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Ackermann, M., et al. (2017). "Identification of shedders of elephant endotheliotropic herpesviruses among Asian elephants (Elephas maximus) in Switzerland." PLoS ONE **12**(5): e0176891.

Elephants, particularly Asian (Elephas maximus), are threatened by lethal elephant hemorrhagic disease (EHD) due to elephant endotheliotropic herpesviruses (EEHV). At least five of seven known EEHV types have been associated to EHD, with types 1, 4, and 5 predominantly affecting Asian elephants. In Switzerland, at least three Asian elephants have been lost due to EHD but nothing is known about the present EEHV1 circulation. Moreover, the prevalence of other EEHV types has never been assessed. Intermittent shedding of EEHV can be monitored through collecting trunk secretions and analyzing them by PCR methods that discriminate the different EEHV types. To identify EEHV shedders, seven of eight Asian elephants in a Swiss zoo were trained to provide trunk wash samples. These were collected at intervals over a period of four months and tested by PCR for presence of EEHV1 through 6. Moreover, the quality of each sample was assessed by testing for the elephant TNF-alpha gene. Overall, 57% of the samples were valid with five of seven participating elephants identified as EEHV shedders. Two of those shed virus only once, whereas the other three, all closely related among each other, shed virus on multiple occasions. One of the frequent shedders had been in very close contact to all of the three EHD victims. Therefore, we speculate that this particular animal may represent the virus source in all three cases. However, when subtyping was conducted, the presently circulating virus was identified as EEHV1B, while the virus subtype causing EHD had been 1A in all three cases. In addition to four animals excreting EEHV1, a recently introduced animal was observed to shed EEHV3/4. We suggest that the policy of trunk washing to identify and characterize EEHV-shedders is to be endorsed in zoos with ongoing or planned elephant breeding programs.

Alberic, M., et al. (2017). "Relation between the Macroscopic Pattern of Elephant Ivory and Its Three-Dimensional Micro-Tubular Network." PLoS ONE **12**(1): e0166671.

Macroscopic, periodic, dark and bright patterns are observed on sections of elephant tusk, in the dentin part (ivory). The motifs-also called Schreger pattern-vary depending on the orientation in the tusk: on sections perpendicular to the tusk axis, a checkerboard pattern is present whereas on sections longitudinal to it, alternating stripes are observed. This pattern has been used to identify elephant and mammoth ivory in archeological artifacts and informs on the continuous tissue growth mechanisms of tusk. However, its origin, assumed to be related to the 3D structure of empty microtubules surrounded by the ivory matrix has yet to be characterized unequivocally. Based on 2D observations of the ivory microtubules by means of a variety of imaging techniques of three different planes (transverse, longitudinal and tangential to the tusk axis), we show that the dark areas of the macroscopic pattern are due to tubules oblique to the surface whereas bright areas are related to tubules parallel to it. The different microstructures observed in the three planes as well as the 3D data obtained by SR-muCT analysis allow us to propose a 3D model of the microtubule network with helical tubules phase-shifted in the tangential direction. The phase shift is a combination of a continuous phase shift of pi every 1 mm with a stepwise phase shift of pi/2 every 500 mum. By using 3D modeling, we show how the 3D helical model better represents the experimental microstructure observed in 2D planes compared to previous models in the literature. This brings new information on the origin of the unique Schreger pattern of elephant ivory, crucial for better understanding how archaeological objects were processed and for opening new routes to rethink how biological materials are built.

Arnold, D. M., et al. (2017). "A simple, field-friendly technique for cryopreserving semen from Asian elephants (Elephas maximus)." Anim Reprod Sci **182**: 84-94.

The specific objectives of the present study were to investigate the effects of manual seeding, differing freeze and thaw rates as well as storage for 24h at 4 degrees C prior to cryopreservation on post-thaw sperm quality in Asian elephants. Extended semen was cooled in an equitainer to 4 degrees C, frozen

in liquid nitrogen vapour at various rates with and without manual seeding or in a dry shipper and thawed at 37, 50 and 75 degrees C. There was a significant effect of freeze rate on post-thaw motility (P<0.0001) and acrosomal integrity (P<0.005). The faster freeze rates in the dry shipper and at 1cm or 2cm above liquid nitrogen consistently provided better cryopreservation than slower freezing rates. Thaw temperature had no effect on post-thaw semen quality but there was an interaction between freeze and thaw rates with higher thaw rates resulting in superior post-thaw semen quality in straws frozen at fast rates. Storage of samples prior to freezing had a detrimental effect on post-thaw semen quality. In summary, our results indicate cooling extended semen in an equitainer and cryopreserving it by placing straws directly in a dry shipper is a simple technique for effectively cryopreserving Asian elephant semen in the field or zoo.

Ashiagbor, G. and E. Danquah (2017). "Seasonal habitat use by Elephants (Loxodonta africana) in the Mole National Park of Ghana." Ecol Evol **7**(11): 3784-3795.

To avoid unnecessary waste of limited resources and to help prioritize areas for conservation efforts, this study aimed to provide information on habitat use by elephants between the wet and dry seasons in the Mole National Park (MNP) of Ghana. We compiled coordinates of 516 locations of elephants' encounters, 256 for dry season and 260 for wet season. Using nine predictor variables, we modeled the probability of elephant's distribution in MNP. We threshold the models to "suitable" and "nonsuitable" regions of habitat use using the equal training sensitivity and specificity values of 0.177 and 0.181 for the dry and wet seasons, respectively. Accuracy assessment of our models revealed a sensitivity score of 0.909 and 0.974, and a specificity of 0.579 and 0.753 for the dry and wet seasons, respectively. A TSS of 0.488 was also recorded for the dry season and 0.727 for the wet season indicating a good model agreement. Our model predicts habitat use to be confined to the southern portion of MNP due to elevation difference and a relatively steep slope that separates the northern regions of the park from the south. Regions of habitat use for the wet season were 856 km2 and reduced significantly to 547.68 km2 in the dry season. We observed significant overlap (327.24 km2) in habitat use regions between the wet and dry seasons (Schoener's D = 0.922 and Hellinger's-based I = 0.991). DEM, proximity to waterholes, and saltlicks were identified as the key variables that contributed to the prediction. We recommend construction of temporal camps in regions of habitat use that are far from the headquarters area for effective management of elephants. Also, an increase in water point's density around the headquarters areas and selected dry areas of the park will further decrease elephant's range and hence a relatively less resource use in monitoring and patrols.

Bankoff, R. J., et al. (2017). "Testing Convergent Evolution in Auditory Processing Genes between Echolocating Mammals and the Aye-Aye, a Percussive-Foraging Primate." Genome Biol Evol **9**(7): 1978-1989.

Several taxonomically distinct mammalian groups-certain microbats and cetaceans (e.g., dolphins)-share both morphological adaptations related to echolocation behavior and strong signatures of convergent evolution at the amino acid level across seven genes related to auditory processing. Aye-ayes (Daubentonia madagascariensis) are nocturnal lemurs with a specialized auditory processing system. Aye-ayes tap rapidly along the surfaces of trees, listening to reverberations to identify the mines of wood-boring insect larvae; this behavior has been hypothesized to functionally mimic echolocation. Here we investigated whether there are signals of convergence in auditory processing genes between aye-ayes and known mammalian echolocators. We developed a computational pipeline (Basic Exon Assembly Tool) that produces consensus sequences for regions of interest from shotgun genomic sequencing data for nonmodel organisms without requiring de novo genome assembly. We reconstructed complete coding region sequences for the seven convergent echolocating bat-dolphin genes for aye-ayes and another lemur. We compared sequences from these two lemurs in a phylogenetic framework with those of bat and dolphin echolocators and appropriate nonecholocating outgroups. Our analysis reaffirms the existence of amino acid convergence at these loci among echolocating bats and dolphins; some methods also detected signals of convergence between echolocating bats and both mice and elephants. However, we observed no significant signal of amino acid convergence between aye-ayes and echolocating bats and dolphins, suggesting that aye-aye tap-

foraging auditory adaptations represent distinct evolutionary innovations. These results are also consistent with a developing consensus that convergent behavioral ecology does not reliably predict convergent molecular evolution.

Baotic, A. and A. S. Stoeger (2017). "Sexual dimorphism in African elephant social rumbles." PLoS ONE **12**(5): e0177411.

This study used the source and filter theory approach to analyse sex differences in the acoustic features of African elephant (Loxodonta africana) low-frequency rumbles produced in social contexts ('social rumbles'). Permuted discriminant function analysis revealed that rumbles contain sufficient acoustic information to predict the sex of a vocalizing individual. Features primarily related to the vocalizer's size, i.e. fundamental frequency variables and vocal tract resonant frequencies, differed significantly between the sexes. Yet, controlling for age and size effects, our results indicate that the pronounced sexual size dimorphism in African elephants is partly, but not exclusively, responsible for sexual differences in social rumbles. This provides a scientific foundation for future work investigating the perceptual and functional relevance of specific acoustic characteristics in African elephant vocal sexual communication.

Barandongo, Z. R., et al. (2017). "DUST-BATHING BEHAVIORS OF AFRICAN HERBIVORES AND THE POTENTIAL RISK OF INHALATIONAL ANTHRAX." J Wildl Dis.

Anthrax in herbivorous wildlife and livestock is generally assumed to be transmitted via ingestion or inhalation of Bacillus anthracis spores. Although recent studies have highlighted the importance of the ingestion route for anthrax transmission, little is known about the inhalational route in natural systems. Dust bathing could aerosolize soilborne pathogens such as B. anthracis, exposing dust-bathing individuals to inhalational infections. We investigated the potential role of dust bathing in the transmission of inhalational anthrax to herbivorous wildlife in Etosha National Park, Namibia, an area with endemic seasonal anthrax outbreaks. We 1) cultured soils from dust-bathing sites for the presence and concentration of B. anthracis spores, 2) monitored anthrax carcass sites, the locations with the highest B. anthracis concentrations, for evidence of dust bathing, including a site where a zebra died of anthrax on a large dust bath, and 3) characterized the ecology and seasonality of dust bathing in plains zebra (Equus quagga), blue wildebeest (Connochaetes taurinus), and African savanna elephant (Loxodonta africana) using a combination of motion-sensing camera traps and direct observations. Only two out of 83 dust-bath soils were positive for B. anthracis, both with low spore concentrations (</=20 colony-forming units per gram). We also detected no evidence of dust baths occurring at anthrax carcass sites, perhaps due to carcass-induced changes in soil composition that may deter dust bathing. Finally, despite observing some seasonal variation in dust bathing, preliminary evidence suggests that the seasonality of dust bathing and anthrax mortalities are not correlated. Thus, although dust bathing creates a dramatic cloud of aerosolized soil around an individual, our microbiologic, ecologic, and behavioral results in concert demonstrate that dust bathing is highly unlikely to transmit inhalational anthrax infections.

Barman, N. N., et al. (2017). "Incidence of elephant endotheliotropic herpesvirus in Asian elephants in India." Vet Microbiol **208**: 159-163.

Elephant endotheliotropic herpesviruses (EEHVs) are the cause of acute hemorrhagic disease in endangered Asian and African elephants. In the present study, we report the incidence of EEHV infection and associated mortality in the captive elephant of Assam, India. Our result showed the gross morphology and histopathological changes of EEHV infection in the elephant. Moreover, the phylogenetic analysis of the polymerase, helicase, and GPCR genes from the infected tissue samples suggested the presence of EEHV1A virus.

Bhusri, B., et al. (2017). "Detection of elephant endotheliotropic herpesvirus 4 in captive asian elephants (Elephas maximus) in Thailand." Thai Journal of Veterinary Medicine **47**(1): 97-102.

Elephant endotheliotropic herpesviruses (EEHVs) can cause fatal hemorrhagic disease in elephants,

especially young captive Asian elephants (Elephas maximus). Currently, seven EEHV types have been reported. In this study, EEHVs were examined in whole-blood samples derived from 56 captive Asian elephants from eight provinces in Thailand by nested PCR using primers specific to the viral DNA polymerase gene in an attempt to monitor EEHV elephant cases. After EEHV testing, one sample (1.78%) was positive and found to be closely related to EEHV4 with 99% amino acid identity. This sample was from a three-year-old female Asian elephant with no clinical signs. These data suggest that asymptomatic EEHV4 infection can occur in Asian elephants.

Biggs, D., et al. (2017). "Breaking the deadlock on ivory." Science **358**(6369): 1378-1381.

Boehlke, C., et al. (2017). "Does diet influence salivary enzyme activities in elephant species?" J Comp Physiol B **187**(1): 213-226.

Asian elephants (Elephas maximus) and African elephants (Loxodonta africana) are herbivore generalists; however, Asian elephants might ingest a higher proportion of grasses than Africans. Although some studies have investigated nutrition-specific morphological adaptations of the two species, broader studies on salivary enzymes in both elephant species are lacking. This study focuses on the comparison of salivary enzymes activity profiles in the two elephant species; these enzymes are relevant for protective and digestive functions in humans. We aimed to determine whether salivary amylase (sAA), lysozyme (sLYS), and peroxidase (sPOD) activities have changed in a species-specific pattern during evolutionary separation of the elephant genera. Saliva samples of 14 Asian and eight African elephants were collected in three German zoos. Results show that sAA and sLYS are salivary components of both elephant species in an active conformation. In contrast, little to no sPOD activity was determined in any elephant sample. Furthermore, sAA activity was significantly higher in Asian compared with African elephants. sLYS and sPOD showed no species-specific differences. The time of food provision until sample collection affected only sAA activity. In summary, the results suggest several possible factors modulating the activity of the mammal-typical enzymes, such as sAA, sLYS, and sPOD, e.g., nutrition and sampling procedure, which have to be considered when analyzing differences in saliva composition of animal species.

Bouts, T., et al. (2017). "DETOMIDINE AND BUTORPHANOL FOR STANDING SEDATION IN A RANGE OF ZOO-KEPT UNGULATE SPECIES." J Zoo Wildl Med **48**(3): 616-626.

General anesthesia poses risks for larger zoo species, like cardiorespiratory depression, myopathy, and hyperthermia. In ruminants, ruminal bloat and regurgitation of rumen contents with potential aspiration pneumonia are added risks. Thus, the use of sedation to perform minor procedures is justified in zoo animals. A combination of detomidine and butorphanol has been routinely used in domestic animals. This drug combination, administered by remote intramuscular injection, can also be applied for standing sedation in a range of zoo animals, allowing a number of minor procedures. The combination was successfully administered in five species of nondomesticated equids (Przewalski horse [Equus ferus przewalskii; n = 1], onager [Equus hemionus onager; n = 4], kiang [Equus kiang ; n = 3], Grevy's zebra [Equus grevyi ; n = 4], and Somali wild ass [Equus africanus somaliensis; n = 7]), with a mean dose range of 0.10-0.17 mg/kg detomidine and 0.07-0.13 mg/kg butorphanol; the white (Ceratotherium simum simum; n = 12) and greater one-horned rhinoceros (Rhinoceros unicornis ; n = 4), with a mean dose of 0.015 mg/kg of both detomidine and butorphanol; and Asiatic elephant bulls (Elephas maximus ; n = 2), with a mean dose of 0.018 mg/kg of both detomidine and butorphanol. In addition, the combination was successfully used for standing sedation in six species of artiodactylids: giraffe (Giraffa camelopardalis reticulata; n = 3), western bongo (Tragelaphus eurycerus eurycerus; n = 2), wisent (Bison bonasus ; n = 5), yak (Bos grunniens ; n = 1), water buffalo (Bubalus bubalis ; n = 4) and Bactrian camel (Camelus bactrianus ; n = 5). The mean dose range for artiodactylid species except bongo was 0.04-0.06 mg/kg detomidine and 0.03-0.06 mg/kg butorphanol. The dose in bongo, 0.15-0.20 mg/kg detomidine and 0.13-0.15 mg/kg butorphanol, was considerably higher. Times to first effect, approach, and recovery after antidote were short. The use of detomidine and butorphanol has been demonstrated to be a reliable, safe alternative to general anesthesia for a number of large

ungulate species.

Bronson, E., et al. (2017). "EPIDEMIOLOGIC EVALUATION of ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS 3B INFECTION in AN AFRICAN ELEPHANT (LOXODONTA AFRICANA)." Journal of Zoo and Wildlife Medicine **48**(2): 335-343.

Brown, J. L. (2017). "Comparative ovarian function and reproductive monitoring of endangered mammals." Theriogenology.

The ability to track gonadal function is facilitated by the use of endocrine and ultrasound techniques, both of which are important tools for optimizing reproduction and ensuring sustainability of fragile populations. With so many species now endangered, captive breeding is increasingly viewed as a means to sustain important insurance populations. As reproduction is key to species survival, understanding how to control and monitor ovarian function is vital. Through decades of study, we now have a greater understanding of the diversity, and plasticity, of reproductive mechanisms across taxa. Even within related species, there are marked differences in seasonal, environmental and social influences on ovarian cycle dynamics, ovulatory mechanisms, and responses to assisted reproductive/ovulation induction protocols. For most wildlife species, endocrine function is assessed noninvasively through analyses of hormones or their metabolites excreted in urine or feces. Perhaps it should not be surprising then, that major differences in metabolism and routes of excretion exist, not only between species, but also among hormone types within a species. This means that a species by species, and sometimes hormone by hormone, approach is essential for developing effective reproductive monitoring and control strategies. Over the past 30 years, our laboratory has developed and validated a number of reproductive assay techniques, which has led to our amassing a database of ovarian cycle dynamics on over 100 species. This paper presents an overview of ovarian physiology, and summarizes comparative ovarian function research on some of our most well-studied species: felids, elephants, rhinos, tapirs and the giant panda, and how that information has been used to aid ex situ management. Each of these species represents a range of reproductive strategies, from the highly seasonal, monestrus giant panda to the aseasonal, polyestrus elephant. Some species exhibit spontaneous ovulations, while others are induced ovulators or both, with variations in ovarian cycle lengths that range from a few days to several months. These differences reinforce the need for studies of species basic biology to optimize breeding strategies.

Buddhachat, K., et al. (2017). "Distinguishing real from fake ivory products by elemental analyses: A Bayesian hybrid classification method." Forensic Sci Int **272**: 142-149.

As laws tighten to limit commercial ivory trading and protect threatened species like whales and elephants, increased sales of fake ivory products have become widespread. This study describes a method, handheld X-ray fluorescence (XRF) as a noninvasive technique for elemental analysis, to differentiate quickly between ivory (Asian and African elephant, mammoth) from non-ivory (bones, teeth, antler, horn, wood, synthetic resin, rock) materials. An equation consisting of 20 elements and light elements from a stepwise discriminant analysis was used to classify samples, followed by Bayesian binary regression to determine the probability of a sample being 'ivory', with complementary log log analysis to identify the best fit model for this purpose. This Bayesian hybrid classification model was 93% accurate with 92% precision in discriminating ivory from non-ivory materials. The method was then validated by scanning an additional ivory and non-ivory samples, correctly identifying bone as not ivory with >95% accuracy, except elephant bone, which was 72%. It was less accurate for wood and rock (25-85%); however, a preliminary screening to determine if samples are not Ca-dominant could eliminate inorganic materials. In conclusion, elemental analyses by XRF can be used to identify several forms of fake ivory samples, which could have forensic application.

Buddhachat, K., et al. (2017). "Telomeric attrition with increasing age in short- (Chihuahua dog) and long- (Asian elephant) life span animals." Kafkas Universitesi Veteriner Fakultesi Dergisi **23**(4): 643-649.

Here, we explored the rate of telomere attrition with increasing age by real-time quantitative PCR

(qPCR) in a short- (Chihuahua dog) and long(Asian elephant) lived species. A total of 122 Asian elephants (female = 106, male = 16) ranging from 24-840 months of age, and 89 Chihuahuas (female = 65, male = 24) 1-179 months of age were used in this study. We found that young (pre- and peri-pubertal) Asian elephants had a higher relative telomere length (RTL) compared to dogs. A low, but significant negative relationship between RTL and increasing age was observed in both Chihuahuas (R2=0.0490, P=0.0017) and Asian elephants (R2=0.0177, P=0.0210). The estimated rate of telomere loss for males and females of both species ranged from -0.0023 to -0.0065, with no clear differences between gender or species. Results suggest that Asian elephants may start with longer telomeres than Chihuahuas, as RTL was higher, but then the rate of telomere attrition proceeds at a similar rate in both species. Age accounted for only a small percentage of the variation in RTL in both Chihuahua dogs and Asian elephants, however. Thus, its use as a biological tool for age estimation would appear to be limited for these species.

Burke, S. M., et al. (2017). "DETECTION OF AEROSOLIZED BACTERIA IN EXPIRED AIR SAMPLES FROM ASIAN ELEPHANTS (ELEPHAS MAXIMUS)." J Zoo Wildl Med **48**(2): 431-439.

Elephant-mediated transmission of tuberculosis is assumed to be similar to human models, which state close and prolonged contact with an infected individual is required for transmission. Although considered a risk factor for infection, several case studies have reported that close contact with an elephant is not always necessary for transmission, and the role of aerosolized bacteria remains unclear. To investigate aerosol-mediated transmission of pathogenic bacteria from elephants, a method for the detection of aerosols using an adapted sampling system was developed. A commensal bacterium was isolated from the upper respiratory tract of elephants (Elephas maximus) and was used as a proxy organism to detect aerosolized droplets in the sampling system. It was found that elephants are capable of producing aerosolized bacterial particles of a size small enough to remain airborne for prolonged periods and penetrate the lower regions of the human respiratory tract.

Calabrese, A., et al. (2017). "Conservation status of Asian elephants: the influence of habitat and governance." Biodiversity and Conservation **26**(9): 2067-2081.

Understanding the drivers of Asian elephant (Elephas maximus) abundance and distribution is critical for effective elephant conservation, yet no such analysis exists despite decades of assessments and planning. We explored the influence of habitat- and governance-related drivers on elephant abundance across the 13 Asian elephant range countries. We tested competing statistical models by integrating a binary index of elephant abundance (IEA) derived from expert knowledge with different predictor variables including habitat, human population, socioeconomics, and governance data. We employed logistic regression and model-averaging techniques based on Akaike's Information Criterion to identify the best-performing subset among our 12 candidate models and used the model-averaged results to predict IEA in other areas in Asia where elephant population status is currently unknown. Forest area was our strongest single predictor variable. The best performing model, however, featured a combination of habitat and governance variables including forest area, level of corruption, proportional mix of forest and agriculture, and total agricultural area. Our predictive model identified five areas with medium–high to high probability to have populations with >150 elephants, which we believe should be surveyed to assess their status. Asian elephants persist in areas that are dominated by forest but also seem to benefit from a mix of agricultural activities. A relatively low level of corruption is also important and we conclude that effective governance is essential for maintaining Asian elephant populations. Asian elephant populations cannot be maintained solely in protected areas but need well-managed, mixed-use landscapes where people and elephants coexist.

Camoin, M., et al. (2017). "Adaptation and evaluation of an ELISA for Trypanosoma evansi infection (surra) in elephants and its application to a serological survey in Thailand." Parasitology: 1-7.

Trypanosoma evansi, the causative agent of surra, is widespread in domestic livestock and wildlife in South East Asia. Surra can affect cattle, buffaloes, horses and also Asian elephants (Elephas

maximus). Despite the 'threatened to extinction' CITES status of elephant, surra's impact has not been thoroughly assessed yet in this species. This work offers to adapt an antibody enzyme-linked immunosorbent assay (ELISA) protocol, to detect Trypanosoma evansi antibodies in elephant serum. The test was validated with 365 negative-reference samples, which allowed the determination of a 16% positive threshold. The test was applied to a serological survey including 375 individuals. The estimated global seroprevalence was 2.1% (95% CI 1.1-4.2%). Therefore, surra does not appear to be endemic in Thai domestic elephants, but occasional outbreaks were reported to our laboratory during the survey period. These outbreaks seemed to be linked to close proximity to cattle or buffaloes, and led to severe clinical signs in elephants. Frequent relapses were observed after treatment with diminazene aceturate, the only trypanocide drug currently available in Thailand. Therefore, care should be taken to keep elephants away from bovine reservoirs, and to monitor the disease in this endangered species. ELISA proved to be reliable for screening purposes as well as for post-treatment monitoring.

Casadevall, A. (2017). "Antibodies to mycobacterium tuberculosis." New England Journal of Medicine **376**(3): 283-285.

Cervena, B., et al. (2017). "Host specificity and basic ecology of Mammomonogamus (Nematoda, Syngamidae) from lowland gorillas and forest elephants in Central African Republic." Parasitology **144**(8): 1016-1025.

Syngamid strongylids of the genus Mammomonogamus undoubtedly belong among the least known nematodes with apparent zoonotic potential and the real diversity of the genus remains hard to evaluate without extensive molecular data. Eggs of Mammomonogamus sp. are frequently found in feces of African forest elephants (Loxodonta cyclotis) and western lowland gorillas (Gorilla gorilla gorilla) in Dzanga-Sangha Protected Areas. Using sedimentation-based coproscopic techniques, we found the eggs of Mammomonogamus in 19.7% elephant and 54.1% gorilla fecal samples with 8-55 and 1-24 eggs per gram of fecal sediment for elephants and gorillas, respectively. We used a combination of light microscopy, scanning electron microscopy and analysis of cytochrome c oxidase subunit I (cox1) and a partial sequence of 18S rDNA isolated from single eggs to test the hypothesis of possible Mammomonogamus conspecificity in gorillas and elephants. Whereas 18S rDNA sequences were identical in both gorillas and elephants, we distinguished seven different haplotypes within the cox1. Two haplotypes were found in both gorillas and elephants suggesting sharing of Mammomonogamus. Assignment of the parasite to M. loxodontis is proposed. Provided sequences represent the first genomic data on Mammomonogamus spp.

Chandranaik, B. M., et al. (2017). "Mycobacterium tuberculosis Infection in Free-Roaming Wild Asian Elephant." Emerg Infect Dis **23**(3): 555-557.

Postmortem examination of a wild Asian elephant at Rajiv Gandhi National Park, India, revealed nodular lesions, granulomas with central caseation, and acid-fast bacilli in the lungs. PCR and nucleotide sequencing confirmed the presence of Mycobacterium tuberculosis. This study indicates that wild elephants can harbor M. tuberculosis that can become fatal.

Cheung, H., et al. (2017). "Ivory ban: Close Hong Kong's ivory-trade window." Nature **544**(7648): 35.

Clegg, B. W. and T. G. O'Connor (2017). "Determinants of seasonal changes in availability of food patches for elephants (Loxodonta africana) in a semi-arid African savanna." PeerJ **5**: e3453.

Loss of biodiversity caused by impact of elephants (Loxodonta africana) on African woodlands may require a management response, but any action should be based on an understanding of why elephants choose to utilise trees destructively. Comprehension of elephant feeding behaviour requires consideration of the relative value of the plant groups they may potentially consume. Profitability of available food is partly determined by the time to locate a food patch and, therefore, as a foundation for understanding the influence of food availability on diet selection, key controls on the density of grass, forb, and browse patches were investigated across space and time in a semi-arid African savanna.

Density of food patches changed seasonally because plant life-forms required different volumes of soil water to produce green forage; and woody plants and forbs responded to long-term changes in soil moisture, while grasses responded to short-term moisture pulses. Soil texture, structure of woody vegetation and fire added further complexity by altering the soil water thresholds required for production of green forage. Interpolating between regularly-timed, ground-based measurements of food density by using modelled soil water as the predictor in regression equations may be a feasible method of quantifying food available to elephants in complex savanna environments.

Crawley, J. A. H., et al. (2017). "Is bigger better? The relationship between size and reproduction in female Asian elephants." J Evol Biol **30**(10): 1836-1845.

The limited availability of resources is predicted to impose trade-offs between growth, reproduction and self-maintenance in animals. However, although some studies have shown that early reproduction suppresses growth, reproduction positively correlates with size in others. We use detailed records from a large population of semi-captive elephants in Myanmar to assess the relationships between size (height and weight), reproduction and survival in female Asian elephants, a species characterized by slow, costly life history. Although female height gain during the growth period overlapped little with reproductive onset in the population, there was large variation in age at first reproduction and only 81% of final weight had been reached by peak age of reproduction at the population level (19 years). Those females beginning reproduction early tended to be taller and lighter later in life, although these trends were not significant. We found that taller females were more likely to have reproduced by a given age, but such effects diminished with age, suggesting there may be a size threshold to reproduction which is especially important in young females. Because size was not linked with female survival during reproductive ages, the diminishing effect of height on reproduction with age is unlikely to be due to biased survival of larger females. We conclude that although reproduction may not always impose significant costs on growth, height may be a limiting factor to reproduction in young female Asian elephants, which could have important implications considering their birth rates are low and peak reproduction is young - 19 years in this population.

Dale, R. and J. M. Plotnik (2017). "Elephants know when their bodies are obstacles to success in a novel transfer task." Scientific Reports **7**.

Dale, R. and J. M. Plotnik (2017). "Elephants know when their bodies are obstacles to success in a novel transfer task." Sci Rep **7**: 46309.

The capacity to recognise oneself as separate from other individuals and objects is difficult to investigate in non-human animals. The hallmark empirical assessment, the mirror self-recognition test, focuses on an animal's ability to recognise itself in a mirror and success has thus far been demonstrated in only a small number of species with a keen interest in their own visual reflection. Adapting a recent study done with children, we designed a new body-awareness paradigm for testing an animal's understanding of its place in its environment. In this task, Asian elephants (Elephas maximus) were required to step onto a mat and pick up a stick attached to it by rope, and then pass the stick forward to an experimenter. In order to do the latter, the elephants had to see their body as an obstacle to success and first remove their weight from the mat before attempting to transfer the stick. The elephants got off the mat in the test significantly more often than in controls, where getting off the mat was unnecessary. This task helps level the playing field for non-visual species tested on cognition tasks and may help better define the continuum on which body- and self-awareness lie.

Desprez, M., et al. (2017). "Optimizing lifetime reproductive output: Intermittent breeding as a tactic for females in a long-lived, multiparous mammal." J Anim Ecol.

In iteroparous species, intermittent breeding is an important life-history tactic that can greatly affect animal population growth and viability. Despite its importance, few studies have quantified the consequences of breeding pauses on lifetime reproductive output, principally because calculating lifetime reproductive output requires knowledge of each individual's entire reproductive history. This

information is extremely difficult to obtain in wild populations. We applied novel statistical approaches that account for uncertainty in state assessment and individual heterogeneity to an 18-year capture-recapture dataset of 6,631 female southern elephant seals from Macquarie Island. We estimated survival and breeding probabilities, and investigated the consequences of intermittent breeding on lifetime reproductive output. We found consistent differences in females' demographic performance between two heterogeneity classes. In particular, breeding imbued a high cost on survival in the females from the heterogeneity class 2, assumed to be females of lower quality. Individual quality also appeared to play a major role in a female's decision to skip reproduction with females of poorer quality more likely to skip breeding events than females of higher quality. Skipping some breeding events allowed females from both heterogeneity classes to increase lifetime reproductive output over females that bred annually. However, females of lower quality produced less offspring over their lifetime. Intermittent breeding seems to be used by female southern elephant seals as a tactic to offset reproductive costs on survival and enhance lifetime reproductive output but remains unavoidable and driven by individual-specific constraints in some other females.

Du, K., et al. (2017). "Ancient duplications and functional divergence in the interferon regulatory factors of vertebrates provide insights into the evolution of vertebrate immune systems." Dev Comp Immunol **81**: 324-333.

Interferon regulatory factors (IRFs) were first discovered as transcription factors that regulate the transcription of human interferon (IFN)-beta. Increasing evidence shows that they might be important players involved in Adaptive immune system (AIS) evolution. Although numbers of IRFs have been identified in chordates, the evolutionary history and functional diversity of this gene family during the early evolution of vertebrates have remained obscure. Using IRF HMM profile and HMMER searches, we identified 148 IRFs in 11 vertebrates and 4 protochordates. For them, we reconstructed the phylogenetic relationships, determined the synteny conservation, investigated the profile of natural selection, and analyzed the expression patterns in four "living fossil" vertebrates: lamprey, elephant shark, coelacanth and bichir. The results from phylogeny and synteny analysis imply that vertebrate IRFs evolved from three predecessors, instead of four as suggested in a previous study, as results from an ancient duplication followed by special expansions and lost during the vertebrate evolution. The profile of natural selection and expression reveals functional dynamics during the process. Together, they suggest that the 2nd whole-genome duplication (2WGD) provided raw materials for innovation in the IRF family, and that the birth of type-I IFN might be an important factor inducing the establishment of IRF-mediated immune networks. As a member involved in the AIS evolution, IRF provide insights into the process and mechanism involved in the complexity and novelties of vertebrate immune systems.

Dutton, C. J., et al. (2017). "SUCCESSFUL TREATMENT OF DIGITAL OSTEITIS BY INTRAVENOUS REGIONAL PERFUSION OF CEFTIOFUR IN AN AFRICAN ELEPHANT (LOXODONTA AFRICANA)." J Zoo Wildl Med **48**(2): 554-558.

A 41-yr-old African elephant (Loxodonta africana) presented with a swollen third digit of the left forelimb and a 2-cm hole in the pad. Corrective trimming, topical treatments, and an oral antibiotic resulted in apparent resolution; however, it reoccurred after 4 mo. Radiographs suggested bone lysis in the third phalanx, with the primary differential diagnosis being septic osteitis. Flushing with metronidazole solution and intravenous regional perfusion (IVRP) of the foot were commenced. A tourniquet was applied just above the carpus, an interdigital vein was identified by ultrasound, and into this vein 2 g (20 ml) of ceftiofur sodium solution, followed by 60 ml of heparinized saline, was administered. The foot was kept raised for 25 min and then the tourniquet was removed. IVRP was repeated every other day for 70 treatments over 6 mo. Healing occurred, which was confirmed radiographically. IVRP offers an excellent treatment modality in a well-trained elephant.

Eisenberg, T., et al. (2017). "Streptococcus agalactiae in elephants - A comparative study with isolates from human and zoo animal and livestock origin." Vet Microbiol **204**: 141-150.

Streptococcus (S.) agalactiae represents a significant pathogen for humans and animals. However, there are only a few elderly reports on S. agalactiae infections in wild and zoo elephants even though this pathogen has been isolated comparatively frequently in these endangered animal species. Consequently, between 2004 and 2015, we collected S. agalactiae isolates from African and Asian elephants (n=23) living in four different zoos in Germany. These isolates were characterised and compared with isolates from other animal species (n=20 isolates) and humans (n=3). We found that the isolates from elephants can be readily identified by classical biochemistry and MALDI-TOF mass spectrometry. Further characterisations for epidemiological issues were achieved using Fourier transform-infrared spectroscopy, capsule typing and molecular fingerprinting (PFGE, RAPD PCR). We could demonstrate that our elephant isolate collection contained at least six different lineages that were representative for their source of origin. Despite generally broad antimicrobial susceptibility of S. agalactiae, many showed tetracycline resistance in vitro. S. agalactiae plays an important role in bacterial infections not only in cattle and humans, but also in elephants. Comparative studies were able to differentiate S. agalactiae isolates from elephants into different infectious clusters based on their epidemiological background.

French, F., et al. (2017). "High tech cognitive and acoustic enrichment for captive elephants." J Neurosci Methods.

This paper investigates the potential for using technology to support the development of sensory and cognitive enrichment activities for captive elephants. It explores the usefulness of applying conceptual frameworks from interaction design and game design to the problem of developing species-specific smart toys that promote natural behaviours and provide stimulation. We adopted a Research through Design approach, and describe how scientific inquiry supported our design process, while the creation of artefacts guided our investigations into possible future solutions. Our fieldwork resulted in the development of an interactive prototype of an acoustic toy that elephants are able to control using interface elements constructed from a range of natural materials.

Fullman, T. J., et al. (2017). "Elephants respond to resource trade-offs in an aseasonal system through daily and annual variability in resource selection." Koedoe **59**(1).

Animals and humans regularly make trade-offs between competing objectives. In Addo Elephant National Park (AENP), elephants (Loxodonta africana) trade off selection of resources, while managers balance tourist desires with conservation of elephants and rare plants. Elephant resource selection has been examined in seasonal savannas, but is understudied in aseasonal systems like AENP. Understanding elephant selection may suggest ways to minimise management trade-offs. We evaluated how elephants select vegetation productivity, distance to water, slope and terrain ruggedness across time in AENP and used this information to suggest management strategies that balance the needs of tourists and biodiversity. Resource selection functions with time-interacted covariates were developed for female elephants, using three data sets of daily movement to capture circadian and annual patterns of resource use. Results were predicted in areas of AENP currently unavailable to elephants to explore potential effects of future elephant access. Elephants displayed dynamic resource selection at daily and annual scales to meet competing requirements for resources. In summer, selection patterns generally conformed to those seen in savannas, but these relationships became weaker or reversed in winter. At daily scales, resource selection in the morning differed from that of midday and afternoon, likely reflecting trade-offs between acquiring sufficient forage and water. Dynamic selection strategies exist even in an aseasonal system, with both daily and annual patterns. This reinforces the importance of considering changing resource availability and trade-offs in studies of animal selection. Conservation implications: Guiding tourism based on knowledge of elephant habitat selection may improve viewing success without requiring increased elephant numbers. If AENP managers expand elephant habitat to reduce density, our model predicts where elephant use may concentrate and where botanical reserves may be needed to protect rare plants from elephant impacts.

Gallup, G. G., Jr. and J. R. Anderson (2017). "The "olfactory mirror" and other recent attempts to demonstrate self-recognition in non-primate species." Behav Processes **148**: 16-19.

The recent attempt by Horowitz (2017) to develop an "olfactory mirror" test of self-recognition in domestic dogs raises some important questions about the kinds of data that are required to provide definitive evidence for self-recognition in dogs and other species. We conclude that the "olfactory mirror" constitutes a compelling analog to the mark test for mirror self-recognition in primates, but despite claims to the contrary neither dogs, elephants, dolphins, magpies, horses, manta rays, squid, nor ants have shown compelling, reproducible evidence for self-recognition in any modality.

Ghielmetti, G., et al. (2017). "Tuberculosis in Swiss captive Asian elephants: microevolution of Mycobacterium tuberculosis characterized by multilocus variable-number tandem-repeat analysis and whole-genome sequencing." Sci Rep **7**(1): 14647.

Zoonotic tuberculosis is a risk for human health, especially when animals are in close contact with humans. Mycobacterium tuberculosis was cultured from several organs, including lung tissue and gastric mucosa, of three captive elephants euthanized in a Swiss zoo. The elephants presented weight loss, weakness and exercise intolerance. Molecular characterization of the M. tuberculosis isolates by spoligotyping revealed an identical profile, suggesting a single source of infection. Multilocus variable-number of tandem-repeat analysis (MLVA) elucidated two divergent populations of bacteria and mixed infection in one elephant, suggesting either different transmission chains or prolonged infection over time. A total of eight M. tuberculosis isolates were subjected to whole-genome sequence (WGS) analysis, confirming a single source of infection and indicating the route of transmission between the three animals. Our findings also show that the methods currently used for epidemiological investigations of M. tuberculosis infections should be carefully applied on isolates from elephants. Moreover the importance of multiple sampling and analysis of within-host mycobacterial clonal populations for investigations of transmission is demonstrated.

Goldenberg, S. Z., et al. (2017). "Challenges of using behavior to monitor anthropogenic impacts on wildlife: a case study on illegal killing of African elephants." Animal Conservation **20**(3): 215-224.

Monitoring anthropogenic impacts on wildlife can be challenging, particularly when human activities affecting wildlife are cryptic. Using anti-predator behaviors as proxies for perceived pressure is appealing because of the relative ease with which they can be recorded and the presumed relationship between the threat of interest and a predator stimulus. However, behaviors are plastic and affected by factors unrelated to human activity. Consequently, it is critical to assess the relationship between behavioral indicators and their context before interpretation. In this study we used a combination of behavior, movement and demography from a threatened population of African elephants in northern Kenya to determine whether reaction to research vehicles was indicative of poaching pressure. We used mixed-effects models predicting reaction of elephants to observer vehicle approaches in which we treated individuals as random effects and included ecological, anthropogenic, spatial, social and demographic predictor variables. Contrary to our hypothesis, recorded levels of reactive behavior did not increase with poaching levels in either a population-level dataset or a data subset of individuals whose spatial behavior was precisely known via radio-tracking. Rather, primary productivity positively predicted reactive behavior in both datasets. This relationship was heightened by the presence of musth males in the radio-collar dataset. Reactivity was not related to the time since entering the protected areas, but increased among groups that spent less time in the protected areas. Inter-individual differences were apparent, suggesting the importance of inherent differences (e.g. personality) across groups. In our study, elephants plagued by a severe human threat did not react defensively to humans in another context, suggesting nuanced discrimination of threats. Our study demonstrates the caution that should be taken in designing studies that use behavioral indices to represent threat and contributes to a growing body of literature employing behavioral indicators to monitor wildlife populations of conservation concern.

Goldenberg, S. Z. and G. Wittemyer (2017). "Orphaned female elephant social bonds reflect lack of access to

mature adults." Sci Rep **7**(1): 14408.

Compensatory social behavior in nonhuman animals following maternal loss has been documented, but understanding of how orphans allocate bonding to reconstruct their social networks is limited. Successful social integration may be critical to survival and reproduction for highly social species and, therefore, may be tied to population persistence. We examined the social partners involved in affiliative interactions of female orphans and non-orphans in an elephant population in Samburu, northern Kenya that experienced heightened adult mortality driven by drought and intense ivory poaching. We contrasted partners across different competitive contexts to gain insight to the influence of resource availability on social interactions. Though the number of partners did not differ between orphans and non-orphans, their types of social partners did. Orphans interacted with sisters and matriarchs less while feeding than did non-orphans, but otherwise their affiliates were similar. While resting under spatially concentrated shade, orphans had markedly less access to mature adults but affiliated instead with sisters, bulls, and age mates. Orphan propensity to strengthen bonds with non-dominant animals appears to offer routes to social integration following maternal loss, but lack of interaction with adult females suggests orphans may experience decreased resource access and associated fitness costs in this matriarchal society.

Goswami, V. R. and D. Vasudev (2017). "Triage of conservation needs: The juxtaposition of conflict mitigation and connectivity considerations in heterogeneous, human-dominated landscapes." Frontiers in Ecology and Evolution **4**(JAN).

Gravett, N., et al. (2017). "Inactivity/sleep in two wild free-roaming African elephant matriarchs - Does large body size make elephants the shortest mammalian sleepers?" PLoS ONE **12**(3): e0171903.

The current study provides details of sleep (or inactivity) in two wild, free-roaming African elephant matriarchs studied in their natural habitat with remote monitoring using an actiwatch subcutaneously implanted in the trunk, a standard elephant collar equipped with a GPS system and gyroscope, and a portable weather station. We found that these two elephants were polyphasic sleepers, had an average daily total sleep time of 2 h, mostly between 02:00 and 06:00, and displayed the shortest daily sleep time of any mammal recorded to date. Moreover, these two elephants exhibited both standing and recumbent sleep, but only exhibited recumbent sleep every third or fourth day, potentially limiting their ability to enter REM sleep on a daily basis. In addition, we observed on five occasions that the elephants went without sleep for up to 46 h and traversed around 30 km in 10 h, possibly due to disturbances such as potential predation or poaching events, or a bull elephant in musth. They exhibited no form of sleep rebound following a night without sleep. Environmental conditions, especially ambient air temperature and relative humidity, analysed as wet-bulb globe temperature, reliably predict sleep onset and offset times. The elephants selected novel sleep sites each night and the amount of activity between sleep periods did not affect the amount of sleep. A number of similarities and differences to studies of elephant sleep in captivity are noted, and specific factors shaping sleep architecture in elephants, on various temporal scales, are discussed.

Gray, T. N. and S. Gauntlett (2017). "African elephants: Scale up elephant anti-poaching funds." Nature **541**(7636): 157.

Greco, B. J., et al. (2017). "Why pace? The influence of social, housing, management, life history, and demographic characteristics on locomotor stereotypy in zoo elephants." Applied Animal Behaviour Science **194**: 104-111.

Stereotypic behaviors (SB) are common in zoo-housed elephants, and these behaviors can be performed at high rates. Elephants perform different SB forms (e.g., weaving, pacing), but no published studies have evaluated the factors contributing to the development or performance of these different forms. Instead, as with most SB studies across species, elephant studies have relied on analyses that aggregate all SB forms, which limits the development and testing of form-specific hypotheses or abatement practices. Our objectives were to characterize the SB forms of North American zoo

elephants and use multivariable epidemiological models to test form-specific hypotheses. We videotaped 77 elephants (African: N = 5 males, 31 females; Asian N = 8 males, 33 females) at 39 zoos who performed SBs and used a novel classification scheme and 5-min instantaneous samples to characterize their SB forms. Locomotor and whole-body SBs were the most common, but most elephants who performed locomotor SBs also performed whole-body SBs. Thus, we characterized each elephant according to whether it included locomotion in its SB repertoire [Locomotor Presence (LP)] or only whole-body movements. We used binomial regression models fitted with generalized estimating equations to test hypotheses about which of 26 social, housing, management, life history, and demographic variables were most associated with LP. The odds of LP increased by 26% for every 10% increase in time housed separately (odds ratio = 1.026, p = 0.04), 96.2% for every additional social group with which an elephant had contact (odds ratio = 1.962, p = 0.01), and 46% for every 10% increase in time housed indoors (odds ratio = 1.046, p = 0.01). Age was non-significantly confounded with all three variables. We hypothesize that the social variables in our models increase LP risk because they are associated with uncontrollable social group changes, anticipation of potentially rewarding social experiences, or the frustration of social behaviors. The housing variable included in our model likely increases LP risk because indoor spaces are less complex, resulting in the channeling of walking or social avoidance behaviors into more simplistic movements. Overall, our results suggest that elephant managers may best be able to prevent locomotor SB by enhancing their elephants' social environment and the spatial complexity of their enclosures. Future research should focus on determining whether addressing the risk factors for LP results in less frequent performance and identifying other temporally proximate eliciting factors. © 2017 Elsevier B.V.

Grocott, H. P. and R. Deutscher (2017). "Irony and the Elephant in the Review." Anesth Analg **124**(5): 1736-1737.

Gross, E. M., et al. (2017). "The potential of medicinal and aromatic plants (MAPs) to reduce crop damages by Asian Elephants (Elephas maximus)." Crop Protection **100**: 29-37.

In all 13 Asian range countries of the wild Asian elephant (Elephas maximus L.), farmers suffer from crop damages caused by this endangered and highly protected species. As elephants are lured by highly nutritional crop types into agricultural lands, measures to deter or repel them from the high attraction will always be costly and labour intensive. The cultivation of crops, which are less attractive to elephants, yet economically viable for local farmers could lead to a new direction of land-use and income generation in human-elephant conflict areas. In this study, seven medicinal and aromatic plants (MAPs) containing higher amounts of specific plant secondary compounds were explored for their attractiveness to wild Asian elephants against a control of rice (Oryza sativa L.) and maize (Zea mays L.). The results show that chamomile (Matricaria chamomilla L.), coriander (Coriandrum sativum L.), mint (Mentha arvensis L.), basil (Ocimum basilicum L.), turmeric (Curcuma longa L.), lemon grass (Cymbopogon flexuosus (Nees ex Steud.) W. Watson) and citronella (Cymbopogon winterianus Jowitt.) were less attractive and were not consumed by elephants compared to rice. Damages to the MAPs occurred only through trampling, with mint being most prone to being trampled. Other wildlife species, however, were observed to feed on lemon-grass. Long-term learning effects and the eventual palatability of crops with less efficient antifeedants need to be further explored. This study, however, gives first evidence that MAPs bear a high potential for a secure income generation in and close to Asian elephant habitats. Furthermore, the strategic plantation of crops unattractive and attractive to elephants could lead to new land-use strategies and improve functionality of elephant corridors. © 2017 Elsevier Ltd

Guldemond, R. A. R., et al. (2017). "A systematic review of elephant impact across Africa." PLoS ONE **12**(6): e0178935.

Contradictory findings among scientific studies that address a particular issue may impede the conversion of science to management implementation. A systematic review of peer-reviewed studies to generate a single outcome may overcome this problem. The contentious topic of the impact that a

megaherbivore such as the savanna elephant have for other species and their environment can benefit from such an approach. After some 68 years, 367 peer-reviewed papers covered the topic and 51 of these papers provided sufficient data to be included in a meta-analysis. We separated the direct impact that elephants had on trees and herbs from the indirect effects on other vertebrates, invertebrates, and soil properties. Elephants have an impact on tree structure and abundance but no overall negative cascading effects for species that share space with them. Primary productivity explained a small amount of variation of elephant impact on vegetation. Elephant numbers (density), study duration, rainfall, tree cover, and the presence of artificial water and fences failed to describe patterns of impact. We conclude that published information do not support the calls made for artificially manipulating elephant numbers to ameliorate elephant impact, and call for the management of space use by elephants to maintain savanna heterogeneity.

Gunaryadi, D., et al. (2017). "Community-based human-elephant conflict mitigation: The value of an evidence-based approach in promoting the uptake of effective methods." PLoS ONE **12**(5): e0173742.

Human-elephant conflict (HEC) is a serious threat to elephants and can cause major economic losses. It is widely accepted that reduction of HEC will often require community-based methods for repelling elephants but there are few tests of such methods. We tested community-based crop-guarding methods with and without novel chili-based elephant deterrents and describe changes in farmers' willingness to adopt these methods following our demonstration of their relative effectiveness. In three separate field-trials that took place over almost two years (October 2005 -May 2007) in two villages adjacent to Way Kambas National Park (WKNP) in Indonesia, we found that community-based crop-guarding was effective at keeping Asian elephants (Elephas maximus) out of crop fields in 91.2% (52 out of 57), 87.6% (156 out of 178), and 80.0% (16 out of 20) of attempted raids. Once the method had been shown to be effective at demonstration sites, farmers in 16 villages around WKNP voluntarily adopted it during the July 2008 to March 2009 period and were able to repel elephants in 73.9% (150 out of 203) of attempted raids, with seven villages repelling 100% of attempted raids. These 16 villages had all experienced high levels of HEC in the preceding years; e.g. they accounted for >97% of the 742 HEC incidents recorded for the entire park in 2006. Our work shows, therefore, that a simple evidence-based approach can facilitate significant reductions in HEC at the protected area scale.

Gupta, S. K. and V. Minhas (2017). "Wildlife population management: Are contraceptive vaccines a feasible proposition?" Frontiers in Bioscience - Scholar **9**(3): 357-374.

To minimize human-animal conflicts for habitation and burden of zoonotic diseases, it is imperative to develop new strategies for wildlife population management. In this direction, contraceptive vaccines eliciting immune response against hormones/proteins critical for reproduction have emerged as one of the promising options. Contraceptive vaccines based on neutralization of gonadotropin releasing hormone (GnRH) have been used for inhibition of fertility in various species such as wild horses, white-tailed deer, pigs, cats, dogs etc. It has been used for immunocastration of male pigs to improve meat quality. However, additional safety studies of GnRH vaccine will be needed in light of presence of its receptor at extra-pituitary sites. Native porcine zona pellucida (PZP)-based contraceptive vaccines have shown their utility in the management of the population of both captive and free-ranging wild horses and white-tailed deer. Long-term use of the PZP-based contraceptive vaccines has also demonstrated their safety. Ideally single injection of the contraceptive vaccine should elicit long lasting immune response and desired contraceptive efficacy, which will require development of novel vaccine delivery platforms and more potent adjuvants.

Haupt, S. and Y. Haupt (2017). "P53 at the start of the 21st century: lessons from elephants." F1000Res **6**: 2041.

Crucial, natural protection against tumour onset in humans is orchestrated by the dynamic protein p53. The best-characterised functions of p53 relate to its cellular stress responses. In this review, we explore emerging insights into p53 activities and their functional consequences. We compare p53 in humans and elephants, in search of salient features of cancer protection.

Haupt, S. and Y. Haupt (2017). "P53 at the start of the 21st century: Lessons from elephants." F1000Res **6**.
Crucial, natural protection against tumour onset in humans is orchestrated by the dynamic protein p53. The best-characterised functions of p53 relate to its cellular stress responses. In this review, we explore emerging insights into p53 activities and their functional consequences. We compare p53 in humans and elephants, in search of salient features of cancer protection. © 2017 Haupt S and Haupt Y.

Hausmann, A., et al. (2017). "Social media reveal that charismatic species are not the main attractor of ecotourists to sub-Saharan protected areas." Scientific Reports **7**(1).
Charismatic megafauna are arguably considered the primary attractor of ecotourists to sub-Saharan African protected areas. However, the lack of visitation data across the whole continent has thus far prevented the investigation of whether charismatic species are indeed a key attractor of ecotourists to protected areas. Social media data can now be used for this purpose. We mined data from Instagram, and used generalized linear models with site- A nd country-level deviations to explore which socio-economic, geographical and biological factors explain social media use in sub-Saharan African protected areas. We found that charismatic species richness did not explain social media usage. On the other hand, protected areas that were more accessible, had sparser vegetation, where human population density was higher, and that were located in wealthier countries, had higher social media use. Interestingly, protected areas with lower richness in non-charismatic species had more users. Overall, our results suggest that more factors than simply charismatic species might explain attractiveness of protected areas, and call for more in-depth content analysis of the posts. With African countries projected to develop further in the near-future, more social media data will become available, and could be used to inform protected area management and marketing. © 2017 The Author(s).

Hunninck, L., et al. (2017). "Being stressed outside the park-conservation of African elephants (Loxodonta africana) in Namibia." Conserv Physiol **5**(1): cox067.
The conservation of the African savanna elephant (Loxodonta africana) is of prime importance for many African countries. Interactions between elephants and humans are known to induce stress and thereby have the potential to affect elephants' fitness. In Namibia, anthropogenic disturbances are increasing due to increasing human population size and development, particularly near protected areas, such as national parks. In this study, we investigated elephant stress levels in relation to their land use, specifically their protection status, comparing elephants within Etosha National Park in Namibia with elephants residing outside the park. We noninvasively collected dung samples of 91 elephants and determined the concentration of faecal glucocorticoid metabolites (fGCM), an indicator of physiological stress. Elephants outside the park (N = 35) had significantly higher concentrations of fGCM than those inside ENP (N = 56), suggesting that, despite including community-based conservancies, unprotected areas are more stressful for elephants than protected areas, most likely due to increased interactions with humans. We also found that males had lower fGCM concentrations than females, but no significant effect of age, body size or group size was detected. Additionally, herd sizes were significantly smaller and calf recruitment was potentially lower in unprotected areas. These findings underpin the importance of protected areas such as ENP, while encouraging decision-makers to continue reducing and mitigating potential human-induced disturbances.

Javare Gowda, A. K., et al. (2017). "Cobboldia elephantis (Cobbold, 1866) larval infestation in an Indian elephant (Elephas maximus)." J Parasit Dis **41**(2): 364-366.
In the present study, post-mortem was conducted on a female elephant aged about 37 years died at Rajeev Gandhi National Park, Hunsur, Mathigoodu Elephant Camp, Karnataka state. The animal suffered with diarrhoea, anorexia, dehydration and was unable to walk for about one week before death and was treated with antibiotics and fluid therapy for three days. The post-mortem examination revealed that, the gastric mucosa was severely congested, hyperaemic and numerous stomach bots attached to the mucosa. The bots were recovered from the gastric mucosa and processed for species identification. The posterior spiracles of the bots showed three longitudinal parallel slits in each spiracle,

the abdominal segments had a row of belt like triangular shaped spines and the anterior end had two powerful oral hooks with cephalo-pharyngeal skeleton. Based on the above said morphological characters, the bots were identified as Cobboldia elephantis. This seems to be the first report of C. elephantis in free range wild elephant from Karnataka state.

Jayakumar, S., et al. (2017). "Ethno-veterinary practices in Southern India for captive Asian elephant ailments." J Ethnopharmacol **200**: 182-204.

Ethenopharmacological relevance India has a long tradition of practicing Ayurvedic medicine not only for human ailments, but also for the management of livestock in the form of ethno-veterinary practices. Asian elephant is a significant part of Indian culture, and ethno-veterinary practices have extended to manage and cure various ailments of Asian elephant in captivity. Much of this knowledge has been lost in the light of modern practices. Aim of the study This study is aimed at documenting the existing knowledge on ethno-veterinary medicines practiced by elephant keepers (mahouts) in Tamil Nadu and Puducherry. Materials and methods The study was carried out between June 2015 and February 2016 employing a questionnaire survey among 50 selected informants (mahouts) with traditional knowledge on plants in veterinary medicine. Information was elicited from the informants on various diseases prevailing among captive elephants and the traditional treatment employed by them. Results In total, the study documented 53 plant species belonging to 29 families being used as medicine for 23 types of ailments prevailing among captive elephants. Ferula assafoetida, Zingiber officinale, Piper longum, P. nigrum, Cuminum cyminum, Trachyspermum roxburghianum and Carum bulbocastanum were the most commonly used plants either independently or in combination. Among them, Ferula assafoetida (12.4%) and Zingiber officinale (10.4%) had the highest usage. Of the 23 diseases reported, constipation was the most common ailment (14.6%) followed by bloating (8.7%) and flatulence (8.7%). Conclusion Documentation of this indigenous knowledge is valuable for the communities concerned, both at present and in future and for scientific consideration for wider use of traditional knowledge in treating captive elephants. The study has identified 53 medicinal plants to treat various ailments among captive elephants in southern India. The most frequently used plants in the captive elephant health care practice are F. assafoetida, Z. officinale, P. longum and P.nigrum. Among the 29 families, Apiaceae and Piperaceae are widely used. The leaves are the most useful part of the plants, while paste is the widely used form of preparation. The present findings show that mahouts have wide knowledge about elephant diseases and their treatment using herbal medicine. A more detailed investigation should be designed on priority to document the dying art of ethno-veterinary practices for the long-term conservation of the Asian elephant. © 2017

Joonè, C. J., et al. (2017). "Ovarian dysfunction associated with zona pellucida–based immunocontraceptive vaccines." Theriogenology **89**: 329-337.

Despite more than 40 years of research into zona pellucida (ZP)–based vaccines, relatively little is known about their mechanism of action. Early research demonstrated precipitation of ZP glycoproteins by antiovarian antiserum, rendering oocytes resistant to sperm binding in vitro. Subsequent work showed significantly decreased fertilization rates following passive immunization, sparking interest in anti-ZP immunocontraception for human and animal use. The primary mechanism of action of ZP vaccines is generally considered to be an antibody-mediated interference with sperm–oocyte binding and/or fertilization. However, this mechanism of action excludes the potential for ovarian dysfunction associated with anti-ZP treatment in some species. A review of relevant literature in pertinent model, domestic and wildlife species reveals a variety of previous and current hypotheses for ovarian effects following ZP-based immunization. Ovarian dysfunction has been suggested to be a species-specific response. In addition, cytotoxic T-lymphocytes and the use of Freund's adjuvants have been suggested to play a role. Finally, the type and extent of glycosylation of ZP antigens have been proposed to influence ovarian effects. The validity of these hypotheses is re-examined in the light of current knowledge. Further investigation of ovarian function in species believed to be resistant to the ovarian effects of anti-ZP vaccines is warranted. To this end, anti-Müllerian hormone may provide a novel tool for the assessment of ovarian function during ZP-based immunocontraception, particularly in wildlife

species not amenable to frequent clinical examination. © 2016 Elsevier Inc.

Karunarathne, H. P. R. N. S., et al. (2017). "Fixation of a radius and ulna fracture in an Asian eephant calf by using fibreglass casts." Gajah **47**: 40-41.

Keen, S. C., et al. (2017). "Automated detection of low-frequency rumbles of forest elephants: A critical tool for their conservation." J Acoust Soc Am **141**(4): 2715.

African forest elephants (Loxodonta cyclotis) occupy large ranges in dense tropical forests and often use far-reaching vocal signals to coordinate social behavior. Elephant populations in Central Africa are in crisis, having declined by more than 60% in the last decade. Methods currently used to monitor these populations are expensive and time-intensive, though acoustic monitoring technology may offer an effective alternative if signals of interest can be efficiently extracted from the sound stream. This paper proposes an automated elephant call detection algorithm that was tested on nearly 4000 h of field recordings collected from five forest clearings in Central Africa, including sites both inside protected areas and in logging concessions. Recordings were obtained in different seasons, years, and under diverse weather conditions. The detector achieved an 83.2% true positive rate when the false positive rate is 5.5% (approximately 20 false positives per hour). These results suggest that this algorithm can enable analysis of long-term recording datasets or facilitate near-real-time monitoring of elephants in a wide range of settings and conditions.

King, L. E., et al. (2017). "Beehive fences as a multidimensional conflict-mitigation tool for farmers coexisting with elephants." Conserv Biol.

Increasing habitat fragmentation and human population growth in Africa has resulted in an escalation in human-elephant conflict between small-scale farmers and free-ranging African elephants (Loxodonta Africana). In 2012 Kenya Wildlife Service (KWS) implemented the national 10-year Conservation and Management Strategy for the Elephant in Kenya, which includes an action aimed at testing whether beehive fences can be used to mitigate human-elephant conflict. From 2012 to 2015, we field-tested the efficacy of beehive fences to protect 10 0.4-ha farms next to Tsavo East National Park from elephants. We hung a series of beehives every 10 m around the boundary of each farm plot. The hives were linked with strong wire. After an initial pilot test with 2 farms, the remaining 8 of 10 beehive fences also contained 2-dimensional dummy hives between real beehives to help reduce the cost of the fence. Each trial plot had a neighboring control plot of the same size within the same farm. Of the 131 beehives deployed 88% were occupied at least once during the 3.5-year trial. Two hundred and fifty-three elephants, predominantly 20-45 years old entered the community farming area, typically during the crop- ripening season. Eighty percent of the elephants that approached the trial farms were kept out of the areas protected by the beehive fences, and elephants that broke a fence were in smaller than average groups. Beehive fences not only kept large groups of elephants from invading the farmland plots but the farmers also benefited socially and financially from the sale of 228 kg of elephant-friendly honey. As news of the success of the trial spread, a further 12 farmers requested to join the project, bringing the number of beehive fence protected farms to 22 and beehives to 297. This demonstrates positive adoption of beehive fences as a community mitigation tool. Understanding the response of elephants to the beehive fences, the seasonality of crop raiding and fence breaking, and the willingness of the community to engage with the mitigation method will help contribute to future management strategies for this high human-elephant conflict hotspot and other similar areas in Kenya.

Kioko, J., et al. (2017). "Temporal gland secretion in African elephants (Loxodonta africana)." Mammalian Biology **82**: 34-40.

The underlying causes of temporal gland secretion (TGS) in African elephants are not well understood. In order to better understand TGS predisposing factors, we assessed TGS in relation to a suite of intrinsic and environmental variables in free ranging elephants. TGS monitoring was done in fully protected areas of Lake Manyara National Park (LMNP) and Tarangire National Park (TNP) and Manyara Ranch (MR), a semi-protected multiple use area. Using a hierarchical modeling approach that

accounted for the nested data structure, we found that TGS was mainly associated with elephant-specific variables. The likelihood of TGS increased with elephant age. Female elephants were more likely to show TGS than male elephants. In larger groups, females were less likely to have TGS, whereas the likelihood for TGS increased with group size in male elephants. This information enhances our understanding of TGS, and its importance as physiological marker. © 2016 Deutsche Gesellschaft für Säugetierkunde

Kiso, W. K., et al. (2017). "REPRODUCTIVE PARAMETERS AND BIRTH STATISTICS FOR A HERD OF ASIAN ELEPHANTS (ELEPHAS MAXIMUS) IN NORTH AMERICA OVER A 20-YEAR PERIOD." J Zoo Wildl Med **48**(4): 987-996.

We reviewed medical records documenting 28 pregnancies occurring within a herd of Asian elephants (Elephas maximus) over a 20-yr (1994-2014) period at a private facility in the southeastern United States. Twenty-six pregnancies resulted in live calves and two ended in stillbirths. The 26 live births represented the offspring of 11 cows and 5 bulls. Twenty-four calves survived their first year, including two critically ill calves born after dystocias. Male and female calves occurred in almost equal numbers. Mean duration of labor in this group was 36 hr although the median duration was 13 hr. Although oxytocin was administered to several cows, parturition did not always immediately ensue. Female fecundity ranged from 1-6 calves while female age at parturition ranged from 9-46 yr. Females delivered their first calves between 9 and 26 yr of age whereas bulls sired their first calves in their 20s, on average. The number of live births and the 93% calf survival rate are among the highest reported in any western hemisphere elephant-holding facility. This may reflect the intensive management of cows before, during, and after each pregnancy, the number of experienced multiparous cows, and the skill level of staff, most of whom had worked with each other and with this herd for many years. The data presented here may assist facilities planning to breed Asian elephants.

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Kitpipit, T., et al. (2017). "Mini-SNaPshot multiplex assays authenticate elephant ivory and simultaneously identify the species origin." Forensic Sci Int Genet **27**: 106-115.

Illegal trading of ivory is mainly responsible for the dramatic decline in elephant populations. Thailand is one of the largest laundering hotspots for African ivory, as the domestic Asian elephant ivory can be legally traded. So, to help combat ivory poaching and smuggling, an efficient method is needed to identify the elephant species from its ivory and ivory products. In this study, a mini-SNaPshot(R) multiplex assay was developed and fully validated for the identification of confiscated ivory and low DNA template ivory products. Elephantid- and elephant species-specific mitochondrial single nucleotide polymorphisms (SNPs) were identified from 207 mammalian and 1705 elephant/mammoth cytochrome

b sequence alignments. Seven informative SNPs were used for assay development. The assay unambiguously and accurately identified authentic elephant ivory and its species of origin on the basis of peak size and color observed in the haplotype profile. The assay was highly efficient for analysis of confiscated ivory and low-template ivory products with a 99.29% success rate (N=140). It was highly reproducible, exhibited no cross-reaction with eight other mammalian DNA; and had 100% identification accuracy. In addition, nested and direct PCR amplification were also compatible with the developed assay. This efficient assay should benefit wildlife forensic laboratories and aid in the prosecution of elephant-related crimes.

Kongsawasdi, S., et al. (2017). "Biomechanical parameters of Asian Elephant (Elephas maximus) walking gait." Kafkas Universitesi Veteriner Fakultesi Dergisi **23**(3): 357-362.

Quadruped animals have a unique mechanism of movement that minimizes energy use and allows muscles to work effectively. Elephants are the biggest quadruped animals on earth and how they stabilize their body and use energy are of interest. This study aimed to analyze the characteristics of kinematic gait in Asian elephants trained to work with a mahout for tourism activities in Thailand. Twenty-one healthy adult Asian elephants were recorded by 2 digital cameras while walking at normal speed (average 1.1 m s-1.) along a 15-meter, solid-soil path. The temporospatial parameters evaluated for each limb consisted of stride length (cm), stride time (sec), swing time (sec), stance time (sec) and stance time percentage, using 2D motion analysis software. The result revealed that the average stride length was varied between 192-199 cm with no significant difference between fore and hindlimbs on either side but the stride length on the right side was significantly longer than that on the left in both forelimbs (right 197.5 cm; left 192.6 cm, $P<0.05$) and hindlimbs (right 198.9 cm; left 193.2 cm, $P<0.01$). The mean gait cycle time (stride time) was varied between 2.26 and 2.34 seconds for each limb and mean stance time was varied between 1.67-1.80 seconds, with both parameters were longer on the forelimbs than hindlimbs significantly ($P<0.01$). Hence, swing time for the forelimb was shorter than that for the hindlimb ($P<0.001$). The calculated stance time percentage for each limb was 72.64-76.09%. Data from this study confirmed that elephants walk with a lateral sequence and footfall pattern, and distribute the center of mass proportionally between all four limbs. Gait analysis is a valuable tool for identifying and understanding the pathogenesis of gait abnormality.

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Kuhrt, H., et al. (2017). "The Retina of Asian and African Elephants: Comparison of Newborn and Adult." Brain Behav Evol **89**(2): 84-103.

Elephants are precocial mammals that are relatively mature as newborns and mobile shortly after birth. To determine whether the retina of newborn elephants is capable of supporting the mobility of elephant calves, we compared the retinal structures of 2 newborn elephants (1 African and 1 Asian) and 2 adult animals of both species by immunohistochemical and morphometric methods. For the first time, we present here a comprehensive qualitative and quantitative characterization of the cellular composition of the newborn and the adult retinas of 2 elephant species. We found that the retina of elephants is relatively mature at birth. All retinal layers were well discernible, and various retinal cell types were detected in the newborns, including Muller glial cells (expressing glutamine synthetase and cellular retinal binding protein; CRALBP), cone photoreceptors (expressing S-opsin or M/L-opsin), protein kinase Calpha-expressing bipolar cells, tyrosine hydroxylase-, choline acetyltransferase (ChAT)-, calbindin-, and calretinin-expressing amacrine cells, and calbindin-expressing horizontal cells. The retina of newborn elephants contains discrete horizontal cells which coexpress ChAT, calbindin, and calretinin. While the overall structure of the retina is very similar between newborn and adult elephants, various parameters change after birth. The postnatal thickening of the retinal ganglion cell axons and the increase in ganglion cell soma size are explained by the increase in body size after birth, and the decreases in the densities of neuronal and glial cells are explained by the postnatal expansion of the retinal surface area. The expression of glutamine synthetase and CRALBP in the Muller cells of newborn elephants suggests that the cells are already capable of supporting the activities of photoreceptors and neurons. As a peculiarity, the elephant retina contains both normally located and displaced giant ganglion cells, with single cells reaching a diameter of more than 50 microm in adults and therefore being almost in the range of giant retinal ganglion cells found in aquatic mammals. Some of these ganglion cells are displaced into the inner nuclear layer, a unique feature of terrestrial mammals. For the first time, we describe here the occurrence of many bistratified rod bipolar cells in the elephant retina. These bistratified bipolar cells may improve nocturnal contrast perception in elephants given their arrhythmic lifestyle.

Limacher-Burrell, A., et al. (2017). "Nuclear organization of the African elephant (Loxodonta africana) amygdaloid complex: an unusual mammalian amygdala." Brain Struct Funct.

Here we describe the nuclear organization of the African elephant amygdaloid complex using Nissl, myelin, and a range of immunohistochemical stains. The African elephant is thought to exhibit many affect-laden and social-empathic behaviours; however, to date the amygdaloid complex, which is the generator of emotional states of the brain is yet to be fully explored in the elephants. For the most part, the amygdaloid complex of the African elephant is similar to that observed in other mammals in terms of the presence of nuclei and their topological relationships; however, we did observe several specific differences in amygdaloid organization. The elephant amygdala has undergone rotation in both the coronal and sagittal planes, seemingly associated with the expansion of the temporal lobe. Numerous scalloped cell clusters, termed glomeruli, forming the intermediate nuclei of the basal, accessory basal and central nuclear groups, were occupied by structures immunopositive to doublecortin. The nuclei typically associated with the accessory olfactory system (posterior cortical nucleus and medial nuclear complex) were absent from the elephant amygdala. The anterior cortical nucleus is very large and appears to be comprised of two subdivisions. The lateral nuclear complex is expanded and has two novel subdivisions. The amygdalohippocampal area appears relatively enlarged. The numerous shared and derived characters make the elephant amygdaloid complex very unusual and unique amongst mammals, but the derived characters appear to relate to observed elephant affect-laden behaviours.

Lindsay, K., et al. (2017). "The shared nature of Africa's elephants." Biological Conservation **215**: 260-267.

Liu, P., et al. (2017). "Conflict between conservation and development: cash forest encroachment in Asian elephant distributions." Sci Rep **7**(1): 6404.

Over the last 4 decades, China has undergone major economic development, resulting in considerable

impacts on its wildlife populations and habitats. It is essential to quantify the conflict between development and conservation to assist with policy-making because forestry policies and market trends affected indirectly the distribution of Asian elephants. Here, we mapped the historical distribution of elephants versus human land use. Elephant distributions appear to occur in unbroken natural forests only. However, over the 40-year period, the distribution ranges have become smaller and fragmented, with natural forest area also declining by 16%. The monoculture of cash trees is encroaching on natural forests. Over the past 10 years, rubber plantations have become concentrated in the south, with extensive natural forests and scattered rubber farms being converted to tea plantations, due to changes in governmental policies and product prices. Through mapping the spatial changes in the distribution of rubber and tea plantations, our study is expected to help local managers to incorporate the needs of endangered elephants through creating space when planning plantations, especially in Xishuangbanna and the south part of Pu'er. In conclusion, restoring elephant habitat and establishing ecological corridors are critical for the survival of elephants in this region.

Locke, P. (2017). "Elephants as persons, affective apprenticeship, and fieldwork with nonhuman informants in Nepal." HAU: Journal of Ethnographic Theory **7**(1): 353-376.

In this account of interspecies intimacy in the enclaved institution of the Nepali elephant stable, I explore not-just-human figurations of personhood and argue for the methodological inclusion of nonhuman informants as subjective actors and contributing participants in ethnographic research. I explain how my experience forming a trusting, working relationship with a female elephant in a hybrid community of humans and elephants revealed the conceptual limitations of a human-focused tradition of ethnography ill-equipped for the generative sociality of interspecies encounters. I discuss questions of nonhuman personhood and I consider developments in the animal behavioral sciences, while also investigating the cultural logic by which Nepali mahouts attribute personhood to their elephants. This exploration of apprenticeship, personhood, and affective encounter is situated in a distinctly interspecies strand of multispecies studies, and is a contribution to ethnoelephantology as an interdisciplinary approach to the social, historical, and ecological relations between humans and elephants. © Piers Locke.

Lopez, J., et al. (2017). "ASSESSMENT OF A LANCET-AND-SWAB BLOOD SAMPLING TECHNIQUE FOR SURVEILLANCE OF ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS INFECTION." J Zoo Wildl Med **48**(3): 659-667.

Lancing a finger elicits minimal pain in humans and is applied routinely to obtain small volumes of blood for clinical diagnostics. A modified lancet bleeding method and several blood sampling matrices were evaluated in this study for the purpose of routine elephant endotheliotropic herpesvirus (EEHV) surveillance in Asian elephants (Elephas maximus). The procedure enabled weekly sampling from elephants as young as 9 mo of age. The blood sampling matrices were evaluated for their sensitivity measuring beta-actin, tumor necrosis factor alpha, and/or EEHV-1 by quantitative polymerase chain reaction assays. Foam and flocked swabs produced significantly ($P < 0.05$) lower quantitation cycles, ie, increased analytical sensitivity, than filter papers, Whatman(R) FTA cards, or conventional cotton-tipped swabs. The two swab types also demonstrated comparable analytical sensitivity to that of a similar volume of EDTA whole blood for the detection of EEHV-1 DNA. This lancet-and-swab technique proved satisfactory for the detection of EEHV-1 viremia in two Asian elephant calves, and in one instance viremia could be detected 5 days prior to the development of clinical signs. Low blood yield from the lancet application may reduce sensitivity and compromise early detection of viremia. Therefore, standard venipuncture remains the recommended blood sampling method, and training for consistent and regular vein access should continue to be the priority for collections holding elephants. However, if appropriate measures are taken to collect an optimum blood volume, this lancet-and-swab technique offers a suitable alternative for EEHV surveillance in situations where venipuncture may not be practical.

Lueders, I., et al. (2017). "Effects of GnRH vaccination in wild and captive African Elephant bulls (Loxodonta

africana) on reproductive organs and semen quality." PLoS ONE **12**(9): e0178270.

OBJECTIVES: Although the African elephant (Loxodonta africana) is classified as endangered by the International Union for Conservation of Nature (IUCN), in some isolated habitats in southern Africa, contraception is of major interest due to local overpopulation. GnRH vaccination has been promoted as a non-invasive contraceptive measure for population management of overabundant wildlife. We tested the efficacy of this treatment for fertility control in elephant bulls. METHODS: In total, 17 male African elephants that were treated with a GnRH vaccine were examined in two groups. In the prospective study group 1 (n = 11 bulls, ages: 8-36 years), semen quality, the testes, seminal vesicles, ampullae and prostate, which were all measured by means of transrectal ultrasound, and faecal androgen metabolite concentrations were monitored over a three-year period. Each bull in the prospective study received 5 ml of Improvac(R) (1000 mug GnRH conjugate) intramuscularly after the first examination, followed by a booster six weeks later and thereafter every 5-7 months. In a retrospective study group (group 2, n = 6, ages: 19-33 years), one examination was performed on bulls which had been treated with GnRH vaccine for 5-11 years. RESULTS: In all bulls of group 1, testicular and accessory sex gland sizes decreased significantly after the third vaccination. In six males examined prior to vaccination and again after more than five vaccinations, the testis size was reduced by 57.5%. Mean testicular height and length decreased from 13.3 +/- 2.6 cm x 15.2 +/- 2.8 cm at the beginning to 7.6 +/- 2.1 cm x 10.2 +/- 1.8 cm at the end of the study. Post pubertal bulls (>9 years, n = 6) examined prior to vaccination produced ejaculates with viable spermatozoa (volume: 8-175 ml, sperm concentration: 410-4000x106/ml, total motility: 0-90%), while after 5-8 injections, only 50% of these bulls produced ejaculates with a small number of immotile spermatozoa. The ejaculates of group 2 bulls (vaccinated >8 times) were devoid of spermatozoa. Faecal androgen metabolite concentrations measured in captive males decreased significantly after the fourth vaccination. None of the males entered musth during the treatment period. CONCLUSIONS: Our results showed a marked decrease in semen quality, testicle and secondary sex gland sizes following repeated GnRH vaccinations. After 2-4 years of continuous treatment every 5-7 months, the effects were similar to surgical castration.

Luz, S. and L. Howard (2017). Guidelines for Management Elephant Endotheliotopic Herpesvirus in Asia 2nd edition, Wildlife Reserves Singapore Group**:** 19.

Lynch, M., et al. (2017). "Hereditary Factor VII Deficiency in the Asian Elephant (Elephas maximus) Caused by a F7 Missense Mutation." J Wildl Dis.

Hereditary disorders and genetic predispositions to disease are rarely reported in captive and free-ranging wildlife, and none have been definitively identified and characterized in elephants. A wild-caught, 41-yr-old male Asian elephant (Elephas maximus) without an apparent increased bleeding tendency was consistently found to have prolonged prothrombin times (PTs, mean = 55+/-35 s) compared to 17 other elephants (PT=10+/-2 s). This elephant's partial thromboplastin times (PTT) fell within the normal range of the other elephants (12-30 s). A prolonged PT in the presence of a normal PTT suggests disruption of the extrinsic pathway via deficiency of coagulation factor VII (FVII). This elephant's plasma FVII activity was very low (2%) compared to that of 15 other elephants (57-80%), but other coagulation factors' activities did not differ from the control elephants. Sequencing of genomic DNA from EDTA blood revealed a single homozygous point mutation (c.202A>G) in the F7 gene of the FVII deficient elephant that was not present in unrelated elephants. This mutation causes an amino acid substitution (p.Arg68Gly) that is predicted to be deleterious. Two living offspring of the affected elephant were heterozygous for the mutation and had normal plasma FVII activities and coagulation profiles. Tissue from a third offspring, a deceased calf, was utilized to show that it was also a heterozygote. A DNA test has been developed to enable the screening of additional elephants for this mutation. Consistent with FVII deficiency investigations in other species, the condition did not cause a serious bleeding tendency in this individual elephant.

Lynch, M., et al. (2017). "HEREDITARY FACTOR VII DEFICIENCY IN THE ASIAN ELEPHANT (ELEPHAS MAXIMUS) CAUSED BY A F7 MISSENSE MUTATION." J Wildl Dis **53**(2): 248-257.

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Lynsdale, C. L., et al. (2017). "Parasite-associated mortality in a long-lived mammal: Variation with host age, sex, and reproduction." Ecol Evol **7**(24): 10904-10915.

Parasites can cause severe host morbidity and threaten survival. As parasites are generally aggregated within certain host demographics, they are likely to affect a small proportion of the entire population, with specific hosts being at particular risk. However, little is known as to whether increased host mortality from parasitic causes is experienced by specific host demographics. Outside of theoretical studies, there is a paucity of literature concerning dynamics of parasite-associated host mortality. Empirical evidence mainly focuses on short-lived hosts or model systems, with data lacking from long-lived wild or semi-wild vertebrate populations. We investigated parasite-associated mortality utilizing a multigenerational database of mortality, health, and reproductive data for over 4,000 semi-captive timber elephants (Elephas maximus), with known causes of death for mortality events. We determined variation in mortality according to a number of host traits that are commonly associated with variation in parasitism within mammals: age, sex, and reproductive investment in females. We found that potentially parasite-associated mortality varied significantly across elephant ages, with individuals at extremes of lifespan (young and old) at highest risk. Mortality probability was significantly higher for males across all ages. Female reproducers experienced a lower probability of potentially parasite-associated mortality than females who did not reproduce at any investigated time frame. Our results demonstrate increased potentially parasite-associated mortality within particular demographic groups. These groups (males, juveniles, elderly adults) have been identified in other studies as susceptible to parasitism, stressing the need for further work investigating links between infection and mortality. Furthermore, we show variation between reproductive and non-reproductive females, with mothers being less at risk of potentially parasite mortality than nonreproducers.

MacKenzie, C. A., et al. (2017). "Changing perceptions of protected area benefits and problems around Kibale National Park, Uganda." J Environ Manage **200**: 217-228.

Local residents' changing perceptions of benefits and problems from living next to a protected area in western Uganda are assessed by comparing household survey data from 2006, 2009, and 2012. Findings are contextualized and supported by long-term data sources for tourism, protected area-based employment, tourism revenue sharing, resource access agreements, and problem animal abundance. We found decreasing perceived benefit and increasing perceived problems associated with the protected area over time, with both trends dominated by increased human-wildlife conflict due to recovering elephant numbers. Proportions of households claiming benefit from specific conservation strategies were increasing, but not enough to offset crop raiding. Ecosystem services mitigated perceptions of problems. As human and animal populations rise, wildlife authorities in Sub-Saharan

Africa will be challenged to balance perceptions and adapt policies to ensure the continued existence of protected areas. Understanding the dynamic nature of local people's perceptions provides a tool to adapt protected area management plans, prioritize conservation resources, and engage local communities to support protected areas.

Magnuson, R. J., et al. (2017). "Rapid screening for Mycobacterium tuberculosis complex in clinical elephant trunk wash samples." Res Vet Sci **112**: 52-58.

Mycobacterium tuberculosis can infect and be transmitted between elephants and humans. In elephants, the 'gold standard' reference test for detection of tuberculosis is culture, which takes a minimum of eight weeks for results and has limited sensitivity. A screening test that is rapid, easily implemented, and accurate is needed to aid in diagnosis of tuberculosis in elephants. Ninety-nine clinical trunk wash samples obtained from 33 elephants were utilized to validate three molecular extraction techniques followed by a polymerase chain reaction for detection of M. tuberculosis. Diagnostic sensitivity and specificity were estimated compared to culture. Kappa coefficients were determined between molecular results and various culture categories and serological test results. An internal amplification control was developed and assessed to monitor for PCR inhibition. One molecular test (the Column method) outperformed the other two, with diagnostic sensitivity and kappa agreement estimates of 100% (CI 57-100) and 0.46 (CI 0.2-0.74), respectively, compared to culture alone. The percentage of molecular-positive/culture-negative samples was 8.4% overall. The molecular extraction technique followed by PCR provides a much-needed rapid screening tool for detection of tuberculosis in elephants. Immediate procedures can be implemented to further assess PCR-positive animals and provide personnel biosecurity. While a positive result is not a definitive test for elephant tuberculosis, the molecular test results can be used to support current diagnostic procedures applied by veterinarians for treatment decisions to prevent the spread of tuberculosis in elephants.

Martin, K., et al. (2017). "Does size matter? Examining the drivers of mammalian vocalizations." Evolution **71**(2): 249-260.

Previous studies of the vocalization frequencies of mammals have suggested that it is either body mass or environment that drives these frequencies. Using 193 species across the globe from the terrestrial and aquatic environments and a model selection approach, we identified that the best-supported model for minimum and maximum frequencies for vocalization included both body mass and environment. The minimum frequencies of vocalizations of species from all environments retained the influence of body mass. For maximum frequency however, aquatic species are released from such a trend with body mass having little constraint on frequencies. Surprisingly, phylogeny did not have a strong impact on the evolution of the maximum frequency of mammal vocalizations, largely due to the pinniped species divergence of frequency from their carnivoran relatives. We demonstrate that the divergence of signal frequencies in mammals has arisen from the need to adapt to their environment.

Maurer, G., et al. (2017). "Wild-captive interactions and economics drive dynamics of Asian elephants in Laos." Sci Rep **7**(1): 14800.

The interactions between wild and captive populations of Asian elephants (Elephas maximus) persist in most countries of the species distribution, notably through the reproduction between captive females and wild males. However, these complex interactions have been poorly studied, despite their relevance for conservation of this endangered species. Laos has a centuries-long tradition of raising Asian elephants. Besides being cultural icons, captive elephants are inextricably linked to economics through their work in forestry. Using an ecological-economic model, we investigated the effect of socio-economic strategies on fecundity of the Lao population whose dynamics is shaped by human practices. We demonstrated that fecundity is impacted by: i) the dynamics of the wild elephant pool through mating of captive females by wild males, and ii) the financial incentive of elephant owners to breed their animals. As a result, we expect fecundity to rise in response to increases in elephant prices. The captive population will tend towards an asymptotic limit determined by the wild pool growth rate.

However, the population will tend to extinction if exports continue. Our ecological-economic approach, by accounting for economic incentives, allows us to predict new equilibria that can serve as a baseline for designing sustainable management strategies for the species.

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The interactions between wild and captive populations of Asian elephants (Elephas maximus) persist in most countries of the species distribution, notably through the reproduction between captive females and wild males. However, these complex interactions have been poorly studied, despite their relevance for conservation of this endangered species. Laos has a centuries-long tradition of raising Asian elephants. Besides being cultural icons, captive elephants are inextricably linked to economics through their work in forestry. Using an ecological-economic model, we investigated the effect of socio-economic strategies on fecundity of the Lao population whose dynamics is shaped by human practices. We demonstrated that fecundity is impacted by: i) the dynamics of the wild elephant pool through mating of captive females by wild males, and ii) the financial incentive of elephant owners to breed their animals. As a result, we expect fecundity to rise in response to increases in elephant prices. The captive population will tend towards an asymptotic limit determined by the wild pool growth rate. However, the population will tend to extinction if exports continue. Our ecological-economic approach, by accounting for economic incentives, allows us to predict new equilibria that can serve as a baseline for designing sustainable management strategies for the species.

Meyer, M., et al. (2017). "Palaeogenomes of Eurasian straight-tusked elephants challenge the current view of elephant evolution." Elife **6**.

The straight-tusked elephants Palaeoloxodon spp. were widespread across Eurasia during the Pleistocene. Phylogenetic reconstructions using morphological traits have grouped them with Asian elephants (Elephas maximus), and many paleontologists place Palaeoloxodon within Elephas. Here, we report the recovery of full mitochondrial genomes from four and partial nuclear genomes from two P. antiquus fossils. These fossils were collected at two sites in Germany, Neumark-Nord and Weimar-Ehringsdorf, and likely date to interglacial periods ~120 and ~244 thousand years ago, respectively. Unexpectedly, nuclear and mitochondrial DNA analyses suggest that P. antiquus was a close relative of extant African forest elephants (Loxodonta cyclotis). Species previously referred to Palaeoloxodon are thus most parsimoniously explained as having diverged from the lineage of Loxodonta, indicating that Loxodonta has not been constrained to Africa. Our results demonstrate that the current picture of elephant evolution is in need of substantial revision.

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Mikota, S. K. (2017). Acupuncture in Elephants. Practical Guide to Traditional Chinese Veterinary Medicine Volume 4. H. Xie and H. Ramirez. Reddick FL, Chi Institute Press. **4:** 297 323.

Mikota, S. K. (2017). "Practical Advice for Grant Writing " Gajah **47**: 45-47.

Miller, M. A., et al. (2017). "Mycobacterium bovis in a free-ranging black rhinoceros, kRuger National Park, South Africa, 2016." Emerging Infectious Diseases **23**(3): 557-558.

Mizuno, K., et al. (2017). "Collective behaviour of wild Asian elephants in risky situations: How do social groups cross roads?" Behaviour **154**(12): 1215-1237.

Among group-living animals, some members may derive benefit by following the decisions of other members. Free-ranging wild Asian elephants in Mudumalai National Park, southern India, must often cross roads and can be disturbed by vehicles.We assessed if measures of road and traffic characteristics serve as indicators of risk, and compared behaviours of different age classes during road-crossing events. More individuals displayed excitable behaviour on wider roads. A larger number of adults entered the road first, which is considered the most dangerous position, compared with immature elephants. Immature individuals tended to move ahead of others on the road, suggesting that it is more important for immature individuals to follow adults at the beginning of a crossing than to follow along for the entire crossing. These findings may suggest that less experienced group members derive benefit by following the decisions of experienced ones under risky situations. © Koninklijke Brill NV, Leiden, 2017.

Moran, D. and K. Kanemoto (2017). "Identifying species threat hotspots from global supply chains." Nature Ecology and Evolution **1**(1).

Morfeld, K. A. and J. L. Brown (2017). "Metabolic health assessment of zoo elephants: Management factors predicting leptin levels and the glucose-to-insulin ratio and their associations with health parameters." PLoS ONE **12**(11).

Screening for metabolic-related health problems can enhance animal welfare, so the purpose of this study was to conduct the first metabolic health assessment of zoo elephants and use epidemiological methods to determine how factors in the captive environment were associated with metabolic hormone concentrations. In addition, we examined relationships between metabolic status and several fitness parameters: foot health, musculoskeletal health, reproductive cyclicity, and body condition. Two blood samples were collected 2 weeks apart from 87 Asian (Elephas maximus) and 105 African (Loxodonta africana) elephants managed by zoos accredited by the Association of Zoos and Aquariums for analysis of serum leptin, insulin, glucose and the glucose-to-insulin ratio (G:I). In females, mean (± SD) leptin concentrations and the G:I were lower ($P<0.05$) in Asian (3.93 ± 2.21 ng/ml and 110 ± 86 units) compared to African (4.37 ± 2.89 ng/ml and 208 ± 133 units) elephants, respectively. For males, mean leptin and the G:I were 4.99 ± 3.61 ng/ml and 253 ± 181 units for Asian, and 3.72 ± 2.00 ng/ml and 326 ± 231 units for African elephants, respectively, with no differences between species ($P>0.05$). As mean leptin concentration increased there was an increase in the odds of a female being non-cycling ($P = 0.0083$). The G:I was associated inversely with body condition ($P = 0.0002$); as the G:I increased there was a decreased risk of BCS = 4 or 5 as compared to the ideal, or BCS = 3. Neither leptin nor G:I were predictive of foot or musculoskeletal health scores. Factors related to walking and feeding practices were most influential in predicting metabolic status, whereas social and housing factors showed smaller, but significant effects. The metabolic health benefits of walking were detected if the time spent in staff-directed walking was 7 hours or more per week. The most protective feeding practices included implementing a random rather than predictable feeding schedule and limiting the number of methods presentation methods. Results indicate that leptin levels and G:I can be used as predictors of both ovarian cycle function and body condition, and are affected by zoo management in elephants. © 2017, Public Library of Science. All rights reserved. This is an open access article, free of all copyright, and may be freely reproduced, distributed, transmitted, modified, built upon, or otherwise used by anyone for any lawful purpose. The work is made available under the Creative Commons CC0 public domain dedication.

Nandini, S., et al. (2017). "Seasonal variation in female Asian elephant social structure in Nagarahole-Bandipur, southern India." Animal Behaviour **134**: 135-145.

Fission–fusion dynamics allow for individuals to deal with spatiotemporally changing food resources, with groups from a community fusing together when resources are abundant and splitting away when competition for resources is high. Such fission–fusion dynamics are often modulated by seasonal changes in resources. We examined the seasonal variation in group size and social structure of female Asian elephants, which show high fission–fusion dynamics, in a population in southern India. Females in this population form many distinct communities or clans in both the dry and wet seasons. At the population level, females were sighted in larger group sizes and associated with more uncommon females in the dry season. However, when associations among common females were considered, a greater number of stronger associations were observed in the wet season. There were no consistently significant seasonal differences in group sizes or associations at the clan level. Thus, population-level results, obtained by a combination of results from different clans, may sometimes be misleading. Female associations showed some temporal stability, with association indices being moderately correlated across consecutive seasons and years. Interestingly, average group sizes were similar across clans of different sizes, indicating a restriction on group size, possibly due to resource distribution. In spite of this restriction, most clan-mates showed low, non-zero associations amongst themselves rather than very strong associations with a small set of individuals. The resulting fluid rather than fixed groups suggest a benefit to socializing with other clan-mates. Thus, unlike the pattern usually seen, fission–fusion dynamics here is a means to maintain multiple associates under conditions of relatively constant but constrained group size, rather than being a means of increasing or decreasing group size in response to ecological factors. © 2017 The Association for the Study of Animal Behaviour

Neupane, D., et al. (2017). "Willingness to pay for mitigating human-elephant conflict by residents of Nepal." Journal for Nature Conservation **36**: 65-76.

Nganvongpanit, K., et al. (2017). "Elemental classification of the tusks of dugong (Dugong dugong) by HH-XRF analysis and comparison with other species." Sci Rep **7**: 46167.

The elemental composition was investigated and applied for identifying the sex and habitat of dugongs, in addition to distinguishing dugong tusks and teeth from other animal wildlife materials such as Asian elephant (Elephas maximus) tusks and tiger (Panthera tigris tigris) canine teeth. A total of 43 dugong tusks, 60 dugong teeth, 40 dolphin teeth, 1 whale tooth, 40 Asian elephant tusks and 20 tiger canine teeth were included in the study. Elemental analyses were conducted using a handheld X-ray fluorescence analyzer (HH-XRF). There was no significant difference in the elemental composition of male and female dugong tusks, whereas the overall accuracy for identifying habitat (the Andaman Sea and the Gulf of Thailand) was high (88.1%). Dolphin teeth were able to be correctly predicted 100% of the time. Furthermore, we demonstrated a discrepancy in elemental composition among dugong tusks, Asian elephant tusks and tiger canine teeth, and provided a high correct prediction rate among these species of 98.2%. Here, we demonstrate the feasible use of HH-XRF for preliminary species classification and habitat determination prior to using more advanced techniques such as molecular biology.

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Nganvongpanit, K., et al. (2017). "Anatomy, histology and elemental profile of long bones and ribs of the Asian elephant (Elephas maximus)." Anatomical Science International **92**(4): 554-568.

This study evaluated the morphology and elemental composition of Asian elephant (Elephas maximus) bones (humerus, radius, ulna, femur, tibia, fibula and rib). Computerized tomography was used to image the intraosseous structure, compact bones were processed using histological techniques, and elemental profiling of compact bone was conducted using X-ray fluorescence. There was no clear evidence of an open marrow cavity in any of the bones; rather, dense trabecular bone was found in the bone interior. Compact bone contained double osteons in the radius, tibia and fibula. The osteon structure was comparatively large and similar in all bones, although the lacuna area was greater ($P < 0.05$) in the femur and ulna. Another finding was that nutrient foramina were clearly present in the humerus, ulna, femur, tibia and rib. Twenty elements were identified in elephant compact bone. Of these, ten differed significantly across the seven bones: Ca, Ti, V, Mn, Fe, Zr, Ag, Cd, Sn and Sb. Of particular interest was the finding of a significantly larger proportion of Fe in the humerus, radius, fibula and ribs, all bones without an open medullary cavity, which is traditionally associated with bone marrow for blood cell production. In conclusion, elephant bones present special characteristics, some of which may be important to hematopoiesis and bone strength for supporting a heavy body weight. © 2016, Japanese Association of Anatomists.

Nganvongpanit, K., et al. (2017). "Osteoarthritis in two marine mammals and 22 land mammals: learning from skeletal remains." J Anat **231**(1): 140-155.

The occurrence of osteoarthritis (OA) in marine mammals is still questionable. Here we investigated the prevalence of OA in marine (dolphin and dugong) and terrestrial mammals (Asian elephant, Asiatic buffalo, camel, cat, cattle, deer, dog, domestic goat, horse, human, hyena, impala, lion, Malayan tapir, Assam macaque, mule, pig, rabbit, red kangaroo, sheep, tiger and waterbuck). Skeletal remains obtained from five institutes were used as subjects; a total of 45 different parts (locations) of bones were observed for OA lesions. The prevalence of OA was reported as number of OA lesions/total number of bones. Our results revealed that the presence of OA in marine species (dolphin and dugong) was 2.44% and 3.33%, respectively. In dolphins, the highest OA occurrence was on the left and right humeral trochlea, with 13.68% and 12.63%, respectively, while the highest number of OA lesions in

dugongs was on the lumbar vertebrae (8.79%). No significant difference (P > 0.05) in the prevalence of OA between sexes in dolphins and dugongs was observed, but we found a significant difference (P < 0.05) in 24 bone locations of human bones, which had the highest OA prevalence (48.93%), followed by dogs (3.94%). In conclusion, OA can occur in marine mammals, similar to terrestrial mammals, even though their natural habitat is the ocean.

Nijman, V. and C. R. Shepherd (2017). "Ethnozoological assessment of animals used by Mon traditional medicine vendors at Kyaiktiyo, Myanmar." J Ethnopharmacol **206**: 101-106.

ETHNOPHARMACOLOGICAL RELEVANCE: Wild animals are widely used in traditional Asian medicine but information from Myanmar is lacking. We show that a wide range of animals are used at a pilgrimage site, mostly for their rendered fats and oils to be used in mixed concoctions. The majority of species were sold to be used to treat aching joints, muscle ache and skin diseases. AIM OF THE STUDY: To assess wildlife for sale for medicinal purposes, and document their medicinal use at Kyaiktiyo, a pilgrimage site at a 1100m tall mountain, with many of the pilgrims climbing to the top. In addition we address legal issues relating to the production and sale of traditional medicine that contain legally protected animals. MATERIAL AND METHODS: Four visits were made to Kyaiktiyo, Myanmar, between 2000 and 2017 to quantify animal parts on display and through discussions with vendors to obtain information on medicinal use of these parts. RESULTS: Twenty-three species, mostly mammals, were recorded to be used for traditional medicine. The most common were Chinese serow Capricornis milneedwardsii, Asian elephant Elephas maximus, and Asiatic black bear Ursus thibetanus. Over 600 bodies or body parts were present. Combined, these parts purportedly provided cures or relief for at least 15 ailments or diseases. The most commonly mentioned treatment was that of using rendered animal fats/oils externally to relieve/cure aching joints or muscles. This treatment allegedly provides instant relief to pilgrims after an arduous climb up the mountain. Purported cures for various skin diseases was the next common use for the animal species on offer. Ten of the species observed for sale at Kyaiktiyo are listed as globally threatened, and 15 are protected and cannot be legally traded. Ambiguities in Myanmar's legislation mean that protected animals or their body parts cannot be traded, however traditional medicines can be made out of them provided rules relating to the manufacturing of traditional medicines are adhered to. CONCLUSION: This study indicated that animals and their parts continue to be openly offered for sale at Kyaiktiyo to treat various illnesses. Despite these products potential medical, traditional or cultural importance, solutions have to been found on how to ensure that, in line with Myanmar's laws, use of traditional local medicine does not impede the conservation of imperilled species.

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Nkoke, C. (2017). IVORY MARKETS IN CENTRAL AFRICA Market Surveys in Cameroon, Central African Republic, Congo, Democratic Republic of the Congo and Gabon: 2007, 2009, 2014/2015, TRAFFIC.

Paudel, S. (2017). "My life with elephants." Veterinary Record **180**(12): i-ii.

Born and raised in western Nepal, Sarad Paudel saw his first elephant at Chitwan National Park, southern Nepal, and resolved to build his career around them. © 2017 British Veterinary Association.

Paungpin, W., et al. (2017). "Serosurveillance for pandemic influenza A (H1N1) 2009 virus infection in domestic elephants, Thailand." PLoS ONE **12**(10): e0186962.

The present study conducted serosurveillance for the presence of antibody to pandemic influenza A (H1N1) 2009 virus (H1N1pdm virus) in archival serum samples collected between 2009 and 2013 from 317 domestic elephants living in 19 provinces situated in various parts of Thailand. To obtain the most accurate data, hemagglutination-inhibition (HI) assay was employed as the screening test; and sera with HI antibody titers >/=20 were further confirmed by other methods, including cytopathic effect/hemagglutination based-microneutralization (microNT) and Western blot (WB) assays using H1N1pdm matrix 1 (M1) or hemagglutinin (HA) recombinant protein as the test antigen. Conclusively, the appropriate assays using HI in conjunction with WB assays for HA antibody revealed an overall seropositive rate of 8.5% (27 of 317). The prevalence of antibody to H1N1pdm virus was 2% (4/172) in 2009, 32% (17/53) in 2010, 9% (2/22) in 2011, 12% (1/8) in 2012, and 5% (3/62) in 2013. Notably, these positive serum samples were collected from elephants living in 7 tourist provinces of Thailand. The highest seropositive rate was obtained from elephants in Phuket, a popular tourist beach city. Young elephants had higher seropositive rate than older elephants. The source of H1N1pdm viral infection in these elephants was not explored, but most likely came from close contact with the infected mahouts or from the infected tourists who engaged in activities such as elephant riding and feeding. Nevertheless, it could not be excluded that elephant-to-elephant transmission did occur.

Pecnerova, P., et al. (2017). "Genome-Based Sexing Provides Clues about Behavior and Social Structure in the Woolly Mammoth." Curr Biol **27**(22): 3505-3510.e3503.

While present-day taxa are valuable proxies for understanding the biology of extinct species, it is also crucial to examine physical remains in order to obtain a more comprehensive view of their behavior, social structure, and life histories [1, 2]. For example, information on demographic parameters such as age distribution and sex ratios in fossil assemblages can be used to accurately infer socioecological patterns (e.g., [3]). Here we use genomic data to determine the sex of 98 woolly mammoth (Mammuthus primigenius) specimens in order to infer social and behavioral patterns in the last 60,000 years of the species' existence. We report a significant excess of males among the identified samples (69% versus 31%; $p < 0.0002$). We argue that this male bias among mammoth remains is best explained by males more often being caught in natural traps that favor preservation. We hypothesize that this is a consequence of social structure in proboscideans, which is characterized by matriarchal hierarchy and sex segregation. Without the experience associated with living in a matriarchal family group, or a bachelor group with an experienced bull, young or solitary males may have been more prone to die in natural traps where good preservation is more likely.

Perera, K. U., et al. (2017). "Redescription and molecular characterization of Anoplocephala manubriata, Railliet et al., 1914 (Cestoda: Anoplocephalidae) from a Sri Lankan wild elephant (Elephas maximus)." Parasitol Int **66**(3): 279-286.

The present work provides a detailed morphological and molecular description of Anoplocephala manubriata in elephants. Adult worms were recovered during an autopsy of a wild elephant in Elephant Transit Home, Udawalawe, Sri Lanka. Necropsy findings revealed a severe cestode infection in the small intestine. These tapeworms were tightly attached to the intestinal mucosae, resulted in hyperemic thickened intestinal mucosae, variable size irregular well-demarcated multifocal ulcerative regions sometimes covered with necrotic membranes and variable size, diffuse, well-demarcated raised nodular masses were evident in the small intestine. The article provides an account of the biology of A. manubriata and a comparative analysis of the morphology and morphometrics of Anoplocephala species that occur in different hosts. Phylogenetic analysis of the second internal transcribed spacer region (ITS-2), a portion of the 28S region and cytochrome oxidase subunit 1 (COX1) genes revealed that A. manubriata is closely associated with Anoplocephala species in horse in comparison to other Anoplocephalines. This study will enhance the current knowledge in taxonomy of elephant tapeworms and contribute to future phylogenetic studies.

Pinyopummin, A., et al. (2017). "The presence of seminal plasma, especially derived from stallion semen, helps preserve chilled Asian elephant (Elephas maximus) sperm motility." Andrologia **49**(6).

The effects of seminal plasma (SP), derived from autologous, homologous and heterologous species (stallion, boar and dog) on chilled Asian elephant sperm quality, were determined. Semen was collected from eight males and samples with >/=30% motile spermatozoa were used in the study. Semen was diluted with Tris-glucose-egg yolk extender, supplemented with different SP types and preserved at 4 degrees C for 48 hr. Experiment 1 (n = 31), showed that the presence of SP (autologous) helped to preserve sperm quality in terms of sperm motility and acrosome integrity ($p < .05$). Homologous SP did not result in better sperm quality than autologous SP. Heterologous SP from stallion provided higher sperm motility and velocities compared to autologous SP ($p < .05$). Experiment 2 (n = 14) determined the effect of different SP from four stallions. All stallion SP gave higher ($p < .05$) results for motile spermatozoa and sperm velocities than autologous SP. In conclusion, the presence of SP helps preserve Asian elephant sperm quality and stallion SP supports the motility of Asian elephant spermatozoa during cold storage.

Platt, J. R. (2017). "How to Get Elephants to Buzz Off." Sci Am **316**(3): 23.

Pokharel, S. S., et al. (2017). "Assessment of season-dependent body condition scores in relation to faecal glucocorticoid metabolites in free-ranging Asian elephants." Conserv Physiol **5**(1): cox039.

We studied seasonal and annual changes in visual body condition scores (BCSs), and assessed how these scores were related to levels of faecal glucocorticoid metabolites (fGCMs) in free-ranging Asian elephants (Elephas maximus) in the seasonally dry tropical forests of the Mysore and Nilgiri Elephant Reserves in southern India. We assessed the animals' BCS visually on a scale of 1 to 5; where 1 represents a very thin and 5 represents a very fat elephant. To understand the influence of seasonality on BCS, we sampled the population during dry (n = 398) and wet seasons (n = 255) of 2013 and 2015 while, for annual changes in BCS, we sampled nine free-ranging adult females from different family groups that had been repeatedly sighted over seven years. To evaluate the influence of body condition on fGCM, 307 faecal samples were collected from 261 different elephants and were analysed. As a parameter of adrenocortical activity, and thus stress, fGCM was measured (mug/g) in the ethanol-extracted samples using a group-specific 11-oxoaetiocholanolone EIA (antibody raised against 11-oxoaetiocholanolone-17-CMO:BSA and biotinylated-11-oxoaetiocholanolone as a label). Effect of age and season on BCS in relation to fGCM was also studied. A seasonal shift in BCS was observed as expected, i.e. individuals with low BCS were more frequent during the dry season when compared with the wet season. Concentrations of fGCM were highest in individuals with lowest BCS (BCS 1) and then significantly declined till BCS 3. fGCM levels were almost comparable for BCS 3, 4 and 5. This pattern

was more conspicuous in female than in male elephants. Season-dependent BCS, hence, reflect the stress status as measured by fGCM, especially in female Asian elephants. This could be used as an important non-invasive approach to monitor the physiological health of free-ranging elephant populations.

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Poulsen, C. B., et al. (2017). "Does mean arterial blood pressure scale with body mass in mammals? Effects of measurement of blood pressure." Acta Physiol (Oxf).

For at least the last 30 years, it has been discussed whether mean arterial blood pressure (MAP) is independent of body mass or whether it increases in accordance with the vertical height between the heart and the brain. The debate has centred on the most appropriate mathematical models for analysing allometric scaling and phylogenetic relationships; there has been previously little focus on evaluating the validity of underlying physiological data. Currently, the 2 most comprehensive scaling analyses are based on data from 47 species of mammals, based on 114 references. We reviewed all available references to determine under which physiological conditions MAP had been recorded. In 44 (38.6%) of the cited references, MAP was measured in anaesthetized animals. Data from conscious animals were reported in 59 (51.8%) of references; of these, 3 (2.6%) were radiotelemetric studies. In 5 species, data were reported from both anaesthetized and conscious animals, and the mean difference in the MAP between these settings was 20 +/- 29 mm Hg. From a literature search, we identified MAP measurements performed by radiotelemetry in 11 of the 47 species included in the meta-analyses. A Bland-Altman analysis showed a bias of 1 mm Hg with 95% confidence interval (from -35 to 36 mm Hg); that is, the limits of agreement between radiotelemetric studies and studies in restrained animals were double the supposed difference in the MAP between the mouse and elephant. In conclusion, the existing literature does not provide evidence for either a positive or neutral scaling of arterial pressure to body mass across taxa.

Poulsen, J. R., et al. (2017). "Poaching empties critical Central African wilderness of forest elephants." Current Biology **27**(4): R134-R135.

Elephant populations are in peril everywhere, but forest elephants in Central Africa have sustained

alarming losses in the last decade [1]. Large, remote protected areas are thought to best safeguard forest elephants by supporting large populations buffered from habitat fragmentation, edge effects and human pressures. One such area, the Minkébé National Park (MNP), Gabon, was created chiefly for its reputation of harboring a large elephant population. MNP held the highest densities of elephants in Central Africa at the turn of the century, and was considered a critical sanctuary for forest elephants because of its relatively large size and isolation. We assessed population change in the park and its surroundings between 2004 and 2014. Using two independent modeling approaches, we estimated a 78–81% decline in elephant numbers over ten years — a loss of more than 25,000 elephants. While poaching occurs from within Gabon, cross-border poaching largely drove the precipitous drop in elephant numbers. With nearly 50% of forest elephants in Central Africa thought to reside in Gabon [1], their loss from the park is a considerable setback for the preservation of the species. © 2017 Elsevier Ltd

Poulsen, J. R., et al. (2017). "Poaching empties critical Central African wilderness of forest elephants." Curr Biol **27**(4): R134-r135.

Elephant populations are in peril everywhere, but forest elephants in Central Africa have sustained alarming losses in the last decade [1]. Large, remote protected areas are thought to best safeguard forest elephants by supporting large populations buffered from habitat fragmentation, edge effects and human pressures. One such area, the Minkebe National Park (MNP), Gabon, was created chiefly for its reputation of harboring a large elephant population. MNP held the highest densities of elephants in Central Africa at the turn of the century, and was considered a critical sanctuary for forest elephants because of its relatively large size and isolation. We assessed population change in the park and its surroundings between 2004 and 2014. Using two independent modeling approaches, we estimated a 78-81% decline in elephant numbers over ten years - a loss of more than 25,000 elephants. While poaching occurs from within Gabon, cross-border poaching largely drove the precipitous drop in elephant numbers. With nearly 50% of forest elephants in Central Africa thought to reside in Gabon [1], their loss from the park is a considerable setback for the preservation of the species.

Poulsen, J. R., et al. (2017). "The ecological consequences of forest elephant declines for Afrotropical forests." Conserv Biol.

Poaching is rapidly extirpating African forest elephants (Loxodonta cyclotis) from most of their historical range, leaving vast areas of elephant-free tropical forest. Elephants are ecological engineers that create and maintain forest habitat, thus their loss will have strong consequences for the composition and structure of Afrotropical forests. We evaluated the roles of forest elephants in seed dispersal, nutrient recycling, and herbivory and physical damage to predict the cascading ecological effects of their population declines. Loss of seed dispersal by elephants will favor tree species dispersed abiotically and by smaller dispersal agents, with tree species composition depending on the downstream effects of changes in elephant nutrient cycling and browsing. Loss of trampling and herbivory of seedlings and saplings will result in high tree density as they are released from the pressures of browsing. Diminished seed dispersal by elephants and high stem density are likely to reduce the recruitment of large trees, resulting in a more homogeneous forest structure and decreased carbon stocks. In sum, the loss of ecological services by forest elephants will likely transform Central African forests to be more like Neotropical forests, from which megafauna were extirpated thousands of years ago. Without intervention, as much as 96% of Central African forests will have modified species composition and structure as elephants are compressed into remaining protected areas. Stopping elephant poaching is an urgent first step to mitigating these effects, but long-term conservation will require land use planning that incorporates elephant habitat into forested landscapes that are being rapidly transformed by industrial agriculture and logging. This article is protected by copyright. All rights reserved.

Pozo, R. A., et al. (2017). "Determining baselines for human-elephant conflict: A matter of time." PLoS ONE **12**(6): e0178840.

Elephant crop raiding is one of the most relevant forms of human-elephant conflict (HEC) in Africa. Northern Botswana holds the largest population of African elephants in the world, and in the eastern Okavango Panhandle, 16,000 people share and compete for resources with more than 11,000 elephants. Hence, it is not surprising this area represents a HEC 'hotspot' in the region. Crop-raiding impacts lead to negative perceptions of elephants by local communities, which can strongly undermine conservation efforts. Therefore, assessing trends in conflict levels is essential to developing successful management strategies. In this context, we investigated the trend in the number of reported raiding incidents as one of the indicators of the level of HEC, and assessed its relationship to trends in human and elephant population size, as well as land-use in the study area. For each of these factors, we considered data spanning historical (since the 1970s) and contemporary (2008-2015) time frames, with the aim of comparing subsequent inferences on the drivers of crop raiding and predictions for the future. We find that the level of reported crop raiding by elephants in the eastern Panhandle appears to have decreased since 2008, which seems to be related to the reduction in agricultural land allocated to people in recent years, more than with human and elephant population size. We show that inferences regarding the drivers of HEC and predictions for the future are dependent on the time span of the data used. Although our study represents a first step in developing a HEC baseline in the eastern Panhandle, it highlights the need for additional multi-scale analyses that consider progress in conservation conflict to better understand and predict drivers of HEC in the region.

Purdon, A. and R. J. van Aarde (2017). "Water provisioning in Kruger National Park alters elephant spatial utilisation patterns." Journal of Arid Environments **141**: 45-51.

Water provisioning is a controversial yet common practice and its consequences for wildlife and vegetation have fuelled well-worn debates. Contradictory opinions exist on the effect of water provisioning on elephant abundance and distribution. Here, we evaluated how water utilisation patterns, water source type, and availability affect the spatial utilisation patterns of elephants in Kruger National Park. We segmented the seasonal movement paths of 26 elephant breeding herds into trips, defined as segments of the trajectory that occur between two consecutive visits to water sources. We classified the trips as natural or artificial depending on the start and end water source. Elephants visited rivers more often than artificial waterholes. The probability of visiting water was highest during the hot afternoon and most trips lasted less than 36 h. Artificial waterholes made trips further from rivers potentially less costly, and for a third of the total area traversed by elephants, they visited waterholes instead of rivers. Additionally, artificial waterholes may increase the intensity of use in some areas. Water provisioning in Kruger alters elephant spatial utilisation patterns. Removing artificial waterholes in Kruger might reduce the area traversed and educe spatio-temporal variability in how elephants utilise space, a desirable outcome for conservation management. © 2017 Elsevier Ltd

Pursell, T., et al. (2017). "Erratum to 'Generation and validation of new quantitative real time PCR assays to detect Elephant Endotheliotropic herpesviruses 1A, 1B, and 4' [J. Virol. Methods 237 (2016) 138-142]." J Virol Methods **240**: 85-86.

Regnault, S., et al. (2017). "Skeletal pathology and variable anatomy in elephant feet assessed using computed tomography." PeerJ **5**: e2877.

Foot problems are a major cause of morbidity and mortality in elephants, but are underreported due to difficulties in diagnosis, particularly of conditions affecting the bones and internal structures. Here we evaluate post-mortem computer tomographic (CT) scans of 52 feet from 21 elephants (seven African Loxodonta africana and 14 Asian Elephas maximus), describing both pathology and variant anatomy (including the appearance of phalangeal and sesamoid bones) that could be mistaken for disease. We found all the elephants in our study to have pathology of some type in at least one foot. The most common pathological changes observed were bone remodelling, enthesopathy, osseous cyst-like lesions, and osteoarthritis, with soft tissue mineralisation, osteitis, infectious osteoarthriti, subluxation, fracture and enostoses observed less frequently. Most feet had multiple categories of pathological change (81% with two or more diagnoses, versus 10% with a single diagnosis, and 9% without

significant pathology). Much of the pathological change was focused over the middle/lateral digits, which bear most weight and experience high peak pressures during walking. We found remodelling and osteoarthritis to be correlated with increasing age, more enthesopathy in Asian elephants, and more cyst-like lesions in females. We also observed multipartite, missing and misshapen phalanges as common and apparently incidental findings. The proximal (paired) sesamoids can appear fused or absent, and the predigits (radial/tibial sesamoids) can be variably ossified, though are significantly more ossified in Asian elephants. Our study reinforces the need for regular examination and radiography of elephant feet to monitor for pathology and as a tool for improving welfare.

Remmers, W., et al. (2017). "Elephant (Loxodonta africana) footprints as habitat for aquatic macroinvertebrate communities in Kibale National Park, south-west Uganda." African Journal of Ecology **55**(3): 342-351.

This is the first study where elephant footprints as habitat for aquatic macroinvertebrate communities were assessed. Preliminary observations during the dry season in Kibale Forest, Uganda, indicated that water-filled footprints constituted the majority of stagnant ponds. Consequently, this study aimed at giving an overview of the diversity and ecology of those habitats and the capacity of elephants as ecosystem engineers. The fauna and abiotic factors (age, size, substrate, organic matter, pH, canopy cover, temperature, conductivity) of 30 water-filled natural elephant footprints were sampled, resulting in the record of 61 morphospecies among 27 families/orders. Species composition was dominated by Hydrophilidae and Dytiscidae and influenced by environmental variables, such as age and organic matter. To study the colonization process, 18 artificial footprints were created within different distances from the water source. After 5 days, 410 specimens were collected, with higher species richness in artificial footprints closer to a natural water source. We conclude that colonization of water-filled footprints is fast, they constitute important habitats with high diversity and variability, and they act as stepping stones for dispersal and add to the ability of elephants as ecosystem engineers. We emphasize the importance of elephants as a key species in ecosystem dynamics and conservation practice. © 2016 John Wiley & Sons Ltd

Robson, A. S., et al. (2017). "Savanna elephant numbers are only a quarter of their expected values." PLoS ONE **12**(4).

Robson, A. S., et al. (2017). "Savanna elephant numbers are only a quarter of their expected values." PLoS ONE **12**(4): e0175942.

Savannas once constituted the range of many species that human encroachment has now reduced to a fraction of their former distribution. Many survive only in protected areas. Poaching reduces the savanna elephant, even where protected, likely to the detriment of savanna ecosystems. While resources go into estimating elephant populations, an ecological benchmark by which to assess counts is lacking. Knowing how many elephants there are and how many poachers kill is important, but on their own, such data lack context. We collated savanna elephant count data from 73 protected areas across the continent estimated to hold ~50% of Africa's elephants and extracted densities from 18 broadly stable population time series. We modeled these densities using primary productivity, water availability, and an index of poaching as predictors. We then used the model to predict stable densities given current conditions and poaching for all 73 populations. Next, to generate ecological benchmarks, we predicted such densities for a scenario of zero poaching. Where historical data are available, they corroborate or exceed benchmarks. According to recent counts, collectively, the 73 savanna elephant populations are at 75% of the size predicted based on current conditions and poaching levels. However, populations are at <25% of ecological benchmarks given a scenario of zero poaching (~967,000)-a total deficit of ~730,000 elephants. Populations in 30% of the 73 protected areas were <5% of their benchmarks, and the median current density as a percentage of ecological benchmark across protected areas was just 13%. The ecological context provided by these benchmark values, in conjunction with ongoing census projects, allow efficient targeting of conservation efforts.

Rossman, Z. T., et al. (2017). "Elephant-Initiated Interactions with Humans: Individual Differences and Specific

Preferences in Captive African Elephants (Loxodonta africana)." Front Vet Sci **4**: 60.

South Africa has seen a recent increase in the number of African elephants (Loxodonta africana) maintained in reserves and parks and managed in free contact, where they may spend a significant amount of time in close proximity to humans. This study investigates how individual elephants choose to initiate interactions with humans by examining whether interaction types and frequencies vary both between elephants and with regards to the category of human involved in the interaction. Observations were made on a herd of seven captive African elephants frequently exposed to elephant handlers (guides), volunteers (who carry out general observations for the park's research unit), and tourists. The elephants differed in the frequencies with which they initiated interactions with each category of human and in the types of behaviors they used to initiate interactions. However, all of the elephants interacted most frequently with guides. Certain individual elephants showed preferences in interacting with specific guides, indicating particular elephant-guide bonds. This study provides evidence for elephant-handler bonds as well as information on the extent of interactions between humans and African elephants managed in free contact.

Roy, M. and R. Sukumar (2017). Railways and wildlife: A case study of train-elephant collisions in Northern West Bengal, India. Railway Ecology, Springer International Publishing**:** 157-177.

The extensive network of the Indian Railways cuts through several forested landscapes, resulting in collisions of trains with a variety of wildlife species, including the largest land mammal-the elephant. In India, railway lines cross elephant habitats in several states, with accidents that resulted in more than 200 elephant deaths between 1987 and 2015. As the 161-km Siliguri-Alipurduar track in the northern West Bengal state witnesses train-elephant collisions frequently, we developed a case study there with the objectives of mapping locations of collisions and generating a susceptibility map showing locations prone to accidents. We mapped elephant crossing points and movement paths along this railway track, as well as accident locations. Between 1974 and 2015, collisions occurred throughout the line, although there were several hotspots where elephant deaths were concentrated. A disproportionate number of accidents occurred during the night. Crop raiding in villages and train elephant accidents seem to be closely related, probably due to an increased frequency of elephant movement near or across this railway track during the cultivation season. Male elephants were much more prone to accidents, possibly because of behavioural characteristics that make them cross railway tracks more frequently. To reduce the frequency of accidents in this region, we recommend reducing the speed of trains, limiting the operation of trains during at night, provisioning overpasses and underpasses, using communications technology, realigning a portion of the track, and fencing the track except for corridor areas. © The Author(s) 2017.

Satitmanwiwat, S., et al. (2017). "Lipid and protein oxidation levels in spermatozoa and seminal plasma of Asian Elephants (Elephas maximus) and their relationship with semen parameters." Reprod Domest Anim **52**(2): 283-288.

Peroxidation damage to spermatozoa and seminal plasma has an important role in sperm quality. Thus, the objective of this study was to determine the levels of lipid and protein oxidation in spermatozoa and seminal plasma of Asian elephants (Elephas maximus) with varying percentage of progressive motility. Lipid and protein oxidation was measured by the thiobarbituric acid-reactive species (TBARS) assay and the 2, 4-dinitrophenylhydrazine (DNPH) carbonyl groups assay, respectively. Fresh semen samples were collected from Asian elephants and classified according to the percentage of motile spermatozoa into good (>60%) and poor (</=20%) motility. Results revealed that seminal plasma malondialdehyde (MDA) and seminal plasma protein carbonyls (PCs) were significantly higher in poor motility than in good motility ($p < .05$). The MDA and PC levels in seminal plasma were negatively correlated with the percentages of progressive motility ($p < .05$). In addition, the negative correlation between sperm concentration and seminal plasma MDA level was investigated ($p < .05$). The sperm viability was also negatively correlated with sperm PC level ($p < .05$). This study indicated that lipid and protein oxidation has deleterious effect on semen quality of Asian elephants.

Sazykina, T. G. (2017). "Population sensitivities of animals to chronic ionizing radiation-model predictions from mice to elephant." J Environ Radioact.

Model predictions of population response to chronic ionizing radiation (endpoint 'morbidity') were made for 11 species of warm-blooded animals, differing in body mass and lifespan - from mice to elephant. Predictions were made also for 3 bird species (duck, pigeon, and house sparrow). Calculations were based on analytical solutions of the mathematical model, simulating a population response to low-LET ionizing radiation in an ecosystem with a limiting resource (Sazykina, Kryshev, 2016). Model parameters for different species were taken from biological and radioecological databases; allometric relationships were employed for estimating some parameter values. As a threshold of decreased health status in exposed populations ('health threshold'), a 10% reduction in self-repairing capacity of organisms was suggested, associated with a decline in ability to sustain environmental stresses. Results of the modeling demonstrate a general increase of population vulnerability to ionizing radiation in animal species of larger size and longevity. Populations of small widespread species (mice, house sparrow; body mass 20-50 g), which are characterized by intensive metabolism and short lifespan, have calculated 'health thresholds' at dose rates about 6.5-7.5 mGy day(-1). Widespread animals with body mass 200-500 g (rat, common pigeon) - demonstrate 'health threshold' values at 4-5 mGy day(-1). For populations of animals with body mass 2-5 kg (rabbit, fox, raccoon), the indicators of 10% health decrease are in the range 2-3.4 mGy day(-1). For animals with body mass 40-100 kg (wolf, sheep, wild boar), thresholds are within 0.5-0.8 mGy day(-1); for herbivorous animals with body mass 200-300 kg (deer, horse) - 0.5-0.6 mGy day(-1). The lowest health threshold was estimated for elephant (body mass around 5000 kg) - 0.1 mGy day(-1). According to the model results, the differences in population sensitivities of warm-blooded animal species to ionizing radiation are generally depended on the metabolic rate and longevity of organisms, also on individual radiosensitivity of biological tissues. The results of 'health threshold' calculations are formulated as a graded scale of wildlife sensitivities to chronic radiation stress, ranging from potentially vulnerable to more resistant species. Further studies are needed to expand the scale of population sensitivities to radiation, including other groups of wildlife - cold-blooded species, invertebrates, and plants.

Sekar, N., et al. (2017). "Functional nonredundancy of elephants in a disturbed tropical forest." Conserv Biol **31**(5): 1152-1162.

Conservation efforts are often motivated by the threat of global extinction. Yet if conservationists had more information suggesting that extirpation of individual species could lead to undesirable ecological effects, they might more frequently attempt to protect or restore such species across their ranges even if they were not globally endangered. Scientists have seldom measured or quantitatively predicted the functional consequences of species loss, even for large, extinction-prone species that theory suggests should be functionally unique. We measured the contribution of Asian elephants (Elephas maximus) to the dispersal of 3 large-fruited species in a disturbed tropical moist forest and predicted the extent to which alternative dispersers could compensate for elephants in their absence. We created an empirical probability model with data on frugivory and seed dispersal from Buxa Tiger Reserve, India. These data were used to estimate the proportion of seeds consumed by elephants and other frugivores that survive handling and density-dependent processes (Janzen-Connell effects and conspecific intradung competition) and germinate. Without compensation, the number of seeds dispersed and surviving density-dependent effects decreased 26% (Artocarpus chaplasha), 42% (Careya arborea), and 72% (Dillenia indica) when elephants were absent from the ecosystem. Compensatory fruit removal by other animals substantially ameliorated these losses. For instance, reductions in successful dispersal of D. indica were as low as 23% when gaur (Bos gaurus) persisted, but median dispersal distance still declined from 30% (C. arborea) to 90% (A. chaplasha) without elephants. Our results support the theory that the largest animal species in an ecosystem have nonredundant ecological functionality and that their extirpation is likely to lead to the deterioration of ecosystem processes such as seed dispersal. This effect is likely accentuated by the overall defaunation of many tropical systems.

Sen, S. (2017). "A review of the pleistocene dwarfed elephants from the Aegean islands, and their

paleogeographic context." Fossil Imprint **73**(1-2): 76-92.

This paper provides a synthesis of the present knowledge on dwarfed endemic elephants from the Pleistocene of the south Aegean islands. Pleistocene elephants are quite well documented from Crete and Tilos, but with scarce remains on other islands. The systematics and affinities of these elephants are discussed here in the light of recent knowledge on their dispersal history and morphological features. There were apparently three different species on Crete, an older species of Early Pleistocene age and related to Mammuthus, and two others of Middle or Late Pleistocene age, namely Palaeoloxodon creutzburgi and P. chaniensis. The unique m3 from Kassos is similar in size and morphology to P. creutzburgi. From the other islands, the most famous and particularly well-documented species is P. tiliensis from Tilos. It was a dwarfed form estimated as being 1.8 m at the shoulders. Other important records are from the islands of Rhodos, Naxos, Dilos, Kalymnos and Kythera. These islands yielded palaeoloxodontine elephant fossils presumably of the Middle-Late Pleistocene age. The pattern of their dentition and the character of the limb bones, when known, resemble those of the European straight-tusked elephant P. antiquus, and the general opinion is that they were derived from this species. The main question discussed in the present study is the relationship between the elephant occurrences and palaeogeographic evolution of the Aegean domain. It appears that elephants populated Crete at least twice at different times using sweepstake roots. On other islands, elephants probably became isolated because of the subsidence of the Aegean domain and the sea level rise during the Late Pleistocene, which reduced land surfaces and food resources. Hence different degrees of dwarfism existed in these elephants and varied from one island to another.

Sim, R. R., et al. (2017). "USE OF COMPOSITE MATERIALS AS A COMPONENT OF TUSK FRACTURE MANAGEMENT IN AN ASIAN ELEPHANT (ELEPHAS MAXIMUS) AND AN AFRICAN ELEPHANT (LOXODONTA AFRICANA)." J Zoo Wildl Med **48**(3): 891-896.

Tusk fractures in Asian (Elephas maximus) and African elephants (Loxodonta africana) can result in damage to the distal end or to longitudinal cracks, potentially progressing to pulpitis. With pulp exposure, endodontic therapy is the treatment of choice, but conservative therapy has sufficed for some elephants. This manuscript describes the use of composite materials as a component of tusk fracture management. A 7-yr-old male Asian elephant fractured the distal end of both tusks with pulp exposure in one. Capping of each tusk with a Kevlar/fiberglass composite prevented further damage, and a modification allowed care of the exposed pulp tissue. A 34-yr-old male African elephant with a longitudinal crack received a carbon fiber/fiberglass composite circumferential wrap to potentially stabilize the crack. Compression of the crack was achieved, but follow-up was truncated due to bacterial pulpitis. Both cases show that composite material allows for lightweight, durable management of tusk fractures with continued radiographic monitoring.

Simpson, G., et al. (2017). "Mycobacterium tuberculosis Infection among Asian Elephants in Captivity." Emerg Infect Dis **23**(3): 513-516.

Although awareness of tuberculosis among captive elephants is increasing, antituberculosis therapy for these animals is not standardized. We describe Mycobacterium tuberculosis transmission between captive elephants based on whole genome analysis and report a successful combination treatment. Infection control protocols and careful monitoring of treatment of captive elephants with tuberculosis are warranted.

Smit, J., et al. (2017). "Using camera traps to study the age–sex structure and behaviour of crop-using elephants Loxodonta africana in Udzungwa Mountains National Park, Tanzania." Oryx: 1-9.

Crop losses to foraging elephants are one of the primary obstacles to the coexistence of elephants and people. Understanding whether some individuals in a population are more likely to forage on crops, and the temporal patterns of elephant visits to farms, is key to mitigating the negative impacts of elephants on farmers' livelihoods. We used camera traps to study the crop foraging behaviour of African elephants Loxodonta africana in farmland adjacent to the Udzungwa Mountains National Park in

southern Tanzania during October 2010–August 2014. Camera traps placed on elephant trails into farmland detected elephants on 336 occasions during the study period. We identified individual elephants for 126 camera-trap detections. All were independent males, and we identified 48 unique bulls aged 10–29 years. Two-thirds of the bulls identified were detected only once by camera traps during the study period. Our findings are consistent with previous studies that found that adult males are more likely to adopt high-risk feeding behaviours such as crop foraging, although young males dispersing from maternal family units also consume crops in Udzungwa. We found a large number of occasional crop-users (32 of the 48 bulls identified) and a smaller number of repeat crop-users (16 of 48), suggesting that lethal control of crop-using elephants is unlikely to be an effective long-term strategy for reducing crop losses to elephants. Copyright © Fauna & Flora International 2017

Smith, S. D., et al. (2017). "Evolutionary adaptation revealed by comparative genome analysis of woolly mammoths and elephants." DNA Res **24**(4): 359-369.

Comparative genomics studies typically limit their focus to single nucleotide variants (SNVs) and that was the case for previous comparisons of woolly mammoth genomes. We extended the analysis to systematically identify not only SNVs but also larger structural variants (SVs) and indels and found multiple mammoth-specific deletions and duplications affecting exons or even complete genes. The most prominent SV found was an amplification of RNase L (with different copy numbers in different mammoth genomes, up to 9-fold), involved in antiviral defense and inflammasome function. This amplification was accompanied by mutations affecting several domains of the protein including the active site and produced different sets of RNase L paralogs in four mammoth genomes likely contributing to adaptations to environmental threats. In addition to immunity and defense, we found many other unique genetic changes in woolly mammoths that suggest adaptations to life in harsh Arctic conditions, including variants involving lipid metabolism, circadian rhythms, and skeletal and body features. Together, these variants paint a complex picture of evolution of the mammoth species and may be relevant in the studies of their population history and extinction.

Somgird, C., et al. (2017). "Reproductive control in elephant: A tool for population and aggression management." Thai Journal of Veterinary Medicine **47**(1): 1-6.

Although Asian elephant is listed among the endangered species, the number of populations is over the carrying capacity in some areas, resulting in human-elephant conflict, as well as African elephants. High aggression associated with musth and female reproductive pathology are observed in captive elephants. Thus, population and aggression management through reproductive control is an alternative method for mitigating these problems. This article reviews methods of reproductive control in both Asian and African elephants with an overview of male and female reproductive physiology. Hormonal control and immunocontraception, i.e. porcine zona pellucida and gonadotropin releasing hormone (GnRH), are described for the control of reproduction, musth and reproductive pathology.

Springer, M. S. and J. Gatesy (2017). "Evolution of the MC5R gene in placental mammals with evidence for its inactivation in multiple lineages that lack sebaceous glands." Mol Phylogenet Evol **120**: 364-374.

MC5R is one of five melanocortin receptor genes found in placental mammals. MC5R plays an important role in energy homeostasis and is also expressed in the terminal differentiation of sebaceous glands. Among placental mammals there are multiple lineages that either lack or have degenerative sebaceous glands including Cetacea (whales, dolphins, and porpoises), Hippopotamidae (hippopotamuses), Sirenia (manatees and dugongs), Proboscidea (elephants), Rhinocerotidae (rhinos), and Heterocephalus glaber (naked mole rat). Given the loss or diminution of sebaceous glands in these taxa, we procured MC5R sequences from publicly available genomes and transcriptomes, supplemented by a newly generated sequence for Choeropsis liberiensis (pygmy hippopotamus), to determine if this gene remains intact or is inactivated in association with loss/reduction of sebaceous glands. Our data set includes complete MC5R sequences for 114 placental mammal species including two individuals of Mammuthus primigenius (woolly mammoth) from Oimyakon and Wrangel Island. Complete loss or inactivation of the MC5R gene occurs in multiple placental lineages that have lost

sebaceous glands (Cetacea, West Indian manatee, African elephant, white rhinoceros) or are characterized by unusual skin (pangolins, aardvarks). Both M. primigenius individuals share inactivating mutations with the African elephant even though sebaceous glands have been reported in the former. MC5R remains intact in hippopotamuses and the naked mole rat, although slightly elevated dN/dS ratios in these lineages allow for the possibility that the accumulation of inactivating mutations in MC5R may lag behind the relaxation of purifying selection. For Cetacea and Hippopotamidae, the absence of shared inactivating mutations in two different skin genes (MC5R, PSORS1C2) is consistent with the hypothesis that semi-aquatic lifestyles were acquired independently in these clades following divergence from a common ancestor.

Sripiboon, S., et al. (2017). "SUCCESSFUL TREATMENT OF A CLINICAL ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS INFECTION: THE DYNAMICS OF VIRAL LOAD, GENOTYPE ANALYSIS, AND TREATMENT WITH ACYCLOVIR." J Zoo Wildl Med **48**(4): 1254-1259.

This article describes the treatment of clinical elephant endotheliotropic herpesvirus (EEHV) infection in a male Asian elephant (Elephas maximus; approximately 3 yr old), the dynamics of viral load during the active infection, and genetic analysis of the virus. Treatment included injectable acyclovir (12 mg/kg iv, bid), antibiotic, vitamin, and fluids. Quantitative polymerase chain reaction was used to measure the viral levels in blood, which decreased continuously after initiation of intravenous acyclovir. Low levels of virus were detected in the blood for 2 wk, and the virus was undetectable after 1 mo. No complication was observed during the treatment period. This case report suggests that acyclovir, given parenterally, could potentially enhance survival of clinical EEHV-infected individuals.

Stacy, N. I., et al. (2017). "First report of changes in leukocyte morphology in response to inflammatory conditions in Asian and African elephants (Elephas maximus and Loxodonta africana)." PLoS ONE **12**(9): e0185277.

Although the hematology of healthy elephants has been well-described, published information on hematological changes during disease is limited. The objective of this study was to describe qualitative morphological changes in the leukocytes of Asian and African elephants (Elephas maximus and Loxodonta africana) diagnosed with a variety of inflammatory conditions. Twenty-five of 27 elephants had morphological changes in their leukocytes, although only 16 of these had a concurrent inflammatory leukogram. Morphological changes included heterophil left-shifting with or without concurrent dysgranulopoiesis, toxicity, or hypersegmentation, reactive lymphocytes, plasma cells, and/or vacuolated monocytes. Although the observed leukocyte morphological changes are non-specific, their early recognition upon blood film evaluation may provide important, clinically-relevant information, particularly if the leukogram is normal. This case series is the first description of qualitative morphological changes in the leukocytes of elephants in association with inflammation.

Stagni, E., et al. (2017). "Distances between individuals in an artificial herd of African elephants (Loxodonta africana africana) during resource utilisation in a semi-captive environment." Res Vet Sci **113**: 122-129.

Space allowance and resource dispersion is recognised as an important factor affecting the welfare of elephants in captivity. In the present pilot study, we investigated distances kept among individuals in an artificially created semi-captive mixed-sex group of African elephants, when individuals were free to disperse. The study involved a herd of six elephants, three females (aged 11 to 16years), and three males (aged 15 to 23years). They were observed through instantaneous scan sampling in order to assess distances between individuals and body orientation in space and through continuous focal animal sampling to assess inter-specific social behaviour and general activity. A total of 312 suitable scans were collected for evaluation of distances between individuals. While foraging in absence of discernible space constraints, elephants maintained a distance equalling five or more body lengths in 63.9% of the scans, with wide differences between dyads. Little social behaviour, mainly affiliative, was recorded. The results of this pilot study suggest further scientific investigation could help to understand whether placing resources at five body lengths distance or over in a controlled environment could increase their simultaneous utilisation by all members of a group and contribute to decrease

aggression. However, caution is warranted when applying results to different groups, environments and management regimes.

Stagni, E., et al. (2017). "Distances between individuals in an artificial herd of African elephants (Loxodonta africana africana) during resource utilisation in a semi-captive environment." Res Vet Sci **113**: 122-129.

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Stoeger, A. S. and A. Baotic (2017). "Corrigendum: Male African elephants discriminate and prefer vocalizations of unfamiliar females." Sci Rep **7**: 46892.

This corrects the article DOI: 10.1038/srep46414.

Stoeger, A. S. and A. Baotic (2017). "Male African elephants discriminate and prefer vocalizations of unfamiliar females." Sci Rep **7**: 46414.

Gaining information about conspecifics via long-distance vocalizations is crucial for social and spatially flexible species such as the African elephant (Loxodonta africana). Female elephants are known to discriminate individuals and kin based on acoustic cues. Specifically, females approached the loudspeaker exclusively with playbacks of familiar individuals with high association indexes, intentionally fusing with their affiliates. For males, which are less bonded, gathering social information via vocalizations could still have important implications, but little is known about their vocal discrimination skills. We experimentally tested the ability of male African elephants to discriminate the social rumbles of familiar (from the same population) versus unfamiliar females. Male elephants discriminated and preferentially moved towards the rumbles of unfamiliar females, showing longer attentive reactions and significantly more orientating (facing and approaching the speaker) behavior. The increased orientating response of males towards playbacks of unfamiliar females is converse to the reaction of female subjects. Our results provide evidence that male elephants extract social information from vocalizations, yet with a different intention than females. Accordingly, males might use social cues in vocalizations to assess mating opportunities, which may involve selection to identify individuals or kin in order to avoid inbreeding.

Suba, R. B., et al. (2017). "Foraging ecology and diet of Bornean elephants (Elephas maximus borneensis) in the Sebuku forest area, North Kalimantan Province of Indonesia: Do the choices matter?" Integr Zool.

The Bornean elephant (Elephas maximus borneensis) was identified as a genetically distinct sub-species of the Asian elephant (E. maximus) (Fernando et al. 2003), possibly related to the Javan elephant, which became extinct following the disappearance of the Java-Borneo connection at the last glacial maximum (Cranbook et al. 2008). Nevertheless, Elephas maximus has been listed as an endangered species (EN) on the Global IUCN Red List since 1986 (IUCN 2016). Under Indonesian Law (Government Regulation No. 7/1999 for Preservation of Fauna and Flora), the Bornean elephant is also listed as an endangered species (Azmi & Gunaryadi 2011). This status would emphasize the urgency

to conserve the Bornean elephant as an evolutionarily significant unit (Fernando et al. 2003; Alfred et al. 2011). This article is protected by copyright. All rights reserved.

Suba, R. B., et al. (2017). "Rapid Expansion of Oil Palm Is Leading to Human-Elephant Conflicts in North Kalimantan Province of Indonesia." Tropical Conservation Science **10**: 1-12.

Crop raiding by Bornean elephants (Elephas maximus borneensis) is increasing rapidly in North Kalimantan, mainly due to a rapid conversion of swiddens and secondary forest into oil palm plantations. In the Tulin Onsoi subdistrict, the area used by oil palm plantations has grown from 3,302.71 ha in 2001 to 21,124.93 ha in 2014. Particularly from 2006 to 2010, the area covered by oil palm plantations increased rapidly (418%). Preventing further encroachment of oil palm plantations in elephant habitat and regulating land use change are keys to stop further population declines and make way for the reestablishment of a viable elephant population in Kalimantan. Crop raiding is a strong determinant of the local people's perceptions of elephants and risks eroding cultural values that enabled people to coexist with elephants. People's perception and attitude toward elephants are generally negative. Nevertheless, negative attitudes have not led to cases of retaliation in the Tulin Onsoi subdistrict. Public education at the community level could strengthen cultural values and foster coexistence between humans and elephants.

T, J., et al. (2017). "Hematologic and Biochemical Reference Intervals for Captive Asian Elephants (Elephas maximus) in Thailand." Kafkas Univ Vet Fak Derg **23**(4): 665-669.

Takatsu, Z., et al. (2017). "Elephant's breast milk contains large amounts of glucosamine." J Vet Med Sci **79**(3): 524-533.

Hand-reared elephant calves that are nursed with milk substitutes sometimes suffer bone fractures, probably due to problems associated with nutrition, exercise, sunshine levels and/or genetic factors. As we were expecting the birth of an Asian elephant (Elephas maximus), we analyzed elephant's breast milk to improve the milk substitutes for elephant calves. Although there were few nutritional differences between conventional substitutes and elephant's breast milk, we found a large unknown peak in the breast milk during high-performance liquid chromatography-based amino acid analysis and determined that it was glucosamine (GlcN) using liquid chromatography/mass spectrometry. We detected the following GlcN concentrations [mean +/- SD] (mg/100 g) in milk hydrolysates produced by treating samples with 6M HCl for 24 hr at 110 degrees C: four elephant's breast milk samples: 516 +/- 42, three cow's milk mixtures: 4.0 +/- 2.2, three mare's milk samples: 12 +/- 1.2 and two human milk samples: 38. The GlcN content of the elephant's milk was 128, 43 and 14 times greater than those of the cow's, mare's and human milk, respectively. Then, we examined the degradation of GlcN during 0-24 hr hydrolyzation with HCl. We estimated that elephant's milk contains >880 mg/100 g GlcN, which is similar to the levels of major amino acids in elephant's milk. We concluded that a novel GlcN-containing milk substitute should be developed for elephant calves. The efficacy of GlcN supplements is disputed, and free GlcN is rare in bodily fluids; thus, the optimal molecular form of GlcN requires a further study.

Tankaew, P., et al. (2017). "Evaluation of an In-house indirect ELISA for detection of antibody against haemorrhagic septicemia in Asian elephants." J Microbiol Methods **134**: 30-34.

Pasteurella multocida causes haemorrhagic septicemia in livestock and wild animals, including elephants. The disease has been reported in Asian elephants in India and Sri Lanka, but to date there have been no reported cases in Thailand. ELISA or indirect hemagglutination assays (IHA) have been

demonstrated to be able to detect the antibody against the disease in cattle, but no data are available for elephants. The present study reports a novel in-house indirect ELISA for antibody detection of haemorrhagic septicemia in Asian elephants, and evaluates the sensitivity and specificity of the method using a Bayesian approach. The characteristics of ELISA and IHA were analyzed using a one population Bayesian model assuming conditional dependence between these two diagnostic tests. The IHA was performed as recommended by the World Organization for Animal Health (OIE) manual for haemorrhagic septicemia. An in-house indirect ELISA was developed with a heat extract antigen of P. multocida strain M-1404 (serovar B:2) as a coating antigen and rabbit anti-immunoglobulin G conjugated with horseradish peroxidase (eIgG-HRP). The checkerboard titration method was done using elephant sera immunized with P. multocida bacterin and negative sera from colostrum-deprived elephant calves. The concentrations of heat extract antigen (160mug/ml), sample serum (1:100), and eIgG-HRP (1:1000) were optimal for the assay. The calculated cut-off value was 0.103. Of the elephant sera, 50.59% (43/85) were considered seropositive by ELISA. The sensitivity of the ELISA test was higher than that of the IHA test [median=86.5%, 95% posterior probability interval (PPI)=52.5-98.9%] while the specificity was lower (median=54.1%, PPI=43.6-64.7%). The median sensitivity and specificity of IHA were 80.5% (PPI=43.8-98.0%) and 78.4% (PPI=69.0-87.0%), respectively. These findings suggest that our in-house indirect ELISA can be used as a tool to detect the antibody against haemorrhagic septicemia in Asian elephants.

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Tanya, L. (2017). Botswana's Elephant-Back Safari Industry – Stress-Response in Working African Elephants and Analysis of their Post-Release Movements, University of Massachusetts Amherst. **Masters**.

Tarbert, D. K., et al. (2017). "EVALUATION OF THE I-STAT PORTABLE CLINICAL ANALYZER FOR MEASUREMENT OF IONIZED CALCIUM AND SELECTED BLOOD CHEMISTRY VALUES IN ASIAN ELEPHANTS (ELEPHAS MAXIMUS)." J Zoo Wildl Med **48**(2): 319-327.

Thei-STAT(R) portable clinical analyzer (PCA) provides patient-side results for hematologic, biochemical, and blood gas values when immediate results are desired. This analyzer is commonly used in nondomestic animals; however, validation of this method in comparison with traditional

benchtop methods should be performed for each species. In this study, the i-STAT PCA was compared with the Radiometer ABL 800 Flex benchtop analyzer using 24 heparinized whole blood samples obtained from healthy E. maximus . In addition, the effect of sample storage was evaluated on the i-STAT PCA. Analytes evaluated were hydrogen ion concentration (pH), glucose, potassium (K+), sodium (Na+), bicarbonate (HCO3-), total carbon dioxide (TCO2), partial pressure of carbon dioxide (PCO2), and ionized calcium (iCa2+). Statistical analysis using correlation coefficients, Passing-Bablok regression analysis, and Bland-Altman plots found good agreement between results from samples run immediately after phlebotomy and 4 hr postsampling on the i-STAT PCA with the exception of K+, which is known to change with sample storage. Comparison of the results from the two analyzers at 4 hr postsampling found very strong or strong correlation in all values except K+, with statistically significant bias in all values except glucose and PCO2. Despite bias, mean differences assessed via Bland-Altman plots were clinically acceptable for all analytes excluding K+. Within the reference range for iCa2+, the iCa2+ values obtained by the i-STAT PCA and Radiometer ABL 800 Flex were close in value, however in light of the constant and proportionate biases detected, overestimation at higher values and underestimation at lower values of iCa2+ by the i-STAT PCA would be of potential concern. This study supports the use of the i-STAT PCA for the evaluation of these analytes, with the exception of K+, in the Asian elephant.

Thitaram, C. and J. L. Brown (2017). "Monitoring and controlling ovarian activity in elephants." Theriogenology. Both Asian (Elephas maximus) and African (Loxodonta africana) elephants are important keystone, umbrella and flagship species. Paradoxically, world population numbers of both species are declining in many of their natural ranges due mainly to poaching, while over population of elephants in some areas is resulting in serious human-elephant conflict, and modifications of natural habitats that impact biodiversity. Understanding mechanisms of reproductive control is vital to effective population management, and for that reason significant advances have been made in endocrine and ultrasonographic monitoring techniques, particularly in studies of elephants ex situ. However, there remains a need to develop new methods to control ovarian activity, both for enhancing and inhibiting reproduction, to maintain population numbers at levels that ensure species survival and their ability to safely cohabitate with humans and other species. We present an overview of reproductive monitoring methods and how they have contributed to our knowledge of elephant reproductive biology, as well as their application for in situ and ex situ conservation purposes.

Tshipa, A., et al. (2017). "Partial migration links local surface-water management to large-scale elephant conservation in the world's largest transfrontier conservation area." Biological Conservation **215**: 46-50. Successful conservation of large mammals requires vast areas to maintain viable populations. This often requires to embrace large-scale approaches that extend beyond the borders of formally protected areas. However, the quality of the scientific knowledge about animal movement across large conservation areas vary, and could limit the effectiveness of conservation efforts. Here we used GPS tracking to conduct the first study of large-scale movements of African elephants (Loxodonta africana) in Hwange NP (Zimbabwe), which is an unfenced park part of the Kavango-Zambezi Transfrontier Conservation Area, the world's largest terrestrial conservation area. We show that some, but not all, elephants migrate seasonally, with wet- to dry-season movements linked to the provision of water in Hwange NP. The distance between the most distant locations of individual elephants reaches 260 km. In this partial migration system influenced by management practices, over 20% of the elephants have wet-season ranges established in Botswana, outside of protected areas in private or communal wildlife management areas. Our results call for the urgent drafting of a regional action plan, involving all stakeholders identified by our study and their neighbours, to predict and react to what would happen if water provision in Hwange NP was to suddenly change because of management practices or extreme climate change. Beyond this critical conservation issue for the world's largest elephant meta-population, our results also highlight the relevance of large-scale conservation areas combined with integrative planning involving national wildlife management institutions and the private and communal sector.

Turkalo, A. K., et al. (2017). "Slow intrinsic growth rate in forest elephants indicates recovery from poaching will require decades." Journal of Applied Ecology **54**(1): 153-159.

African forest elephants Loxodonta cyclotis are experiencing persistent declines driven by illegal killing and range loss. Despite the importance for policy debates regarding elephant trade managed through the Convention on International Trade in Endangered Species (CITES), little is known about forest elephant demography and, consequently, the impacts of offtake and subsequent population recovery potential. Using 23 years of individually based demographic data from Dzanga, Central African Republic, we found low reproductive potential resulting from annual birth rates averaging 4·3% (SD: 1·4%), a median inter-birth interval of 68 months and a median primiparous age of 23 years. Average mortality was 3·1% per year (SD: 1·0%) during the study, with approximately 1·4% of that attributed to human killing. This population of forest elephants demonstrated concerningly slow growth rates, with a doubling time of nearly 60 years under current conditions (41 years excluding human impacts), amounting to three times that reported for savanna elephants. As such, forest elephants appear to be significantly more sensitive to human-induced mortality than their congeneric species. Such slow intrinsic growth challenges current perceptions of historic and contemporary ivory trade impacts on forest elephants, highlighting the urgent need to stem poaching and institute long-term protective measures. Policy implications. Debates regarding the sustainability of the ivory trade for the species appear to have overestimated growth rates of forest elephants. The information presented here indicates that sustainable offtake models for forest elephants need reassessment. © 2016 The Authors. Journal of Applied Ecology © 2016 British Ecological Society

Veerasami, M., et al. (2017). "Point of Care Tuberculosis Sero-Diagnosis Kit for Wild Animals: Combination of Proteins for Improving the Diagnostic Sensitivity and Specificity." Indian Journal of Microbiology: 1-12.

Tuberculosis is a significant problem globally for domestic animals as well as captive and free ranging wild life. Rapid point of care (POC) serology kits are well suited for the diagnosis of TB in wild animals. However, wild animals are invariably exposed to environmental non-pathogenic mycobacterium species with the development of cross reacting antibodies. In the present study, POC TB diagnosis kit was developed using a combination of pathogenic Mycobacteria specific recombinant antigens and purified protein derivatives of pathogenic and non-pathogenic Mycobacteria. To benchmark the TB antibody detection kit, particularly in respect to specificity which could not be determined in wildlife due to the lack of samples from confirmed uninfected animals, we first tested well-characterized sera from 100 M. bovis infected and 100 uninfected cattle. Then we investigated the kit's performance using sera samples from wildlife, namely Sloth Bears (n = 74), Elephants (n = 9), Cervidae (n = 14), Felidae (n = 21), Cape buffalo (n = 2), Wild bear (n = 1) and Wild dog (n = 1).In cattle, a sensitivity of 81% and a specificity of 90% were obtained. The diagnostic sensitivity of the kit was 94% when the kit was tested using known TB positive sloth bear sera samples. 47.4% of the in-contact sloth bears turned seropositive using the rapid POC TB diagnostic kit. Seropositivity in other wild animals was 25% when the sera samples were tested using the kit. A point of care TB sero-diagnostic kit with the combination of proteins was developed and the kit was validated using the sera samples of wild animals. © 2017 Association of Microbiologists of India

Vigne, L. and E. Martin (2017). THE IVORY TRADE OF LAOS: NOW THE FASTEST GROWING IN THE WORLD.

Wiedner, E., et al. (2017). "Vital signs and first occurrences in normal and abnormal newborn Asian elephant (Elephas maximus) calves." J Zoo Wildl Med **48**(4): 997-1015.

Sixteen years of medical records documenting 19 births within a herd of Asian elephants (Elephas maximus) at a private facility in the southeastern United States were reviewed. Of the 19 calves, 11 were normal at birth, requiring no additional veterinary care, and eight were abnormal, requiring veterinary care immediately or within the first week of birth. Descriptive statistics were used to evaluate morphometrics, vital signs, and behavioral milestones in newborn calves both normal and abnormal.

Blood work and urinalysis results from all calves were compared to values for adult elephants. Medical management of abnormal calves is described. All calves had faster heart rates and respiratory rates than did adult elephants, but rectal temperatures were the same. Calves were precocious with regard to sitting and standing but could be very slow to nurse. The most-common medical conditions of newborn calves were umbilical abnormalities and problems associated with nursing. Two calves required cardiopulmonary resuscitation after birth but made full recoveries. Some conditions were not apparent at birth but were recognized a few hours or days later. Following veterinary intervention, six of the eight calves made full recoveries, suggesting that early identification and treatment of problems can greatly decrease mortality. This is the first report of multiple veterinary and behavioral parameters in normal and abnormal neonatal Asian elephants from a facility with a calf survival rate above 90%. This information may be helpful to other elephant-holding facilities in providing care to their newborn elephant calves.

Wyse, J. M., et al. (2017). "The impact of competition on elephant musth strategies: A game–theoretic model." Journal of Theoretical Biology **417**: 109-130.

Mature male African Savannah elephants are known to periodically enter a temporary state of heightened aggression called “musth”, often linked with increased androgens, particularly testosterone. Sexually mature males are capable of entering musth at any time of year, and will often travel long distances to find estrous females. When two musth bulls or two non-musth bulls encounter one another, the agonistic interaction is usually won by the larger male. However, when a smaller musth bull encounters a larger non-musth bull, the smaller musth male can win. The relative mating success of musth males is due partly to this fighting advantage, and partly to estrous females' general preference for musth males. Though musth behavior has long been observed and documented, the evolutionary advantages of musth remain poorly understood. Here we develop a game–theoretic model of male musth behavior which assumes musth duration as a parameter, and distributions of small, medium and large musth males are predicted in both time and space. The predicted results are similar to the musth timing behavior observed in the Amboseli National Park elephant population, and further results are generated with relevance to Samburu National Park. We discuss small male musth behavior, the effects of estrous female spatial heterogeneity on musth timing, conservation applications, and the assumptions underpinning the model. © 2017 Elsevier Ltd

Yamamoto, Y., et al. (2017). "Different origins of two corpora lutea recovered from a pregnant African elephant (Loxodonta africana)." Reprod Domest Anim.

Elephant ovaries contain multiple corpora lutea (CLs) throughout pregnancy. Two CLs (P-1 and P-2) collected from a pregnant African elephant were used to investigate their origin and physiological state in this study. The mRNA expressions of prolactin receptor, CYP11A and inhibin betaB subunit were higher in P-2 than in P-1, while LHCGR and inhibin betaA subunit mRNA were higher in P-1 than in P-2. Protein expression of cleaved caspase-3 was detected in P-1 but not in P-2. These results suggest different origins for the two CLs in this one pregnant elephant, and we also demonstrated the production of bioactive prolactin by the elephant placenta.

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Yang, P. J., et al. (2017). "Hydrodynamics of defecation." Soft Matter **13**(29): 4960-4970.

Animals discharge feces within a range of sizes and shapes. Such variation has long been used to track animals as well as to diagnose illnesses in both humans and animals. However, the physics by which feces are discharged remain poorly understood. In this combined experimental and theoretical study, we investigate the defecation of mammals from cats to elephants using the dimensions of large intestines and feces, videography at Zoo Atlanta, cone-on-plate rheological measurements of feces and mucus, and a mathematical model of defecation. The diameter of feces is comparable to that of the rectum, but the length is double that of the rectum, indicating that not only the rectum but also the colon is a storage facility for feces. Despite the length of rectum ranging from 4 to 40 cm, mammals from cats to elephants defecate within a nearly constant duration of 12 +/- 7 seconds (N = 23). We rationalize this surprising trend by our mathematical model, which shows that feces slide along the large intestine by a layer of mucus, similar to a sled sliding down a chute. Larger animals have not only more feces but also thicker mucus layers, which facilitate their ejection. Our model accounts for the shorter and longer defecation times associated with diarrhea and constipation, respectively. This study may support clinicians use of non-invasive procedures such as defecation time in the diagnoses of ailments of the digestive system.

Zachariah, A., et al. (2017). "Mycobacterium tuberculosis in Wild Asian Elephants, Southern India." Emerg Infect Dis **23**(3): 504-506.

We tested 3 wild Asian elephants (Elephas maximus) in southern India and confirmed infection in 3 animals with Mycobacterium tuberculosis, an obligate human pathogen, by PCR and genetic sequencing. Our results indicate that tuberculosis may be spilling over from humans (reverse zoonosis) and emerging in wild elephants.