17th INTERNATIONAL ELEPHANT CONSERVATION & RESEARCH SYMPOSIUM

November 15-19, 2021

INTERNATIONAL ELEPHANT FOUNDATION.ORG

17th INTERNATIONAL ELEPHANT CONSERVATION AND RESEARCH SYMPOSIUM
NOVEMBER 15-19, 2021
PROGRAM

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MONDAY November 15, 2021

4:45 am – 5:05 am Entry into Zoom, morning "housekeeping" notes

5:05 am – 6:00 am **Keynote Address - Canopies, Corridors and Community**
Susie Weeks & Charlene Wandera
Mount Kenya Trust

Elephant Behavior

6:00 am – 6:15 am Agonistic interactions among adult male Asian elephants in Nagarahole-Bandipur, southern India
P. Keerthipriya

6:15 am – 6:30 am Social and seasonal factors contribute to shifts in male African elephant (*Loxodonta africana*) foraging and activity patterns in Kruger National Park, South Africa
Kara du Plessis

6:30 am – 6:45 am The role of calves in female Asian elephant social organization
T. Revathe

6:45 am – 7:00 am Ecology of agonistic interactions and dominance relationships in female elephant societies
Hansraj Gautam

7:00 am – 7:15 am The effect of moon phase and time of the day on movement patterns of Asian elephants (*Elephas maximus maximus*) in Wasgamuwa, Sri Lanka
Chandima Fernando

7:15 am – 7:30 am Sleeping pattern and preferences when lying down in a semi-captive population of African elephants
Maud Bonato

7:30 am – 7:45 am Discrimination ability of African elephants when using olfactory cues
Elena Mariotti

Elephant Physiology

7:45 am – 8:00 am Effect of the COVID-19 crisis on tourist camp management and elephant welfare in Chiang Mai, Thailand
Jarawee Suparta

8:00 am – 8:15 am Evaluation of stress on the basis of physio-clinical parameters in captive Asian elephants (*Elephas maximus*)
Madhvee Dhairykar

8:15 am – 8:30 am The effect of COVID-19 lockdown restriction on anxiety related behavior in semi-captive African elephants (*Loxodonta africana*)
Primrose Manning
8:30 am – 8:45 am The force is strong with the tusk
George Dian Balan
8:45 am – 9:00 am Biomechanics of the elephant trunk
Paule Dagenais

TUESDAY November 16, 2021

4:45 am – 5:00 am Entry into Zoom, morning "housekeeping" notes

Elephant Endotheliotropic Herpesvirus and Research
5:00 am – 5:15 am Elephant Endotheliotropic Herpesvirus is omnipresent in elephants in European zoos and an Asian elephant range country
Tabitha Hoornweg
5:15 am – 5:30 am Possibility of perinatal transmission of Elephant Endotheliotropic Herpesvirus
Yaoprapa Yun
5:30 am – 5:45 am Closing the gap on African elephant EEHV: Update from the San Diego Zoo Wildlife Alliance
Lauren Howard
5:45 am – 6:00 am Generating an immunogenic Elephant Endotheliotropic Herpesvirus (EEHV) vaccine
Jennifer Clinton
6:00 am – 6:15 am Evolving EEHV research priorities and the North American EEHV Advisors group
Priya Bapodra

Veterinary Medicine
6:15 am – 6:30 am Improving the detection and diagnosis of tuberculosis in African elephants (*Loxodonta africana*)
Tanya Kerr
6:30 am – 6:45 am Surgical removal of cystic calculi in an Asian elephant: A case report
Supaphen Sripiboon
6:45 am – 7:00 am Diet consumption shapes different profiles of gut microbiota in various age groups of Asian captive elephants
Sarissa Klinhom

Field Conservation
7:00 am – 7:15 am The millennial males: Adaptive social strategy of male Asian elephants in increasingly anthropogenic landscapes of southern India
Nishant Srinivasaiah
7:15 am – 7:30 am Conservation through the lens of elephant orphans
Rachael Murton, Mary Muyoyeta

7:30 am – 7:45 am Resurrecting an elephant migration route in Limpopo, South Africa
Marc Sherratt
7:45 am – 8:00 am Declining numbers of Bornean elephants (*Elephas maximus borneensis*) in Sabah Malaysia Borneo, due to unintentional and intentional poisonings
Kat Pirelli Zucchetta
8:00 am – 8:15 am Low-cost thermal early warning systems for human-elephant conflict mitigation
Alasdair Davies
8:15 am – 8:30 am Eavesdropping on African forest elephants: Passive acoustic monitoring as an effective conservation tool in Central Africa.
Daniela Hedwig
8:30 am – 8:45 am Assessing the trends of human elephant conflict in Keonjhar forest division, India using spatial-temporal analysis
Bismay Ranja Tripathy
8:45 am – 9:00 am Tracking forest loss and fragmentation between 1930 and 2020 in Asian elephant (*Elephas maximus*) range in Nepal
Ashok Ram

WEDNESDAY November 17, 2021

4:45 am – 5:00 am Entry into Zoom, morning "housekeeping" notes

Education/Community Engagement
5:00 am – 5:15 am Human elephant coexistence *HECx*: Advocating through awareness programmes in Tamil Nadu
Rengasamy Marimuthu
5:15 am – 5:30 am Living with elephants, a cultural shift towards coexistence
Walona B. Sehularo
5:30 am – 5:45 am Assessing perception of the local community towards the African savannah elephant and to determine the impact of PEACE Project education courses on participants and human-elephant conflict
Shannon Diener
5:45 am – 6:00 am Role of religious beliefs in elephant damage compensation claims: lessons from indigenous communities
Aritra Kshettry
6:00 am – 6:15 am The devastating impact of agriculture and its contribution to human elephant conflict in Sri Lanka
Ravi Corea
6:15 am – 6:30 am Protecting the elephants of Kibale National Park, Uganda through school-based conservation education programs
Elizabeth Ross & Emily Otali
6:30 am – 6:45 am Using participatory methods to investigate and support human-elephant coexistence in complex socio-ecological systems
Lynn Von Hagen

6:45 am – 7:00 am Elephant conservation in Mali in times of war and peace
Susan Canney
7:00 am – 7:20 am Conservation Lower Zambezi: An overview of programs to support communities while protecting wildlife
Ian Stevenson & Nikita Iyengar

7:20 am – 9:00 am Education/Community Engagement Roundtable
Those who live with elephants receive very few benefits from them yet experience enormous disadvantages in ruined harvests, damage to property and livelihoods, and even injury and death. To help in developing long-term solutions to the problems people face living with elephants, and we invite you to join us to discuss challenges and implementing effective solutions for elephant conservation.

THURSDAY November 18, 2021

4:45 am – 5:00 am Entry into Zoom, morning "housekeeping" notes

Human-elephant conflict

5:00 am – 5:15 am Utilizing drought forecasts to anticipate and mitigate human-elephant conflict
Victoria Boult
5:15 am – 5:30 am The use of deterrent fences and environmental correlates to alleviate human elephant conflict in southern Kenya
Sophia Corde
5:30 am – 5:45 Human elephant coexistence challenges and solutions in northwest Namibia
Christin Winter
5:45 am – 6:00 am Human elephant conflict mitigation measures: Lesson from Bardia National Park, Nepal
Rabin Kadariya
6:00 am – 6:15 am Using chili peppers as a mitigation tool or human elephant conflict in Africa
Loki Osborn
6:15 am – 6:30 am Bees on guard: Optimizing the impact of beehive fences around Kibale National Park, Uganda, through citizen science
Marianne Staniunas
6:30 am – 6:45 am Local data leads to local solutions for human-elephant competition for resources bordering a National Park in Botswana
Kate Evans
6:45 am – 7:00 am Efficacy of ex-gratia policy in mitigating human-elephant conflict in Odisha, India
Medha Nayak
7:00 am – 7:15 am Human elephant conflict (HEC) from a research perspective
Bruce Schulte, Chase LaDue

7:15 am – 9:00 am Human-elephant conflict Roundtable
Those who live with elephants receive very few benefits from them yet experience enormous disadvantages in ruined harvests, damage to property and livelihoods, and even injury and death. To help in developing long-term solutions to the problems people face living with elephants, and we invite you to join us to discuss challenges and implementing effective solutions for elephant conservation.

FRIDAY November 19, 2021

4:45 am – 5:00 am Entry into Zoom, morning "housekeeping" notes

Elephant Habitat
5:00 am – 5:15 am The role of African savanna elephants (*Loxodonta africana*) in seed dispersal and regeneration of woody plant species in Chobe National Park, Botswana
Kaelo Nkile
5:15 am – 5:30 am The potential of photogrammetric point clouds derived from conventional aerial survey for estimating tree heights within savanna ecosystems
Katie Thompson

Africa's Two Elephant Species
5:30 am – 5:45 am Pan-African population genomic analysis of savannah and forest elephants
Patricia Pečnerová
5:45 am – 6:00 am IUCN Red List assessments of Africa's two elephant species
Kathleen Gobush

Sociopolitical Perspectives
6:00 am – 6:15 am Addressing human and elephant conflict in northwest Uganda
Joanna Hill
6:15 am – 6:30 am Conserving the Asian elephant in range countries
Heidi S. Riddle
6:30 am – 6:45 am Public policy frameworks for elephant conservation
Kelly Dunning

International Captive Elephant Programs
6:45 am – 7:00 am Cheyenne Mountain Zoo's Role in the Palm Oil Crisis
Chelsea Wellmer
7:00 am – 7:15 am An Overview of the Asian Elephant Conservation Programme at African Lion Safari
Taryn Prosser
7:15 am – 7:30 am It takes a Village
Daryl Hoffman, Christine Molter
7:30 am – 7:45 am Welfare standards for elephants in human care: a multi-stakeholder initiative
Jake Rendle-Worthington

Conservation Partners

7:45am – 8:00 am Asian Elephant Support 2020-2021 Progress Report
Liz Beem & Mandy Ussrey

8:00 am – 8:15 am African Forest Elephant Foundation: Boots on the Ground
Christian Triay

8:15 am – 8:30 am International Elephant Foundation
Sarah Conley & Deborah Olson

Open Forum and Networking

8:30 am – 9:00 am

Canopies, Corridors and Community
Keynote Address
Susie Weeks, Charlene Wandera
Mount Kenya Trust

This year's keynote speaker is Susie Weeks, Executive Director of the Mount Kenya Trust. Leading them for the last 20 years, Weeks has spearheaded the Mount Kenya Trust workings with local people, government agencies and development partners for the conservation of the unique natural resources of Africa's second-highest mountain, a UNESCO Heritage Site, established in 1999. Extensive poaching of wildlife, logging of indigenous tree species, overgrazing and large-scale growing of marijuana were destroying the region. The Trust has been working around the mountain on a range of projects including:

• Forest restoration: Large-scale reforestation of indigenous trees species at many sites, with over 1.5 million trees planted, as well as woodlots, community tree nurseries and energy saving cook stoves for homes and schools;

• Wildlife conservation: Four anti-poaching teams based around the mountain, education projects, human-wildlife conflict mitigation, wildlife research, one-way elephant gates and the Mt Kenya Elephant Corridor that maintains landscape connectivity;

• Water management: rainwater capture and storage, and research into over-abstraction of rivers and water sources; and

• Community development: Environmental education, community health projects, income generating activities, agroforestry, and sustainable farming methods.

Agonistic interactions among adult male Asian elephants in Nagarahole-Bandipur, southern India

P. Keerthipriya S. Nandini, T.N.C. Vidya
Evolutionary and Organismal Biology Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India.

Asian elephants (*Elephas maximus*) have a polygynous mating system. Females are rarely available for mating (females are receptive for a few days every five years or so), and range over large areas. Therefore, mating opportunities for males are rare, and males are expected to compete fiercely for them. We used six years of observation on identified adult (>= 15 years of age) male Asian elephants in the Kabini elephant population in southern India to examine agonism amongst them. Dominance bouts between adult males were almost always resolved, and the initiator won most of the bouts, as expected in a socially complex species with high male-male competition. We had earlier found that old (>=30 years) nonmusth adults preferentially associated with each other in the absence of female groups and hypothesized that males might use these associations to settle dominance relationships between them when they were out of musth. In this study, we found that most dominance bouts between males of known musth statuses were between nonmusth males and occurred in female absence. Old males engaged in dominance with each other more than expected in female absence. Further, nonmusth males who associated more with each other also engaged in more dominance bouts, and most dominance bouts between nonmusth males occurred during associations (rather than as just dominance alone without associating before or after that). Thus, the associations made by adult nonmusth males, especially those in female absence, seemed to facilitate opportunities to test strength and settle dominance relationships. Dominance networks were somewhat sparse, as expected in a species in which males rove between social groups. However, dominance relationships were unidirectional and showed more transitive triads than expected by chance, indicating orderliness in dominance among nonmusth males. Factors such as male age, body condition, and tusk shape affected the probability of winning a dominance bout between nonmusth males. Overall, tusk length did not affect the outcome of agonistic interactions. Weapon morphology, thus, seemed to have a complex relationship with weapon performance. Musth was a strong (musth males almost always won over nonmusth males) but rare (only 16% of total bouts involved a musth male) advantage in dominance bouts in Kabini. Musth is thought to be a signal of aggressive intent and an investment in mating. Dominance bouts involving musth males occurred more in the presence of a female group, than in female absence. In another Asian elephant population (Kaziranga), in which male agonism had been studied, most dominance bouts had involved musth males, and tusk length had had a weak effect on the outcome of agonistic interactions. We suggest that these differences are due to the lower occurrence of musth and the much higher proportion of tusked males in the Kabini population.

Social and seasonal factors contribute to shifts in male African elephant (*Loxodonta africana*) foraging and activity patterns in Kruger National Park, South Africa

Kara du Plessis[1], Stefanie Ganswindt[1], Henk Bertschinger[2], Bruce Crossey[1], Michelle Henley[3,4], Mmatsawela Ramahlo[1] and André Ganswindt[1]
[1]Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, South Africa [2]Veterinary Population Management Laboratory, Section of Reproduction, Department of Production Animal Studies, University of Pretoria [3]Applied Behavioural Ecology

and Ecosystem Research Unit, School of Environmental Sciences, University of South Africa
[4]Elephants Alive, South Africa
The foraging activities of megaherbivores are crucial to study, as these mammals play a large role in regulating plant communities. African elephants (*Loxodonta africana*), in particular, are well-known as ecosystem engineers with the ability to modify vegetation structure. Due to their notable influence on their environment, it is imperative to fully understand their behaviour and the drivers behind them, in order to create successful management and conservation plans. The present study aimed to examine how male African elephant foraging behaviour is affected across a) season (wet *versus* dry); b) time of day (before or after noon); c) presence or absence of other elephants; and d) reproductive state (musth *versus* no musth). Six radio-collared elephant bulls were observed twice per week from June 2007-June 2008 in the Kruger National Park (KNP), South Africa. Using generalized linear mixed effect modelling, the results indicate that elephant bulls graze more during the wet season and browse more during the dry season. It therefore, seems that elephants may weigh the costs and benefits of grazing *versus* browsing as a result of their nutritional needs, and this may be one of the key drivers of repeated seasonal switches in diet. Furthermore, in order to potentially offset the costs associated with thermoregulation during the heat of the day, KNP elephants spent more time foraging during the morning and more time resting during the afternoon. Male elephants also foraged significantly less when they were associated with females compared to when they were alone or with other males. This is likely due to male-female associations forming mainly for reproductive purposes, thus impeding on male foraging behaviours. In contrast, the condition of musth, defined by occurrence of related physical signs, had no significant effect on foraging behaviour, nonetheless, these results differ from previous findings creating an opportunity for further research into this subject. These finding provide valuable knowledge that can aid in the management and conservation of male African elephants in the Kruger National Park.

The role of calves in female Asian elephant social organisation

T Revathe, S Nandini, P Keerthipriya, H Gautam, and TNC Vidya
Evolutionary and Organismal Biology Unit, Jawaharlal Nehru Centre for Advanced Scientific Research

Female Asian elephants are useful in studying the roles of various factors that shape social organisation because they are highly social and occupy diverse habitats. Female Asian elephant society in Nagarahole-Bandipur National Parks is organized into distinct clans that do not positively associate with one another, and within which fission-fusion dynamics are seen. Previous work indicated group size restriction, but females maintained their associations with clanmates through fission-fusion dynamics rather than remaining in small, fixed groups.

Since allomothering might be an advantage of such extended associations, we examined whether and how calf presence influences female sociality. We compared group sizes and female social networks in calf presence and absence. Total group size and the numbers of adult females and non-mother females increased in the presence of calves, as did the strength of female associations. This suggests that calves influence female sociality in this population. Since the allomother was not necessarily the mother's closest associate before the birth of the calf, it appears that the presence

of calves increases female sociality by attracting females other than the closest associate of the mother.

The ecology of agonistic interactions and dominance relationships in female elephant societies

Hansraj Gautam, Vidya TNC
Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), India

Socioecological theory predicts group living and within-group relationships in females to be a function of the resources and risks in their environment, such as food resources and predation. Here we study agonistic behaviour and dominance relationships in female elephant societies to understand if they can be explained by variation in food abundance and distribution. First, we examined this by quantifying the relationship between food distribution, rate of agonistic interactions, and dominance relationships among female clan members in the Asian elephant population in a resource-rich grassland habitat patch around Kabini reservoir, southern India. Food distribution and abundance did not explain the rate of within-clan agonistic interactions, contrary to expectations. Our analysis of female dominance suggests weakly expressed dominance relationships, with some advantage to older females. In keeping with weak dominance expression, dominance rank did not influence priority of access to better feeding sites. Further, a positive relationship between dominance expression and rate of agonistic interactions conforms to socioecological theory. Second, we qualitatively compared dominance structure in Asian and African elephants to understand if habitat differences can explain variation in female dominance structure. While ecology seems to explain some variation in female dominance relationships, quantitative assessment of ecology variables and female dominance in more populations is required to further understand sources variation in female elephant societies.

The effect of moon phase and time of the day on movement patterns of Asian Elephants (elephas maximus maximus) in Wasgamuwa, Sri Lanka.

Fernando, C.[1], Weston, M. A.[2], Rendall, A.[2], Pathirana, K [3]., Corea, R[1]
[1]Sri Lanka Wildlife Conservation Society, Wasgamuwa, Matel, Sri Lanka. [2]Deakin University, Geelong, Australia, Victoria, Australia. [3]Department of Wildlife Conservation, Battaramulla, Sri Lanka.

In Sri Lanka, 70% of Asian Elephant distribution lies outside protected areas. Thus, there is frequent interactions between humans and elephants, and wherever crop raiding occurs, Human-Elephant Conflicts predominate. Elephant habitats within human-dominated landscapes are highly degraded and fragmented. An apparent behavioural adaptation of elephants is the temporal partitioning of habitat use, with “natural” refugia used by day when people are most active, and movement out from these areas by night to exploit resources including human crops. We surmise that in rural Sri Lanka (with limited electricity and nocturnal surveillance technology), darkness provides protection from human persecution, and this will drive movements from refugia around dusk, with a return movement around dawn. While this pattern has been observed for African Elephant, it has not been demonstrated for Asian Elephant. We also propose that the capacity of people to detect elephants and protect their crops is mediated by prevailing light levels, i.e. by

moon phase. This has not been studied previously in any species of elephant. The risk profiles experienced by elephants may also vary between male-only and other social units, so we also surmise these may influence movements.

We quantified the movement patterns of elephants between refugia and croplands/villages in relation to time of day and moon phase by using four remote cameras for approximately two years, and applying temporal kernel analysis implemented in R. In general, elephants moved from refugia around dusk, and returned around dawn, confirming that the basic pattern shown for African Elephants also applies to Asian Elephants. For all social units combined, moon-phase influenced movements with fewer movements under lighter conditions. When considered separately, moon phase affected the timing of movements of non-male-only social units but not male-only groups.

Combined, this study confirmed the basal elephant pattern of daytime use of refugia and nocturnal roaming. It also shows that elephant movement patterns vary between social units, and that light levels mediate timing of movements in a fashion which is consistent with the idea that elephants perceived greater risk from humans under lighter nocturnal conditions and adjusted their movements accordingly. This study suggests that elephant crop raiding behaviour is adapted to the human capacity to defend crops, which may change with increasing urbanisation and nocturnal deterrent technology.

Sleeping pattern and preferences when lying down in a semi-captive population of African elephants

Maud Bonato[1,2], Clare Padfield[3], Christina Tholander[1] & Debbie Young[1]
[1]African Elephant Research Unit, Knysna Elephant Park, South Africa, [2]Department of Animal Sciences, University of Stellenbosch, South Africa

Sleep is an essential welfare aspect of African elephant (*Loxodonta africana*) maintained in captivity. Yet, despite the recent improvements in elephant habitats and husbandry, night-time behaviours are still not well documented. Hence, this study investigated sleep behaviour when lying down on a herd of 9 African elephant (3 juveniles, 3 young adults and 3 mature adults) maintained in semi-captivity in South Africa. A total of 111 nights were recorded over a 33 months period (2015 to 2018). Closed circuit television cameras were used to record the elephants behaviour from 17:00 to 07:00. 4 elephants were individually penned in a boma at night (2 bulls and 1 cow in 2015/2016; 2 bulls and 2 cows in 2017/2018) while the rest of the herd could move freely between the boma and an outdoor camp. Time laying down, time up, location, sleeping side, head direction, quality of the saw dust and number of elephants present in the boma were recorded. Data were analyzed using linear mixed model and Chi-square test procedures of R (version 3.5.2). On average, the elephants slept lying down for (mean±SEM) 65.64±0.79min, ranging from 1 to 267min. Interestingly, no difference in sleep duration when lying down was observed between gender, age category, sleeping side, head direction, whether they were penned or not and quality of the saw dust ($P>0.05$). However, elephants slept longer lying down as the number of elephants present in the boma increased ($F_{7,511} = 3.55$, $P<0.001$) with a maximum duration attained when all elephants were inside the boma. Furthermore, while they did not seem to have a favourite side to sleep on ($P>0.05$), they did prefer a specific location in the boma ($\chi^2 = 443.99$, df = 32, $P <0.001$) and orientate their head in a certain direction when lying down ($\chi^2 = 125.83$, df = 36, $P < 0.001$),

both of which being influenced by age category (location: χ^2 = 173.89, df = 16, P<0.001; head direction: χ^2 = 46.56, df =18, P<0.001). Specifically, mature elephants appeared to prefer places further away from the main entrance of the boma, as compared to younger elephants. These results clearly highlight the importance to cater for individual and age related needs of elephants maintained in captive conditions to allow appropriate levels of quality sleep, especially in tourism orientated parks. In addition, further studies are required to investigate the effect of environmental conditions, especially ambient air temperature, wind speed and relative humidity on sleep behaviour position (i.e standing vs. lying down) and patterns.

Discrimination ability of African elephants when using olfactory cues

Elana Mariotti1 Glenn Harrison[2], Sean Hensman[3], Francesca Parrini[1], Don Ross[4], Elisabet Rutström[2]

[1]Centre for African Ecology, University of the Witwatersrand, [2]Center for the Economic Analysis of Risk, Georgia State University, [3]Adventures with Elephants, [4]University of Cape Town

Many models of quantity discrimination characterise animals and humans as comparing alternative quantities in terms of the ratio or the difference between the quantities of the alternatives. These models apply quite generally, spanning discrimination of many types of stimuli, such as weight, sound or smell. We investigated African elephants (*Loxodonta africana*) discrimination ability when choosing between varying quantities of food when the cue is olfactory only. We asked: is it the ratio or the difference between the quantities that lead to choosing the larger alternative? Is there a "ratio" effect, such that smaller quantity differences make it more difficult to choose the larger alternative, whether it is the ratio or the difference that is the driver? Is there a "magnitude" effect from the overall number of reward units increasing?

Previous studies of Asian (*Elephas maximus*) and African elephants have come to differing conclusions. Differences can be attributed to small sample sizes, making it hard to statistically discern ratio or magnitude effects, or to different methodological and statistical procedures. Previous studies have generally tested zoo animals using visual and/or auditory cues, while only one study with Asian elephants used olfactory cues alone.

Our study involved four semi-tamed adult elephants hosted at Adventures with Elephants, Limpopo, South Africa. We tested each elephant individually, by offering a choice between two options that differed in quantities of boskos (game feed), presented in two perforated buckets, such that the boskos could not be seen but could be smelt. Each elephant was given all combinations of choices between 1 and 6 boskos, as well as the comparisons 4 to 8 and 5 to 10. The aggregate magnitude across both alternatives ranged from 3 to 12 in increments of 1, plus 15. Each elephant was asked to approach the buckets, smell both, retract the trunk, choose one bucket, and then received the boskos contained in the chosen bucket. The design ensured that the handlers involved did not know the content of the buckets.

Over the 1,126 observed choices, each elephant correctly selected the larger alternative 60%, 70%, 70%, and 74% of the time, significantly more than by chance. For the herd, there was a significant linear correlation between the proportion of choices of the larger alternative and both the ratio (r = -0.76) and the difference in the alternative quantities (r = 0.92), and no statistically significant

correlation with the magnitude of boskos over the two alternatives. We also evaluated the marginal effect of ratio and difference on quantity discrimination using statistical models that allow for covariates and individual heterogeneity in behavioural responses. We found that most individual elephants used a combination of ratio and difference between the alternatives, with the fraction of their choices characterized best by each model varying from individual to individual.

What our results show is that there is considerable heterogeneity in the individual cognitive processes of our elephants, so our next step will be to see how those are mediated, if at all, when the cognitive process of the herd is examined.

Effect of the COVID-19 Crisis on Tourist Elephant Camp Management and Elephant Welfare in Chiang Mai, Thailand

Jarawee Supanta[1], Janine L. Brown[1,2], Pakkanut Bansiddhi[1], Chatchote Thitaram[1], Veerasak Punyapornwithaya[1] and Jaruwan Khonmee[1]
[1]Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai, Thailand
[2]Center for Species Survival, Smithsonian Conservation Biology Institute, Front Royal, VA, USA

Background: The COVID-19 crisis has greatly affected how elephants in tourist camps are managed today in many countries, especially Thailand. Starting in April 2020, the Thai government banned international travel and all of the elephant camps closed. A wide variety of camp management changes were implemented because of the lack of tourists, which could be having a major impact on the health and welfare of individual elephants.

Materials and Methods: This study surveyed 28 camps that care for >400 elephants in northern Thailand to obtain information on camp, elephant, and mahout management before and during the COVID-19 crisis from April 2020 to April 2021. The survey consisted of a questionnaire that interviewed elephant camp owners, managers, camp veterinarians and mahouts, and captured information on changes in camp operations and management, including the number of tourists, number of elephants remaining, number of mahouts remaining, elephant, mahout activities, problems noted by owners and mahouts, health care, sanitation, and potential plans to cope with the crisis. Sixty elephants from seven tourist camps were further examined assigned a monthly body condition score (1=thin, 5=fat), with monthly blood and fecal samples collected for monitoring stress makers: fecal glucocorticoids metabolites (FGM) and heterophil to lymphocyte (H:L) ratios.

Results: The COVID-19 crisis has greatly affected tourist camp management in Thailand. Data revealed significant changes in camp structure, elephant work activities, and elephant care. Elephant activities have gradually decreased, with reduced exercise opportunities, whereas chain hours have increased, with some elephants chained for up to 48 straight hours. Many camps have laid off mahouts and other staff because the number of visitors has been substantially reduced and are not expected to return in any number until 2022. Overall, body condition has declined (Month 1, 4.63 ± 0.08, range 3-5 versus Month 12, 4.08 ± 0.1, range 2-5) due to less tourist feeding of supplements (bananas, sugar cane, etc) compared to pre-COVID-19, although many are still in the

overweight categories (4 or 5). Average FGM concentrations and H:L ratios also have increased slightly with positive slopes over time.

Discussion and Conclusion: The COVID-19 crisis has altered elephant management significantly, directly affecting animal welfare due to changes in nutrition, health, exercise, sanitation, and mahout care. Changes in welfare markers suggest altered well-being during the year after the travel ban. The results of this study will be useful for developing better management plans and guidelines for elephant camps in Thailand so they can cope with the current and potential future pandemics that result in decreased tourism income. Ultimately, we hope to identify some camps that have adapted management to still meet elephant health and welfare needs, which could serve as models for other camps.

Evaluation of stress on the basis of physio-clinical parameters in captive Asian elephants (*Elephas maximus*)

Madhvee Dhairykar, K.P.Singh, A.B. Shrivastav, Shobha Jawre, Nidhi Rajput, Amol Rokde, Kajal Jadav, Somesh Singh and Devendra Podhade
School of Wildlife Forensic and Health, NDVSU, Jabalpur, India

Keeping many captive and wild populations of endangered species without taking care of their social behaviour and basic instincts hence stress condition evolved leading to aggression and effects metabolism, hence measuring faecal cortisol metabolites will be useful to identify factors affecting animal well-being in captivity. The Asian Elephant (*Elephas maximus*) has a strong affinity to acquire taming characters hence they are utilized for transportation and vehicles for reaching distant places or forest hills. Tiger conservation programme is also becoming successful owing to assistance of captive elephants as they help in restraining as well as searching of big cats in the protected and non-protected forests. However, extensive workload and restless conditions followed by shrinking food resources and increased parasitic infections may lead to high rise of stress level in the captive elephants. Looking to these factors we have evaluated the stress level with the physiological and clinical parameters to identify the health status of captive elephants.

Total number of 30 captive Asian elephants were analysed for haematobiochemical and cortisol level in the different tiger reserves (Kanha tiger reserve, Bandhavgarh tiger reserve and Panna tiger reserve) of Madhya Pradesh. The freshly laid feacal samples were collected and blood was collected from the ear vein. These biological samples were analyzed by using commercially available diagnostic kits and reagents. Haematobiochemical parameters showed correlation between high rise of neutrophils, TEC, TLC, SGOT/AST, SGPT/ALT, ALP, UA in elephants those have higher level of cortisol. Out of (n=30) elephants, male (n=14) and female (n=16) showed non significant levels of cortisol whereas age wise assessment of cortisol levels showed significant including elephant calves (n=9), sub-adults (n=9) and adults (n=12). Subsequently, increased level of cortisol and high rise of haematobiochemical values of elephants have showed strong correlation of stress levels with hematological parameters viz. elevation of total erythrocyte counts, hemoglobin and differential leukocytes count. The haematological values including TEC, HB, HCT, monocytes, neutrophils observed higher than its normal range. Higher value of RBC count and neutrophils could be correlated with more secretion of glucocorticoid which leads to stress condition. Similarly, elevation of serum biochemical parameters viz. AST, ALT might be

due to interruption of liver function because of parasitic load in the body. However, the cortisol level observed elevated in elephants those have higher infestation of Amphistomes followed by Strongyles, Schistosomes and Coccidia.

The effect of COVID-19 lockdown restrictions on anxiety-related behaviour in semi-captive African elephants (*Loxondonta africana*)

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African elephants used in the tourism industry are routinely exposed to tourists within a close proximity, and/or human-elephant interactions, which are known to cause stress in both captive and wild populations, and can negatively affect health, welfare, and fitness. The impact of tourism is typically constant, with fluctuation occurring only in line with seasonal demand. However, the COVID-19 pandemic resulted in the sudden and prolonged absence of tourists at animal-interaction facilities, and thus provided a unique study opportunity. Here, we examined the impact of this abrupt change on 10 semi-captive African elephants (8 females, 2 males; ages 12-30 yrs) housed at Knysna Elephant Park, an elephant tourism venue in the Western Cape of South Africa which offers a variety of close-contact experiences (feeding, touching, and walks). We monitored the rate of primarily trunk related self-directed behaviours (SDBs), a form of displacement activity and novel behavioural indicator of anxiety or short-term stress in this species, before and after lockdown was implemented. Using a combination of instantaneous and interval sampling, each individual was focal followed for a period of 30 minutes, twice a day. SDBs were recorded as they occurred, and numbers of tourists during the sample period were noted. South Africa entered a nationwide lockdown on 23rd March 2020, therefore data examined represented 1-month pre-lockdown (February-March), where tourist pressure was high, and 1-month post-lockdown implementation (March-April), where tourist pressure was non-existent. A Linear Mixed Effects model with lockdown phase (pre- and post-implementation), age class, and sex entered as fixed factors, and elephant identity as a random factor, revealed that SDB rates were significantly lower post-lockdown implementation (LS-mean = 8.42) compared to pre-lockdown (LS-mean = 24.83; t = -5.125, p <.001), indicating a reduction in the short-term stress or anxiety experienced by this population due to the absence of tourists. Furthermore, the expression of SDBs did not differ between age class, sex, and elephant (p >.05). The findings of this study highlight the effect of tourist presence and human-elephant interactions on elephant welfare, which has ramifications for the management of anthropogenic impacts on this species. They also provide additional evidence that SDBs can be used to monitor anxiety-inducing situations experienced by elephants, and supports the establishment of SDBs as an elephant behavioural and welfare index. Moreover, since SDBs are observed in both captive and wild populations, the behaviour set can be used as a non-invasive, reliable welfare assessment in various settings, and has application potential in human-elephant conflict mitigation strategies.

The force is strong with the tusk: On African, Asian and woolly big tuskers
George Dian Balan

Big tusks are not only the appanage of certain woolly mammoths. They are part of Nature's original design of the glorious trunk-bearing pachyderms, including the Asian and African elephants of today. In fact, I have found evidence of hundreds and hundreds of Asian and African Plough-the–Earth large ivory carriers. Because of the shifting baseline syndrome, we tend to judge Asian and African elephants by the ones left today. Instead, we should travel back in time some 3500 years for Asian elephants and at least 150 years for African elephants, in order to have the correct reference points.

Indeed, in his famous Proboscidea monograph (1936), Henry Osborn depicts African elephants with very big ivory (as they should), in the same league with prehistoric stars, while Asian elephants sport average ivory, showing that 100 years ago the image of the Asians was already severely damaged by the constant elimination of tuskers. As the African and Asian big tuskers have fallen victims to trophy hunting, poaching and captivity, the elephant populations surviving today give the wrong impression that woolly elephants were more endowed.

In fact, African elephants have usually the heaviest tusks, while the woollies have normally the longest, perhaps also because of the different shape leading to less wear towards the tips. Yet, Asian elephants can also sport 3 m long, 73 kg each tusks. The longest recorded African tusk was 3.5 m and the heaviest allegedly 117 kg. The longest woolly elephant tusks exceeded 4 m and the heaviest may match the Africans.

Why does tusk size matter?
First, this is called honest advertising. The main purpose of big tusks is to impress the other gender. In the case of males, they are a proof of a healthy, long-lived animal with superior genetics, features sought after by females. They are an excellent health certificate. Indeed, Sukumar Raman (2003) found that the longer the tusks, the lower the parasite loads. Second, big tusks are also a deterrent, intimidating possible rivals and making certain fights avoidable. They help winning fights without physical contact. In the elephants' world, they are the equivalent of weapons of mutually assured destruction. Mature bulls with big tusks mean more peaceful elephant societies. Third, when fights are unavoidable, big tusks may be a blessing or a curse, depending on their shape. Big straight tusks are formidable weapons and may quickly decide the winner against a bull with smaller tusks. However, elephants with heavily curved/crossed big tusks have a disadvantage in such fights, losing sometimes to their opponents.

Big tusks are also used as handy tools, when digging for roots, water and minerals, debarking trees and breaking branches, or lifting and pulling vines. In light of the above, specific conservation measures should be taken in order to preserve and extend the remaining big tusker gene pool in Asian and African elephants, including targeted breeding programmes in captivity.

Biomechanics of the elephant trunk
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The elephant trunk functions as a muscular hydrostat: it can achieve elaborate movements without the support of any bone. Elephants have evolved unique biomechanical strategies to manage the complexity of this organ. Sophisticated behaviours emerge from the combination of a finite set of basic movements such as the propagation of an inward curvature when transporting objects, piece-wise elongation of the trunk when reaching for a target in front, and the formation of pseudo-joints when reaching to the side. Using motion-capture technologies developed for the movie industry, we show that the 3D trajectories of the trunk are composed like a language, in which the building blocks are basic elements of torsion, curvature and elongation. How these motion primitives are combined depends on the task: when varying the attributes of target objects during prehension experiments, we observed robust behavioural transitions. In addition, our study reveals that the elephant trunk velocity obeys a mathematical law observed in human hand drawing movements. Using state-of-the-art anatomical analyses, we characterised the morphology of the African and Asian elephant trunks in unprecedented details, thus drawing strong connections between the muscular system of the trunk and its biomechanical functions. These results could serve as the developmental basis of a new concept of soft robotic manipulation that will allow bio-inspired robots to detect, reach, grasp, manipulate and release a whole range of payloads and objects of various shapes and sizes.

Elephant Endotheliotropic Herpesvirus Is Omnipresent in Elephants in European Zoos and an Asian Elephant Range Country

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Elephant endotheliotropic herpesviruses (EEHVs) may cause acute, often lethal, hemorrhagic disease (EEHV-HD) in young elephants, generally between one and eight years of age. To date, eight different EEHV subtypes have been discovered, of which seven have been associated with lethal disease. Yet, prevalence of the EEHVs in different elephant populations is still largely unknown. In order to improve diagnostic tools for the detection of EEHV infections and to obtain

insight into its spread among elephants, we developed novel ELISAs based on EEHV antigens gB and gH/gL. Performance of the ELISAs was assessed using sera from 126 individual European zoo elephants and 69 semi-captive elephants from Laos, one of the Asian elephant range countries.

Initially, ELISAs using the EEHV1A gB and gH/gL protein as antigens were developed and used to screen a large number of sera. Sera from the vast majority of animals (197/205 = 96%) showed clear reactivity in both ELISAs, indicating that EEHV prevalence has been highly underestimated so far. Only eight animals were found to be seronegative; all were EEHV-HD cases between 1.5 and eight years of age, sampled just before or during their disease episode. Comparison of the reactivity observed for individual sera in the EEHV1A gB and gH/gL ELISAs suggested that gB can be used as a pan-EEHV antigen, reacting strongly with serum of each animal, independent of the EEHV type to which it was exposed. In contrast, in the EEHV1A gH/gL ELISA reactivity of the sera was much more variable, suggesting that subtype-specific responses had been elicited. Hence the latter may be suitable to differentiate between infections with the different EEHV types. With the aim to cover the complete spectrum of Asian elephant EEHV subtypes gH/gL of EEHV subtypes 1B, 4 and 5 were cloned, expressed and putative subtype specific ELISAs developed. Using these ELISAs, it was shown that six additional EEHV-HD cases that did show reactivity in the pan-EEHV ELISA, always had low to non-detectable antibody levels toward the EEHV subtype that inflicted disease. Overall, these results suggest that EEHV-HD is the result of a primary infection with a specific EEHV subtype.

In conclusion, our study suggests that essentially all (semi-)captive adult elephants in European zoos and in Laos carry at least one EEHV subtype. Furthermore, young elephants with low to non-detectable antibody to (a) particular EEHV subtype(s) appear to be at risk of dying from EEHV-HD when first infected with the particular subtype(s).

Possibility of perinatal transmission of elephant endotheliotropic herpesvirus (EEHV) in Asian elephants *(Elephas maximus)*

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Elephant endotheliotropic herpesvirus (EEHV) is one of the most important disease-causing high mortalities in juvenile Asian elephants *(Elephas maximus*). With limited knowledge in pathogenesis and no report of vertical transmission in EEHV, our study aims to investigate the possibility of this disease via transplacental or intrauterine (congenital), colostral transmission or milk-borne infection.

Methods: Samples of delivered placenta, colostrum, biological secretions, whole blood and postmortem tissue samples of the dead ones from eight late pregnancy female Asian elephants; three cows with EEHV positive-PCR tested, five cows with negative tested, and their neonates were used to investigate the possibility of EEHV perinatal infection by PCR and immunohistochemistry assay using the rabbit polyclonal anti-EEHV glycoprotein B antibodies (anti-EEHV gB Ab).

Results: Placenta samples from two cows with asymptomatic EEHV1 DNAmia were found positive EEHV-PCR tests and immunohistochemical but no EEHV genome detected from their biological secretion, colostrum nor offspring's samples. And samples from the rest of elephants and their offspring were tested negative.

Discussion and conclusion: Our findings indicate the possibility of EEHV harboring in placenta endothelia but cause no harm to the fetuses. It is possible that the fetuses produce antibody or procured transplacental maternal immunity against EEHV, or the virus are in latency state and not causing any infection. Requirement of more positive samples study in conjunction with further investigate of EEHV placental pathogenesis and transplacental immunity are essential to confirm perinatal transmission in EEHV.

Closing the Gap on African Elephant Endotheliotropic Herpesvirus: An Update from the San Diego Zoo Wildlife Alliance

Lauren Howard, Patty Gaffney, Carmel Witte
San Diego Zoo Wildlife Alliance

In just the last two years, eleven African elephants in North America have fallen ill to elephant endotheliotropic herpesvirus (EEHV) hemorrhagic disease. Four of these elephants died due to the virus, and the rest survived due to timely, intensive care on the part of elephant and veterinary teams. In the twenty years prior to 2019, only five EEHV hemorrhagic disease cases total were documented in African elephants. There is a gap in knowledge on the impact, biology and behavior of EEHV on African elephant individuals and herds. The San Diego Zoo Wildlife Alliance, in partnership with Sedgwick County Zoo and Reid Park Zoo, is working to close the knowledge gap. Through a targeted one-year study, we are collecting multiple paired samples and behavioral data weekly from 24 African elephants and 2 Asian elephants across four herds, spanning all age groups. We are evaluating presence of EEHV in the blood (viremia), trunk secretions, saliva and feces. We are then determining whether viremia and shedding are associated with other factors, including white blood cell and platelet counts, serum cortisol, social interactions, behavior, and subtle clinical signs of illness.

Through evaluation of these data, we hope to better understand the significance of viremia, events or activities associated with shedding of the virus, influence of age and herd dynamics on EEHV epidemiology. We will also work to validate non-invasive methods of EEHV detection and field-based methods of storing and testing samples, to better understand EEHV in African elephant range countries.

Generating an immunogenic elephant endotheliotropic herpesvirus (EEHV) vaccine

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Asian elephants are an endangered species facing many threats, including severe hemorrhagic disease (HD) caused by the elephant endotheliotropic herpesvirus (EEHV). EEHV-HD is the leading cause of death in captive juvenile Asian elephants in North America and Europe, and also affects elephants in their natural range countries. EEHV can also cause lethal disease in captive African elephants, with at least 11 cases and four fatalities in North American zoos since 2019. Due to the rapid severe onset of EEHV, detection and treatment options are limited. Thus, our goal is to develop a vaccine eliciting strong antibody and cell-mediated immunity (CMI) against EEHV to prevent lethal disease. Previous studies with EEHV and human herpesviruses indicate that glycoproteins B, H, and L (gB, gH, gL) are likely to induce protective humoral immunity and CMI. Therefore, our vaccine approach will include two strategies: (1) protein subunit, and (2) a recombinant virus vector using Modified Vaccinia Ankara (MVA). We have successfully generated an MVA recombinant expressing the EEHV gB glycoprotein and purified recombinant gB protein from mammalian cells. In preclinical studies, we have shown that MVAgB or gB subunit vaccinated mice induce robust gB-specific antibodies and polyfunctional CD4+ and CD8+ T cell responses after homologous prime-boosts. We also observed that a single priming vaccine and one boost are sufficient to induce immune responses and are not significantly different than two subsequent vaccine boosts. Future studies will incorporate multiantigenic MVA recombinants expressing EEHV gH/gL antigens in addition to gB, as well as compare immunogenicity of heterologous prime-boost vaccines with MVA and purified antigen subunits. Completion of these studies will provide support for the possible use of these vaccines in elephants.

Evolving EEHV Research Priorities and the North American EEHV Advisory Group

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The global elephant endotheliotropic herpesvirus (EEHV) community has made tremendous strides over twenty years of collaborative research and innovation. Since the first EEHV Meeting, hosted by the Houston Zoo in 2005, published literature and elephant care enhancements have grown on a logarithmic scale. Increased understanding of certain aspects of EEHV has led even more questions and has increased the complexity of EEHV related research and goals.

The EEHV Advisory Group was formed in 2014 with the mission to disseminate knowledge of current best practices for prevention, diagnosis, and treatment of EEHV; provide elephant-holding facilities with technical assistance; and facilitate research by building international collaborations. The group, which evolved to be The North American EEHV Advisory Group, has focused on this mission through formal and informal communications, and upkeep of the international resource www.eehvinfo.org.

While the EEHV Advisory Group does not have any official authority to "approve" research, it does have a responsibility to advise on which aspects of EEHV-focused research hold the most promise for impact, and the highest chance of success. The EEHV Advisory Group also offers letters of support for scientists applying for funding or TAG approval. The group discussed and

voted on research priorities in 2016 and in 2018, with each participant at the meeting allowed the same number of votes. In 2016, the highest priorities identified were virus culture, antiviral efficacy, and understanding the pathogenesis of EEHV HD. In 2018, the highest priorities identified were understanding risk factors associated with EEHV HD, understanding the pathogenesis of EEHV HD, early detection of EEHV HD, and understanding elephant immune response, and vaccine development.

With advancements in EEHV HD treatment, the ability to measure elephant EEHV antibody levels, and potential EEHV HD risk level, and use of laboratory technology that has potential to produce a vaccine for EEHV1 within the next several years, our EEHV research priorities are more complex and varied than ever before. A new approach to identifying research priorities, and, more importantly, gaps in our research, is more than overdue. Our Research Priority Working Group is excited to introduce our preliminary EEHV Research Matrix, and share where we are so far, and what our next steps in the process are.

Improving the detection and diagnosis of tuberculosis in African elephants (*Loxodonta africana*)

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In addition to poaching, habitat loss and human-elephant conflict, infectious diseases like tuberculosis (TB) pose a threat to already declining African (*Loxodonta africana*) and Asian elephant (*Elephas maximus*) populations. Tuberculosis, caused by *Mycobacteria tuberculosis* complex organisms (MTBC), including *M. tuberculosis* and *M. bovis*, has been documented in African elephants in Kruger National Park (KNP) and National Zoological Gardens (NZG) of Pretoria in South Africa, and Tsavo East National Park in Kenya as well as zoos around the world. These findings demonstrate the potential risk of disease in free-ranging and captive African elephant populations. In addition to impacting individual health, TB presents a potential threat to fragmented populations through inadvertent introduction of infected animals during translocation or movement of animals. Tools for detecting early MTBC infections are therefore essential to assess prevalence, and investigate pathogenesis, evaluate risk factors, as well as to develop surveillance and prevention strategies. Therefore, the overall goal of this study is to improve the detection of *M. tuberculosis* and *M. bovis* in African elephants by developing new diagnostic tools which will in turn facilitate disease management strategies. Respiratory, blood and tissue samples were collected from free-ranging African elephants from the KNP and processed for screening with one or more of the following tests: a) the Chembio Dual Path Platform (DPP®) Vet TB Assay which detects antibodies to MTBC-specific peptides; b) cytokine gene expression assays (GEA) and cytokine release assays (CRA) using heparinized whole blood samples stimulated using commercially available *M. bovis* and *M. avium* purified protein derivatives (PPDs) as well as mycobacterial peptides in QuantiFERON®-TB Gold Plus (QFT®-Plus) tubes; c) mycobacterial

culture and speciation; and d) GeneXpert® MTB/RIF Ultra (GXU) assay for detection of MTBC DNA. Preliminary results using respiratory samples and tissue homogenates from African elephants with known MTBC infection status have shown that GXU can rapidly and accurately detect both *M. bovis* and *M. tuberculosis* infected animals. In addition, a preliminary seroprevalence survey (DPP) suggests that there is a seroprevalence of 6-9% in the free-ranging KNP elephant population. We have also successfully optimized the RNA extraction protocol, amplified, and sequenced novel mRNA transcripts from African elephants, designed qPCR primers and developed cytokine GEAs (*IL10, TGFβ* and *TNF*) for the relative quantification of the African elephant cell-mediated immune responses in preparation for future work, with the preliminary data supporting the feasibility of using cytokine GEAs to measure host immune responses. We hope that this continued research will result in development of assays for accurate and rapid diagnosis of MTBC infection in African elephants and aid in better understanding immunological responses and pathogenesis in this species. Rapid accurate diagnostic tests will improve detection of infection in zoo and free-ranging elephant populations to enhance management, prevent transmission, and enhance health care and welfare.

Surgical removal of cystic calculi in an Asian elephant: a case report

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Sai-Thong, an approximately 54 years old, female captive Asian elephant was admitted at Wildlife Unit, Kasestsart University Veterinary Teaching Hospital, KampheangSean Campus, Thailand. The elephant presented the signs of depression, anorexia, and abdominal pain. Further physical examination revealed mild dehydration, small and dry fecal bolus, and anuria, which no precise duration of anuria was recorded by the owner. High level of creatinine (5.32; normal 1-2 mg/dI) was noted on the first at the hospital. The rectal ultrasonography was performed and revealed large abnormal mass with hyper-echogenicity inside the urinary bladder (UB). Further transvaginal endoscopy examination also confirmed the present of stone in the urinary bladder. Therefore, the surgery for removing the calculi was planned on the next day.

The elephant was sedated by administrating Dexmedetomidine (0.0012 mg/kg, IM). The epidural nerve block and local anesthesia at the incision line were performed using 2% lidocaine HCl. An episiotomy with a 15-cm incision line was conducted at the perineum. The attempted to directly remove the stone by hand was failed due to the size of stone was larger than the size of urethral sphincter. Diazepam was administration intravenously and 2% lidocaine HCl was injected around urethral sphincter in order to relax the muscle. However, the stone still could not get through. Thus, urethral sphincterotomy was applied to wider the opening of urethral sphincter. In addition, rope basket was created to put the stone inside and then pulled the basket out. A single of 1.7 kg with 17x10 cm diameter calculi was finally pulled out from the urinary bladder. The temporally closing of vestibular wall and skin was performed. The total time for surgery was 7 hour 20 minutes, after sedation.

Post-operative care included daily UB flushing via the modified UB catheter, systemic antibiotic, and other forms of supportive treatment. The elephant urinated via incision wound and defecated normally. The blood parameter and general signs of elephants improved at two weeks after surgery. However, endoscopic examination revealed severe inflammation, necrotic tissue and pus inside urinary bladder. The ultrasonography of kidney showed the enlargement and un-structural of kidney, both sides. The elephant was diagnosed with acute to chronic kidney disease due to severe cystitis and retrograde infection. Unfortunately, the elephant died, three months after surgery.

Post-operative care is crucial for the success of the treatment. Severe nephritis and cystitis were the cause of death in this elephant. The modified UB catheter was used in this case – however, prolonged urethral catheterization can possibly lead to retrograde infection, which should be carefully considered in the future. Moreover, calcium carbonate was identified as the main component of the stone in this elephant. History taking revealed that the elephant used to drink the water from the source that potentially contained high amount of minerals for many years; and urine incontinence was occasionally observed. Thus, to prevent the urolithiasis, the level of calcium salts in the diet (both food and water) should be concerned, and routine monitoring of urine is recommended.

Diet consumption shapes different profiles of gut microbiota in various age groups of Asian captive elephants

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Background: Asian elephants have been captured and domestically used under human care for thousands of years. Gastrointestinal (GI) problem is one of the most common disorders found in captive elephants, resulting in deaths of elephants worldwide. The imbalance of gut microbiota or gut dysbiosis in animals/human has been associated with GI problem. Gut microbiota is a high population community of microorganisms which plays a crucial part in the immunity, nutrition metabolism, and energy acquisition of animal/human. However, the information of gut microbiota in captive elephants has not been thoroughly investigated. Therefore, the present study aimed to characterize the profiles of gut microbiota in different ages of Asian captive elephants in Northern Thailand. The information from this study will be useful for further nutritional and heath management in captive elephants.

Methods: Elephant feces samples (n=136) were collected Asian captive elephants based on nutritional status from nine elephant camps in the same geographical location of Northern

Thailand. Samples were from infant calves (1 day – 4 months old, n=6), suckling calves (4 months – 3 years old, n=12), weaned calves (3 years – 10 years old, n=30), adult elephants (10 – 55 years old, n=77), and geriatric elephants (more than 55 years old, n=11). 16S rRNA metagenomic sequencing approach was used to profile gut microbiota.

Results: We found that the dominant bacterial phyla in feces of all groups of elephants, except infant group, were Firmicutes followed by Bacteroidetes and Actinobacteria. In infant group, Firmicutes was the most abundant as well as other groups, including Actinobacteria and Euryarchaeota (Archaea), but Bacteroidetes showed less abundant than other groups. Interestingly, Verrucomicrobia was significantly detected only in infant group.

Conclusion: These findings suggest that the diversity and relative abundance of gut microbiota in elephants have been affected by their age and dietary. This information should provide us to gain more knowledge of biology and microbiology in elephants, and will contribute to the way to improve elephant health near future.

The Millennial Males: Adaptive Social Strategy of Male Asian Elephants in Increasingly Anthropogenic Landscapes of Southern India

Nishant Srinivasaiah
Frontier Elephant Programme

Male Asian elephants are known to adopt a high-risk high-gain foraging strategy by venturing into agricultural areas and feeding on nutritious crops. High risks to survival posed by increasingly urbanising and often unpredictable production landscapes may necessitate the emergence of behavioural strategies that allow male elephants to persist in such landscapes. Through the long-term monitoring of behaviour of male Asian elephants in the wild, we show that they display striking emergent behaviours, particularly the formation of all-male groups, typically in non-forested or human-modified and highly fragmented areas. They remained solitary or associated in mixed-sex groups, however, within forested habitats. These novel, large all-male associations, may constitute a unique life history strategy for male elephants in the high-risk but resource-rich production landscapes of southern India. This may be especially true for the adolescent males, which seemed to effectively improve their body condition by increasingly exploiting anthropogenic resources when in all-male groups. This observation further supports our hypothesis that such emergent behaviours are likely to constitute an adaptive strategy for male Asian elephants that may be forced to increasingly confront anthropogenically intrusive environments.

Conservation through the lens of elephant orphans

Rachael Murton, Mary Muyoyeta
Game Rangers International

Game Rangers International (GRI) is a wildlife conservation NGO working in close partnership with the Zambian Department of National Parks and Wildlife (DNPW) and local communities to protect wildlife in Zambia. GRI aims to tackle wildlife conservation holistically through three main approaches: Resource Protection, Community Outreach and Wildlife Rescue. Under Wildlife Rescue the Elephant Orphanage Project has rescued 55 elephants. As a critically endangered

species we believe the survival of every elephant counts, but it is important that the considerable investment has a wider conservation value. In this presentation we will take you on the journey of the orphan elephants from rescue to release and discuss how they support the conservation of wild elephants and the wild spaces they inhabit.

Resurrecting an Elephant Migration Route Limpopo, South Africa

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This research and development project led by Marc Sherratt, Sustainability Architects (MSSA) restores the extinct ability of the African Savanna Elephant (*Loxodonta africana*) to migrate across the Limpopo Province of South Africa. This approximately 1000 km wildlife migration corridor links existing conservation areas that already house over-populated herds of elephant. This route uses elephant's sophisticated infrasonic communication as a method to "call" the animal along this route. This project has been designed to support rural communities by increasing food security and economic resilience while at the same time reversing global warming.

The IUCN reports that up to 70% of the current African elephant population is found on unprotected land (IUCN, 2021). Conservation solutions therefore must include ex-situ proposals, as the formal process of reserving public land for wildlife is simply not happening quickly enough to secure the African elephant population. In the South African context there is an over-population of elephants found in some public conservation areas such as the Kruger National Park (Reardon, 2012). Elephants cause greater environmental impact of any mammal excluding humans (Estes, 2012). So when confirmed in a wildlife reserve they can cause extensive damage to natural ecological systems. A problem therefore exists of how to secure this endangered species' population while preventing irreparable damage to the confined, existing ecological systems in which it lives.

The presented solution to the problem relating to South Africa's over-population of wild elephants in conservation areas is a return to the large-scale act of seasonal wildlife movement between grazing lands but now along man-made wildlife corridors. This will be presented using a proof of concept currently implemented in the Limpopo province of South Africa which consists of an Artificial Intelligence (AI) driven, automatic gate system and an infrasonic elephant communication tower. In combination this system allows wild elephants to transverse between electrified conservation areas without direct human interference using uniquely developed, ecologically sensitive, infrasonic "language".

Declining numbers of Bornean elephants (Elephas maximus borneensis) in Sabah Malaysia Borneo, due to unintentional and intentional poisonings

Katerina Pirelli-Zucchetta
Borneo Wildlife Preservation

Declining numbers of Bornean elephants (Elephas maximus borneensis) in Sabah Malaysia Borneo, due to unintentional and intentional poisonings have been ongoing since the death of an entire herd in 2013. Where is the root of the problem occurring and why? What is the solution to

protect the future of the remaining highly endangered Bornean Elephants from poisonings as well as the biodiversity of Sabah.

Low-cost thermal early warning systems for human-elephant conflict mitigation
Alasdair Davies
Arribada Initiative

The Zoological Society of London (ZSL), together with technology and engineering partner Arribada, have developed a new low-cost, affordable, thermal camera solution, Project H.E.A.T (Human Elephant Alert Technologies), that utilises embedded machine learning to automatically detect the presence of elephants, 24/7 in all weather conditions. Our solution aims to revolutionize the early detection of elephants through the introduction of low-cost thermal imaging technologies to alert communities, conflict response teams or Government officials to the presence or movement of elephants in and around conflict hotspots.

Over 30,000 photographs have been captured at ZSL Whipsnade Zoo to create the first thermal elephant database of its kind. The photographs were then used to create a machine learning algorithm capable of detecting Asian elephants autonomously. We can currently detect the presence of Asian elephants with a 90% success rate at a range of 30-40 metres.

In this presentation we will share and comment upon research conducted to date, demonstrate the current performance of the thermal system and discuss its applicability for use in Asia and Africa. We will also detail our data collection methodology and summarise our next research steps and field objectives to validate the system.

Eavesdropping on African forest elephants: Passive acoustic monitoring as an effective conservation tool in Central Africa
Daniela Hedwig
The Elephant Listening Project, Cornell Lab of Ornithology, Cornell University

Passive acoustic monitoring (PAM) is an emerging non-invasive method that allows for the continuous, long-term and large-scale monitoring of populations of elusive, yet, acoustically conspicuous terrestrial species as well as anthropogenic disturbance, such as illegal gun hunting and logging, at reasonable cost. As such, PAM can serve as an excellent evaluation tool enabling information-based decision making and adaptive management in wildlife conservation. The Elephant Listening Project at Cornell University is at the forefront of developing and implementing PAM tools to support protected area managers across Central Africa in monitoring forest elephant populations and illegal gun hunting. This talk will illustrate methods and applications of PAM for forest elephants across Central Africa, as well as challenges encountered in the field and analysis lab.

Assessing the trends of human elephant conflict in Keonjhar forest division, India using spatial-temporal analysis

Bismay Ranjan Tripathy, WMS Wickramasinghe
School of Environment, Tsinghua University, Beijing

Background: Escalation of human-elephant conflict (HEC) is influencing quality of local communities and threatens Asian elephant (Elephas maximus) survival in India, which supports 60% of the total Asian elephant population in the world. From 2018 to 2020, 1400 people died from HEC in India and 0.5 million families were annually affected by crop-raiding, during 2000 and 2010. It is a key challenge for maintaining a balance between economic development and elephant conservation. Information gaps due to data deficiency is hampering efforts of HEC management and misleading our observation of HEC influences, which makes the mitigation projects debatable even after numerous investments. Escalating HEC being a major barrier in conservation of Asian elephants, demands strengthening of mitigation strategies for co-existence.

Study area: This study deals with the spatial aspects of HEC in Keonjhar forest division of Odisha province in India, where 345 people were killed and 5145 hectares of croplands were destroyed by elephant attack during 2001 to 2018. This area has evidenced a declining elephant population from 112 elephants (2002) to only 70-75 individuals (2020), most likely due to habitat degradation from mining, cultivation and rural development.

Objectives: Investigating the seasonal variation of crop-raiding by elephants, we hypothesized that conflict in winter season would be dominant over other seasons (rainy and summer) because it is the crop ripening season. We classified HEC data based on the type of damage (crop damage, house damage, human death and injury) and also temporally, into three phases (2001-2006, 2007-2012 and 2013-2018), in order to (1) assess the temporal trends and seasonal variation in HEC; (2) derive spatial patterns of HEC in all 3 temporal phases using Ripley's K-function; (3) map the temporal change in the spatial risk of HEC and number of people under threat of HEC in the hotspot zones using spatial scan statistics.

Result: We found that (1) intensity of human death and injury, and house damage has declined over the 18-year period, but crop damage was the most frequent form of HEC which severely intensified since 2009, (2) winter season has a significantly higher risk of HEC occurrence, (3) The spatial distribution of HEC was found to be clustered and the north-east and central regions of the study area became hotspots from 2007. (4) People under HEC threat escalated from 14700 individuals during 2001-2006 and 34300 people in 2007-2012, to 65500 people during 2013-2018.

Implication: This study will act as a baseline against which future changes in HEC can be assessed and the level of HEC, within as well as across various bio-geographical regions, can be compared. It can also help in developing spatially and temporally adaptive management plans. Identification of high priority regions through risk mapping can spatially prioritize mitigation approaches by devising streamlined compensation policies. This provides a better context of the risks associated with the identified hotspots which helps to maximize the effectiveness and minimize the cost of HEC management.

Tracking Forest loss and fragmentation between 1930 and 2020 in Asian elephant (*Elephas maximus*) range in Nepal

Ashok Kumar Ram[1,2], Nabin Kumar Yadav[3], Pem Narayan Kandel[2], Samrat Mondol[1], Bivash Pandav[1], Lakshminarayanan Natarajan[1], Naresh Subedi[4], Dipanjan Naha[5], C. Sudhakar Reddy[6], Babu Ram Lamichhane[4]

Forest cover is the primary determinant of elephant distribution in Asia. Loss of forest cover and fragmentation are serious long-term threats facing conservation of Asian elephants. Quantifying loss in forest cover and extent of fragmentation is urgently needed to inform policy makers and create regional strategic action plans for elephant conservation. We assessed deforestation and patterns of forest fragmentation in the elephant range of Chure Terai Madhesh Landscape (CTML) in Nepal for the period spanning 1930–2020. Forest cover maps were generated using multi-source data of the years 1930, 1975, 2000, and 2020. We generated elephant range-wise forest cover maps and fragmentation matrices for each consecutive year, and quantified spatiotemporal changes over time. The current extent of potential elephant habitat in Nepal was estimated to be about 19,069 km^2, with the western region supporting highest major fraction of habitat with a forest cover of 6,754 km^2 (56.9 %). Overall, 21.5% of elephant habitat was lost between 1930 to 2020 with the highest (12.3%) forest cover loss recorded during the period 1930 to 1975. The loss of elephant habitat was highest in the western region, followed by eastern, far western and central regions of the CTML landscape. Forest fragmentation was highest in the eastern region, followed by central, far western and western regions. We found that CTML had lost 57.3% of the large core forest (Core3) in the eastern region, followed by central 46.4%, far western 30.9%, and western 25.5% between 1930 to 2020. Our objective assessment of habitat loss and fragmentation suggests that continued threat to elephant habitats in Nepal during the last century had probably fragmented elephant populations and made them insular with long-term ramifications for both elephant conservation and human-elephant conflict Given the substantial loss in forest cover and high levels of fragmentation, improving the resilience of elephant habitats in Nepal would urgently require habitat and corridor restoration, and reduction in anthropogenic impacts to enable movement of elephants

Human elephant coexistence HECx: Advocating through awareness programmes in Tamil Nadu

Rengasamy Marimuthu
Zoo Outreach Organisation

International Elephant Foundation *IEF* has been supporting Zoo Outreach Organisation's Human Elephant Coexistence awareness programmes in India for over a decade. With IEF funding support we had conducted teaching of trainer's programmes especially for teachers who work in the elephant range area schools, street plays for community people and school awareness programmes for school children. Most of the programmes were held in Coimbatore Forest Division, Sathyamangalam Tiger Reserve, Erode Forest Division in Tamil Nadu and few programmes in adjacent Kerala state. The programems had received positive response from the participants.

Human elephant conflict is a 'burning issue' today and has become a perennial problem in most of the places in India and other elephant range countries. There is no simple solution for human

elephant conflict and different approaches should be integrated to mitigate this problem. Creating awareness to increase the tolerance of the people towards the animal is very important for both human and elephants well being. So it is the need of the hour to conduct awareness programmes for the community who live in the conflict areas through different ways of teaching how to save their own life by following some simple do's and don't's. This presentation is about recently held street plays and school awareness programmes conducted during corona pandemic in Erode Forest Division in Tamil Nadu.

Living with Elephants, A Cultural Shift Towards Coexistence
Walona Burkie Sehularo

Over much of Africa the rangelands of the elephant have shrunk due to increasing pressure from humans, as populations increase and demands on natural resources also increase. However, in Botswana, home to the largest remaining elephant population, there has been a recent re-colonisation of historical rangelands due to ecological shifts in the north and an increasing population. Throughout Africa human-elephant interaction have increased in their frequency; bringing challenges to many rural communities that rely on subsistence farming. Normally we perceive this interaction as being due to human infringement on elephant ranges, but a case that may predict future interactions is that of the village of Khumaga that borders the Makgadikgadi Pans National Park in Botswana.

Here we can see, understand, and learn from communities that have lived for generations without ever interacting with elephants. How does a culture evolve to become tolerant of a presence that brings with it massive changes to how you live, work, and interact? When a population of people with no experience with elephants begins to encounter them daily, dangerous situations for both people and elephants can, and do, occur. As we face increasing challenges from climate change and more recently an increase in reliance on subsistence farming due to the economic consequences of the global pandemic, how do we move from having designated lands for humans and wildlife to a world of coexistence, where humans and wildlife live side by side. During this talk I will take you on Elephants for Africa's journey as we strive to empower the communities that we partner with to do exactly that and the evolution of our Living with Elephants workshops, through which we ty to take away the fear aspect of this change as we move towards coexistence.

Assessing perception of the local community towards the African savannah elephant and to determine the impact of PEACE Project education courses on participants and human-elephant conflict.
Shannon Diener, Rachel Harris
Elephant Human Relations Aid (EHRA)

EHRA's PEACE Project was established in 2009 due to a perceived high human-elephant conflict (HEC) rate within the Erongo and Kunene Regions in Namibia centred around competition for food, water and habitat. This study aims to determine the perception of community members towards elephants, and to document the total area where the PEACE Project has conducted

educational courses and how the PEACE Project teachings impacted HEC in the area and the livelihoods of the people.

Role of religious beliefs in elephant damage compensation claims: Lessons from indigenous communities

Aritra Kshettry
Innovation in Science Pursuit for Inspired Research (INSPIRE)-Fellow, Department of Science and Technology, Government of India, New Delhi, India

Economic damages due to elephants pose a serious threat to shared spaces between people and elephants. To offset losses faced by local communities, ex-gratia or compensation programs are widely used, yet, the efficacy of such programs is rarely tested. In this study, we assess the efficacy of the crop compensation program in West Bengal, India. Our results throw up interesting variations in local communities' perception of losses by elephants, anchored by religious beliefs and socio-cultural norms. Belief in the elephant god, 'Mahakal' made certain communities accept crop losses as offering to the gods whereas other communities not having such beliefs did claim compensation for the losses. Our findings highlight the importance of incorporating local religious beliefs, community dynamics, and socio-cultural norms in human-elephant conflict mitigation policy.

The devastating impact of agriculture and its contribution to human elephant conflicts in Sri Lanka

Ravi Corea, Chinthaka Weerasinghe and Chandima Fernando
Sri Lanka Wildlife Conservation

Human-Elephant Conflict (HEC) is prevalent in almost all elephant range countries in Asia with India having the highest human death rate at 571 per annum. Given that India’s population is 63 times that of Sri Lanka, per capita Sri Lanka has the second highest number of annual human death rate from HEC globally. Since receiving independence from the British in 1948, successive Sri Lankan governments have invested in agriculture development as a means to achieve self-sufficiency in food production and to create economic opportunities for the rural populace.

More than 81 per cent of Sri Lanka’s population lives in rural areas and 70 percent of the rural population’s livelihood is agriculture. For all the billions of rupees that has been invested in agriculture development, in 2020, the share of agriculture in Sri Lanka's gross domestic product was 8.36 percent.

After 26 years of developing innovative solutions for HEC mitigation, the SLWCS recognizes that agriculture is the biggest factor that contributes to creating HEC. Therefore, the SLWCS sees non-agro-based economic development and not deterrence as the key to resolving HEC and is advocating an Elephant Centric Economic Development paradigm as the most effective and sustainable solution to resolve human-elephant conflicts.

HEC is a problem because the national development agenda has disregarded the needs of elephants in their planning. Successive governments have invested in agriculture by destroying over 80% of the forest cover since Sri Lanka received independence in 1948. Yet, agriculture is the least dynamic sector of the economy contributing less than 9 percent to the country's GDP.

Rural economies need to move away from a purely agricultural economy to a robust and sustainable alternative industry-based economy adhering to an elephant centric development paradigm.

The SLWCS is bridging HEC mitigation, sustainable development and stakeholder aspirations to implement a new paradigm that balances HEC mitigation with economic development to create coexistence and a win-win situation for people and elephants in Sri Lanka.

Protecting the Elephants of Kibale National Park, Uganda through school-based conservation education programs

Elizabeth Ross, Emily Otali
Kibale Forest's Schools' Program and The Kasiisi Project

Better environmental knowledge is key to engaging people in conservation and has been shown to play a vital role in changing attitudes about the value of wildlife. As an organization committed to raising new generations of young people committed to conservation, we note with deep concern a shift away from support for conservation education over the past few years with donors less convinced that it is the best use of their funds. It has been shown that successful conservation needs both short and long-term approaches which must include, along with good policing, engaging the support of local people and educating their children about the environment. We strongly concur with this conclusion having seen the impact of our own successful conservation education programs over the past 20 years, as well as that from a range of other studies. Family values, experiential learning and a sense of inclusion in the natural world, all increase pro-environmental behaviors and people who experience nature in childhood are more likely to have the positive attitudes to the environment that are vital in determining a person's future behavior. Our conservation education programs have significantly improved attitude toward the forest, elephants, chimpanzees, climate change and factors impacting clean water. Empathy also activates people's motivation to protect animals and our conservation education project engaging children with sanctuary chimpanzees increased empathy to them in 85% of children. We strongly believe that despite the length of time for most traditional conservation education programs to show results, they are a critical component of a comprehensive conservation program.

Using participatory methods to investigate and support human-elephant coexistence in complex socio-ecological systems

Von Hagen, R.L.[1], Schulte, B.A.2, Lepczyk, C.A[2]
[1]Auburn University, [2]Western Kentucky University

Negative human-elephant interactions represent a primary threat to elephant conservation. Impoverished shareholder farmers regularly endure crop raiding by elephants (*Loxodonta*

africana) and try to prevent elephants from entering their fields or may retaliate by attempting to kill or injure them. To find pathways towards human-elephant coexistence, our goal was to understand the drivers and solutions, allowing for optimizing this seemingly intractable problem. In addressing this goal we hypothesized that: 1) most farmers used traditional deterrents, but few had knowledge of more modern deterrents; 2) if deterrent information was available, lack of economic resources would inhibit uptake; 3) farmers had negative attitudes towards elephants including being fearful in part because of crop raiding; 4) there were unforeseen socioecological drivers fueling negative interactions between farmers and elephants; and, 5) community workshops about deterrent methods, farming and alternative lifestyle practices, and elephant behavior could improve farmer livelihoods and reduce human-elephant conflicts. To test our hypotheses, we used participatory modeling and survey sessions with local stakeholders in 6 communities in the Kasigau Wildlife Corridor of the Greater Tsavo Ecosystem. In the first session we administered a community survey (n=206) and constructed mental models, a form of fuzzy-logic cognitive mapping (n=90) that illustrate how someone perceives an issue. We used this information to create a curriculum for community workshop programs designed to provide and demonstrate information on mitigating elephant crop raiding combined with a take-home manual. We provided information in the form of 5 strategies: elephant deterrents, climate smart agricultural practices, alternative livelihoods, how to behave safely around elephants and the importance of elephants and stewardship to the environment. We found that most farmers used some type of deterrents, but the majority had never received information from authorities on how to deter elephants or used modern methods. Farmers cited lack of resources as their main barrier to implementation, and most villagers had negative perceptions of elephants and were very fearful. Interestingly, we discovered a complex understanding of the necessity of elephants for Kenya's economy and ecosystem health. We built intricate models using Mental Modeler software from fuzzy-logic sessions and found unaddressed drivers of conflict such as dilapidated roads that prevented wildlife officers from reaching farms. Our workshop sessions are complete and to address our final hypothesis we will distribute a survey to the same participants in 2022. Our results demonstrate a greater need for distribution of deterrent awareness (which we attempted with our workshops) and revealed negative attitudes towards elephants and crop raiding. Community members helped us create an intricate narrative of issues that continue to drive conservation conflicts. Collectively these methods represent a holistic strategy for understanding and ultimately addressing a complex issue that has implications for human livelihoods and elephant conservation.

Elephant Conservation in Mali in times of war and peace

Susan Canney, Nomba Ganamé
WILD Foundation

While strictly protected areas are the vital cornerstone of conservation policy there are other valuable areas for conservation that contain people – such as landscapes with wide-ranging species - where the challenge is to find models to conserve biodiversity in the face of competing demands. The Mali Elephant Project attempts to find inherently sustainable ways for elephants and people to thrive together. It is founded on two key aspects of local attitudes: (1) an understanding that the loss of elephants is an indicator that the ecosystem is impoverished and less able to support life, and (2) an understanding that human impact must occur within the physical limits of nature.

After three years (2003-6) of studies to understand the migration using GPS collar data from Save the Elephants, the vast open populated area (32,000 km^2) over which these elephants roamed suggested that the problem of elephant conservation would be best viewed as an emergent property of the complex social-ecological system of the Gourma. This meant understanding more about the socio-economic aspects and deeper engagement with local people.

The result involved empowering the local population to develop a model of "elephant-centred natural resource management" through adapting local governance systems to become representative, inclusive and transparent. This makes space for elephants, protects and restores habitat and improves local livelihoods. We have also found that it improves social cohesion and provides occupations for youth that are locally valued and respected, therefore having relevance for many of the complex problems facing the Sahel. The local engagement model appears to work because it brings a range of local benefits, and in the process we have discovered more about the nexus between elephants, humans and their environment and the fundamental links between environmental degradation, poverty, compromised governance, inequality, war and terrorist insurgency.

It is a dynamic process that has evolved over the years in response to challenges, including the creation of an anti-poaching unit from scratch that is able to operate in areas of lawlessness and insurgency. It has also resulted in the imminent creation of a protected area covering the whole of the elephant migration route reflecting a biosphere model.

Conservation Lower Zambezi: An overview of programs to support communities while protecting wildlife

Ian Stevenson & Nikita Iyengar
Conservation Lower Zambezi

The Lower Zambezi National Part (LZNP) forms part of the greater Lower Zambezi Valley system, spanning across Zambia, Zimbabwe, and Mozambique. Despite ongoing law enforcement efforts, the national wildlife authority – Department of National Parks and Wildlife (DNPW), remains critically underfunded which effectively has led to a severe shortage in the workforce, very limited mobility, and the inability to access necessary funds for operational costs. This not only severely restricts DNPW in being able to effectively fulfil its mandate as the local wildlife protection authority, but also negatively impacts on the morale and dedication of its officers and staff, who often risk their lives to protect wildlife.

Conservation Lower Zambezi (CLZ) is a non-governmental organisation committed to the conservation of wildlife and the environment in the Lower Zambezi, Zambia and was founded in 1994 to provide support to DNPW and help them fulfil their mandate to mitigate threats to wildlife from poaching in the region. Over the years, CLZ has grown to focus on three main pillars of support: Wildlife Protection, Environmental Education and Community Empowerment and is actively working towards a vision of "*A valued, protected and thriving Lower Zambezi Landscape*."

Utilising drought forecasts to anticipate and mitigate human-elephant conflict University of Reading

Victoria L Boult[9], George Wittemyer[1,2], Jeremy Goss[3], Emmah Mwangi[4,5], Mary Kilavi[6], Shamton Waruru[7], George Otieno[8], Emily Black[9]

Colorado State University[1], Save the Elephants[2], Big Life Foundation[3], University of Sussex[4], Kenya Red Cross Society[5], Kenya Meteorological Department[6], National Drought Management Authority[7], IGAD Climate Prediction and Applications Centre[8], University of Reading[9]

Across Africa, human population growth and the associated conversion of natural habitats into human-dominated landscapes bring people and elephants into increasingly close proximity. These changes have seen conflict between people and elephants escalate, such that in some places, human-elephant conflict (HEC) has become an influential driver of elephant population decline and regularly threatens the lives and livelihoods of local people.

Despite the general worsening picture, regionally, HEC fluctuates at seasonal-to-interannual timescales, driven in part by rainfall variability; HEC increases during drought, when elephants engage in crop-foraging behaviour to supplement nutrient intake and come into contact with people and livestock at limited water sources.

Climate change is projected to increase the variability of rainfall and the intensity of drought. It follows therefore, that HEC will become an increasing problem under future conditions. However, advances in the forecasting of seasonal rainfall now provide reliable early warnings of drought. Early warnings present a window of opportunity in which anticipatory actions, triggered by forecasts, could mitigate HEC before it occurs. In the humanitarian sector, this "forecast-based action" (FbA) approach is seen as a key tool to build resilience to climate change, saving lives and livelihoods whilst sparing limited resources.

We investigate the potential use of seasonal drought forecasts and FbA to anticipate and mitigate HEC in Kenya. Kenya is home to more than 36,000 elephants, many of which live in close proximity to communities engaged in small-scale agriculture (crops and livestock). It's also a "sweet-spot" for rainfall predictability; drought conditions can often be anticipated several months in advance.

We examine:

- What is the relationship between rainfall variability and rates of HEC in Kenya?
- With what lead time can elevated rates of HEC be reliably anticipated?
- What early actions, triggered by forecasts, could mitigate HEC?

The resulting FbA protocol has the potential to reduce rates of HEC and secure coexistence, improving the conservation of elephants and protecting the lives and livelihoods of local people.

The use of deterrent fences and environmental correlates to alleviate human elephant conflict in southern Kenya

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In areas where human settlements and elephant habitats overlap, human-elephant conflict is a major issue for human livelihoods and elephant conservation. These interactions harm farmers, as crop raiding events compromise food and economic security, and elephants, as farmers may retaliate against them. Our *Elephants and Sustainable Agriculture in Kenya* project is located in the Kasigau Wildlife Corridor of Kenya. Over the past four years, we tested the effectiveness of eight deterrent fence designs, including 5 single deterrents (one line of deterrent strung between fence posts), and 3 double deterrents (a combination of two strands of single deterrents). We also examined moon phase and season as environmental factors in relation to crop raiding. A total of 8 blocks of land were leased from farmers along the boundary between the village of Sasenyi and Rukinga Wildlife Sanctuary. Four of the 8 blocks were split into 8 fields each. Four experimental deterrents were compared with 4 matched controls containing all components of the deterrent except the stimulus being tested. The traditional acacia deterrent had a matched control of just fence posts, which also acted as the grand control for the experiment. The other four blocks were separated into 2 equal fields comparing a deterrent made of hanging beehives and its matched control. Moon phase and season were documented with elephant presence at the experimental fields. During each of the two growing seasons per year, all elephants within 12 meters of the deterrent fences were categorized as approaching, and any that entered a field were designated as breaching. Effectiveness of deterrents, and correlation with environmental factors was measured through the comparison of approaches and breaches using Generalized Linear Models. The novel deterrent fence designs including double deterrents were hypothesized to deter elephants better than the acacia fence, due to their ability to stimulate more sensory modalities more intensely. Elephant crop raiding events were hypothesized to be higher during the new moon phase when ambient light at night is lowest. We also hypothesized a seasonal effect on crop raiding with breaching occurring most often when crops were ready for harvest and wild food resources were beginning to dwindle, which is during the transition from the wet to the dry season. Elephants breached fences significantly more during the waning crescent moon phase compared to the full moon, while food-growing season had no significant effect on the number of breaches of the deterrent fences. All new experimental deterrents performed better than the grand control. The acacia fence was the only deterrent tested that did not perform significantly better than the grand control at deterring approaching elephants, and the double deterrent fence designs were significantly better at deterring elephants than the single ones. The results of this study are being shared with the farmers living in the KWC as well as relevant policy makers to improve food and nutrition security, as well as enhance coexistence. Our findings may be useful to others living in high HEC areas by providing additional crop raiding mitigation strategies for coexisting with elephants.

Human-Elephant Coexistence Challenges and Solutions in northwest Namibia

Christian Winter, Rachel Harris
Elephant-Human Relations Aid (EHRA)

Since 2003, Elephant-Human Relations Aid (EHRA) has been working to protect the desert-dwelling elephants and promote a peaceful coexistence in Namibia and we achieve this through various approaches, including community development, capacity building, education, research and data sharing, long-term conflict mitigation strategies and strong national collaborations.

Since the usually western-bound desert-dwelling elephants in our core project site have expanded their home range 65km to the east, which includes 30+ commercial farms that are crisscrossed with fences, new human-elephant conflicts erupted, resulting in several elephant deaths. This new, challenging type of conflict demands innovative and long-term solutions, which includes the development of elephant migratory corridors and safe elephant habitat and sustainable coexistence strategies.

Human elephant conflict mitigation measures: Lesson from Bardia National Park, Nepal
Rabin Kadariya
National Trust for Nature Conservation

Nepal is a typical example of an elephant range country with a small but growing population of ~240 individuals, of which ~120 populations are from Bardia National Park which is located in the western terai part of Nepal. Along with the increasing population of the elephants, people of the lowland Terai are suffering the externalities or the consequences of the conservation success as a result of increased human-elephant conflict (HEC). Our long-term database on human-wildlife conflict from the Bardia National Park showed that within the period of 2010 – 2020, elephant raided crops of over 2627 farmers and destroyed 1399 houses. The worst of all, 47 people lost their lives, and 125 people were injured by the elephant attack since 1998. On the other hand, 34 elephants found dead, of which 5 were killed in retaliation in the same period. Various efforts both preventive (e.g., electric fence, growing of non-palatable and high-value cash crops, watch tower, physical barriers, behavior changing education, mobilization of Rapid Response Teams) and relief (e.g., compensation, crop insurance, scholarship, income generation) measures have been carried out by the governments and conservation partners to reduce the cases of HEC. These interventions were appreciated by the community and park management, however, with the magnitude of HEC cases, the interventions are still inadequate and need more strategic and integrated interventions to maintain human-elephant co-existence (HECx) – a win win scenario in the landscape.

Using Chilli Peppers as a Mitigation Tool for Elephant Human Conflict in Africa
Loki Osborn and Malvern Karidozo

Researchers and managers have been testing chilli peppers - specifically the active ingredient in hot peppers (Capsaicin) - to mitigate human elephant conflict in Africa for over 25 years. Many reports and manuscripts have been generated but the results have varied between sites and there has been disagreement about the effectiveness of this approach. This review outlines the origin of the idea of using a chemical irritant as a way to repel elephants and its implementation in different situations. Both low and high tech dispersal methods are reviewed and the successes and failures are evaluated. The value of growing chilli peppers by subsistence farmers as a conservation tool will also be discussed.

Bees on guard: Optimizing the impact of beehive fences around Kibale National Park, Uganda through citizen science

Marianne Staniunas
Kibale Forest's Schools' Program and The Kasiisi Project

This presentation will discuss an ongoing Citizen Science collaboration between the Kibale Forest Schools Program and farmer-beekeepers from the Busiriba Beekeepers and Conservation Association who manage elephant deterring beehive fences around Kibale National Park, Uganda. Through this collaboration, we are setting baselines for African Honeybee health against which the impact of future environmental changes can be measured. These data along with developing and sharing best practices for apiary management help farmers manage colonies that are healthy and active enough to be effective elephant deterrents. The consequent reduction in human elephant conflict along with potential income from the honey benefits both elephant conservation and community development.

Local data leads to local solutions for human-elephant competition for resources bordering a National Park in Botswana

K.E. Evans, T. Motsentwa, K. Ngaka.
Elephants for Africa

The second largest threat to the continued survival of the African savannah elephant (*Loxodonta africana*) is the competition for resources with humans. As human populations increase, their footprint on uncultivated and protected lands throughout Africa increase as we strive to feed and provide for more people. The competition for resources between humans and wildlife are being exasperated by the effects of climate change and wildlife moving out of protected areas in search of the resources they require.

Partnering with communities bordering the Makgadikgadi Pans National Park (MPNP), we work to understand their needs, challenges, and ambitions, to provide them with access to information to enable them to work towards human-elephant coexistence and limit the negative impact of living with elephants, both on their livelihood but also their welfare. Funding from the International Elephant Foundation enabled us to investigate how elephants utilize the community lands bordering the MPNP, providing local data on elephant movements through community lands to better equip communities with knowledge through our Living with Elephants workshops, on how elephants utilize their land and adjust mitigation practices accordingly and for national stakeholders to plan for the future when it is likely that climate change will drastically alter the moment of both elephants and humans.

With a predominantly male population it was no surprise that all crop raiding was carried out by male elephants, in small groups with the majority at night (89%). Elephants often moved directly from one field to the next, suggesting that they are repeat raiders and identified hotspots for transgression points of elephant along the western of border of the MPNP are in alignment with where crop raiding occurred but at this stage it is hard to ascertain which is the causation factor, the location of the fields or the ease of exiting/entering the park at those points, the recent re-erection of the National Park fence will potentially help us answer this question.

The knowledge we have gained from this research has helped us improve our Living with Elephants workshops and deliver temporal and spatial specific information to communities in our region.

Efficacy of ex-gratia policy in mitigating human-elephant conflict in Odisha, India

Medha Nayak,
Fakir Mohan Autonomous College, Balasore, India.

In the recent years, animosities between the humans and elephants have made headlines in Odisha, India. In order to mitigate the conflict and prevent retaliatory killings of elephants, the government has been installing solar-powered fences, digging trenches and making hefty expenses to aid aggrieved communities to mention a few. Despite the efforts human-elephant conflict is ubiquitous and there is much dissatisfaction over damage recovery with ex-gratia provisions. Therefore, realizing the fact that ex-gratia policy affects the attitudes and perceptions towards elephants so this study aimed to analyse the efficacy of ex-gratia policy towards mitigation of human-elephant conflict. The primary respondents were the local communities and frontline forest staffs of Balasore district. To elicit responses semi-structured interviews were conducted. Every respondent of the study agreed that it is necessary to pay ex-gratia to those affected by elephant depredation because the afflicted communities are usually from backward classes who struggle to make ends meet. However, the local people raised several issues that stand in the way of benefitting them that subsequently discourages them from claiming ex-gratia. For instance, issues with damage estimation, favouritism, faulty claims, delay in payment and inadequacy of payments. Frontline forest department staffs, on the other hand, shared their worries and challenges in disbursing ex-gratia benefits to affected families. In conclusion, this study suggested improvements to enhance the efficacy of ex-gratia policy to better mitigate human-elephant conflict in Odisha.

Human–Elephant Conflict (HEC) from a Research Perspective

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Human–elephant interactions encompass direct and indirect contacts that can affect either or both species. When interactions have a negative outcome for one or both species, they are termed conflicts, hence the acronym HEC for human elephant conflicts. The conflict emanates from competition over a limited resource, typically food, water, and/or space. HEC is quickly becoming the major impediment for elephant conservation, as the consequences have deeper and longer lasting impacts than poaching. A major category of HEC involves the raiding of crops by elephants. In regions of Africa and Asia with elephants, most crops are grown on small farms and the produce serves as both food and income for a family or community. Even when elephants are not the primary cause for crop failure, they may be blamed; when they do raid extensive damage can result. Elephants also are feared, and their ecological value may not be understood, so some communities have little sympathy for elephants or concern for their conservation. To reduce crop raiding, extensive research has occurred to improve the repertoire of means for people to enhance

their food security. The deterring of elephants from entering crop fields is often the first line of defense. Traditional methods include scaring elephants using fires or the sounds of drums and chanting; chasing them on foot, on elephant back, or with dogs; and building obstacles such as ditches or fences. None of these methods have proven to be effective consistently over time and place. Thus, a variety of new fences have been created using such means as active beehives, chili pepper extracts, metal strips, or flashing lights. In addition to effectiveness, affordability and practicality need to be considered in deterrent designs. While some results have been highly promising, other tests of these deterrents have indicated that they are ineffective. Each new idea stimulates further tests that tend to yield variable results based on species, ecology, and/or geography. A key issue in the progress of this line of research is what explains the variability from one species, region, or time of year to another. Logical explanations are often provided, but these lead to the need for further tests. The impetus of this presentation is to stimulate discussion on how researchers can coordinate with each other better to examine underlying assumptions (e.g., elephant fear of bees) and design experiments that provide good replicates across time and landscapes. We will use two deterrent types (chili pepper and beehive fences) to illustrate possibilities and provide research-based paths forward.

The role of African savanna elephants (Loxodonata Africana) in see dispersal and regeneration of woody plant species in Chobe National Park, Botswana

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The woodland biomass, particularly large trees, along the Chobe and Linyanti riverfronts in Botswana, has declined over the years due to foraging by elephants. This has incited widespread debates on the value of elephants in an ecosystem, as they are often perceived as destructive forces in woodland ecosystems. Little is known, however, as to whether or not elephants could potentially be ‘architects’ of savanna ecosystems through their role in seed dispersal and regeneration of woody plant species. To answer this question, we examined the potential presence of woody plant seeds in elephant dung balls sampled along transects in the riparian woodland of the Linyanti and Chobe riverfronts as well as drier woodlands in the Chobe National Park. A total of 522 seeds were recorded, representing eight (8) different genera and nine (9) species of woody plants. Out of the 9 species recorded, *Vachellia erioloba*, *Sclerocarya birrea* and *Diospyros mespiliformis* were the most abundant species. We also recorded and ranked (from 1 to 5 according to declining abundance) all the woody trees along the same transects where elephant dung balls were sampled. A total of 35 woody tree species were recorded in the riparian woodland and the drier woodland vegetations. A degree of comparability between the seeds and the transect species was then calculated using the Jaccard Index and was found to be 0.073. The next step will be to investigate the viability of the collected seeds by conducting germination tests. Should these seeds germinate, this would prove that indeed not only do elephants disperse seeds, but that the defecated seeds have the potential to re-establish new woodlands.

The potential of photogrammetric point clouds derived from conventional aerial survey for estimating tree heights within savanna ecosystems
Katie Thompson

The ability to measure tree metrics within savanna ecosystems, will support studies quantifying impacts and recovery on tree species as a result of elephant presence. Individual tree detection (ITD) is an approach that has been used to detect tree heights for boreal forest management and inventory purposes. ITD has commonly been applied using an area-based approach (ABA) to derive canopy height models (CHM) from airborne laser scanning (ALS) data. However, ALS data are limited both spatially and temporally, where ITD methods have largely been applied to boreal forests. The potential for using 3-dimensional (3D) photogrammetric point clouds to determine tree metrics within a savanna environment is not fully recognised. Thus, the aim of this study was to determine how effective photogrammetric point clouds derived from conventional aerial surveys were for ITD. Point clouds were generated for Karongwe Private Game Reserve (KPGR, South Africa) and some surrounding areas (380 km2). 634 reference trees were selected in order to validate ITD. We found a strong positive correlation between observed and reference tree height estimates ($R^2 = 0.79$). 95% of estimated tree heights, using this method in similar environments, are likely to have a ΔH between -1.79 and 2.45 m. In addition, no bespoke data collection is required as our method uses existing aerial survey data. Our results have shown that tree heights can be estimated using ITD approaches directly from a point cloud which will enable effective quantification of tree heights, supporting studies on the impact of elephants on vegetation. This will in turn, support elephant conservation by enabling effective, remote monitoring of vegetation. Further research is suggested within similar environments, in collaboration with other mapping agencies.

Pan-African population genomic analysis of savannah and forest elephants
Patrícia Pečnerová, Yasuko Ishida, Rasmus Heller, Anders Albrechtsen, Ida Moltke, Love Dalén, Alfred L. Roca, Hans Siegismund

Elephants in Africa experienced drastic population declines but the impact that these declines had on their genetic diversity is not clear. Previous genetic studies suggested that elephant populations in different regions, as well as individual populations within the same region, were affected and responded in dramatically different ways. Here, we use whole-genome sequencing to analyze savanna and forest elephants from 20 locations spread across most of their current range. Sampling elephants continent-wide across Africa offers a unique resolution on the spatial scale, and genome-wide sequencing provides an unprecedented power on the analytical scale. We aim to use this dataset to analyze finer-grain population structure, to explore the extent of gene flow between regions, as well as to reconstruct demographic history in various regions of the elephant distribution. While this project is in its starting phase and the data is waiting to be analysed, I will showcase what kind of information we are planning to look at with genomic data by presenting a few examples from an analogous study on African leopards that we have published recently. Besides being a source of information about the population genomics of savanna and forest African elephants, the aim is for it to also serve as a foundation for future research of elephant genetics, since all the data will be made publicly available with the publication of the research. Moreover,

we hope that this data can be applied in conservation practice and that it has the potential to complement microsatellites as the genetic marker of choice, for example in genetic monitoring.

IUCN Red List Assessments of Africa's Two Elephant Species
Kathleen S. Gobush, C.T.T. Edwards, D.Balfour, G.Wittemyer, F. Maisels, R.D. Taylor
IUCN African Elephant Specialist Group Red List Lead & Coordinator

For the first time, we assess Africa's elephants as two separate species for the IUCN Red List on the basis of accumulating genetic, behavioural, morphological, ecological and demographic data differentiating forest elephants from savanna elephants. Forest elephants occur in the tropical forests of Central Africa and a variety of habitats in West Africa, rarely overlapping with the range of the savanna elephant, which prefers open country such as grasslands, deserts and other habitats across Sub-Saharan Africa. A random-effects hierarchical density model was developed and fit to quality data for each species to estimate population reduction over 1 to 2 elephant generations. A combined 1500 surveys of 495 sites from across the continent were included going back as far as the 1970s for the forest elephant and 1960s for the savanna elephant. Poaching for ivory tusks and habitat loss are the primary threats to both species resulting in an estimate! d reduction of 86% of the critically endangered forest elephant between 1984 to 2015 (31 years) and over 60% of the endangered savanna elephant between 1965 and 2015 (50 years). Despite these overall declining trends, some well-managed populations in Gabon, Republic of Congo, Kenya and the Kavango-Zambezi Transfrontier Conservation Area in southern Africa, for example, have stabilized or are increasing. Anti-poaching, anti-trafficking and anti-demand of ivory measures along with supportive legislation have been key to successful elephant conservation. Land use planning that seeks to foster human-wildlife coexistence, as well as increased funding for wildlife conservation, are also exceedingly important for the two species as Africa's human population and footprint expands.

Addressing human and elephant conflict in northwest Uganda
Joanna Hill
Rutgers University, New Jersey, USA

This presentation tells the story of human-elephant conflict occurring around Murchison Falls Protected Area in Uganda. As will be revealed, it is just as much a story about human-human conflict as it is between people and elephants. Since 2019, our team has been deeply embedded in the local communities around Murchison collecting critical base-line data on elephants and crop raiding. I discuss some of our research activities, findings, and highlight the challenges for developing peaceful coexistence between humans and elephants in Uganda and beyond.

Conserving the Asian Elephant in Range Countries
Heidi S. Riddle
IUCN-SSC Asian Elephant Specialist Group

The Asian Elephant Specialist Group (AsESG) is a global volunteer network of diverse elephant specialists organized under the International Union for the Conservation of Nature (IUCN)'

Species Survival Commission (SSC). The AsESG works with the 13 Asian elephant range countries, conservation organisations, and international partners to address key priority issues and conservation of the species.

The current population of Asian elephants is distributed in 13 countries in South and Southeast Asia and is estimated to be 48,099–51,680 individuals in the wild and 14,930-15,130 in captivity. The overall population trend of the Asian elephant is downwards. While populations of Asian elephants in South Asia are believed to be relatively stable in the recent past, numbers have plummeted in some SE Asia countries. Only 100–130 wild elephants are thought to be left in Vietnam, with the number likely to be even lower.

The challenge of conserving Asian elephants in the new millennium is not confined to the borders of any one country. Habitat loss and fragmentation, human–elephant conflict, poaching, and illegal trade are all threatening the elephants that survive in Asia today. The fragmentation of elephant habitat has resulted in a decline of available undisturbed spaces, thereby leading to compression of elephant herds in Protected Areas causing an escalation of human–elephant conflict in the adjoining human-dominated landscapes. Conflicts between people and elephants result in the loss of more than 600 humans and 450 elephant lives every year in Asia.

An important initiative of the AsESG is to facilitate a unique communication platform for elephant conservation amongst Asian elephant range country governments. The Asian Elephant Range States Meeting encourages the governments to share knowledge and set clear and measurable conservation goals while incorporating technical inputs from the AsESG. Based on key priorities identified for the conservation of Asian elephants by the AsESG, range country governments, and the 2017 Jakarta Declaration for Asian Elephant Conservation, the AsESG specifically aims to:

- Assess threats to key elephant populations and the effectiveness of current conservation efforts;
- Assist in conservation planning for improved management and conservation of Asian elephants;
- Map the current distribution of elephants in all 13 Asian range countries;
- Increase public awareness of the challenges of Asian elephant conservation through the AsESG website, social media, and Gajah, the journal of the AsESG;
- Increase the AsESG skill base and geographic representation for improved planning and implementation; and
- Foster international cooperation to protect and conserve Asian elephants.

Public Policy Frameworks for Elephant Conservation

Kelly Dunning
Assistant Professor Auburn School of Forestry and Wildlife Sciences

This research asks how public policy frameworks can be applied to the issue of international elephant conservation? Public policy frameworks can help move elephant conservation from a fragmented exercise with immense variability across nations and subnational jurisdictions to a more concerted, international effort with clear goals and best practices. This research takes the form of a review and a theoretical exercise where I specifically apply John Kingdon's seminal

Multiple Streams Framework (MSF) to elephant conservation (Kingdon 2003). The MSF frames political events as occurring at a critical moment in time, or *policy window*. The policy window was the signing of important elephant conservation treaties such as the African Elephant Action Plan in CoP 15 in 2010, causing elephant range nations to secure and restore elephant populations. Kingdon's MSF places *policy entrepreneurs* at the center of policy implementation. They are the influential actors such as policymakers, NGO staff, international organization staff, and think tank staff that enact policy. In Kingdon's MSF, policy entrepreneurs implement policy through combining three *streams*: the *problem stream, policy stream,* and *politics stream*. The problem stream is the issue that international treaties and the policymakers want addressed (i.e. poaching, illegal trade, and human elephant conflict). The policy stream is what Kingdon calls the "soup of ideas" or solutions that compete to win the attention of policy entrepreneurs (Kingdon 2003). The soup of ideas in this situation is where the long list of elephant conservation policies that vary country to country, including events like the 2017 banning the sale of ivory in China or range nations encouraging innovative fencing to reduce human elephant conflict, among many others. A comprehensive examination of the policy stream is necessary for a more unified and concerted effort at elephant conservation and can occur within the IEF21 meeting. Returning to the MSF, the politics stream refers to the national mood, impacted by pressure group campaigns, administrative reorganization, elections, or political crises. The politics stream causes policymakers to act and prioritize an agenda item. The signing of the international treaties or even domestic elections which may cause countries to reform their bureaucracy where responsibilities for elephant conservation are vested. These same bureaucracies may also be responsible for developing biodiversity plans, work which may be interrupted by elections and bureaucratic reshuffling in the politics stream. What is needed in the field of elephant conservation is a comprehensive, theory-driven assessment of the multiple streams of elephant conservation using public policy frameworks. This type of assessment can determine where power centers are located, and where dynamism is most prevalent. Insights on these two topics can assist in policy reforms and greater cohesion to international elephant conservation.

Cheyenne Mountain Zoo's Role in the Palm Oil Crisis

Chelsea Wellmer
Palm Oil and Conservation Programs Coordinator

For the past decade, Cheyenne Mountain Zoo in Colorado Springs, CO has been a leader in sustainable palm oil conservation. In this presentation we will be providing an introduction to palm oil--and why we should be talking about it--as well as an overview of how conservation-minded organizations can get involved in promoting sustainable palm oil. Sustainable palm oil resources will be shared so that every participant will be prepared to talk about sustainable palm oil with different audiences and will even be prepared to start or improve a sustainable palm oil awareness program at their organization. You are encouraged to come with questions!

An Overview of the Asian Elephant Conservation Programme at African Lion Safari
Taryn Prosser
Afircan Lion Safari

African Lion Safari® is a drive through Wildlife Park dedicated to the conservation of declining wildlife species, including the Asian elephant. With 25 elephant births since 1991, the park has one of the most successful conservation and propagation programs for Asian elephants in the world, and is home to 18 Asian elephants. This presentation provides a general overview of the conservation programme and illustrates the key components to the programme's success. It also shows the unique seasons within Ontario, and how these elephants adapt to the seasonal changes, as well as give a brief outline of in-situ and ex-situ research involvement within the programme.

It takes a Village
Daryl Hoffman, Dr. Christine Molter
Houston Zoo

The Houston Zoo has a long history managing elephant endotheliotropic herpesvirus (EEHV) in its Asian elephant herd, including several deaths. It was the passing of Mac in November 2008 that prompted the zoo to reevaluate the elephant program, the impact of EEHV on calf survivorship, and whether to continue the breeding. In early 2009, the zoo formed a partnership with Baylor College of Medicine (BCM) to research EEHV. The zoo knew that without a better understanding of the EEHV disease process, diagnostic tools to test for it, and a plan to better medically manage it, the future of elephants in Houston would be in jeopardy. Over the last decade, the partnership between the Houston Zoo and Baylor College of Medicine has been tremendously productive including the characterization of viremia and viral shedding, sequencing of the viral genome, recognition of bloodwork patterns associated with EEHV, development of PCR and serologic diagnostic tests, building towards a vaccine, advancement of medical treatments, and setting training standards for calves to facilitate early blood sample collection. It is only through this collaboration that the zoo has been able to continue its successful breeding program, which has seen the birth of 8 elephant calves and despite several calves becoming ill with EEHV, none of the cases have resulted in deaths. Although much of the progress with EEHV has come from knowledge gained through the Houston Zoo's partnership with BCM, there is an entire network of partners across the city, state, country, and world working on different aspects of this disease, in both Asian and African elephants, in human care and in the wild. The entire elephant community has benefited from this global collaboration, especially in times of need – it truly takes a village to help elephants everywhere fight against EEHV.

Welfare standards for elephants in human care: A multi-stakeholder initiative
Dr. Marthe Kiley-Worthington[1], Kim (Jake) Rendle-Worthington[1], Christine Nicol[1] Lisa Yon[2]
We Are All Mammals[1], University of Nottingham[2]

Concerns have been raised about the welfare of elephants involved in tourism activities world wide, including disquiet about management and training practices. We present some of the key issues around these concerns, with a focus on elephants in human care in Southern Africa. We

describe a process, initiated in 2018, which has identified how the needs of elephants might be addressed. The first phase of the initiative involved organising knowledge-exchange workshops, based at facilities with elephants in human care in Zimbabwe. The process garnered support from local communities and professional bodies. During each workshop, lectures, discussion groups and on-site demonstrations were held, bringing together experts in welfare science, elephant conservation and humane cooperative teaching techniques with facility owners, managers and handlers. As a result of these workshops a consensus was reached amongst stakeholders that it would be valuable to develop a set of Standards that would apply to all aspects of the keeping of elephants under any form of human care, with the aim of ensuring a life of quality for every individual.

To assist in producing the Standards, three major stakeholder groups were identified:

1. Welfare science and animal behaviour experts;
2. Local professionals concerned with elephant welfare (NGOs, veterinarians and conservationists);
3. Those responsible for the elephants in human care (tourism operations, sanctuaries, release programs, handlers).

Through a subsequent series of workshops over 2 years in Zimbabwe, Zambia and online, a thorough set of guidelines and standards for aspects of management and welfare of elephants in human care was agreed via an iterative process by representatives of each stakeholder group. This culminated in the publication of 'Standards for the Management and Welfare of Elephants in Human Care in Southern Africa' in July 2021 by the Charity 'We Are All Mammals'. This represents the first such set of Standards produced in Africa.

In this paper we present:- (i) an overview of the contents of the Standards, including elephant management, husbandry and teaching and training methods and how these impact on welfare (ii) integration with conservation and education objectives, health and safety considerations, and long-term facility missions (iii) mechanisms by which the welfare of elephants can be assessed and improved, including record keeping, monitoring and auditing processes leading to Accreditation and membership of a new group, the Zimbabwe Elephant Careers' Association. We also present a strategy for how the Standards may be used by facilities worldwide wishing to comply and be accredited. A case study is described of how this document is being applied to an elephant facility (Elephant C.R.E.W.) at Jafuta, Victoria Falls, Zimbabwe

Asian elephant support 2020-2021 progress report

Liz Beem, Mindy Ussrey
Asian Elephant Support

Asian Elephant Support is pleased to participate in the 2021 International Elephant Foundation Virtual Conference, with two years of updates on our organization and the projects we have supported. Prior to the COVID pandemic shutting down most world travel, we funded a variety of projects in Borneo, Cambodia and efforts to mitigate Human-Elephant Conflict in the West Bengal and Mysore regions of India.

When the pandemic began, and for a year, the AES Board switched gears and made the decision to fund only grant requests that were for emergency needs for camps to sustain their elephants due to the halt of ecotourism throughout Asia and to provide veterinary assistance. One of our largest projects in 2020 and 2021 was in Thailand, where we provided funds to hire a second veterinarian with the Chiang Mai University Mobile Vet Clinic. Our support of the CMU veterinary team allowed them to still make their life-saving calls. This was only possible thanks to AES supporters who purchased t-shirts and gave generously during our Chang Vet Aid fundraiser in February.

On top of that project, we continued to support efforts to care for both captive and wild elephants in Sumatra where we provided funds for the Elephant & Conservation Response Units in that country - providing food and medicine for the Units' elephants and as a result supporting their work patrolling National Parks in the region to prevent poaching and Human-Elephant Conflict.

As of the second quarter of 2021 AES has been able to return to funding non-emergency efforts, including an educational project with the Biodiversity and Elephant Conservation Trust's program in Sri Lanka. We are still seeing the impacts of COVID on Asian countries and remain committed to funding some of the basic yet vital needs for food and medical care wherever needed.

AES will share the ups-and-downs of the last two years and of course our thanks for those who assisted us in our mission to care for and conserve Asian elephants in range countries.

African Forest Elephant Foundation: Boots on the Ground
Christian Triay

An overview of the African Forest Elephant Foundation and its project 'Boots on the Ground', which aims to support rangers with their antipoaching and biomonitoring operations across central and west Africa conserving the critically endangered African forest elephant and its forest habitat into the future.

International Elephant Foundation
Sarah Conley, Deborah Olson

IEF supports our global conservation efforts including: rangers who find and stop poachers, helping people and elephants live together peacefully, and teaching children to respect elephants and other wildlife. In 2021 IEF supported 22 projects in 13 countries across 3 continents. We have projects in Kenya, Uganda, Rwanda, Zambia, Botswana, Namibia, Tanzania, Nepal, India, Sumatra (Indonesia), China, Sri Lanka, and the United States.

IEF works with communities who live with elephants, making them conservation partners not just program recipients. We believe it is those people who will ultimately decide the fate of the wildlife with which they live so they must be involved in all aspects of the project from initial decision making to actions taken. Only then lasting changes be made that will help both the humans, elephants and other wildlife.

Since elephants are an 'umbrella species', safeguarding elephants protects all wildlife who share their habitat including other rare and endangered species like the Sumatran tiger, Sumatran rhino, pangolin,

orangutans, tapir, sun bear, Rothschild's giraffe, lions, cheetah, and more. Many of our projects specifically address this cross-species benefits.

We at the International Elephant Foundation thank all of you for attending the 17th International Elephant Conservation and Research Symposium.