close proximity. The aim of this study was to determine species diversity of *Mycobacterium tuberculosis* complex MTBC) and their public health significance at human-animal interface of the Serengeti ecosystem, Tanzania.DNA was extracted from Mycobacterium cultures obtained from sputum samples of 214 TB patients and tissues of 606 animals (livestock and wildlife). Multiplex PCR was used to differentiate *Mycobacterium tuberculosis* complex (MTBC) from non-tuberculous mycobacterium (NTM) culture isolates. Spoligotyping and Mycobacteria Interspersed Repetitive Units-Variable Tandem Repeats (MIRU-VNTR) typing on 24 loci were performed on DNA isolates. Five (5) MTBC and 55 Non tuberculous Mycobacterium (NTM) isolates representing 16 mycobacterial species were detected. Based on spoligotyping, three *M. bovis* strains were isolated from wildlife all belonging to SB0133, while 2 novel strains of *M. bovis* were identified in cattle and none from tuberculosis patients. *M. bovis* isolates from wildlife had 96.8% and 45.2% spoligotype pattern agreement with novel strains namely SB2290 and SB2289 isolated in cattle. Of the 24 MIRU-VNTR loci, QUB 11b showed the highest discrimination among the *M. bovis* strains.We found a diverse of *M. tuberculosis* strains dominated by CAS 55 (25.7 %), T 52 (24.3%), LAM 38 (17.8%) and EAI 25 (11.7%) families in TB patients. Other identified families were unassigned (‘named Serengeti strains’) 25 (11.7%) and Beijing 8 (3.7%). The minority group that included Haarlem, X and S altogether accounted for 11 (5.2%) of all genotypes. This study found Haarlem, EAI_Somalia, LAM3 and S/convergent and X2 subfamilies which were not reported in previous studies in Tanzania. This study found no clear evidence for recent cross-species transmission of *M. bovis* between human, livestock and wildlife at their interface. It was revealed that a large diversity of *M. bovis* and *M. tuberculosis* strains in the Serengeti ecosystem, some of which were novel. One of the novel strains of *M. bovis* isolated from cattle was genetically linked to the SB0 133 isolated from buffaloes indicating possible interspecies transmission of bovine tuberculosis (bTB) infections. The high prevalence of *M. intracellulare* is of concern in this setting, given a high HIV prevalence and the ability of *M. intracellulare* to cause pulmonary and extrapulmonary TB in such individuals.

FREE-ROAMING DOMESTIC DOG DEMOGRAPHY AND VACCINATION NEAR SERENGETI NATIONAL PARK IN TANZANIA

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Free-roaming dogs are a both a public health and conservation concern because of their potential to transmit diseases such as rabies. Understanding domestic dog population dynamics and how they are impacted by interventions, such as rabies vaccination, is vital for the planning and implementing of such disease control efforts. This 4-year longitudinal study compared the demography of free-roaming domestic dogs in villages with and without a rabies vaccination campaign near Serengeti National Park in Tanzania. We identified and followed the life histories of 2,649 owned free-roaming domestic dogs living in four rural villages west of Serengeti National Park. Two villages were part of an existing annual domestic dog rabies vaccination program while two villages were not engaged in any disease control efforts. We revisited households annually and collected dog health, demographic and ownership practice data. Adult dogs (>12mos) had overall higher survival than puppies in all villages. We observed a male-biased sex ratio across all age classes and higher adult male dog survival. Within the vaccination villages, vaccinated dogs had a decreased risk of death. However, overall mortality in one non-vaccination village was significantly higher than in the two vaccination villages and other non-vaccination village. Dogs in poor body condition had lower survival than dogs in ideal body condition in all villages. Sickness and spotted hyena, *Crocuta crocuta*, predation were the two main causes of dog death. Free-roaming domestic dogs in rural communities exist in the context of their human owners as well as the surrounding wildlife. Our results demonstrate that vaccination alone does not impact domestic dog population dynamics and highlights the need to examine ownership practices. Understanding the role of dogs and their care within these communities is important for planning and implement rabies control measures such as

CAUSES OF MORTALITY IN BABOONS AT GOMBE NATIONAL PARK: THE ROLE OF INTRINSIC FACTORS, PREDATION, DISEASE, AND CONFLICT WITH HUMANS.

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A population of between three and nine baboon-groups has been studied in Gombe National Park since 1967. This study has relied on identifying individual baboons and tracing their life histories. Although many of these individuals eventually died undetected, there is a proportion for whom some details were available, (for example, last seen ill, or badly wounded). For a still smaller proportion of those, was known the type of illness, or the cause of the wounds. Others were found dead, and recent (undecayed) carcases have been examined to discover the cause of

death. And for other individuals, their deaths were actually observed (for example, from predation). We will present data showing the proportions of different known causes of death, and their changes over time. For both sexes, mortality is high in early infancy, particularly for firstborn infants. During juvenile life, at ages 3-5 years, mortality rates are low for both sexes. However more deaths occur during adult life, especially so for males, apparently related to their migrating to new groups, competing for high dominance rank, and fighting over oestrus females. Whereas for adult females, among whom conflict is less intense, but reproductive costs much higher, deaths are more evenly distributed with age, and most live longer than their male peers. Causes of death which will be reviewed are illness (in which *Schistosoma*, *Treponema*, and possibly *Strongyloides* and *Paragonimus* are implicated), predation (chiefly by chimpanzees), failure of maternal care (through maternal incompetence, illness, or death), socially induced mortality (wounding in fights, infanticide, kidnapping of infants), and old age (23-26 in males, 27-28 in females). However another important factor is mortality caused by interaction with humans at the research centre and tourist facility, in which conflict over unprotected food supplies, and insecure trashpits, sometimes lead to deaths.

HEALTH AND DEMOGRAPHICS OF AFRICAN BUFFALO (*SYNCERUS CAFFER*) IN RUAHA NATIONAL PARK, TANZANIA

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The African buffalo (*Syncerus caffer*) population of Ruaha National Park may be in decline, but little information is available on the ecology and health of the population. Seasonal drying of the park's water source due to upstream irrigation may have caused loss of dry season habitat, increased pressure on remaining water sources, and possibly increased contact between wildlife and livestock at the park borders. Ruaha National Park is collaborating with the Health for Animals and Livelihood Improvement project toinvestigate the health and population status of African buffaloes in Ruaha. Between 2011 and 2015, this partnership has resulted in testing 30 young and 10 adult African buffaloes for bovine tuberculosis (2011, 2014), conducting 3 dry season demographic surveys and herd level parasite screenings (2011, 2013, 2014), and conducting one aerial population survey in collaboration with the Tanzania Wildlife Research Institute (2013). In October 2014, 10 adult female buffaloes were collared with satellite GPS collars to learn more about the seasonal movements, habitat preferences, and herd dynamics of Ruaha's buffalo herds. The research hasshown that bovine tuberculosis and brucellosis is present in the buffalo population, that the population number appear to be reduced since the last total count in 2004, that the herd composition may be influenced by seasonal rainfall, and the herd level gastrointestinal parasite counts generally are low. The collar data has shown that some herds leave the Rift Valley in the wet season, and that herds inhabit fairly distinct areas within

the park. The data generated in this study will be used to inform management and conservation of Ruaha National Park's buffaloes.

SYSTEMATIC SURVEILLANCE AND CAPACITY STRENGTHENING TO DETECT EMERGING VIRAL ZOONOSES OF WILDLIFE ORIGIN IN TANZANIA

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Emerging zoonotic diseases pose a global threat to human and animal health, as the majority of emerging zoonoses come from wildlife. Increased interaction between humans, livestock, and wildlife due to human population growth and other influences can amplify the potential for disease transmission among these host groups, e.g. the recent Ebola outbreaks in Central and West Africa. From 2009-2014, the USAID-funded PREDICT project, a partnership in Tanzania between Sokoine University of Agriculture and University of California Davis, implemented a systematic viral surveillance approach in wildlife. PREDICT improved awareness of the presence of high-risk human-animal interfaces, targeting animal sampling in key taxa at prioritized sites representing Tanzania's biological and geographic diversity and building the infrastructure and human resource base for the detection of emerging viruses of pandemic potential. PREDICT collected samples from a total of 1,753 animals (650 bats, 632 rodents, 251 nonhuman primates, and 220 samples from other taxa). Through PREDICT's novel diagnostic approach designed to detect virus at the family level using broadly reactive consensus PCR, samples were screened for 10 viral families/genera including Arena-, Corona-, Filo-, and Influenza viruses to identify known and emerging pathogens. Findings included a novel Arenavirus and strains of the known Arenavirus, Morogoro virus, detected in rodents in the Ruaha Ecosystem, multiple novel and known Paramyxoviruses, Coronaviruses, and Influenza viruses in bat and rodent populations throughout the country. Novel viral findings are awaiting further characterization to determine potential public health and conservation implications as the project continues into the next five years.

FREE FROM THE COLD-CHAIN? A RABIES VACCINE THERMO-STABILITY TRIAL

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The overarching goal of this study is the global elimination of human rabies through domestic dog vaccination. To facilitate this novel vaccination models, such as community-led initiatives, will be required. Currently in remote areas of Africa this is not possible because the temperature sensitive vaccine requires cold-chain conditions not available in poor communities. A solution to this will be the development of thermo-stable vaccines that can be stored outside of the cold-chain where refrigerators aren't available. As with rinderpest eradication, this would enable communities to manage their own rabies control initiatives. The specific objective of this study, therefore, was to carry out a bioequivalence trial to determine if, following storage under different temperatures, the Nobivac® rabies vaccine retained its efficacy at eliciting a protective serological response. Mass dog vaccination campaigns were hosted in villages surrounding Babati Town during which 390 dogs were recruited. Each had a blood sample taken and received a vaccination that had been kept under temperature specific conditions. After 28 days a second blood sample was collected. Serological assays are currently being performed which will enable the calculation of the proportion of dogs in each treatment group that have produced the minimum protective antibody titre (0.5 IU / ml) and the mean rabies antibody titre for each group. The results are expected imminently and will be reported. The fate of the null hypotheses, that storage does affect i) the proportion of dogs that develop protective immunity and ii) the rabies specific antibody titres, will be determined and conclusions regarding the efficacy of the vaccine stored under non cold-chain conditions drawn. If the vaccine is thermo-stable this will have significant impacts on global rabies elimination efforts, as it will enable the design of novel participatory vaccination initiatives with a reach extending into remote communities where rabies remains endemic.

SEROPREVALENCE OF TUBERCULOSIS IN DOMESTICATED ELK (*CERVUSCANADENSIS*) IN KOREA

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Tuberculosis is a contagious disease in animals, primarily cattle, although it also affects wild

animals and humans. There are few data on the state of tuberculosis in domesticated elk (*Cervuscanadensis*) in Korea. In order to investigate tuberculosis in elk, the performance of an enzyme linked immunosorbent assay (ELISA) using MPB70 and MPB83 antigens was compared with the tuberculin skin test (TST), and seroprevalence was measured with this assay using serum samples collected from domesticated elk herds in Korea. The respective sensitivities of the MPB70 and MPB83 ELISAs were 51.9% (95% CI: 42.0–61.6) and 49.1% (95% CI: 39.3–58.9), and the specificities of MPB70 and MPB83 ELISAs were 100.0% (95% CI: 92.8–99.8) and 97.9% (95% CI: 88.9–100.0) in comparison with TST. The herd prevalence ranged from 50–80% and the mean herd seropositive rate was 67.7% (21 of 31). Of 819 serum samples, 163 (19.9%) were seropositive, and seroprevalence ranged from 18.5–58.0%. In conclusion, the ELISA using MPB70 and MPB83 antigens showed moderate sensitivity and high specificity in elk, and tuberculosis was assumed to be fairly prevalent in domesticated elk in Korea.

PRELIMINARY FIELD AND LABORATORY OBSERVATIONS OF THE EFFECTS OF HANDLING STRESS OF NATURAL POPULATIONS OF THE PANCAKE TORTOISE (*Malacochersus tornieri*)

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The pancake tortoise, *Malacochersus tornieri*, is the most exploited of east African terrestrial chelonians. Despite of the previous excessive collection of the species in Tanzania, effects of handling stress remains unevaluated and nothing is known. Understanding of the effects of stress and stressors of animals is important in order to address animal welfare, during exploitation, transportation and ultimate captive environment. The study was therefore conducted around Vilima Vitatu area, in north-western boundary of Tarangire National Park, in May 2015 with the following objectives: i) evaluate proportion of sampled individuals with faecal elimination as a response to handling, ii) determine relationship between faecal wet mass, water content in the wet faecal mass, and tortoise body weight, iii) determine amount of water lost by tortoises through faecal elimination. Thirty one pancakes were handled, out of which 22 (70.97%) had faecal elimination, and these were significantly greater than those without faecal elimination (n=9, 20.3%) (χ^2= 5.4, df=1, $p<0.05$). Average percentage of water contained in the faecal wet mass was 83% (range: 69.81% - 97.3%, n=22). While a paired t-test indicated a significant difference between wet and dry faecal mass (t=3.4, df=21, $p<0.05$), there was no significant difference between wet faecal mass and mass of water content (t=2.04, df=21, $p>0.05$). Weak correlation existed between tortoise body mass and wet faecal mass (r=0.25), but quite strong correlation was found between faecal wet weight and weight of water contained in the faeces (r = 0.99). Implications of these results, regarding species handling management, are discussed.
Key words: Field Observation, Handling Stress, Natural Populations, Pancake Tortoise

DETECTION OF ARENAVIRUSES IN RODENT AND SHREWS FROM SELECTED WILDLIFE-HUMAN INTERFACES IN TANZANIA

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Arenaviruses are RNA viruses, sometimes responsible for viral hemorrhagic fevers in humans and animals. We investigated viral shedding of Arenaviruses by rodents and shrews in areas with high potential for contact between wildlife and people to compare shedding of Arenaviruses in paired fecal and oropharyngeal specimens. Rodents and shrews were sampled at a subset of the wildlife-human contact interfaces targeted by the PREDICT project (Ruaha, Kilombero, Mtwara, Mbeya, Mbinga and Mikumi). As Arenaviruses can be shed in saliva and feces, oropharyngeal swab and feces or rectal swab specimens were respectively collected from a total of 121 animals (114 rodents and 7 shrews) for viral detection. Specimens were screened for Arenaviruses using consensus polymerase chain reaction (PCR) with family level primers, and cloning and sequencing were used to confirm and characterize positive samples. Of the 121 animals, 7 (5.8%) were shedding Arenavirus at the time of sampling. All of these animals were captured in the Ruaha ecosystem (Iringa District) in agricultural fields or around dwellings. Of the infected animals, 6 (86%) were *Mastomys* spp., which have been identified as reservoirs of Arenaviruses in diverse areas of Africa. Age and sex were not significantly associated with Arenaviruses shedding ($p>0.05$). Detection of Arenaviruses in fecal and oropharyngeal specimens was similar, suggesting that both specimen types may be effective for Arenavirus screening in rodents. Based upon phylogenetic analyses, six of the animals were shedding strains of the known Arenavirus, Morogoro virus, and one rodent was shedding a novel Arenavirus. Although the zoonotic potential of the detected Arenaviruses is currently unknown, other viruses within this family can cause severe human illness. Further investigation of the Ruaha ecosystem site where positive rodents were found would help to increase our understanding of the ecology and epidemiology of Arenaviruses in rodent hosts, other animals and human populations.

SERO-PREVALENCE AND SPATIAL DISTRIBUTION OF RIFT VALLEY FEVER IN HUMANS RESIDING IN AGRO-PASTORAL AND PASTORAL COMMUNITIES DURING INTER-EPIDEMIC PERIOD IN THE SERENGETI ECOSYSTEM, NORTHERN TANZANIA

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Rift Valley Fever (RVF) remains an important public health problem as it may result to loss of human's life and cause severe destruction to livestock export trade across the continents. The last outbreak (2006/7) was most devastating, causing 141 human deaths out of 309 cases, with thousands of abortions and deaths in domesticated animals. Recent study in the Serengeti ecosystem shows active circulation of virus in insects, domestic and wildlife communities. This study determined the sero-prevalence and its spatial distribution, knowledge and demographic factors associated with RVF disease in humans residing in the Serengeti ecosystem. Hospital based cross-sectional study that involved agro pastoral and pastoral community and was conducted in the Serengeti ecosystem. General exposure status (IgG) was analysed by using competitive ELISA while recent infection (IgM) was analysed by capture ELISA. Questionnaires were used to collect demographic information as well as community knowledge regarding disease transmission. Data was entered, validated and analysed using Epi-info 7. A total of 751 study respondents were enrolled in the study. Their median age was 35.5 with a range of 5-90, female constituted 58.5% while age group 30-49 contributed 51% of all respondents. Of them, 34 tested for IgG giving a prevalence of 4.5%. Of the 34 that tested positive for (IgG), 6(17.6 %) tested positive for IgM. Sero-prevalence was high in pastoralist (9.8%) p=0.008 and in Ngorongoro district (8.1%) p= 0.003.There was very low knowledge of disease in the community with only 4.9% of respondents with good knowledge of RVF disease. All knowledgeable respondents were males. Increase in age shows a significant relation with knowledge of the disease. The study found both previous and recent exposure of RVF in humans residing in the Serengeti ecosystem. Ngorongoro district, especially in typical pastoral communities were most vulnerable to the disease. There was low knowledge of disease among the community members. Therefore, there is possibility of outbreak occurrence as virus circulates in community with poor knowledge of RVF disease.

SUB-THEME: BEEKEEPING, BEE ECOLOGY, BEE PRODUCTS AND POLLINATION SERVICES

CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE BEEKEEPING LIVELIHOODS IN MIOMBO WOODLAND OF MLELE DISTRICT, WESTERN TANZANIA

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Beekeeping is considered to provide livelihood opportunities for a considerable number of local communities in Tanzania. This study was conducted in Inyonga Division of Mlele District, July 2014. Mlele District located in Katavi Region in the western Tanzania and is one of the remote areas recognized as among the higher potential areas for honey production in the Miombo Woodlands. . The study aimed to assess challenges and opportunities for sustainable beekeeping among the rural community. Participatory questionnaire survey, Focus Group Discussion, and Key Informant Interviews were used during data collection. A total of 101 beekeepers were interviewed from purposively selected three villages. Results indicated that traditional beekeeping is widely used in the area with bark hives being highly used (63%, n=11,928). Main challenges identified were lack of beekeeping equipment (20.4%, n=101), prolonged droughts (14%), unreliable market and price fluctuation (8.9%), long distances to bee apiaries (8.9%) and lack of enough capital (7.2%). Tree cutting, tree debarking, use of fire during honey harvesting were reported as major cause of loss of both flora and fauna species that also limit beekeeping in the area. Main opportunities included presence of beekeeping groups, 101 beekeepers who responded, 91.4% belonged to beekeeping groups. Other opportunities observed were; Government willingness to support beekeepers, market availability, availability of skilled beekeepers and presence of extensive miombo woodlands. The study thus conclude that, though there are many challenges, however with the existing opportunities, the area can produce more bee products if identified opportunities are fully utilized and sustainable beekeeping is promoted.

Key words: Beekeeping, Challenges, Opportunities, Livelihoods

CURRENT CHALLENGES OF BEEKEEPING SECTOR IN TANZANIA

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Beekeeping history in Tanzania dates back during colonial period from the late 1880s to 1960s. Beekeeping sector has metamorphosed through several stages in its quest to contribute to Gross National Product (GDP) and urban and rural livelihoods. Colonial times and early years after

independence, it was run without policy and legal framework. In 1998, the first beekeeping policy was developed to enhance the contribution of beekeeping for sustainable conservation and management of natural resources. Beekeeping Act No. 15 of 2002 was enacted to provide appropriate legal framework to implement the national beekeeping policy. Currently, Tanzania ranks second in Africa after Ethiopia and 10 among top countries in the world. It is haphazardly estimated that only 3.5% of its potential in beekeeping is utilized with only archaic 9.2 million bee colonies. The study was carried out in 21 districts in nine geographical zones of Tanzania mainland. Data were collected using structured questionnaires, Key Informant Interviews and direct observations; Data was analyzed qualitatively and presented in tables and charts. Results from this study showed that there are critical decline in bee product production compare to the total country's beekeeping potential. This requires a thorough research in order to suggest actions towards enhancing sustainable production of bee products;–Key challenges includes: (i) poor beekeeping practices (ii) poor markets for bee products (iii) uses of bee products (iv) bee pests and diseases (v) poor understanding of legal and regulatory frameworks and, (vi) lack of appreciation and realization of the contribution of pollination services to improved agricultural and forest goods, services and health. These challenges remain to be provoked by researchers both in beekeeping, forestry, agriculture and manufacturing industry sectors.

Key words: Beekeeping, bee products, Beekeeping policy, Conservation, Beekeeping Master Plan.

SUB-THEME: NATURAL RESOURCES GOVERNANCE AND INFRASTRUCTURE DEVELOPMENT

IMPACTS OF THE TANZANIA - ZAMBIA TARMAC ROAD ON WILDLIFE ROAD KILLS AND WASTEIN MIKUMI NATIONAL PARK

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This cross sectional study was conducted in Mikumi National Park to establish the magnitude, spatial and temporal trend of road kills, vehicle speeds and time spent by vehicles to cross the park as well as impact of waste in the park. Results showed that, in a period from April to June, a total of 86 wildlife were killed [an average of 29 per month and mainly mammals (56)]. The most killed species were birds, yellow baboons, African hare and miombo genet. Adult animals were more killed than young/juveniles ($P<0.05$). Long term data analysis showed that the number of animals killed has increased from 3 animals per month in the 1970's to 29 animals per month in 2014. The average day speed of vehicles calculated at the two gates was 77km/hr (Lories) to 105km/hr (for SUVs and saloons); which was over the park recommended day speed of 70km/hr. Similarly, the average day speed of vehicles recorded using a speed gun at various random points was 63.34km/hr (Lories) to 90km/hr (for SUVs and saloons); which was also over the park recommend day speed. The average time spent by vehicles to cross the road section in the park during the day was 30 minutes (mini-buses) to 37 minutes (lories); which was above the park recommended time of 50 minutes. The average total number of vehicles passing through the road section per day was 1,991 (average of 83 vehicles/hr); the average amount of waste

collected on the road section per day was 138.3kg (4,149kg/month). The majority of waste by volume was plastic bottles while by weight it was tire and tubes (70.4%) and glasses/mirrors (10.3%). It is concluded that the impacts of the road in terms of wildlife kills and waste in the park is huge and increasing steadily over time.

Key words: road kills, wildlife, waste, Mikumi, Tanzania

THE IMPACT OF THE TANZAM HIGHWAY ON DIET, RANGING AND FORAGING BEHAVIOUR OF YELLOW BABOONS IN MIKUMI NATIONAL PARK

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The Tanzam Highway transverses Mikumi National Park and has been a focus of concern for wildlife managers since it was first paved in 1973-4. Since the road was upgraded in 1989-90; ABRU, TANAPA and TAWIRI observers have documented increasing traffic resulting in considerable animal and human injury and mortality. Baboons including the Viramba troops studied by the Animal Behaviour Research Unit (ABRU) are known to use the road. In addition to the risk of injury and mortality, road use could potentially alter the natural diet and behaviour of baboons. Using data from a two year study of feeding and foraging we test the extent to which baboons feed on exotic and anthropogenic sourced foods from the highway. Exotic road food of all types was less then 3% of observed feeding intervals out of nearly 38,000 intervals. We examine the potential and real effects of the Tanzam Highway on baboon social groups and the Mikumi population. We suggest that road effects on foraging, diet and overall behaviour is slight but ranging and habitat use may be altered by the nature of the road and it's location near the sleeping site tree refugia.

Keywords: Yellow baboons, Tanzam highway, habitat use, social groups, Mikumi population, overall behaviour.

PERFORMANCE OF WILDLIFE CONSERVATION APPROACHES IN NORTHERN TANZANIA

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The Tarangire-Manyara ecosystem in Northern Tanzania contains a patchwork of conservation and land-use utilisation approaches. Unfortunately, we know little how different conservation approaches affect wildlife populations and which measurable wildlife parameters effectively mirror conservation performance. To address these questions we estimated illegal hunting pressure, and assessed behaviour, population densities and community structure of large mammals in different multiple-use areas and national parks. Evidence for anthropogenic drivers of wildlife declines (hunting and livestock) was highest in the game controlled area (CA), immediate in a pastoral area (PA) and lowest in national parks (NP). Large mammal species richness in PA and NPs were similar but the mammal community was considerably impoverished in CA. Most, but not all large mammal species showed a gradual adjustment of responsiveness towards humans according to conservation status and were most responsive in CA and least responsive in NPs. However, behavioural budgets of common herbivores did not differ consistently between study areas. Matched comparisons of population densities revealed that CA and PA occasionally held higher species-specific densities than adjacent NPs. Most wildlife populations in the study areas have remained fairly stable in the past decade but current wildlife densities are below historic baselines. Results suggest that only species richness unambiguously reflected the level of human disturbance in a management unit. In this dynamic and fragmented ecosystem, potential early warning indicators of human exploitation were not reliable indicators of conservation performance, highlighting the need for ecosystem-wide monitoring and management of threats and wildlife populations.

EFFECT OF LAND COVER–LAND USE CHANGE ON ABUNDANCE OF LARGE HERBIVORES IN THE NATIONAL PARKS IN TANZANIA

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Large herbivores prefer certain types of land cover and their components during different seasons, and stability of their populations is determined by quantity and quality of heterogeneous habitats available for their utilization. The paper examines how land cover change relates to the abundances of elephant, giraffe, and zebra from the 1980s to 2010s in Katavi and Tarangire National Parks, Tanzania. To address this goal we sought to answer three key questions: 1) have

landscape metrics changed over time, both inside and outside the national parks; 2) if changes have occurred, are the patterns of change similar across parks; and, 3) are the abundances of large herbivores related to specific land cover metrics? Seven types of land cover types utilized by large herbivores were identified and four landscape metrics (class area, number of patches, mean patch size, mean distance between land cover patches) were computed for each cover type. Metrics for each type were analyzed using general linear models (GLM). Open shrubland, closed shrubland, woody savannah, and grassland all changed significantly over the years. Elephant, giraffe, and zebra abundances were positively related to changes in land cover class and/or number of patches. Closed shrubland and woody savannah declined between the 1980s and 2010s, where woody savannah appeared to influence the densities of zebra and elephant. Results suggest that land cover homogenization, reduction, or loss of can have a profound effect on species population.

Keyword: Landscape metrics, landcover, large herbivores, Katavi, Tarangire

PERCEPTIONS OF THE MAASAI INHABITING THE LOLIONDO DISTRICT OF TANZANIA REGARDING AGENCIES INVOLVED IN THE PROCESS OF CONSERVATION-BASED LAND-USE PLANNING

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Conservation of wildlife within protected areas (PAs) generally is best accomplished through a holistic approach that integrates PA-conservation practices in a manner that complements land-use planning in adjacent communities. Land-use planning in areas neighboring PAs may be confounded by conflicts with residents regarding past, present and future use of the land. Conflicts often are associated with conservation of the landscape for wildlife and use of the land by local people. Understanding the perception of residents towards agencies responsible for managing PAs is therefore imperative for minimizing conflicts related to land use. This paper reviews results of social human-dimension surveys conducted in 2013 with residents of 4 Maasai villages in the Loliondo district of Tanzania, focusing on the Maasai's familiarity, perception of, and trust of governmental agencies involved with land use and land-use planning (in this case Tanzania National Parks Authority [in this case specifically pertaining to Serengeti National Park [SNP)] and Ngorongoro Conservation Area Authority [NCAA]). Generally, the Maasai were well informed about missions of these agencies. Many Maasai indicated that preservation of wildlife and the landscape within SNP and the Ngorongoro Conservation to be a source of national pride and that the agencies should persist in their current form, but many also expressed an underling level of distrust towards SNP and NCAA. This distrust was based on the dominant perception that one private business had excessive influence on SNP, NCAA, and other levels of governmental land-use decision makers regarding land-use policy, especially in relation to access to big game hunting this is just too long to be once sentence. Dissect them into short but

meaningful sentences. Issues pertaining to boundaries and wildlife corridors (generally related to limited access of livestock to grazing) were other common concerns expressed by the Maasai. We discuss and review issues the complexity of conserving wildlife and achieving support from the Maasai in regards to land-use planning in the Loliondo district.

Key words: Conservation agencies, , Land-use conservation, Land-use planning, Loliondo district, Maasai, Tanzania

NATURAL RESOURCES GOVERNANCE IN A MULTIPLE USE PROTECTED AREA, MLELE BEEKEEPING ZONE – KATAVI REGION

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Populations of Inyonga Division have limited rights concerning access, benefits and management of natural resources as most of the lands are protected areas with status of Forest Reserve and Game Controlled Area. This situation, combined with important population growth, has led to an increased predation on natural resources and permanent conflicts between stakeholders. Aiming to address this issue a Swiss NGO, Association for Development of Protected Areas (ADAP), has supported a community based natural resources management project since 2002. Objectives were to empower communities toward natural resources access and management, enable cohabitation between users and ensure sustainable uses of natural resources. ADAP implemented different activities: support to a sustainable village based beekeeping industry; support to the establishment of an area co-managed by a community organization, Inyonga Beekeepers Association (IBA), District and Villages; capacity building for IBA and Village Natural Resources Committees. After more than a decade activities, results are: - Establishment of Mlele Beekeeping Zone (MBKZ), 850 km2 within a forest reserve, through Memorandum of Understanding signed between IBA and the Ministry of Natural Resources and Tourism – Forestry and Beekeeping Division;- 3000 beekeepers trained to modern beekeeping. The quality (IBA honey meets International standards and price was multiplied by ten) and quantity (production raised from 7 tons in 2002 to 100 tons in 2013) of honey were improved; Conflict resolution between villagers' stakeholders through implementation of village land use plan; 30 Village Game Scouts trained for anti-poaching and ecological monitoring (camera traps); Ecological surveys of MBKZ confirmed the presence of 53 medium/large mammals species, mentioned 124 tree species and a diversity index of 6.89, indicating well preserved forests.The remaining challenge to be addressed concerning MBKZ' governance is covering the management costs in an independent manner. One solution could be a clear benefit sharing agreement regarding permit and license fees and penalties between IBA, District, villages and

MNRT. Another challenge is to transfer more power to IBA regarding permits and licenses issuance. The multiple legal status of MBKZ is challenging, nevertheless, this multiple uses situation does not hinder a sustainable management and protection of ecosystems. This could even be a new way of thinking low status protected areas in Tanzania to ensure a governance of natural resources that addresses current social stakes.

INDIGENOUS KNOWLEDGE UTILIZATION AND LAND USE IN TANZANIA: THE CASE OF USAMBARA MOUNTAINS

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Utilization of Indigenous Knowledge (IK) in forests is mostly manifested in the local level of forest management, and more used by those who directly depend on forest resources. Rural dwellers have for a long time developed ways to interact with forest and forest products for their survival. Ways which created a sense of forest ownership to the local people, supported their livelihood, and sustained forest needs from one generation to the other. These ways are referred to as IKs and has for long defined forest people interactions in the rural areas. Unfortunately, IK is perceived to lack scientific bound, a weakness that is used by forest scientist and manager to make conservation of forest without considering its existence. As a result, local ways of interacting with forest are eroded and washed away. They are not considered significant during forest decisions, hence compromising local people's forest needs and change ownership of the forest from people cantered to conservators cantered. Although scientific, Eurocentric forest conservation aims at attaining sustainable supply of forest services, the rate of forest degradation seems to increase year after year. This called for a need to investigate on decision of forest management with the aim of identifying IK and their relation to forest management. Remote sensing and Geographical Information Systems were applied for land use cover changes assessment, Focus Group Discussion was also used to capture IK. The results reveals existing of forest related IK aspects in eastern Usambara Mountains, however, there is no manifestation of IK utilization in forests. It is recommended to consider utilization of IK in forest for reduced forest degradation and sustained people's livelihoods

Key words; Indigenous Knowledge, Forest Management, Decision Making, Rural Communities

AN OVERVIEW OF ENVIRONMENTAL DATA AND DATA OWNERS IN THE COASTAL AREA OF TANZANIA – AN EMERGING ENVIRONMENTAL SPATIAL DATA INFRASTRUCTURE

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Environmental data management is a crucial part of any decision making related to the local, regional, national and global aspects of the environment. Several studies indicate that traditional policies for data management, or lack thereof, are obstructing the development of adequate responses to rapidly expanding human economic activity. Infrastructure development is one such activity. Lack of such information or the coordination thereof can have impacts on wildlife management, both terrestrial and marine. The National Environment Management Council (NEMC) in Tanzania has, together with the Norwegian Environment Agency (NEA), taken steps to establish an overview of coastal environmental information. This paper describes the results of a survey made by the consulting company COWI Tanzania in April to July 2015. Through contact and interviews with 41 institutions, we have documented available data sets with subject, categories, access restrictions, formats and more. We have also mapped the institutions' willingness to contribute to a national environmental information network (EIN). Management of environmental information in Tanzania has so far not been coordinated using standards for exchange of data or registration of metadata. Nor has there been any centralized efforts to establish standardized open access registries of environmental information. Based on interviews and advice from UNEP a way forward for establishing a shared data infrastructure for environmental in formation in Tanzania is proposed. Consequences for wildlife management and the land use planning are described.

AVIAN FLIGHT HEIGHTS ACROSS POWER LINES IN DAR ES SALAAM

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In recent years, Africa has experienced an increase in power generation projects. However, such development projects come with their negative side on the environment. For example, electrocution and collision with powerlines has become one of the causes of mortality to populations of large terrestrial birds. Many species of birds are especially vulnerable to collision with high voltage transmission lines because of the height of these structures with respect to flight altitudes. Despite the increased power lines networks, there have been very little or no

studies on the flight heights of birds in relation to power lines. From December to February 2015, we studied flight heights of local birds as they commuted across low (LVP, 33KV) and high (HVP, 132KV) voltage power lines in Dar es Salaam. In additional to avian flight heights, we also studied their behaviours as they approached the power lines. The two power lines haddifferent heightsfrom the ground(13m *versus* 24m) but we targeted birds that passed between 8m and 29m recording whether a bird passed below, between or above the cables. Using the abundance of birds that crossed the powerlines, we found nopreferred flight height at LVP and HVP although all egrets passed above the cables. Changing of flight heightsas birds approached power lines was recorded only for egrets whereas collision was observed only for Indian House Crow and House Sparrow. Species which moved in large flocks were more vulnerable to collision than smaller ones. We recommend that before any installation or erection of power lines, investigation on birds' routes (migratory and local movement to roosts/foraging sites) must be conducted first. Use of underground connections and wire-marking at sensitive locations can help to reduce the impact of power lines for local and migratory flying animals especially birds.

INDIGENOUS KNOWLEDGE UTILIZATION AND LAND USE IN TANZANIA: THE CASE OF USAMBARA MOUNTAINS

SUB-THEME ETHNO-BOTANY AND VEGETATION ECOLOGY

DRIVERS OF TREE COMMUNITY COMPOSITION AND DEMOGRAPHY OF *ACACIA ROBUSTA* AND *ACACIA TORTILIS* SEEDS IN SERENGETI NATIONAL PARK.

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Savannas are spatially diverse and susceptible to high rates of disturbance from fire and herbivory. While most studies in savanna have focused on tree/grass ratios and factors driving the dichotomy, less has been done to determine what drives species composition across environmental gradient and the role of seed stage in shaping the savannas. It is not clear how limitations such as production, infestation, viability, germination and dispersal are influenced by rainfall and what role they play in species composition turnover. Assessment on species compositional change across multiple environmental gradients in Serengeti National Park was done and the influence of long term rainfall gradient on seed limitations was tested. Quantification of the seed bottlenecks for two dominant tree species, *Acacia tortilis* and *Acacia robusta* was done and the analysis for their relationship with long term rainfall was done. Results showed that tree community composition is largely driven by mean annual precipitation and to a lesser extent by elephant population density. Non-metric multi-dimension scaling analysis showed that *Acacia tortilis* dominates the dry end of the ecosystem while *Acacia robusta* dominates the wet end. Fire showed no significant effect on species composition.Seed

survival bottlenecks differed between species within years showing no consistent patterns. Against expectations, infestation did not completely inhibit germination. These results provide only weak support for rainfall-mediated effects on seed limitation for observed species turnover across the Serengeti rainfall gradient in adult trees, suggesting that post-germination filters may be more important.

Key words: *Acacia*, Serengeti, species composition, bottom-up factors, savanna, structural equation modeling, top-down effects

HOW TO LIVE WITH INVASIVES? POSITIVE ENVIRONMENTAL AND CLIMATE MITIGATION EFFECTS OF *PROSOPIS JULIFLORA* IN ETHIOPIAN RANGELANDS

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Invasive alien species are of global concern as they are often detrimental to native fauna and flora. In Ethiopia, rangelands are being invaded by Prosopis juliflora, a woody encroacher species, which drastically reduces forage productivity in already overgrazed areas. Little research has been conducted to quantify the environmental effects of its invasion and to date management strategies have been rather unsuccessful. We investigated the prevalent soil physical and chemical properties, soil seed bank, vegetation composition, biomass and Carbon (C) stocks across sites of different P. juliflora encroachment categories in the Afar region, Ethiopia. Plant species richness was reduced while overall plant biomass and above- and belowground C stocks were more than three times higher in highly infested sites compared to sites without P. juliflora. Soil moisture, Phosphorus, Nitrogen and C stocks were highest in highly invaded sites. The soil seed bank was still intact under P. juliflora infestation, including a variety of native plant species. Low recruitment of P. juliflora in highly infested sites points towards self-thinning effects while plant population dynamics and remote sensing images show that P. juliflora is still spreading rapidly across rangelands. We conclude that soil properties of invasion sites are rather beneficial for reclamation and immediate use after removal of this invasive species. Management should focus on preventing P. juliflora spread and removal at freshly invaded sites rather than on already highly infested sites. After P. juliflora removal, immediate use and continuous monitoring and management of the restored sites is necessary to prevent resprouting and further invasion spread. Potential benefits through P. juliflora C stocks, provision of fertile soils, and forage production might outweigh labor costs for overall removal.
Key words: Carbon stocks; soil fertility; biomass; livestock; Eastern Africa

PHYLOGENETIC DIVERSITY OF PLANT COMMUNITIES AT MT KILIMANJARO IN RELATION TO ELEVATION AND HUMAN IMPACT

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Phylogenetic diversity is an important measure of plant community diversity complementing species diversity. It can improve our understanding of climate effects and human impact on natural habitats and inform conservation priorities. We studied the phylogenetic diversity of vascular plants in 30 natural habitats along an elevation gradient from 860 to 4600 m at Mt Kilimanjaro. We compared the phylogenetic diversity of the 30 communities of natural habitats (savannah woodlands, undisturbed montane forests, alpine vegetation) with 30 human-influenced habitats (maize fields, traditional home gardens, coffee plantations, grasslands, previously logged and previously burned montane forests). From systematic nomenclature we deduced a phylogeny of all 962 plant species from our sixty 20m by 50m study plots. These species belonged to 539 genera, 135 families, 48 orders and 6 classes. Average taxonomic distinctness (AvTD) and its variation (VarTD) were used as measures of phylogenetic diversity. In contrast to species richness, which declined linearly with elevation, AvTD showed a strong quadratic relationship across elevation forming a unimodal pattern peaking at mid-elevation between 2000-3000 m. VarTD also showed a unimodal elevational relationship which increased with elevation up to about 3500 m and then slightly decreased in the alpine belt indicating a more uneven distribution of taxa in the classification tree at lower and highest elevations. In the savannah and montane elevational belts, natural and human-impacted habitats harboured communities of similar phylogenetic diversity. In the lower montane zone both AvTD and VarTD were lower in human-influenced habitats than in natural forest. We concluded that structural diversity is more important than species diversity in shaping phylogenetic diversity. As we found the highest phylogenetic diversity in montane forests, which form part of Kilimanjaro National park, It was recommended that enforcing the National Park regulations is of highest conservation relevance, along with conserving remaining lower montane forests below the park is crucial.

Key words: Phylogenetic diversity, elevation, human-impact, Mt. Kilimanjaro

IMPORTANCE OF ETHO-MEDICINAL PLANTS AMONGST THE IRAQW OF THE KARATU DISTRICT: Cultural and Conservation Implications.

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Medicinal plants are valuable in their provision of products that are used by communities in treating various ailments. However, most of the valuable medicinal plants are facing threat of

local extinction in the areas they have traditionally occurred, and in most landscapes the conservation status, the traditional knowledge of their utilization is often not understood. In this study, we document the conservation status, utilization by indigenous communities and threats to 32 species of medical plants in Buger village, Karatu District, using semi-structured interviews. Only 30.2% of indigenous community members indicated that they use ethno-medicinal plants to treat human diseases. The most common diseases treated by these medicinal plants were stomach diseases, common colds, menstruation, malaria and dental pains. Most of these medicinal plants were collected from small farms around the households. Matrix analysis showed that Mgunga moto (*Acacia mellifera)*, Msokoni (*Warburgiasalutaris*), and Durang (*Faureaspeciosa*) were the top ranked most important species used for medicine followed by Matsafi (*Fagaropsisangolensis*) and Garmo (*Acacia albida*). Results also showed that the use of ethno-medicinal plants is dependent upon education level but not on gender and age class structures. Young lack a detailed understanding of the value and importance of ethno-medicinal plants, Community members noted that these plants are decreasing on their availability in the area. Therefore awareness on young people on their values and knowledge on use will improve medicinal plants values and wide use among the communities in the area. It should be emphasized that controlled harvesting of these plants and conservation of the Buger Community forest will improve their sustainable availabilities.

Key words: Endabash area, Iraqw people, Plant utilization, human disease, medicinal plants,

FOREST EDGE EFFECTS FOR THE THREE GLADE TYPES IN MOUNT MERU GAME RESERVE

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Forest edges have conservation value due to differences in plant species composition, richness and diversity based on the habitat characteristics. This study characterized and compared the forest edge effects of five man-made, five upper and 15 lower natural glades in the Mount Meru Game Reserve. The plant species composition differed significantly between the three glade types. The edge effect was observed between 12.5 - 22.5 and 42.5 - 52.5 meters from the forest edge into the forest interiors of lower and upper natural glades respectively. Eight plant species (*Selaginella kraussiana, Plectranthus elegans, Cynoglossum coeruleum, Bersama abyssinica, Asplenium bugoiense, Nuxia congesta, Carrisa edulis and Clutia abyssinica*) were found to be indicator species along the forest edge of upper natural glades, one species (*Diospyros abyssinica*) were indicator of lower natural glades and three species (*Solanum incanum, Croton macrostachyus and Teclea nobilis*) were indicators of man-made glades. In summary, natural glades and their edges have high plant conservation value as compared to man-made glades due to high plant species abundance, richness and diversity and this rate the conservation value of

man-made glades to be low. Therefore, clearing of plants from the forest edges of man-made glades does not in itself contribute to plant biodiversity, although forest-edge plant composition, diversity and richness contributes to ecosystem heterogeneity which supports wildlife conservation.

Keywords*:* Conservation value, edge effects, glade types, indicator species,

THE DISTRIBUTION AND CAUSES OF ALIEN PLANT SPECIES IN SERENGETI NATIONAL PARK

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Understanding the factors for the introduction and spread of alien invasive plants is key to their control and management. We assessed the distribution and factors for the spread of alien plant species along 900 km road transects, tourist lodges and woodland areas in the Serengeti National Park (SENAPA) by recording the occurrence of each alien plant species in 10 x 10 m quadrants. The location of each sampling point was tracked using GPS and analyzed data with descriptive summaries and generalized mixed effects model. A total of twenty alien plant species were recorded, whereby six of them which include *Amaranthus hybridus, Bidens pilosa, Chromolaena odorata, Opuntia vulgaris, Datura stramonium and Tagetes minuta* were frequent. *C. odorata,* is a known fast invader of grazing lands, the existence of which in the SENAPA threatens the management of grazing land in the ecosystem. Most alien plants were frequently recorded along road sections (due to road grading) and settlement areas (due to waste damping), which was evidence that human disturbance contributed highly to the spread of alien plants in the SENAPA. Understanding how the ongoing human disturbance activities contribute to the spread of some potentially invasive plants in the Park is necessary for managing the spread. Furthermore, there is need for proactive control measures which involve community awareness creation before these species become widespread.
Key words: Serengeti National Park, Factors for distribution of alien and invasive plants, Conservation.

PROJECTED POPULATION GROWTH AND DEFORESTATION IN THE SERENGETI ECOSYSTEM

Aine Seitz McCarthy, Amy L. Damon and Brooke L. Krause

Population growth is one of the major causes of deforestation (Angelsen and Kaimowitz, 1999). In the Serengeti ecosystem in northern Tanzania, one of the world's most ecologically sensitive areas, it is imperative to understand of the dynamics of population growth and anthropogenic natural resource consumption. In the rural district of Meatu, the confluence of ecological

degradation and expanding families can exacerbate poverty through the scarcity of firewood. A dearth of this natural resource will necessitate increased time spent collecting firewood in place of agricultural or other productive activities. In our sample of twelve villages across the Meatu district, 99.5 percent of households use firewood for cooking fuel, all of which collect this firewood from nearby forests. The total fertility rate in the region is 8.6 births per woman (DHS, 2010). If the current natality trends continue in Tanzania, the population will triple by 2050. This study projects population growth on deforestation and discusses the potential for family planning and sustainable development to serve as a solution to mitigate the depletion of natural resources. The data used in this study comes from a three -year study analyzing the impact of a family planning program across twelve villages in Meatu. This study is part of a larger research project called Conservation Research in East Africa's Threatened Ecosystem (CREATE). CREATE aims to broadly understand the links between poverty, human health and environmental sustainability in key African ecosystems. In the 2012 Meatu household survey, 53 percent of households reported that they anticipate using slightly more firewood in five years. If households in this region continue to rely on locally gathered firewood for fuel, the growing anthropocentric needs will increase demands on the forest ecosystem. This paper discusses the implications of population growth and deforestation, and offers suggestions for community-based family planning programs.

DAY THREE: SEMINAR PAPER PRESENTATION

WHAT HAS SCIENCE EVER DONE FOR LAW ENFORCEMENT

Howard Frederick, Edward Kohi and Colin Beale

TAWIRI's Conservation Information Monitoring Unit (CIMU) has a long-term (40+ years) set of data from regular aerial censuses over many of the protected areas in Tanzania, providing estimates and maps of large mammals populations and some human activities. These data are used by many TAWIRI stakeholders – for management (TANAPA / WD / NCAA), ecological research (researchers, ecologists from anagement) and tourism. In the past, occasional (3-5 yearly) surveys providing basic maps and estimates were sufficient for management and research, but the change in the conservation landscape (increasing fragmentation nd human populations) and events (such as the Africa-wide elephant poaching crisis) may require that ifferent kinds of data are needed for long term conservation in Tanzania. This plenary session is intended to resent some recent information on wildlife censuses, review the methods that are in use and the new technologies and methods being trialled by TAWIRI-CIMU, and open a discussion with TAWIRI stakeholders on their needs and gaps in knowledge that could be filled by expanding the way in which data are gathered, analysed and presented. Specifically:

- How can detailed spatial data inform conservation of elephants?
- How frequently do we need to monitor our protected areas? Would more regular (but lower intensity and cheaper) surveys provide better information given the rapid changes we experience?

- What technologies (cameras, UAVs, ground-based methods) could complement what is already being done?