

Recent Publications on Asian Elephants

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If you need additional information on any of the articles, please feel free to contact me. You can also let me know about new (2019) publications on Asian elephants.

T.V. Abhijith, M. Ashokkumar, R.T. Dencin & C. George

Gastrointestinal parasites of Asian elephants (*Elephas maximus* L. 1798) in south Wayanad forest division, Kerala, India

Journal of Parasitic Diseases 42(2018) 382-390

Abstract. Microscopic-coprolological examination of Asian elephant (*Elephas maximus* L., 1798) dung piles (n=55) in South Wayanad Forest Division from March to August, 2017 revealed 74.5% prevalence of parasites in elephants. *Ancylostoma* sp. *Anoplocephala* sp., Strongyle type egg and Strongyloides sp. were the major parasites recorded. Strongyloides sp. and Strongyle type egg were observed more frequently (58.1%). *Ancylostoma* sp. and *Anoplocephala* sp. were constituted 1.8% each; mixed parasitic species infections were recorded. The frequency distribution of parasitic load in elephants showed skewed distribution of propagules. Centrifugal sedimentation and floatation methods of fecal examination of outer and inner regions of dung did not show significant difference in number of propagules. The highest number of parasitic propagules was recorded in floatation method. The number of propagules varied among dung samples of different herds collected from different localities. There were no relation between the parasitic load and age of elephants. The mean density of parasite eggs was higher in solitary animals (214.3 ± 155.4 epg) than herd elephants (147.78 ± 111.1 epg). Though parasitic load was higher in solitary males, based on the occurrence of parasites using logistic regression it was found that females had 1.83

times higher occurrence for parasitic infection than males. Both length and width of parasite egg size classes were used to classify into different taxonomic groups using discriminate function analysis. Three distinct size clusters were identified. Nematode and Cestode eggs were classified correctly with 95.7% accuracy. Since, the egg size was similar in nematode group separation into genus was difficult. Further, inclusion of stages of development of egg and larvae enable better separation. © 2018 Reprinted by permission from Springer Nature.

P. Bansiddhi, J.L. Brown, C. Thitaram, V. Punyapornwithaya, C. Somgird, K.L. Edwards & K. Nganvongpanit

Changing trends in elephant camp management in northern Thailand and implications for welfare

PeerJ 6 (2018) e5996

Abstract. Elephant camps are among the most attractive destinations in Thailand for tourists from many countries. A wide range of management strategies are used by these camps, which can have varied impacts on health and welfare of elephants. This study surveyed 33 camps with 627 elephants in northern Thailand to quantify the types of management practices and work activities experienced by captive elephants. The survey consisted of an interview with camp owners, and direct observations of camp operations. Data revealed considerable variation in elephant demographics, work activities, elephant care (i.e., housing, restraint, nutrition, health care, and breeding), and mahout management among the camps. In general, older camps (those in existence for >16 years) were involved in more intensive activities, like riding with saddles and shows. By contrast, newer camps provided more one-on-one activities for tourists

and elephants, and emphasized more intimate, relaxing experiences (e.g., feeding, bathing, walking) than entertainment. A demographic shift also was observed, with elephants 20 years of age and younger having a sex ratio closer to 1:1 compared to elephants in older age categories (1:4.1–1:9.8). Shifts in elephant management to less intensive activities were observed, which could have positive implications for elephant welfare. The shifting sex ratio suggests successful captive breeding is resulting in the birth of more males, which could present new welfare challenges in the future, because bulls can be more difficult to manage and socialize, and are more likely to be kept isolated during musth. Ultimately, the goal is to understand how camp activities affect welfare, and to develop science-based guidelines and standards to aid in the management of both male and female elephants used in tourism. © 2018 The Authors.

K.L. Bauer, E. Latimer & M. Finnegan

Long-term, intermittent, low-level elephant endotheliotropic herpesvirus 1A viremia in a captive Asian elephant calf

Journal of Veterinary Diagnostic Investigation 30 (2018) 917-919

Abstract. A 2-y-old male Asian elephant (*Elephas maximus*), with an elevated platelet count ($1,100 \times 10^9/L$ [$1,100 \times 10^3/mm^3$]), tested positive for elephant endotheliotropic herpesvirus 1A (EEHV-1A) on conventional PCR (cPCR) of EDTA whole blood. No clinical signs were ever reported and no treatment was administered, but low-level viremia persisted for 2.5 y based on results of cPCR and/or real-time PCR (rtPCR). Sequencing confirmed that the EEHV-1A detected was identical at the beginning through the end of the time period. No other elephants in the herd tested positive for EEHV-1 during this time period. Platelet counts remained elevated throughout the viremia and throughout the animal's life, and direct correlation between the elevated platelet counts and EEHV-1A viremia could not be confirmed. We document long-term, intermittent, low-level viremia of EEHV-1A and provide additional information to consider when determining if treatment is warranted in a case of EEHV infection. © 2018 The Authors.

V. Behringer, C. Deimel, G. Hohmann, J. Negrey, F.S. Schaebs, T. Deschner

Applications for non-invasive thyroid hormone measurements in mammalian ecology, growth, and maintenance

Hormones and Behavior 105 (2018) 66-85

Abstract. Thyroid hormones (THs) play a pivotal role in the regulation of metabolic activity throughout all life stages. Cross-talk with other hormone systems permits THs to coordinate metabolic changes as well as modifications in growth and maintenance in response to changing environmental conditions. The scope of this review is to explain the relevant basics of TH endocrinology, highlight pertinent topics that have been investigated so far, and offer guidance on measuring THs in non-invasively collected matrices. The first part of the review provides an overview of TH biochemistry, which is necessary to understand and interpret the findings of existing studies and to apply non-invasive TH monitoring. The second part focuses on the role of THs in mammalian ecology, and the third part highlights the role of THs in growth and maintenance. The fourth part deals with the advantages and difficulties of measuring THs in non-invasively collected samples. This review concludes with a summary that considers future directions in the study of THs. © 2018 Reprinted with permission from Elsevier.

John Carey

Science and culture: Animal cognition research offers outreach opportunity

PNAS 115 (2018) 4522-4524

Abstract. none.

Daniel C. Fisher

Paleobiology of Pleistocene proboscideans

Annual Review of Earth and Planetary Sciences 46 (2018) 229-260

Abstract. The paleobiology of Pleistocene proboscideans plays a pivotal role in understanding their history and in answering fundamental questions involving their interactions with other taxa, including humans. Much of our view of proboscidean paleobiology is influenced by analogies with extant elephants. However, a wealth of information is available for reconstructing the paleobiology of ancient

proboscideans using data from fossil specimens and preservational settings. Remarkable opportunities include permafrost-derived specimens with preserved soft tissue, intestinal contents with direct evidence of diet, and compositional and structural profiles with subannual temporal resolution archived in appositional systems such as proboscidean tusks. New information on diets and local climates puts our understanding of proboscidean paleoecology on a firmer foundation, but the greatest prospects for new insight spring from life history data now being retrieved from accelerator mass spectrometry-dated fossil material. Interaction between humans and proboscideans has been a critical factor in the history of both groups. © 2018 Reproduced with permission from Annual Reviews.

Dennys Frenez

Manufacturing and trade of Asian elephant ivory in Bronze Age Middle Asia. Evidence from Gonur Depe (Margiana, Turkmenistan)
Archaeological Res. in Asia 15 (2018) 13-33

Abstract. This paper presents the detailed stylistic and functional analysis of a large collection of artifacts made from Asian elephant ivory discovered at the Oxus Civilization site of Gonur Depe in southern Turkmenistan. Artifacts in ivory of Asian elephant from Bronze Age sites in Middle Asia have usually been considered as evidence for the import of finished items from the greater Indus Valley. The detailed study of the Gonur Depe ivories has instead proven that there are significant morphological and stylistic differences between these artifacts and those found at contemporaneous sites in the Indus Valley. This evidence raises important questions about the provenance of the raw material and about the origin and training of the craftsmen who manufactured the objects. Detailed research in textual sources about traditional arts and crafts in South Asia and in classical and medieval commentaries about ivory carving, integrated with ethnographic data about skilled crafting in traditional societies, has led to propose new hypotheses about the complex socioeconomic and cultural organization of manufacturing and trade of Asian elephant ivory during the Bronze Age. © 2017 Reprinted with permission from Elsevier.

A. Fuery, A.M. Leen, R. Peng, M.C. Wong, H. Liu & P.D. Ling

Asian elephant T cell responses to elephant endotheliotropic herpesvirus (EEHV)

Journal of Virology 92 (2018) e01951-17

Abstract. Elephant Endotheliotropic Herpesvirus (EEHV) can cause lethal hemorrhagic disease in juvenile Asian elephants, an endangered species. One hypothesis to explain this vulnerability of some juvenile elephants is that they fail to mount an effective T cell response to the virus. To our knowledge, there have been no studies of Asian elephant T cell responses to EEHV. To address this deficiency, we validated the IFN- γ ELISpot assay for tracking antigen-directed T cell activity by monitoring rabies-specific responses in vaccinated elephants. Additionally, we generated monoclonal antibodies to Asian elephant CD4 and CD8 to facilitate phenotypic T cell profiling. Using these tools, we screened healthy elephants with a prior history of EEHV infection for reactivity against 9 EEHV proteins whose counterparts in other herpesviruses are known to induce T cell responses in their natural hosts. We identified glycoprotein B (gB) and the putative regulatory protein E40 as the most immunogenic T cell targets (IFN- γ responses in 5 of 7 elephants) followed by the major capsid protein (MCP) (IFN- γ responses in 3 of 7 elephants). We also observed that IFN- γ responses were largely from CD4+ T cells. We detected no activity against the predicted major immediate early (E44) and large tegument (E34) proteins- both immunodominant T cell targets in humans latently infected with cytomegalovirus. These studies have identified EEHV-specific T cells in Asian elephants for the first time, lending insight into the T cell priming that might be required to protect against EEHV disease and will guide the design of effective vaccine strategies. © 2018 The Authors.

Mayuri Gogoi

Emotional coping among communities affected by wildlife-caused damage in north-east India: Opportunities for building tolerance and improving conservation outcomes

Oryx 52 (2018) 214-219

Abstract. Human-wildlife conflict has been the focus of much research, and incidents of damage caused by wildlife to communities, as well as

damage inflicted on wildlife by people, have been studied extensively to determine causes, conditions, impacts and mitigation strategies. However, few studies have explored the coping strategies employed by communities to deal with these stressful events. Understanding coping is important, as effective coping builds tolerance towards wildlife, whereas poor coping erodes tolerance and thus jeopardizes conservation. Interviews conducted with people who had experienced damage caused by wild elephants *Elephas maximus* in eight villages of Assam, in north-east India, found that the stress experienced by the communities as a result of the damage was eased by their religious beliefs associated with elephants, and their feelings of empathy towards these animals. Belief in the elephant as God and as avenger of wrong-doing further strengthened people's coping capacity. These findings have positive implications for elephant conservation, showing that people's tolerance towards marauding elephants can be based on religious beliefs rather than compensation for losses. © 2018 Fauna & Flora International.

B.L. Hart & L.A. Hart

How mammals stay healthy in nature: The evolution of behaviours to avoid parasites and pathogens

Philosophical Transactions of the Royal Society B 373 (2018) e20170205

Abstract. Mammals live and thrive in environments presenting ongoing threats from parasites in the form of biting flies, ticks and intestinal worms and from pathogens as wound contaminants and agents of infectious disease. Several strategies have evolved that enable animals to deal with parasites and pathogens, including eliminating away from the sleeping–resting areas, use of an array of grooming techniques, use of saliva in licking, and consuming medicinal plant-based compounds. These strategies all are species-specific and reflect the particular environment that the animal inhabits. © 2018 The Authors.

N.D. Harvey, C. Daly, N. Clark, E. Ransford, S. Wallace & L. Yon

Social interactions in two groups of zoo-housed adult female Asian elephants (*Elephas*

***maximus*) that differ in relatedness**

Animals 8 (2018) e132

Abstract. Opportunities for positive social interaction are important in captive animals, and social interactions can be used as a welfare indicator. Wild elephants live in related multi-generational herds; however, in captivity they are often managed in less related groups, which could impact the quality of their social interactions, and thus their welfare. Here, we used a limited social network analysis to investigate the social interactions in two groups of four female captive Asian elephants, one of which contained individuals that were all related to one another, whilst the other was a mix of related and unrelated individuals. Data on pairwise social interactions was collected from eight days of video footage using an all-occurrence sampling technique. More affiliative, and fewer agonistic interactions were observed in the related elephant group. Additionally, non-contact displacement was observed at a higher frequency in the related elephant group, which we theorise represents an established functioning hierarchy, avoiding the need for overt aggression over resources. Although kinship is not likely to be the only factor affecting captive elephant social behaviour, these findings support the recommendation that for optimal welfare, elephants should be managed in multigenerational family herds. Evaluations of social interactions such as those conducted here would have wider applicability for aiding the management of any captive social species to identify when groups might be incompatible. © 2018 The Authors.

R. Hufenus, C. Schiffmann, J.-M. Hatt, D.W.H. Müller, L.B. Lackey, M. Clauss & P. Zerbe

Seasonality of reproduction in Asian elephants *Elephas maximus* and African elephants *Loxodonta africana*: Underlying photoperiodic cueing?

Mammal Review 48 (2018) 261-276

Abstract. Animals in seasonal environments often rely on photoperiodicity to time their reproduction. Elephants have a gestation length of approximately two years and a historical geographic distribution including higher latitudes than at present, so the evolution of a seasonal breeding pattern cued by photoperiodicity and

timed to the long-day period is a theoretical option in both species. We reviewed literature on reproductive patterns in free-ranging, semi-captive and captive Asian and African elephants, photoperiodic cueing, seasonal variation in body condition, and other factors influencing their reproduction, as well as data from zoological collections on the timing of births. Most of the free-ranging and all the semi-captive and captive elephant populations showed a moderate yet distinct seasonal breeding pattern. Peak breeding activity of free-ranging Asian elephants took place in either the dry or the wet season, with no preference for short-day or long-day breeding at low latitudes (close to the equator) but a preference for long-day breeding at higher latitudes. Semi-captive Asian elephants mainly bred in the dry season when body condition was lowest and day-lengths were increasing. Peak conception often occurred in the wet season in free-ranging African elephants when body condition was highest, with no evident preference for short-day or long-day breeding at low latitudes but preference for long-day breeding at higher latitudes. Asian and African elephants in zoos at latitudes from 43 to 53°N tended to conceive more often during spring and summer, i.e. when day-lengths were increasing. Body condition was not reported to vary significantly throughout the year and was rather high compared to in the wild. We hypothesise that elephants are 'long-day breeders' in which the photoperiodic timing of conception can be influenced by many additional factors. Strategies to encourage natural conception in captive populations should include measures aimed at increasing breeding incentives in the northern hemisphere spring. © 2018 The Mammal Society and John Wiley & Sons Ltd.

S. Jarvie & J.-C. Svenning

Using species distribution modelling to determine opportunities for trophic rewilding under future scenarios of climate change

Philosophical Transactions of the Royal Society B 373 (2018) e20170446

Abstract. Trophic rewilding, the (re)introduction of species to promote self-regulating biodiverse ecosystems, is a future-oriented approach to ecological restoration. In the twenty-first century and beyond, human-mediated climate change

looms as a major threat to global biodiversity and ecosystem function. A critical aspect in planning trophic rewilding projects is the selection of suitable sites that match the needs of the focal species under both current and future climates. Species distribution models (SDMs) are currently the main tools to derive spatially explicit predictions of environmental suitability for species, but the extent of their adoption for trophic rewilding projects has been limited. Here, we provide an overview of applications of SDMs to trophic rewilding projects, outline methodological choices and issues, and provide a synthesis and outlook. We then predict the potential distribution of 17 large-bodied taxa proposed as trophic rewilding candidates and which represent different continents and habitats. We identified widespread climatic suitability for these species in the discussed (re)introduction regions under current climates. Climatic conditions generally remain suitable in the future, although some species will experience reduced suitability in parts of these regions. We conclude that climate change is not a major barrier to trophic rewilding as currently discussed in the literature. © 2018 The Authors.

D. Jebb & M. Hiller

Recurrent loss of HMGCS2 shows that ketogenesis is not essential for the evolution of large mammalian brains

eLife 7 (2018) e38906

Abstract. Apart from glucose, fatty acid-derived ketone bodies provide metabolic energy for the brain during fasting and neonatal development. We investigated the evolution of *HMGCS2*, the key enzyme required for ketone body biosynthesis (ketogenesis). Unexpectedly, we found that three mammalian lineages, comprising cetaceans (dolphins and whales), elephants and mastodons, and Old World fruit bats have lost this gene. Remarkably, many of these species have exceptionally large brains and signs of intelligent behavior. While fruit bats are sensitive to starvation, cetaceans and elephants can still withstand periods of fasting. This suggests that alternative strategies to fuel large brains during fasting evolved repeatedly and reveals flexibility in mammalian energy metabolism. Furthermore, we show that *HMGCS2* loss preceded brain size

expansion in toothed whales and elephants. Thus, while ketogenesis was likely important for brain size expansion in modern humans, ketogenesis is not a universal precondition for the evolution of large mammalian brains.

Yuan Jin & Hui Fan

Land use/land cover change and its impacts on protected areas in Mengla County, Xishuangbanna, Southwest China

Environmental Monitoring and Assessment 190 (2018) e509

Abstract. Land use/land cover change (LUCC) in tropical areas threatens biodiversity and protected area integrity and then affects global ecosystem functions and services. In this study, the spatiotemporal patterns and processes of LUCC in Mengla County, Xishuangbanna, which is located on the northern edge of tropical Asia, were examined using a modified post-classification change detection technique based on random forest classifiers and Landsat images acquired at a 5-year time interval (e.g., 1994, 1999, 2004, 2009, and 2014) from 1994 to 2014, with a special focus on protected areas and their surroundings. The overall accuracies of land use/land cover classification reached 90.13–97.90%, with kappa coefficients of 0.84–0.96. Massive but decelerating conversion from forests to artificial plantations has occurred in recent decades. From 1994 to 2014, the area of plantations increased by 1833.85 km², whereas that of forests decreased by 1942.67 km². The expanded areas of artificial plantations decreased from 158.41 km² per year in 1994–1999 to 59.70 km² per year in 2009–2014. More considerable transformation from forests to artificial plantations occurred in lowland areas with elevations below 1000 m and at the edges of National Nature Reserves, which observed a forest loss rate of greater than 40% between 1994 and 2014. This poses serious challenges for sustaining both protected areas and surrounding human communities and to solve the increasingly escalating human–elephant conflicts. The complex food, biodiversity, and land use nexus in this region remain to be untangled in future study. © 2018 Reprinted by permission from Springer Nature.

A.M. Jukar, S.K. Lyons & M.D. Uhen

A cranial correlate of body mass in proboscideans

Zoological Journal of the Linnean Society 184 (2018) 919–931

Abstract. Allometric scaling relationships are often used to estimate the body mass (BM) of extinct mammalian taxa. For proboscideans, shoulder height or limb bone dimensions have typically been used to estimate BM. However, these skeletal correlates are only useful when a complete forelimb is available, or when limb elements can be identified to the species level. Several taxa are known or can be identified from cranial remains alone, which poses a problem for BM estimation. Here, we develop allometric equations to predict the total length and the minimum circumference of the humerus or femur of derived proboscideans from the breadth of the occipital condyles. These predicted measurements are then used to estimate body size from existing equations derived from regressions on limb bones. We developed equations using a combined sample of both extinct and extant proboscidean taxa. Equations for specific families were derived when possible. We find that occipital condyle breadth is a robust predictor of limb bone dimensions. Estimated BM values from predicted limb measurements were a good match to actual BM, and estimates from actual limb measurements. Our method will allow researchers to study BM evolution in proboscideans using a greater range of specimens. © 2018 The Linnean Society of London.

T. Kalam, H.K. Baishya & D. Smith

Lethal fence electrocution: A major threat to Asian elephants in Assam, India

Tropical Conservation Science 11 (2018) 1–8

Abstract. India has the largest population of Asian elephants (*Elephas maximus*) worldwide. Habitat fragmentation and loss of habitat have diminished food resources, and wild elephants have resorted to raiding crops grown within or adjacent to their home range. Elephants are often deliberately electrocuted for foraging into human-used areas, and this is a key reason for elephant mortalities in India. We collated data on elephant mortalities for a 13-year period (2003–2016) from the Forest Department records. We

conducted surveys across Sonitpur District (East and West Forest Division), Assam, where electric fences are installed and documented their location, properties, and elephant presence. Overall, 138 elephants died between 2003 and 2016 due to retaliation, electrocution, accidental or natural death, and unknown reasons. We recorded 47 electric fences (27 lethal and 20 nonlethal) of which 49% were situated within notified forest boundaries. Most lethal fences (63%) protected agriculture fields and were seasonal installations, whereas nonlethal fences protected settlements and forest edges (25% each) and were permanent. Individuals controlled 52% of all lethal fences, while nonlethal fences were primarily controlled by the communities (50%). Most lethal fences (83%) were less than 1 km, whereas 80% of nonlethal fences were over 1 km. Elephant presence was seasonal in 56% of lethal fence locations and year-round in 85% of nonlethal fence locations. We postulate habitat loss and encroachment as two key drivers of fence installations. We recommend rehabilitation of encroachers, monitoring of areas where electricity is tapped illegally, sensitization of local communities, and involving multiple stakeholders to help reduce elephant mortalities because of electrocution. © 2018 The Authors.

K. Karenina & A. Giljov

Mother and offspring lateralized social behavior across mammalian species

Progress in Brain Research 238 (2018) 115-141

Abstract. Findings on nonprimate mammals place the issue of mother–infant lateralized relations in a broader context, demonstrating that humans are one of many species showing this feature. The remarkable interspecies consistency in the direction of lateralization points to a continuity between lateralized mother–infant interactions in primates and nonprimate mammals and suggests ancient evolutionary roots of human cradling bias. The results from species which, in contrast to primates, have no direct involvement of forelimbs in mother–infant spatial interactions clearly support the perceptual origin of this type of lateralization. A right hemisphere advantage for social functions relevant to mother–infant interactions is the most probable background for the left-sided biases in the behavior of

mothers and infants. Recent findings suggest the contribution of lateralized mother–infant interactions to biological fitness. Mother and infant both can gain advantage from keeping the other on the left side. © 2018 Elsevier.

N. Kido, S. Tanaka, T. Omiya, Y. Shoji, M. Senzaki, S. Hanzawa, M. Ando, T. Osaki, H. Hatai, N. Miyoshi, T. Hifumi, N. Suzuki & S. Kawakami
Novel treatment for chronic pododermatitis in an Indian elephant (*Elephas maximus indicus*) with Mohs' paste

Journal of Veterinary Medical Science 80 (2018) 1834-1838

Abstract. Asian and African elephants are frequently afflicted by foot disorders that can be very challenging to manage even with aggressive therapy. Such conditions may have indirect life-threatening effects. Mohs' paste (zinc chloride based escharotic agent) was used to treat a female Indian elephant (*Elephas maximus indicus*) aged 39 years with foot disorder at Kanazawa Zoological Gardens. Degenerated hyperplastic tissue was observed inside the hoofs of digits 2 and 5. Mohs' paste was applied on the lesions, which coagulated the hyperplastic tissue and restrained its proliferation. Subsequently, the hyperplastic tissue could be trimmed with little pain, and the disorder became manageable. Mohs' paste treatment was effective and is expected to be an alternative treatment for hoof disorder. © 2018 Japanese Society of Veterinary Science.

J.C. Kishbaugh, M.T. Valitutto, J.E. Ober, D.M. Zimmerman, L.L. Howard, D.L. Schmitt, C.R. Sanchez & S. Murray

Do lyophilized platelets hold promise for treatment of hemorrhagic diseases in wild animals?

Journal of the American Veterinary Medical Association 252 (2018) 168-170

Abstract. none.

V. Kochakul, K. Boonsri, S. Tiwananthagorn, C. Somgird, C. Thitaram & K. Pringproa

Development of in situ hybridization for detection of elephant endotheliotropic herpesvirus in Asian elephants

Journal of Veterinary Diagnostic Investigation 30 (2018) 628-632

Abstract. Elephant endotheliotropic herpesvirus (EEHV) is one of the most important viral infectious diseases affecting the elephant population worldwide, especially juveniles and young adults. We developed a chromogenic in situ hybridization (ISH) test for detection of EEHV in Asian elephants (*Elephas maximus*). Digoxigenin (DIG) DNA probes from the polymerase and terminase genes of EEHV were synthesized using a PCR DIG-labeling method, and detection of hybridized probe to target EEHV DNA was carried out by anti-DIG immunolabeling. Distribution of EEHV-1A and EEHV-4 genomes was found to be prominent in mononuclear phagocytic cells of spleen and endothelial cells of visceral organs. ISH enables the detection of EEHV infection and has applications in understanding pathogenesis of EEHV in Asian elephants. © 2018 The Authors.

W. Kriangwanich, K. Nganvongpanit, K. Buddhachat, J.L. Brown, P. Siengdee, S. Chomdej, P. Bansiddhi & C. Thitaram

Genetic diversity and variation in captive Asian elephants (*Elephas maximus*) in Thailand

Tropical Conservation Science 11 (2018) 1-10

Abstract. Numbers of wild Asian elephants (*Elephas maximus*) have been decreasing gradually throughout Asia due primarily to human activities, such as poaching, and habitat encroachment and destruction that lead to human–elephant conflict. Sustainability problems exist in captive populations as well, where morbidity and mortality rates are high and reproduction is low. Determining the genetic diversity of these populations is essential for conservation and sustainable utilization efforts. Intersimple sequence repeat markers were used to assess the genetic variation and differentiation in 97 captive Asian elephants from seven elephant camps in Chiang Mai, Thailand. The nine primers chosen for the analysis revealed 88 bands in male and 115 bands in female elephants, of which 37 (42.05%) and 83 (63.64%) were polymorphic, respectively. Shannon's index information ($I = 2.415 \pm 0.054$) and expected heterozygosity ($H_e = 0.892 \pm 0.008$) indicated high species-level genetic diversity. The fixation index (F_{st}) was -0.130 ± 0.016 , demonstrating there was no genetic subdivision

between populations. A cluster analysis was performed using Unweight Pair-Group Method with Arithmetic Mean and dendrograms, which illustrated genetic relationships among captive Asian elephants that included 2 main clusters across the seven camps and 27 clusters for the 97 individual elephants. This high variability may be due to the different origins of these individuals, including originating from other Asian countries. Thus, this study showed that intersimple sequence repeat marker analysis was effective in demonstrating high genetic diversity among captive Asian elephants in Chiang Mai province and found cluster differences that could be used to guide breeding management to decrease the risk of inbreeding among Asian elephant groups. © 2018 The Authors.

M.A. Kumar, S. Vijayakrishnan & M. Singh
Whose habitat is it anyway? Role of natural and anthropogenic habitats in conservation of charismatic species

Tropical Conservation Science 11 (2018) 1-5

Abstract. Developmental activities have been one of the major drivers of conversion of natural forest areas into mosaics of forest fragments, agriculture, and plantations, threatening the existence of wildlife species in such altered landscapes. Most conservation research and actions are protected area centric and seldom addresses the importance of landscape matrices around these protected areas in providing habitats to a wide range of species. In this article, we bring out the crucial role of natural and anthropogenic habitats for the existence of three charismatic species, namely, Asian elephants, leopard, and lion-tailed macaques. The larger public perception of where the animals should be and where the animals actually are is also discussed. We emphasize that, while habitat generalists often adapt behaviorally and ecologically to modified landscapes, habitat specialists, such as the lion-tailed macaques could find survival harder, with increasing anthropogenic pressures and loss of their habitats. © 2018 The Authors.

S.P.S. Kushwaha, S. Nandy, M.A. Shah, R. Agarwal & S. Mukhopadhyay
Forest cover monitoring and prediction in a Lesser Himalayan elephant landscape

Current Science 115 (2018) 510-516

Abstract. We have monitored the forest cover depletion in parts of Assam and Arunachal Pradesh over an area of 42,375 km² in an elephant landscape falling in the Lesser Himalaya, North East India and report the results here. The US Army topographic maps (1924) and multi-date satellite images (1975, 1990, 2000 and 2009) were visually interpreted on-screen for post-classification comparison and forest cover change detection. The exercise showed continuous high loss of forest cover during the study period. A land area having 17,846.27 km² forest in 1924 was depleted to 12,514.56 km² by 1975, 11,861.75 km² by 1990, 10,808.92 km² by 2000 and 10,256.58 km² by 2009, thereby indicating a constant decrease in forest cover by 12.59%, 1.54%, 2.48% and 1.31% respectively. The total loss in forest cover was estimated to be about 7590 km² from 1924 to 2009. The Cellular Automata Markov Model has predicted a further likely decrease of 9007.14 km² by 2028. In general, more districts of Assam than Arunachal Pradesh and more plains than hills faced deforestation. We have identified increasing human population and subsequent demand on the land for cultivation as major reasons for forest cover depletion.

S. Kusza, F. Suchentrunk, H. Pucher, K.U Mar & F.E. Zachos

High levels of mitochondrial genetic diversity in Asian elephants (*Elephas maximus*) from Myanmar

HYSTRIX the Italian Journal of Mammalogy 29 (2018) 152-154

Abstract. We analysed mtDNA control region sequences and 11 microsatellites in 78 Asian working elephants (*Elephas maximus*) from two camps in Myanmar (ca. 60 km apart), which holds the second largest elephant population in Asia. We found limited heterozygosity (overall H_o and H_e of 0.55 and 0.59) but high mtDNA diversity (overall haplotype and nucleotide diversities of 0.89 and 0.011, respectively) due to the presence of both mitochondrial lineages (α and β) known for Asian elephants. The fact that 13 of the 23 haplotypes found in this study were novel emphasises the importance of Myanmar for the conservation of this endangered species. Both markers support the occurrence

of a single panmictic population in the region. Demographic tests produced some indication of a recent bottleneck in the microsatellite dataset, but the mtDNA sequences did not show either a signature of past expansion or bottlenecks. © 2018 Associazione Teriologica Italiana.

M. Lahdenperä, K.U. Mar, A. Courtiol & V. Lummaa

Differences in age-specific mortality between wild-caught and captive-born Asian elephants

Nature Communications 9 (2018) e3023

Abstract. Wild-capture of numerous species is common for diverse purposes, including medical experiments, conservation, veterinary interventions and research, but little objective data exists on its consequences. We use exceptional demographic records on Asian elephants from timber camps in Myanmar to investigate the long-term consequences of wild-capture during 1951–2000 on their mortality (N=5150). We show that captured elephants have increased mortality compared to captive-born elephants, regardless of their capture method. These detrimental effects of capture are similar for both sexes but differ substantially according to age. Elephants captured and tamed at older ages show a higher increase in mortality after capture than elephants captured and tamed young. Moreover, the increased mortality risk following capture and taming is still perceived several years after capture. Our results are timely given the continued capture of elephants and other wild animals to supplement captive populations despite the alarming declines of wild populations globally. © 2018 The Authors.

Nicolas Lainé

Asian elephant conservation: Too elephantocentric? Towards a biocultural approach of conservation

Asian Bioethics Review 10 (2018) 279-293

Abstract. Drawing from the example of Asian elephant (*Elephas maximus*) conservation in Laos, this article primarily intends to reveal the elephantocentric vision adopted by mainstream conservation project in direction to the species. In the second part, I will present some ethnographic notes collected among local population who daily live and work with pachyderms. These

notes will help in opening up a broader and more ecocentric approach of elephant conservation by highlighting links between biological and cultural diversity. By revealing the cosmological view of elephants as thought locally, I will then propose an enlarged vision of elephant conservation. © 2018 Reprinted by permission from National University of Singapore and Springer Nature.

P. Laricchiuta, V. Russo, A. Costagliola, G. Piegari, M. Capasso, P. Silvestre, M. Martano & O. Paciello

Histological and immunohistochemical characterisation of uterine adenocarcinoma in an Asian elephant (*Elephas maximus*)

Folia Morphologica 77 (2018) 771-774

Abstract. A 56-year-old nulliparous female Asian elephant (*Elephas maximus*) living at the zoological garden of Naples (Italy), with a clinical history of recurrent colic, was found in agonal state and humane euthanasia was elected. At necropsy the uterine body was moderately increased in size and the lumen was reduced due to a poorly demarcated and infiltrative neoplasm. Furthermore, multiple, whitish, firm nodules were present in both lungs. Histological examination of the uterine mass revealed epithelial cells arranged in tubular or solid pattern infiltrating the endometrium and the muscular layer. Immunohistochemical examination showed immunoreactivity of neoplastic cells to oestrogen receptors antibody. Pulmonary lesions were histologically and immunohistochemically superimposable to the epithelial uterine neoplasm. A definitive diagnosis of uterine adenocarcinoma with pulmonary metastases was made. © 2018 Via Medica.

W. Li, P. Liu, X. Guo, L. Wang, Q. Wang, Y. Yu, Y. Dai, L. Li & L. Zhang

Human-elephant conflict in Xishuangbanna Prefecture, China: Distribution, diffusion, and mitigation

Global Ecology and Conserv. 16 (2018) e462

Abstract. The conflict between humans and wild animals is a special type of phenomena between human development and wild animal conservation, not only leading to massive economic loss to local residents, but also

imposing severe impacts upon the production and living activities and even personal safety of the residents. Human-elephant conflict has existed as a phenomenon of human settlement development for more than 20 years in Xishuangbanna, China. There are periodic incidents of wild elephants hurting/killing people as well as feeding on and destroying subsistence and cash crops. It is an increasingly urgent and important issue for China to resolve while protecting and managing Asian elephants. Our study employed an Ecological-Niche Factor Analysis model to perform a risk assessment of areas where the Asian elephant currently is distributed and to predict future risks. It employed a Circuit Theory model based on random walk theory to predict multiple potential movement or migration pathways of Asian elephants within Xishuangbanna. The results indicated that: (1) the regions with human-elephant conflict risk in Xishuangbanna Prefecture had an area of about 4349.08 km², accounting for 22.77% of the total prefecture area, with the risk regions primarily present in the middle and north parts of Menghai County and Jinghong City and in Mengla County in which there was a wide geographical distribution covering from the south to the north; (2) The regions of agriculture and garden that were close to Asian elephant distribution and roads were likely occurring risk; (3) There were more potential movement paths of elephants within Mengyang and Menghai distribution regions, which indicated that the connection of these areas was better. While the potential movement paths of elephants within Mengla and Shangyong were little; (4) There were some potential movement paths between different distribution areas of Asian elephant, but the migration possibility of elephants in different distribution areas was decreasing due to natural barriers (Mengyang-Menghai has Lancang river) and discontinuous potential paths between Mengla and Shangyong. Additionally, we discussed that created ecological corridors between different natural reserves to allow more dispersal and gene flow of elephants and diminish conflict between human and elephant. We also put forward compensation suggestions in different risk area. We hope our analytical methods can be applied, improved and expanded to other areas with similar wildlife

damage. © 2018 The Authors. Reprinted with permission from Elsevier.

I. Lueders, C. Niemuller, H.W. Steinmetz, T. Bouts, C. Gray, T. Knauf-Witzens, K. Taya, G. Watanabe, Y. Yamamoto & A.-K. Oerke

Prolonged luteal lifespan and pseudopregnancy in Asian elephants (*Elephas maximus*)

Animal Reproduction Science 197 (2018) 58-66

Abstract. Pseudopregnancy is a physiological occurrence in mammals which have copulation induced ovulation, but is rarely described in spontaneous ovulating species. In this study, three cases of prolonged luteal lifespan are reported in non-pregnant Asian elephants (*Elephas maximus*). Case 1 was a 25-year-old female that had produced three calves previously; Case 2 was a nulliparous and 32-year-old at the start of the pseudopregnancy episode; and Case 3 occurred in a 49-year-old nulliparous elephant. Serum progesterone metabolite concentrations remained elevated for 10 months in Case 1. Urinary progestagens were high for >16 months in Case 2 and for five months in Case 3. In Case 1, multiple persistent corpora lutea were visualized monthly by ultrasonography. In all three cases, uterine leiomyoma were present and progestagen concentrations decreased spontaneously. In Case 1, the elephant became pregnant 3 years later, whilst with Case 2, the female resumed estrous cycling normally, and for the Case 3 female, there was continuation with another prolonged luteal phase before ovarian function was purposely suppressed. These examples indicate that persistently elevated progestagen concentrations may not always be indicative of pregnancy in elephants. The reasons for prolonged luteal lifespan are not understood, although serum prolactin concentrations quantified in the Case 1 female were elevated compared to values from previous reports and two other herd mates. Furthermore, all three elephants had varying degrees of uterine pathologies. It is believed that the resulting damage to the endometrium may have led to a reaction similar to implantation, which includes prolactin secretion. Prolactin may exert luteotropic properties and is thought to initiate luteal rescue during pregnancy in elephants. © 2018 Reprinted with permission from Elsevier.

K.R. McConkey, A. Nathalang, W.Y. Brockelman, C. Saralamba, J. Santon, U. Matmoon, R. Somnuk & K. Srinoppawan

Different megafauna vary in their seed dispersal effectiveness of the megafaunal fruit *Platymitra macrocarpa* (Annonaceae)

PLoS ONE 13 (2018) e0198960

Abstract. The world's largest terrestrial animals (megafauna) can play profound roles in seed dispersal. Yet, the term 'megafauna' is often used to encompass a diverse range of body sizes and physiologies of, primarily, herbivorous animals. To determine the extent to which these animals varied in their seed dispersal effectiveness (SDE), we compared the contribution of different megafauna for the large-fruited *Platymitra macrocarpa* (Annonaceae), in a tropical evergreen forest in Thailand. We quantified 'seed dispersal effectiveness' by measuring the quantity and quality contributions of all consumers of *P. macrocarpa* fruit. Seed dispersal quantity was the proportion of the crop consumed by each species. Quality was defined as the proportion of seeds handled by each animal taxon that survived to produce a 2-month seedling. Megafauna (elephants, sambar deer, bears) dispersed 78% of seeds that produced seedlings, with 21% dispersed by gibbons (a medium-sized frugivore). The main megafaunal consumers displayed different dispersal strategies. Elephants were the most effective dispersers (37% of seedlings) and they achieved this by being high-quality and low-quantity dispersers. Bears displayed a similar strategy but were especially rare visitors to the trees (24% of the total seedlings produced). Sambar were high-quantity dispersers, but most seeds they handled did not survive and they were responsible for only 17% of seedlings. Gibbons displayed a high SDE relative to their body size, but they probably cannot match the role of elephants despite being more regular consumers of the fruit. The low density and poor regeneration of *P. macrocarpa* in the study site suggest that current dispersal rates by megafauna are insufficient, possibly reflecting reduced or missing megafauna populations. We show that different megafaunal species disperse seeds in different ways and may make unique contributions to the reproductive success of the plant species. © 2018 The Authors.

L.J. Miller, J.F. Luebke & J. Matiasek

Viewing African and Asian elephants at accredited zoological institutions: Conservation intent and perceptions of animal welfare
Zoo Biology 37 (2018) 466-477

Abstract. African and Asian elephants are popular within zoos, however there is currently limited information on how viewing them impacts zoo visitors. The goal of the current study was to examine the relationship between viewing elephants in zoos accredited by the Association of Zoos and Aquariums and zoo visitors' reported conservation intent and perceptions of animal welfare. Visitors were systematically selected to fill out questionnaires following elephant observation at nine facilities throughout North America. Questions included information on conservation predispositions, exhibit experience, exhibit perceptions, animal welfare perceptions, emotional experience, learning outcomes, conservation intent, and demographics. Results suggest that observing elephants engaged in a variety of species - typical behaviors and having an up - close experience was significantly correlated to visitors having a positive emotional response. The positive emotional response, combined with visitor conservation predisposition had a significant positive relationship with reported interest in getting involved in conservation. Perceptions of animal welfare were significantly related to a positive emotional experience driven by seeing animals engaged in a variety of active species - typical behaviors as well as exhibit perceptions and whether or not visitors thought it was important to have elephants in zoos. Exhibit perception was primarily correlated with exhibit size. The results provide factors that could help to increase visitor interest in conservation as well as the potential impact of viewing elephants in an accredited zoo. Facilities can use this information to help ensure their visitors have similar type experiences in order to inspire visitors' interest in conservation as well as positive perceptions of animal welfare. © 2018 Wiley Periodicals, Inc.

M.A. Miller, M. Finnegan, T. Storms, M. Garner & K.P. Lyashchenko

Outbreak of *Mycobacterium tuberculosis* in a herd of captive Asian elephants (*Elephas maximus*): Antemortem diagnosis, treatment,

and lessons learned

Journal of Zoo and Wildlife Medicine 49 (2018) 748-754

Abstract. Tuberculosis (TB) was diagnosed in four Asian elephants (*Elephas maximus*) in a zoo in the United States. The first case was detected by isolation of *Mycobacterium tuberculosis* during routine trunk wash (TW) culture testing of a herd of eight elephants. Retrospective antibody analyses revealed seroconversion 1 yr before diagnosis. Serological testing of the whole elephant herd identified two additional suspect bulls with detectable antibody, but which remained culture-negative and had no clinical signs of disease. In the following months, *M. tuberculosis*, identical to the isolate from the index case, was isolated from TW samples of these two elephants. A fourth elephant seroconverted nearly 4 yr after the first TB case was detected, and *M. tuberculosis* was isolated from a TW sample collected 1 mo later. All four infected elephants received anti-TB therapy. Two treated elephants were eventually euthanized for reasons unrelated to *M. tuberculosis* and found to be culture-negative on necropsy, although one of them had PCR-positive lung lesions. One infected animal had to be euthanized due to development of a drug-resistant strain of *M. tuberculosis*; this animal did not undergo postmortem examination due to risk of staff exposure. The fourth animal is currently on treatment. Serial serological and culture results of the other four herd mates have remained negative. © 2018 American Association of Zoo Veterinarians.

T. Norkaew, J.L. Brown, P. Bansiddhi, C. Songird, C. Thitaram, V. Punyapornwithaya, K. Punturee, P. Vongchan, N. Somboon & J. Khonmee

Body condition and adrenal glucocorticoid activity affects metabolic marker and lipid profiles in captive female elephants in Thailand
PLoS ONE 13 (2018) e0204965

Abstract. Studies in western zoo elephants have found relationships between body condition and physiological function, and identified mitigating management strategies to optimize health and welfare. A similar methodological approach was used in this study, which evaluated a body condition score (BCS; 1 = thinnest, 5 = fattest)

every other month and fecal glucocorticoid metabolite (FGM) concentrations twice monthly in 33 tourist camp elephants in Thailand for a 1-year period to assess seasonal variations, and determine how lipid profiles [total cholesterol (TC), low density lipoproteins (LDL), high density lipoproteins (HDL), triglycerides (TG)] and metabolic parameters [insulin, glucose, fructosamine, glucose to insulin ratio (G:I)] related to measures of body condition and adrenal function. The most prevalent BCS was 3–3.5 (60.6%), with 27.3% at BCS = 4 (overweight) and 12.1% at BCS = 4.5–5 (very overweight); no elephants had a BCS <2. BCSs were higher in rainy and winter seasons compared to summer, with FGM, TG, HDL, LDL, and insulin also higher in the rainy and/or winter seasons ($p < 0.05$). By contrast, TC and glucose were lowest in the rainy season. FGM measures were negatively associated with two environmental factors: temperature and rainfall, but not humidity. Positive correlations were found between BCS and TC, LDL, and HDL, and between FGM and TC, HDL, glucose, and insulin ($p < 0.05$), whereas BCS and FGM were both negatively associated with the G:I ($p < 0.05$). However, there was no relationship between BCS and FGM among the camp elephants. Using BCS and FGM measures as outcome variables in separate regression models, this study found high BCS and elevated FGM concentrations were associated with altered lipid profiles and metabolic status in elephants. Furthermore, more work hours/day was associated with better body condition and health measures. Thus, being overweight and exposed to factors that increase adrenal activity could adversely affect health status, requiring alterations in management for some individuals, whereas exercise appears to have a protective effect.

E. Palkopoulou, M. Lipson, S. Mallick, S. Nielsen, N. Rohland, S. Baleka, E. Karpinski, A.M. Ivancevic, T.-H. To, R.D. Kortschak, J.M. Raison, Z. Qu, T.-J. Chin, K.W. Alt, S. Claesson, L. Dalén, R.D.E. MacPhee, H. Meller, A.L. Roca, O.A. Ryder, D. Heiman, S. Young, M. Breen, C. Williams, B.L. Aken, M. Ruffier, E. Karlsson, J. Johnson, F. Di Palma, J. Alföldi, D.L. Adelson, T. Mailund, K. Munch, K. Lindblad-Toh, M.

Hofreiter, H. Poinar & D. Reich

A comprehensive genomic history of extinct and living elephants

PNAS 115 (2018) E2566-E2574

Abstract. Elephantids are the world's most iconic megafaunal family, yet there is no comprehensive genomic assessment of their relationships. We report a total of 14 genomes, including 2 from the American mastodon, which is an extinct elephantid relative, and 12 spanning all three extant and three extinct elephantid species including an ~120,000-y-old straight-tusked elephant, a Columbian mammoth, and woolly mammoths. Earlier genetic studies modeled elephantid evolution via simple bifurcating trees, but here we show that interspecies hybridization has been a recurrent feature of elephantid evolution. We found that the genetic makeup of the straight-tusked elephant, previously placed as a sister group to African forest elephants based on lower coverage data, in fact comprises three major components. Most of the straight-tusked elephant's ancestry derives from a lineage related to the ancestor of African elephants while its remaining ancestry consists of a large contribution from a lineage related to forest elephants and another related to mammoths. Columbian and woolly mammoths also showed evidence of interbreeding, likely following a latitudinal cline across North America. While hybridization events have shaped elephantid history in profound ways, isolation also appears to have played an important role. Our data reveal nearly complete isolation between the ancestors of the African forest and savanna elephants for ~500,000 y, providing compelling justification for the conservation of forest and savanna



Elephants in Minneriya National Park (Sri Lanka)

elephants as separate species. © 2018 The Authors.

I.N. Pathirana, C. Rajapaksa, N. Kawate, A. Wimalarathne, L. Fonseka, P.N. Weerakoon, M.A. Hannan, B. Alexander, A. Pushpakumara, S. Ariyaratne & H. Tamada

Effects of gonadotropin-releasing hormone antagonist degarelix on musth and serum testosterone concentrations in Asian elephants (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 49 (2018) 779-783

Abstract. Two male Asian elephants (bulls 1 and 2) in musth were subcutaneously injected with a long-acting gonadotropin-releasing hormone (GnRH) antagonist, degarelix acetate (240 µg/kg; total dose of 960 mg). Musth behavior (MB) and temporal gland secretions (TGS) were monitored and serum testosterone concentrations were determined. In bull 1, MB and TGS ceased on day 1 and reappeared 5.5 mo after the treatment (day 0). During the subsequent musth cycle, MB and TGS ceased on day 1 and did not appear for 4 mo. In bull 2, MB and TGS ceased at day 7 after the treatment. Musth behavior and TGS recurred on Day 11 and continued for 1 wk, then disappeared for 8 mo. Serum testosterone concentrations decreased ($P < 0.05$) in all occasions from day 0 (29.8 ± 15.8 ng/ml; mean \pm SEM) to day 1 (2.2 ± 1.1 ng/ml), suggesting a sudden drop in circulating testosterone in musth elephants after the GnRH-antagonist treatment. © 2018 American Association of Zoo Veterinarians.

S. Paudel, S.K. Mikota, J. Thapa, K.P. Lyashchenko, K.P. Gairhe, I.P. Dhakal, N. Subedi, B. Maharjan, S. Subedi, G.E. Kaufman & T. Tsubota

Serodiagnosis of elephant tuberculosis: A useful tool for early identification of infected elephants at the captive-wild interface

European Journal of Wildlife Research 64 (2018) e70

Abstract. Tuberculosis (TB) is an emerging disease in elephants primarily caused by *Mycobacterium tuberculosis* (*M. tb*) and in some occasions by *M. bovis*. We performed culture and three serological tests—the Elephant TB STAT-PAK,[®] DPP VetTB[®] Assay, and MAPIA (multi-antigen print immunoassay)—prospectively

on samples from eight elephants in Nepal that died of suspected or confirmed tuberculosis (TB) between 2007 and 2013. Among them, all elephants were reactive to DPP VetTB[®] Assay, five to Elephant TB STAT-PAK,[®] and two were reactive to MAPIA. Similarly, six elephants were positive on culture on samples collected antemortem or postmortem. We observed antibody responses months to years before culture confirmation of TB which shows that serological tests can be highly useful for the early diagnosis of TB in elephants. Validated point-of-care serological tests are easily performed in the field and hold promise for improved TB surveillance in other non-domestic species. © 2018 Reprinted by permission from Springer Nature.

P. Paul, T. Hasan & M.M. Rahman

Medical management of bilateral corneal opacity in an Asian elephant (*Elephas maximus*): A case report

Journal of Advanced Veterinary and Animal Research 5 (2018) 98-100

Abstract. This study was aimed at studying efficacy of medical management of corneal opacity in an Asian elephant (*Elephas maximus*). A 42 years old male Asian elephant was brought to the Teaching Veterinary Hospital (TVH) at Chittagong Veterinary and Animal Sciences University (CVASU) with a history of chronic lacrimation and impaired vision. On clinical examination, the animal was found apparently healthy. Ophthalmological examination tentatively revealed the condition as corneal opacity. The left eye was much more affected as compared to the right one. Medical management was instituted with topical administration of ciprofloxacin, dexamethasone, subconjunctival prednisolone and dexamethasone along with intramuscular ketoprofen (at 1 mg/kg bwt) and vitamin A (at 5000 IU/kg bwt). The “mahout” (elephant caretaker) of the elephant was kept in close contact over cell phone to follow up the progress of the condition. Clinical examination after 19 days revealed complete recovery of the corneal opacity. There was no sign of lacrimation and the animal regained its normal vision. The treatment protocol successfully eliminated the discomfort along with corneal opacity and lacrimation in an Asian elephant.

E.J. Polla, C.C. Grueter & C.L. Smith

Asian elephants (*Elephas maximus*) discriminate between familiar and unfamiliar human visual and olfactory cues

Animal Behavior and Cognition 5 (2018) 279-291

Abstract. Social animals use individual identity cues to form and maintain social relationships with conspecifics. This ability to discriminate between individuals extends to heterospecifics in some social mammals. The aim of this study was to determine if Asian elephants (*Elephas maximus*) could differentiate between familiar and unfamiliar people using visual, auditory, and olfactory cues independently. Two female Asian elephants at the Perth Zoo were tested with stimuli generated from six humans. Video playbacks, auditory playbacks and pieces of worn shirts were used to present familiar and unfamiliar human stimuli to the elephants using a simultaneous two-choice task. Trunk reach duration and trunk reach frequency were used as measures of the elephants' interest in the stimuli. The elephants' trunk reach durations revealed a significant difference between familiar and unfamiliar human stimuli using visual cues alone, with significantly more trunk reaching toward familiar human stimuli. No significant difference in trunk reach duration was seen between familiar and unfamiliar human stimuli for auditory or olfactory cues. Trunk reach frequency revealed a significant difference between familiar and unfamiliar human stimuli for visual and olfactory stimuli, with a greater frequency of trunk reaching towards familiar stimuli for both modes. No significant difference in trunk reach frequency was seen between familiar and unfamiliar human stimuli for auditory cues. This is the first study to use video playbacks with any species of elephant and demonstrates a potential new method for cognitive testing in this species. The results suggest that familiar humans may be important to zoo-housed Asian elephants. © Attribution 3.0 Unported (CC BY 3.0).

Sreejith Radhakrishnan

A note on wildlife poisoning cases from Kerala, South India

European Journal of Wildlife Research 64 (2018) e58

Abstract. Wildlife poisoning is an important conservation threat for endangered species in India. There are no publications in the scientific literature that identify the specific poisons or chemicals involved in wildlife poisoning cases from the state of Kerala. In this report, all cases of wildlife mortality recorded between 2011 and 2013 at the office of the Assistant Forest Veterinary Officer, Periyar Tiger Reserve in Kerala were reviewed and cases where poisoning was considered as a differential diagnosis were identified. Specific poisons or chemicals were identified in three cases, while in a fourth, poisoning was determined to have occurred based on physical traces of the poison in gut contents. The poisons identified include carbofuran (a carbamate pesticide) in a bonnet macaque (*Macaca radiata*), warfarin (a rodenticide) in a mortality event involving four wild boars (*Sus scrofa*), endosulfan (an organochlorine pesticide) toxicity in a gaur (*Bos gaurus*) and imidacloprid (a neonicotinoid pesticide) toxicity in a wild adult Asian elephant (*Elephas maximus*). This communication thus reports for the first time on the specific chemical compounds identified in wildlife poisoning cases from Kerala state and argues for greater regulation of the sale and use of such toxic compounds in India. © 2018 The Author.

C. Schiffmann, M. Clauss, P. Fernando, J. Pastorini, P. Wendler, N. Ertl, S. Hoby & J.-M. Hatt

Body condition scores of European zoo elephants (*Elephas maximus* and *Loxodonta africana*): Status quo and influencing factors

Journal of Zoo and Aquarium Research 6 (2018) 91-103

Abstract. Obesity is a common problem in captive elephants. Therefore, physical state monitoring presents a critical aspect in preventive elephant healthcare. Some institutions lack the equipment to weigh elephants regularly, so body condition scoring (BCS) is a valuable alternative tool. As yet, the BCS of both elephant species has not been assessed comprehensively for the European captive population. Using a previously validated visual BCS protocol, we assessed 192 African (*Loxodonta africana*) and 326 Asian elephants (*Elephas maximus*) living in European

zoos (97% of the living European elephant population). The majority of elephants scored in the upper categories with 56% of adults assessed in the range 7–10 out of 10. Adult Asian elephants had significantly lower BCS (males: mean 6.2 ± 1.0 , median 6.0, range 4–8; females: mean 6.6 ± 1.3 , median 6.0, range 3–9) than African elephants (males: mean 6.7 ± 0.7 , median 6.0, range 6–8; females: mean 6.9 ± 1.2 , median 6.0, range 1–9). Comparison with samples of free-ranging populations (163 Asian elephants and 121 African elephants) revealed significantly lower scores in free-ranging elephants independent of species, age and sex category. Compared to previous reports from captive populations, the European zoo elephant population is nevertheless less obese. In adult Asian elephant females, BCS was significantly correlated to their breeding status with lower scores in current breeders; however, breeding status was also correlated to group size, enclosure size, and a diet with less vegetables. Further attention to zoo elephant weight management is recommended with regular longitudinal monitoring by body condition scoring. © 2018 The Authors.

R.W. Sites, P. Lago & G.A. Gale
Associations of scarab beetles (Insecta: Coleoptera: Scarabaeidae) with dung of four species of mammals in Khao Yai National Park, Thailand

Raffles Bulletin of Zoology 66 (2018) 87-95

Abstract. To determine if dung from various species of native mammals are attractive to species of Scarabaeidae differentially in a seasonal evergreen forest in Thailand, we used pitfall traps baited with fresh dung of four species (barking deer, sambar deer, Asian elephant, pigtailed macaque) and an unbaited control. The pitfalls were deployed in Khao Yai National Park for 24 hours in March 2010. All totaled, 9 genera and 23 species of scarab beetles were collected. Of these, *Lobopariis schereri* (Petrovitz) represents a new country record with a known range to the northwest of Thailand. Overall scarab abundance and richness each differed significantly ($p < 0.001$) among bait types. From a multivariate perspective, discriminant function analysis computed four axes to distinguish the community of scarab beetles that was attracted

to each dung type. The pigtailed macaque dung community was significantly different from that of all other baits ($p < 0.001$), whereas overlap existed among the other bait treatments; 83.3% of the pitfalls were re-classified to the correct bait type. Dung of the omnivorous macaques attracted a beetle community that was dramatically distinct from those of the other bait treatments and with the greatest abundance and richness of scarab species, whereas dung of the herbivorous species was far less attractive. This corroborates New World studies that have shown dung from the diet of omnivorous mammals attracts greater numbers and diversity of dung beetles. As such, conservation of omnivorous large animals in tropical forest systems is necessary for the conservation of rich dung beetle communities. © 2018 National University of Singapore. Reproduced with permission from Lee Kong Chian Natural History Museum.

C.D. Sullivan, E.M. Slade, M. Bai, K. Shi & P. Riordan

Evidence of forest restoration success and the conservation value of community-owned forests in Southwest China using dung beetles as indicators

PLoS ONE 13 (2018) e0204764

Abstract. Protection of the world's remaining forests and biodiversity is a matter of global concern. Yunnan, China is home to China's only mainland tropical rainforests, and 20% of China's total biodiversity. Despite restoration measures and establishment of new protected areas, this region is still experiencing biodiversity loss due to inadequate management and monitoring. We evaluate restoration success of China's tropical forests in Xishuangbanna National Nature Reserve (XSBN-NNR), Yunnan, China using dung beetles as an indicator taxon. We sampled across a land-use gradient of human alteration: protected forest, restored forest, community owned forest, and rubber plantation. We collected 3,748 dung beetles from 21 species over a 3 month period. Multivariate analyses revealed unique assemblages in each land-use category, but with restored forest most similar to protected areas, suggesting restoration success in this region. Community forests were more diverse than plantations, suggesting that community

forests may be a valuable and practical conservation tool in this region. Most species were generalists, although some had dietary and habitat preferences. Furthermore, dietary niche breadths were, on average, higher in disturbed areas, suggesting that disturbance may result in dietary changes. We show that restoration of tropical forests appears to be successful for a key ecological and biological indicator group- dung beetles. Furthermore, community-owned forests appear to be valuable and practical method of maintaining ecosystem health and biodiversity in the region. Future management in this region would likely benefit from encouragement to maintain community-owned forests, economic incentives for restoring farmland to forest, and increased environmental monitoring across the land-use gradient. © 2018 The Authors.

N.R. Talukdar, B. Singh & P. Choudhury

Conservation status of some endangered mammals in Barak Valley, Northeast India

Journal of Asia-Pacific Biodiversity 11 (2018) 167-172

Abstract. From the ancient time, the Northeast part of India is rich in biodiversity because of its diverse topographic, climatic features. Different varieties of mammalian, avian, and herpetofauna are endemic to this region. Unfortunately, life of this diverse flora and fauna is in jeopardy due to serious anthropogenic pressure. Once a large number of globally important species sustained in the Barak Valley. However, with the increasing population and subsequent demand on natural resources and developing activities, many of the species are no more found in the valley. If the conservation action is not initiated, the remaining species will also vanish with time. This article highlights the distribution and conservation problems of four endangered species in the Barak Valley of Assam, India and recommended conservation tactics. © 2018 National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA), Publishing Services by Elsevier.

P. Thammarat, C. Kulsing, K. Wongravee, N. Leepipatpiboon & T. Nhujak

Identification of volatile compounds and selection of discriminant markers for ele-

phant dung coffee using static headspace gas chromatography-mass spectrometry and chemometrics

Molecules 23 (2018) e1910

Abstract. Elephant dung coffee (Black Ivory Coffee) is a unique Thai coffee produced from Arabica coffee cherries consumed by Asian elephants and collected from their feces. In this work, elephant dung coffee and controls were analyzed using static headspace gas chromatography hyphenated with mass spectrometry (SHS GC-MS), and chemometric approaches were applied for multivariate analysis and the selection of marker compounds that are characteristic of the coffee. Seventy-eight volatile compounds belonging to 13 chemical classes were tentatively identified, including six alcohols, five aldehydes, one carboxylic acid, three esters, 17 furans, one furanone, 13 ketones, two oxazoles, four phenolic compounds, 14 pyrazines, one pyridine, eight pyrroles and three sulfur-containing compounds. Moreover, four potential discriminant markers of elephant dung coffee, including 3-methyl-1-butanol, 2-methyl-1-butanol, 2-furfurylfuran and 3-penten-2-one were established. The proposed method may be useful for elephant dung coffee authentication and quality control.

A.A.E. van der Geer, G.A. Lyras, P. Mitteroecker & R.D.E. MacPhee

From Jumbo to Dumbo: Cranial shape changes in elephants and hippos during phyletic dwarfing

Evolutionary Biology 45 (2018) 303-317

Abstract. Members of the mammalian families Elephantidae and Hippopotamidae (extant and extinct elephants and hippos) include extinct dwarf species that display up to 98% decrease in body size compared to probable ancestral sources. In addition to differences in body mass, skulls of these species consistently display distinctive morphological changes, including major reduction of pneumatized areas in dwarf elephants and shortened muzzles in dwarf hippos. Here we build on previous studies of island dwarf species by conducting a geometric morphometric analysis of skull morphology and allometry in target taxa, living and extinct, and elaborate on the relation between skull size and body

size. Our analysis indicates that skull size and body size within terrestrial placental mammals scale almost isometrically (PGLS major axis slope 0.906). Furthermore, skull shape in dwarf species differed from both their ancestors and the juveniles of extant species. In insular dwarf hippos, the skull was subject to considerable anatomical reorganisation in response to distinct selection pressures affecting early ontogeny (the “island syndrome”). By contrast, skull shape in adult insular dwarf elephants can be explained well by allometric effects; selection on size may thus have been the main driver of skull shape in dwarf elephants. We suggest that a tightly constrained growth trajectory, without major anatomical reorganization of the skull, allowed for flexible adaptations to changing environments and was one of the factors underlying the evolutionary success of insular dwarf elephants. © 2018 Reprinted by permission from Springer Nature.

J.M. Vazquez, M. Sulak, S. Chigurupati & V.J. Lynch

A zombie LIF gene in elephants is upregulated by TP53 to induce apoptosis in response to DNA damage

Cell Reports 24 (2018) 1765-1776

Abstract. Large-bodied organisms have more cells that can potentially turn cancerous than small-bodied organisms, imposing an increased risk of developing cancer. This expectation predicts a positive correlation between body size and cancer risk; however, there is no correlation between body size and cancer risk across species (“Peto’s paradox”). Here, we show that elephants and their extinct relatives (proboscideans) may have resolved Peto’s paradox in part through refunctionalizing a leukemia inhibitory factor pseudogene (LIF6) with pro-apoptotic functions. LIF6 is transcriptionally upregulated by TP53 in response to DNA damage and translocates to the mitochondria where it induces apoptosis. Phylogenetic analyses of living and extinct proboscidean LIF6 genes indicates that its TP53 response element evolved coincident with the evolution of large body sizes in the proboscidean stem lineage. These results suggest that refunctionalizing of a proapoptotic LIF pseudogene may have been permissive (although

not sufficient) for the evolution of large body sizes in proboscideans. © 2018 The Authors.

S. Vijayakrishnan, M.A. Kumar, G. Umopathy, Vinod Kumar & A. Sinha

Physiological stress responses in wild Asian elephants *Elephas maximus* in a human-dominated landscape in the Western Ghats, southern India

General and Comparative Endocrinology 266 (2018) 150-156

Abstract. Increasing anthropogenic pressures on forests, especially in the tropical regions of the world, have restricted several large mammalian species such as the Asian elephant to fragmented habitats within human-dominated landscapes. In this study, we assessed the effects of an anthropogenic landscape and its associated conflict with humans on the physiological stress responses displayed by Asian elephants in the Anamalai Hills of the Western Ghats mountains in south India. We have quantified faecal glucocorticoid metabolite (FGM) concentrations in focal individual elephants within and across herds, inhabiting both anthropogenic and natural habitats, and evaluated their physiological responses to different socio-ecological situations between November 2013 and April 2014. Physiological stress responses varied significantly among the tested elephant age- and sex categories but not across different types of social organisation. Adults generally showed higher FGM concentrations, even in the absence of stressors, than did any other age category. Males also appeared to have higher stress responses than did females. Although there was no significant variation in mean stress levels between elephants on the plateau in the absence of human interactions and those in adjacent, relatively undisturbed forest habitats, FGM concentrations increased significantly for adult and subadult individuals as well as for calves following drives, during which elephants were driven off aggressively by people. Our study emphasises the general importance of understanding individual variation in physiology and behaviour within a population of a seriously threatened mammalian species, the Asian elephant, and specifically highlights the need for long-term monitoring of the stress physiology and

behavioural responses of individual elephants across both human-dominated and natural landscapes. Such studies would not only provide comprehensive insights into the adaptive biology of elephants in changing ecological regimes but also aid in the development of effective management and conservation strategies for endangered populations of the species. © 2018 Elsevier Inc.

E. Williams, C.L. Chadwick, L. Yon & L. Asher
A review of current indicators of welfare in captive elephants (*Loxodonta africana* and *Elephas maximus*)

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Abstract. Concerns over elephant welfare in UK zoos have implications for their future in captivity. To monitor improvements made to elephant welfare in UK zoos, non-invasive, valid and reliable indicators of welfare are needed. Using a rapid review strategy and critical appraisal tool, we aimed to appraise evidence from peer-reviewed literature on potential welfare indicators for captive elephants. Scopus, Web of Knowledge and Ovid were searched in January 2014 using terms relevant to captive elephants and welfare assessment. Inclusion and exclusion criteria were applied and remaining articles were critically appraised against a specially designed welfare indicator appraisal tool. Thirty-seven unique indicators of welfare were extracted from 30 peer-reviewed papers which met the inclusion criteria. Behavioural measures of welfare (n = 21) were more common than either physical (n = 11) or physiological (n = 5) measures. Stereotypies were the most frequently used behavioural measure, glucocorticoids were the most frequently used physiological measure and body condition scores were the most frequently used physical measure. There was most support for the following indicators of improved welfare state: reduced stereotypies, reduced glucocorticoids and improved body condition scores. Additional measures which require further validation but had strong associations with the most supported measures, and thus have potential use in welfare assessment, were: increased lying rest and positive social interactions. Further validation of the described measures is needed, but this information forms a crucial part of the knowledge

required to efficiently monitor and improve the welfare of elephants in captivity. © 2018 Universities Federation for Animal Welfare.

Z. Yang, Y. Chen, J. Li, L. Wang, Y. Piao, Z. Song & K. Shi

Individual identification and population size assessment for Asian elephant based on camera-trapping techniques

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Abstract. We studied and assessed the minimum population number of Asian elephants (*Elephas maximus*) in Shangyong Sub-Reserve (SYSR), Xishuangbanna National Nature Reserve in Yunnan Province, China using camera-traps. We set up 27 camera-traps in SYSR from January to April 2016, which ran for a total of 621 camera-trap days and obtained 1944 sample photographs. Within this period individual camera units were active for between 9–52 full days (mean = 24). We identified a minimum number of 69 unique individual elephants from photographs (38 adults, 16 sub-adults, 15 calves) in SYSR. We detected 7 Asian elephants that moved actively across the China-Laos border. The advantages and disadvantages of our camera-trap methodology compared with those of other techniques for individual identification is discussed, and we explore the potential for robust methods for fast, real-time and effective population evaluation in the future. This study strengthened our understanding of Asian elephant status in SYSR and provides scientific evidence to support conservation planning and actions. [MAIN TEXT IN CHINESE]

S. Yoshida, S. Suga, S. Ishikawa, Y. Mukai, K. Tsuyuguchi, Y. Inoue, T. Yamamoto, & T. Wada
***Mycobacterium caprae* infection in captive Borneo elephant, Japan**

Emerging Infectious Diseases 24 (2018) 1937-1940

Abstract. In 2016, disseminated tuberculosis caused by *Mycobacterium caprae* was diagnosed in a captive Borneo elephant in Japan. The bacterium was initially identified from clinical isolates. An isolate collected during a relapse showed isoniazid monoresistance and a codon 315 katG mutation.