

Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

Anthropologisches Institut, Universität Zürich, Zürich, Switzerland

Centre for Conservation and Research, Rajagiriya, Sri Lanka

E-mail: jenny@aim.uzh.ch

If you need additional information on any of the articles, please feel free to contact me. You can also let me know about new (2016) publications on Asian elephants.

S. Aini, A.M. Sood & S. Saaban

Analysing elephant habitat parameters using GIS, remote sensing and analytic hierarchy process in Peninsular Malaysia

Pertanika Journals Science & Technology 23 (2015) 37-50

Abstract. Geographic Information System (GIS) and remote sensing are geospatial technologies that have been used for many years in environmental studies, including gathering and analysing of information on the physical parameters of wildlife habitats and modelling of habitat assessments. The home range estimation provided in a GIS environment offers a viable method of quantifying habitat use and facilitating a better understanding of species and habitat relationships. This study used remote sensing, GIS and Analytic Hierarchy Process (AHP) application tools as methods to assess the habitat parameters preference of Asian elephant. Satellite images and topographical maps were used for the environmental and topographical habitat parameter generation encompassing land use-land cover, normalized digital vegetation index, water sources, digital elevation model, slope and aspect. The kernel home range was determined using elephant distribution data from satellite tracking, which were then analysed using habitat parameters to investigate any possible relationship. Subsequently, the frequency of the utilization distribution of elephants was further analysed using spatial and geostatistical analyses. This was followed by the use of AHP for identifying habitat preference, selection of significant habitat parameters and classification of

criterion. The habitats occupied by the elephants showed that the conservation of these animals would require good management practices within and outside of protected areas so as to ensure the level of suitability of the habitat, particularly in translocation areas. © 2015 Universiti Putra Malaysia Press.

N. Angamma, K.B. Ranawana & G. Ellepola Evaluation of damage caused by elephants (*Elephas maximus maximus*) to the woody vegetation in Udawalawe National Park

WildLanka 3 (2015) 20-30

Abstract. Elephants can have profound effects on the structure and composition on woodlands. In this study, the damage caused by elephants to woody plants in the Udawalawe National Park was investigated. The study was carried out in three major habitat types in the Udawalawe National Park, namely grasslands, scrub forests and tall forests. Five plots were established in each habitat. Types of damages caused to the woody plants were categorized in to six main groups viz, crown damage, bark removal, branch damage, pushing down, partially damaged and totally damaged. Plant species, which were highly vulnerable for elephant damages and the areas in which elephant damages are high were identified. These results were used to identify the food preferences of elephants, highly recorded damage types and the area, which they prefer to stay. Based on the intensity of damages the study revealed that, crown damages, branch damages, pushing down and bark removal as highly recorded damage categories in the three habitats. *Bauhinia recemosa*, *Phyllanthus polyphyllus*, *Limonia acidissima* and *Diospyros ovalifolia* were the species that were more susceptible for elephant damages and the grassland habitats were the areas where elephant damages were high.

J.S. Anni & A.K. Sangaiah

Elephant tracking with seismic sensors: A technical perceptive review

Jurnal Teknologi 74 (2015) 193-203

Abstract. This paper presents a systematic literature review of elephant tracking approaches via seismic sensors. Elephant tracking is broadly divided into two categories: technical approach and non-technical approach. Among these two research directions technical approach has proved to be risk-free. It helps accumulation of the life of both human and elephants in the human-elephant conflict scenario. In the technical approach, seismic sensors have been preferred as an effective methodology for elephant tracking as reported in the literature. Seismic scenarios address research gap in the existing methodologies through their efficiency and precision in monitoring elephant movements without causing any harm to them while, at the same time, helping humans to solve their problems and saving environment from hazards. The main contribution of this paper is review of and address to the technical approaches that are employed for elephant tracking using seismic sensors, which also include seismic communication through sensor devices and encourage future research on this topic. © 2015 Penerbit UTM Press.

N. Arya, W. Moonarmart, N. Cheewamongkolnimit, N. Keratikul, S. Poon-iam, A. Routh, P. Bumpenpol & T. Angkawanish

Osteocalcin and bone-specific alkaline phosphatase in Asian elephants (*Elephas maximus*) at different ages

The Veterinary Journal 206 (2015) 239-240

Abstract. Bone turnover markers could offer a potential alternative means for the early diagnosis of metabolic bone disease in young growing elephants although the baseline of bone turnover markers in elephant is not well established. The aim of this study was to determine any relationship between the age of captive Asian elephants and markers of bone formation. Serum samples from 24 female Asian elephants were collected to evaluate levels of two bone formation markers, namely, osteocalcin (OC) and bone-specific alkaline phosphatase (BAP). Both intact and N-terminal midfragment OC and BAP were negatively correlated with age. The findings

demonstrate that younger elephants have a higher rate of bone turnover than older elephants. Use of these and additional bone markers could lead to the establishment of validated protocols for the monitoring of bone disease in elephants. © 2015 Reprinted with permission from Elsevier.

A. Athanassiou, V. Herridge, D.S. Reese, G. Iliopoulos, S. Roussiakis, V. Mitsopoulou, E. Tsiolakis & G. Theodorou

Cranial evidence for the presence of a second endemic elephant species on Cyprus

Quaternary International 379 (2015) 47-57

Abstract. Cyprus, the largest Eastern Mediterranean island, hosted a highly impoverished endemic mammalian fauna during the Pleistocene to early Holocene times. This was a result of its extreme biogeographic isolation since its formation, which prevented the immigration of most terrestrial mammals, except for those with apparent sea channel crossing abilities. The main faunal elements are the extremely dwarfed hippo *Phanourios* minor, commonly found in many sites across the island, and the dwarf elephant *Palaeoloxodon cypriotes*. The latter is a very small-sized elephant species, comparable in size with the Siculo-Maltese *Palaeoloxodon falconeri*. Larger dental specimens found sporadically during the last century, raised the possibility that a second endemic elephant, larger than *P. cypriotes*, may have also existed in Cyprus. Here we describe a skull recently excavated in the coastal area of Xylophágou, SE Cyprus, which provides evidence that, indeed, two elephant species have existed on the island. The larger species, *Palaeoloxodon xylophagou* n. sp., is still strongly dwarfed and characterised by elongated, low and wide skull, diverging tusk alveoli and comparatively large molars. Dimensionally the dentition is distinctly larger than *P. cypriotes* and close to *Palaeoloxodon tiliensis*, though the skull size is intermediate between *P. tiliensis* and *P. falconeri*. Both Cypriot elephant species exhibit morphological affinities with *Palaeoloxodon antiquus*, which is their probable ancestor. Stratigraphic data suggest that *P. xylophagou* is older (late Middle Pleistocene), while *P. cypriotes* is more recent (latest Pleistocene to early Holocene) and may have descended from the former or evolved as a result

of a separate, more recent colonisation event. © 2015 Elsevier Ltd and INQUA.

M.J. Boone, C.N. Davis, L. Klasek, J.F. del Sol, K. Roehm & M.D. Moran

A test of potential Pleistocene mammal seed dispersal in anachronistic fruits using extant ecological and physiological analogs

Southeastern Naturalist 14 (2015) 22-32

Abstract. Using *Elephas maximus* (Asian elephant) and *Equus ferus caballus* (domesticated horse) as ecological analogs to extinct Pleistocene mammals, we tested the effect of gut passage on 3 proposed anachronistic fruits: *Diospyros virginiana* (American persimmon), *Maclura pomifera* (osage orange), and *Asimina triloba* (paw paw). We found that elephant-gut passage of persimmon seeds increased their germination success and decreased their time to sprout, while osage orange seeds showed no benefit to gut passage. Neither American Persimmon nor osage orange seeds survived gut passage through horses. Both mammals refused to consume Paw paw fruits. Assuming a similar physiology and behaviour compared to our modern analogs, we suggest that extinct North American elephant species could have been important seed dispersers for American Persimmons but were unlikely to be effective for osage orange or paw paw, while horses would have been poor dispersers for all plant species tested. © 2015 Eagle Hill Institute.

K. Brantberg, B. Falahat & D.C. Kalthoff

Do extant elephants have superior canal dehiscence syndrome?

Acta Oto-Laryngologica 135 (2015) 1259-1263

Abstract: Conclusion: X-ray CT of an Asian elephant's skull suggests that elephants do not have a labyrinthine 3rd mobile window. This excludes the concept that elephants benefit from enhancement of bone conducted vibration by an extra opening of the labyrinth. This finding does not, however, exclude that elephants use bone conducted hearing for seismic detection, nor that other species may use an extra labyrinthine opening for improved detection of seismic signals. Objectives: In man, a pathologic extra opening of the bony labyrinth causes altered hearing with supranormal bone conduction. Theoretically, this variation in auditory performance could be

advantageous for detection of seismic waves. Method: The skull of an adult Asian elephant was examined by X-ray computed tomography to investigate whether a natural '3rd mobile window' mechanism for enhanced sensitivity of body sounds exist in elephants. Results: Although the entire elephant's skull was otherwise broadly aerated, the labyrinth areas were surrounded by dense bone. © 2015 Informa Healthcare.

J.F. Brodie, A.J. Giordano & L. Ambu

Differential responses of large mammals to logging and edge effects

Mammalian Biology 80 (2015) 7-13

Abstract. Selective logging is one of the most widespread disturbances to tropical forests worldwide, yet its impacts on large mammals remain poorly understood. We used camera trapping and hierarchical models to compare local abundance of a variety of terrestrial mammal species in Borneo between selectively logged and unlogged forest, and to assess the impacts of edge effects. Our methods circumvent confounding factors that have plagued previous assessments of logging impacts by explicitly accounting for differential detection probability among habitats, separating the effects of hunting from those of logging-induced habitat disturbance, and explicitly measuring the distances over which edge effects occur. We found that mammalian carnivore species were either largely or completely confined to primary forest, although habitat use for the Sunda clouded leopard increased toward the ecotone. Several large ungulates, however, were either completely (Asian elephant and banteng) or mostly (sambar) found in logged forest. This suggests that, in the absence of hunting, disturbed habitats can be important for the conservation of certain endangered and vulnerable species. Sambar and muntjac both strongly avoided habitat edge in logged forest and primary forest, respectively. Lower habitat use by these species persisted 2–4 km from the habitat boundary – farther than has been observed for the infiltration of other edge effects such as canopy desiccation. Such avoidance of ecotones implies that 20–40% of the intact primary forest habitat in our study area is actually degraded "edge habitat" from the point of view of primary forest specialists.

Our results suggest that, while selectively logged forests retain conservation value for certain large mammal species, it is critical that thresholds in logging intensity be identified so as to avoid declines in habitat use by taxa, such as carnivores, which appear intolerant of intensive logging pressure. © 2014 Deutsche Gesellschaft für Säugetierkunde. Reprinted with permission from Elsevier.

R. Chaiyarat, N. Youngpoy & P. Prempree
Wild Asian elephant *Elephas maximus* population in Salakpra Wildlife Sanctuary, Thailand

Endangered Species Research 29 (2015) 95-102
Abstract. The population of wild Asian elephants is declining worldwide; therefore, understanding the dynamics of the remaining population is critical for effective conservation. We monitored the population and distribution of elephants in Salakpra Wildlife Sanctuary, Thailand between May 2010 and March 2011. Using 32 camera trap locations and 1391 trap nights, we recorded 882 elephant photos. A total of 180 individuals were identified in the photos and classified as follows: 55 adult males, 60 adult females, 11 sub-adult males, 17 sub-adult females, 18 juveniles, and 19 calves. The age structure ratio (based on adult females) was 0.9:1.0:0.2:0.3:0.3:0.4, and the ratio of reproductive ability between adult females, juveniles, and calves was 1.0 : 0.3 : 0.3. The ratio between adult females and infants was highest in areas containing a high concentration of salt licks, which could indicate that salt licks are a keystone resource for wild Asian elephants. © 2015 The Authors.

K.-G. Chan, M.F. Loke, B.L. Ong, Y.L. Wong, K.W. Hong, K.H. Tan, S. Kaur, H.F. Ng, M.A. Razak & Y.F. Ngeow

Multiphasic strain differentiation of atypical mycobacteria from elephant trunk

PeerJ 3 (2015) e1367

Abstract. Background: Two non-tuberculous mycobacterial strains, UM 3 and UM 11, were isolated from the trunk wash of captive elephants in Malaysia. As they appeared to be identical phenotypes, they were investigated further by conventional and whole genome sequence-based methods of strain differentiation. Methods:

Multiphasic investigations on the isolates included species identification with hsp65 PCR-sequencing, conventional biochemical tests, rapid biochemical profiling using API strips and the Biolog Phenotype Microarray analysis, protein profiling with liquid chromatography-mass spectrometry, repetitive sequence-based PCR typing and whole genome sequencing followed by phylogenomic analyses. Results: The isolates were shown to be possibly novel slow-growing schotochromogens with highly similar biological and genotypic characteristics. Both strains have a genome size of 5.2 Mbp, G+C content of 68.8%, one rRNA operon and 52 tRNAs each. They qualified for classification into the same species with their average nucleotide identity of 99.98% and tetranucleotide correlation coefficient of 0.99. At the subspecies level, both strains showed 98.8% band similarity in the Diversilab automated repetitive sequence-based PCR typing system, 96.2% similarity in protein profiles obtained by liquid chromatography mass spectrometry, and a genomic distance that is close to zero in the phylogenomic tree constructed with conserved orthologs. Detailed epidemiological tracking revealed that the elephants shared a common habitat eight years apart, thus, strengthening the possibility of a clonal relationship between the two strains. © 2015 The Authors.

D.P. Croft, L.J.N. Brent, D.W. Franks & M.A. Cant

The evolution of prolonged life after reproduction

Trends in Ecology & Evolution 30 (2015) 407-16

Abstract. Why females of some species cease ovulation before the end of their natural lifespan is a longstanding evolutionary puzzle. For many species in captivity, post-reproductive life is simply an epiphenomenon of lengthened lifespan. Yet in natural populations of humans as well as some cetaceans and insects, reproductive senescence occurs much faster than somatic aging and females exhibit prolonged post-reproductive lifespans (PRLSs). Determining the mechanisms and functions that underpin PRLSs has proved a significant challenge. Here we bring together both classic and modern hypotheses proposed to explain PRLSs and discuss their application to both human and nonhuman animals. By taking

an integrative and broad taxonomic approach we highlight the need to consider multiple interacting explanations for the evolution of PRLSs. © 2015 Elsevier Ltd.

A. Das, M. Saini, S. Katole, S.S. Kullu, D. Swarup & A. K. Sharma

Effect of feeding different levels of wheat roti on nutrient utilization and blood metabolite profile in semi-captive Asian elephants (*Elephas maximus*)

Journal of Animal Physiology and Animal Nutrition 99 (2015) 367-378

Abstract. This experiment was conducted to study the effect of different levels of wheat roti (WR) on nutrient utilization and blood metabolites in Asian elephants fed roughages ad libitum. Nine (3 M, 6 F) Asian elephants (14–52 years of age, 1909–3968 kg BW) were used in an experiment based on replicated Latin square design. Animals in each group (n = 3) were assigned to one of the three dietary treatments in a manner that animals in all the three groups were exposed to all the three treatments in three different periods. Each feeding trial comprised 30 days (25 days of adaptation and 5 days collection period). The amount of WR fed to the elephants was 0.18, 0.12 and 0.06% of BW in groups I, II and III, respectively. They were allowed to forage in the nearby forests for 6 h/day and to bathe for 2 h/day. The animals had ad libitum access to cut rohini (*Mallotus philippensis*) trees in their night shelter. Intake and apparent digestibility of dry matter (DM), crude protein (CP), gross energy (GE), Ca, P, Fe, Cu and Zn were measured. Feed consumption was not significantly different among the groups. Significant ($p < 0.01$) decrease in digestibility of DM and GE and blood glucose concentration was observed with decreased level of WR in the diet. Feeding of WR at 0.06% of BW supplied adequate amount of DE, CP, Ca, P, Fe, Cu and Zn to meet requirement for adult maintenance. Feeding of WR in excess of 0.06% of BW supplied DE in excess of requirement, increased blood glucose concentration which may cause obesity and other associated health problems. It was concluded that the amount of WR should be restricted to 0.06% of BW in the diet of captive Asian elephants. © 2014 Blackwell Verlag GmbH.

A. Das, M.L. Smith, M. Saini, S. Katole, S.S. Kullu, B.K. Gupta, A.K. Sharma & D. Swarup
Effect of concentrates restriction on feed consumption, diet digestibility, and nitrogen utilization in captive Asian elephants (*Elephas maximus*)

Zoo Biology 34 (2015) 60-70

Abstract. In order to study the effect of concentrates restriction on feed consumption, diet digestibility, and utilization of nitrogen in captive Asian elephants, two feeding trials were conducted on three juveniles, four sub-adults, and three adults. During trial I, the conventional zoo diets of juveniles, sub-adults, and adult contained 22, 17, and 16% of concentrates on dry matter (DM) basis, respectively. During trial II, the amount of concentrate was reduced by 50%. A digestion trial of five days collection period was conducted during each period. The animals ate more roughages when concentrates were restricted. Intake of DM (g/kg BW 0.75/day) was highest in sub-adults, followed by juveniles and adults. Apparent digestibility of crude protein (CP), neutral detergent soluble (NDS), and supply of digestible energy (DE) was highest in juveniles, followed by sub-adults and adults. Based upon the estimated metabolic fecal nitrogen (MFN) and calculated endogenous urinary nitrogen (EUN) and dermal losses, minimum dietary CP required to meet maintenance requirement was estimated to be 6.12, 6.05, and 5.97% in juveniles, sub-adults, and adults, respectively. Restriction of concentrates resulted in decreased ($P < 0.05$) digestibility of DM and GE, but the diet still supplied adequate amounts of DE and CP to fulfil estimated requirements of energy and protein during the period of experimentation. Thus, the concentrates portion of the diets of captive Asian elephants should be fed in a restricted way so as to reduce the intake of excessive calories and the potential risk of obesity. © 2014 Wiley Periodicals, Inc.

E.F. Egelund, R. Isaza, A. P. Brock, A. Alsultan, G. An & C. A. Peloquin

Population pharmacokinetics of rifampin in the treatment of *Mycobacterium tuberculosis* in Asian elephants

Journal of Veterinary Pharmacology and Therapeutics 38 (2015) 137-143

Abstract. The objective of this study was to develop a population pharmacokinetic model for rifampin in elephants. Rifampin concentration data from three sources were pooled to provide a total of 233 oral concentrations from 37 Asian elephants. The population pharmacokinetic models were created using Monolix (version 4.2). Simulations were conducted using ModelRisk. We examined the influence of age, food, sex, and weight as model covariates. We further optimized the dosing of rifampin based upon simulations using the population pharmacokinetic model. Rifampin pharmacokinetics were best described by a one-compartment open model including first-order absorption with a lag time and first-order elimination. Body weight was a significant covariate for volume of distribution, and food intake was a significant covariate for lag time. The median C_{max} of 6.07 $\mu\text{g/ml}$ was below the target range of 8–24 $\mu\text{g/ml}$. Monte Carlo simulations predicted the highest treatable MIC of 0.25 $\mu\text{g/ml}$ with the current initial dosing recommendation of 10 mg/kg, based upon a previously published target $\text{AUC}_{0-24}/\text{MIC} > 271$ ($\text{fAUC} > 41$). Simulations from the population model indicate that the current dose of 10 mg/kg may be adequate for MICs up to 0.25 $\mu\text{g/ml}$. While the targeted AUC/MIC may be adequate for most MICs, the median C_{max} for all elephants is below the human and elephant targeted ranges. © 2014 John Wiley & Sons Ltd.

P. Fernando, T. Prasad, H.K. Janaka, S.K.K. Ekanayaka, H.G. Nishantha & J. Pastorini

The use of radio-tracking data to guide development and manage elephants

WildLanka 3 (2015) 12-19

Abstract. Asian elephants are difficult to observe because of habitat constraints and behavioural adaptations to avoid people. Consequently, accurate information on their movement patterns, habitat occupancy and resource use can only be obtained through radio-tracking. GPS radio telemetry is particularly useful for this purpose as it provides a wealth of high quality data. Around 60 elephants have been tracked in Sri Lanka over the past two decades using GPS collars. Here we present four case studies demonstrating the importance of such data in guiding development so as to prevent or reduce human-elephant conflict

and for the effective management of elephants to ensure their conservation.

V.R. Goswami, K. Medhi, J.D. Nichols & M.K. Oli

Mechanistic understanding of human-wildlife conflict through a novel application of dynamic occupancy models

Conservation Biology 29 (2015) 1100-1110

Abstract. Crop and livestock depredation by wildlife is a primary driver of human-wildlife conflict, a problem that threatens the coexistence of people and wildlife globally. Understanding mechanisms that underlie depredation patterns holds the key to mitigating conflicts across time and space. However, most studies do not consider imperfect detection and reporting of conflicts, which may lead to incorrect inference regarding its spatiotemporal drivers. We applied dynamic occupancy models to elephant crop depredation data from India between 2005 and 2011 to estimate crop depredation occurrence and model its underlying dynamics as a function of spatiotemporal covariates while accounting for imperfect detection of conflicts. The probability of detecting conflicts was consistently < 1.0 and was negatively influenced by distance to roads and elevation gradient, averaging 0.08–0.56 across primary periods (distinct agricultural seasons within each year). The probability of crop depredation occurrence ranged from 0.29 (SE 0.09) to 0.96 (SE 0.04). The probability that sites raided by elephants in primary period t would not be raided in primary period $t+1$ varied with elevation gradient in different seasons and was influenced negatively by mean rainfall and village density and positively by distance to forests. Negative effects of rainfall variation and distance to forests best explained variation in the probability that sites not raided by elephants in primary period t would be raided in primary period $t+1$. With our novel application of occupancy models, we teased apart the spatiotemporal drivers of conflicts from factors that influence how they are observed, thereby allowing more reliable inference on mechanisms underlying observed conflict patterns. We found that factors associated with increased crop accessibility and availability (e.g., distance to forests and rainfall patterns) were key drivers

of elephant crop depredation dynamics. Such an understanding is essential for rigorous prediction of future conflicts, a critical requirement for effective conflict management in the context of increasing human–wildlife interactions. © 2015 Society for Conservation Biology.

R. Joshi

Tusker's social bonds in Rajaji

Hystrix, the Italian Journal of Mammalogy 26 (2015) 41-45

Abstract. Male elephants are known to live a solitary life after attaining the pubertal stage which is considered at the age of about 15 years. However, observations of single young males (about 10 years old) have also been reported. In contrast, few studies have explored that male elephants do have associations; however these associations are occasional and temporary. In Rajaji National Park, north-western Shivalik landscape of India, bull elephants were observed to have a year round association, mainly to perform movements outside the boundaries of protected habitats and to enjoy palatable crops. A recognised group of bull elephants (c. 2–8) was recorded between 2006–2010, performing movements in parts of Rajaji National Park, Haridwar forest division and agriculture fields nearby the protected habitats. Bull elephant interactions and social bond are illustrated. Since a long continuous chain of forests, which existed in the Rajaji–Corbett wildlife corridor, has been disrupted mainly because of habitat fragmentation, and since man–elephant conflict is increasing rapidly, regular monitoring of elephant habitat and population dynamics is of paramount importance. This is the first time that male–male interactions/male elephant behaviour in groups has been recorded from north-west India and possible explanations for the behaviour are discussed. © 2015 Associazione Teriologica Italiana.

S. Kaffashi, M.R. Yacob, M.S. Clark, A. Radam & M.F. Mamat

Exploring visitors' willingness to pay to generate revenues for managing the National Elephant Conservation Center in Malaysia

Forest Policy and Economics 56 (2015) 9-19

Abstract. Financial sustainability of protected

areas is one of the main challenges of management. Financial self-sufficiency is an important element in improving conservation effort in these areas. This study seeks to review best practices in recreational fee systems in different countries and to find a relevant entry fee for a wildlife sanctuary in Malaysia. The revenue of the National Elephant Conservation Center (NECC) in Kuala Gandah, Malaysia, comes from several sources, including the national government, but all these budgetary sources are strained by tighter public budgets and greater demands. The present study investigates the introduction of visitor entrance fees to supplement an otherwise inadequate budget for supporting the operational costs of the sanctuary. Factor analysis and a double-bounded contingent valuation method were combined to estimate tourists' willingness to pay (WTP) the proposed entrance fee. Factor analysis showed that respondents' motivation to support the NECC with user fees is conditioned by their direct experiences with elephants, their satisfaction with NECC's educational programs and services, and other experiences it gives to users. The WTP model considered respondents' four motivation factors with their sociodemographic characteristics. Since NECC visitors arrive from both within and outside the country, this study suggests to centre managers a two-tier fee structure (residents vs. nonresidents of Malaysia), based upon mean WTP estimates. This study further suggests that revenue from such an entrance fee for NECC could support the centre's management and development costs. © 2015 Reprinted with permission from Elsevier.

A.C. Karawita, R.C. Rajapakse, P.G.I.D. Amarasiri, R.M.T.M. Ramanayake, W.R. Jayaweera, T.K. Bollinger, & G.S.P.D.S. Gunawardena

Cecocolic intussusception in an Asian elephant (*Elephas maximus*) in Sri Lanka associated with chronic hepato-intestinal schistosomiasis: A case report

International Journal of Applied Sciences and Biotechnology 3 (2015) 744-746

Abstract. A 25 year old female captive Asian elephant weighing approximately 3000 kg died and was subjected to a complete necropsy within 5 hours post mortem. Grossly, the elephant had subcutaneous edema, cecocolic intussusception and

ascites. Histopathological examination revealed multifocal, granulomatous, portal phlebitis in the liver, multifocal, granulomatous, peri-portal hepatitis with marked portal and perisinusoidal fibrosis, and multifocal granulomatous colitis with intralesional *Schistosoma* eggs. To our knowledge, this is the first report of cecocolic intussusception in an Asian elephant associated with *Schistosoma* infection. © 2015 International Journal of Applied Sciences and Biotechnology.

T. Komatsu, M. Maruyama, S. Hasin, V. Woraguttanon, S. Wiyanan & W. Sakchoowong
Observations of immature and adult stages of the myrmecophilous cetonine beetle *Campsiura nigripennis* (Coleoptera: Scarabaeidae)

Entomological Science 18 (2015) 288-291

Abstract. Several cetonine species are known or speculated to be associated with ants, based on their specialized morphological characters. However, there are only a few species where biological information on the larval and adult stages is available. Field observations revealed that *Campsiura nigripennis* spends the immature stages inside elephant dung, and that adult females fly to elephant dung for oviposition. In addition, adult beetles of *C. nigripennis* intruded into arboreal nests of *Oecophylla smaragdina*. Specialized morphological characters appear to allow them to tolerate attacks from the ants. Furthermore, the distribution of the beetle in continental Asia largely overlaps that of the Asian elephant, indicating that dung of elephants, in conjunction with that of other large mammals, is fundamental to the biology of *C. nigripennis*. © 2014 The Entomological Society of Japan.

J.A. Landolfi, K.A. Terio, M. Miller, B.F. Junecko & T. Reinhart

Pulmonary tuberculosis in Asian elephants (*Elephas maximus*): Histologic lesions with correlation to local immune responses

Veterinary Pathology 52 (2015) 535-542

Abstract. Although *Mycobacterium tuberculosis* infection is an important health concern for Asian elephants, no studies have evaluated the associated local immune responses or histologic lesions. In primates including humans, latent tuberculosis is distinguished by well-organized

granulomas with TH1 cytokine expression, whereas active disease is characterized by poorly organized inflammation and local imbalance in TH1/TH2 cytokines. This study examined archival, formalin-fixed, paraffin-embedded lung samples from 5 tuberculosis-negative and 9 tuberculosis-positive Asian elephants. Lesions were assessed by light microscopy, and lymphoid infiltrates were characterized by CD3 and CD20 immunolabeling. Expression of TH1 (interferon [IFN]- γ , tumor necrosis factor [TNF]- α) and TH2 (interleukin [IL]-4, IL-10, transforming growth factor [TGF]- β) cytokines was determined using in situ hybridization. In 6 of 9 samples, inflammation was similar to the pattern of primate active disease with low to moderate numbers of lymphocytes, most of which were CD20 positive. In 1 sample, inflammation was most similar to latent tuberculosis in primates with numerous CD3-positive lymphocytes. Expression of IFN- γ was detected in 3 of 8 tuberculosis-positive samples. Expression of TNF- α was detected in 3 of 8 positive samples, including the one with latent morphology. Low-level expression of IL-4 was present in 4 of 8 positive samples. Only single positive samples displayed expression of IL-10 and TGF- β . Tuberculosis-negative samples generally lacked cytokine expression. Results showed heterogeneity in lesions of elephant tuberculosis similar to those of latent and active disease in primates, with variable expression of both TH1 and TH2 cytokines. © 2014 The Authors.

J.A. Leonard, R.-J. den Tex, M.T.R. Hawkins, V. Muñoz-Fuentes, R. Thorington & J.E. Maldonado
Phylogeography of vertebrates on the Sunda Shelf: A multi-species comparison

Journal of Biogeography 42 (2015) 871-879

Abstract. Aim: Pleistocene environmental fluctuations had well-characterized impacts on the patterns of within-species divergences and diversity in temperate habitats. Here we examine the impact the Pleistocene had on widely distributed forest vertebrates in a tropical system where the distribution of the habitat was affected by those fluctuations. Location: Sundaland, tropical Southeast Asia. Methods: We conducted a comparative phylogeographical analysis of 28 non-migratory, forest-dependent vertebrates,

for which we constructed rooted, intraspecific phylogenies based on mitochondrial DNA sequences of individuals from at least the three major landmasses in the area (Borneo, Sumatra and the Malay Peninsula) and compared them to hypothetical phylogenies based on independent geological data and climate models regarding connections and relationships between the major landmasses of Sundaland. Java was included where possible. We dated the phylogenies to determine whether patterns of differentiation were concordant across species. Results: In most species, populations on the Malay Peninsula and Sumatra were most closely related, and sister to those from Borneo. The dates of these divergences, however, varied extensively between species. Borneo harbours multiple deeply divergent lineages of many species compared to the diversity within those species. Javan populations of several birds were most divergent relative to those from the rest of the Sunda Shelf. Main conclusions: These results suggest a dynamic history, including recurrent population extinctions and replacements and a strong priority effect for local populations. The close relationship between populations in Sumatra and the Malay Peninsula supports the existence of forest on the exposed shelf during the Pleistocene at many different times, and suggests that proximity was more important than the presence of palaeorivers for dispersal of forest taxa between landmasses. © 2015 John Wiley & Sons Ltd.

X. Li, G. Jiang, H. Tian, L. Xu, C. Yan, Z. Wang, F. Wei & Z. Zhang

Human impact and climate cooling caused range contraction of large mammals in China over the past two millennia

Ecography 38 (2015) 74-82

Abstract. Many species have experienced dramatic declines over the past millennia due to the accelerated impact of human activity and climate change, but compelling evidence over such long-term time scales is rare. China has a unique system archiving historical records of important social, meteorological, agricultural and biological events over the last three millennia. We derived historical species occurrences (0–2000 AD) based on a comprehensive review of literature.

To detect the driving forces of range contraction, we used correlation and multiple regression to quantify the linear association between species range indices and climate variables (five temperature series and three precipitation series), as well as a human population size series. We also used a machine learning technique, random forest, to quantify the nonlinear effects of the climate variables and human population size. The southward retreat of the Asian elephant and the rhinoceroses (*Dicerorhinus sumatrensis*, *Rhinoceros unicornis*, *R. sondaicus*) was closely associated with climate cooling and intensified human impact (represented by high population size), and the westward retreat of the giant panda was associated with intensified human impact. One temperature series and human population size showed interactive effect on range shift of the Asian elephant and the rhinoceroses; the effect of temperature was positive at low population size, but negative at high population size. Our results imply that a higher temperature caused the northward or eastward range shift of the Asian elephant, the rhinoceroses and the giant panda, and currently this trend is impeded by human activities. We also illustrate how human activity and climate act synergistically to cause range contraction. © 2014 Nordic Society Oikos and The Authors.

V. Lynch, O.C. Bedoya-Reina, A. Ratan, M. Sulak, D.I. Drautz-Moses, G.H. Perry, W. Miller & S.C. Schuster

Elephantid genomes reveal the molecular bases of woolly mammoth adaptations to the arctic

Cell Reports 12 (2015) 217-228

Abstract. Woolly mammoths and living elephants are characterized by major phenotypic differences that have allowed them to live in very different environments. To identify the genetic changes that underlie the suite of woolly mammoth adaptations to extreme cold, we sequenced the nuclear genome from three Asian elephants and two woolly mammoths, and we identified and functionally annotated genetic changes unique to woolly mammoths. We found that genes with mammoth-specific amino acid changes are enriched in functions related to circadian biology, skin and hair development and physiology,

lipid metabolism, adipose development and physiology, and temperature sensation. Finally, we resurrected and functionally tested the mammoth and ancestral elephant TRPV3 gene, which encodes a temperature-sensitive transient receptor potential (thermoTRP) channel involved in thermal sensation and hair growth, and we show that a single mammoth-specific amino acid substitution in an otherwise highly conserved region of the TRPV3 channel strongly affects its temperature sensitivity. © 2015 The Authors.

S. Magda, O. Spohn, T. Angkawanish, D.A. Smith & D.L. Pearl

Risk factors for saddle-related skin lesions on elephants used in the tourism industry in Thailand

BMC Veterinary Research 11 (2015) e117

Abstract. Background: Lesions related to working conditions and improper saddle design are a concern for a variety of working animals including elephants. The objectives of the present study were to determine the prevalence of cutaneous lesions in anatomic regions (i.e., neck, girth, back, tail) in contact with saddle-related equipment among elephants in Thailand working in the tourism industry, and to identify potential risk factors associated with these lesions. Data for this cross-sectional study were collected between May 2007 and July 2007 on 194 elephants from 18 tourism camps across Thailand. Results: There was a high prevalence (64.4%; 95% CI 57.3 – 71.2) of active lesions, most often located on the back region. Using multilevel multivariable logistic regression modelling containing a random intercept for camp we identified the following risk factors: increasing elephant age, the use of rice sacks as padding material in contact with the skin, and the provision of a break for the elephants. Working hours had a quadratic relationship with the log odds of an active lesion where the probability of an active lesion initially increased with the number of working hours per day and then declined possibly reflecting a “healthy worker” bias where only animals without lesions continue to be able to work these longer hours. Conclusions: While we recognize that the cross-sectional nature of the study posed some inferential limitations, our

results offer several potential intervention points for the prevention of these lesions. Specifically, we recommend the following until longitudinal studies can be conducted: increased monitoring of older elephants and the back region of all elephants, working less than 6 hours per day, and the avoidance of rice sacks as padding material in contact with skin. © 2015 The Authors.

J.N. Maslow & S.K. Mikota

Tuberculosis in elephants — A reemergent disease: Diagnostic dilemmas, the natural history of infection, and new immunological tools

Veterinary Pathology 52 (2015) 437-440

Abstract. Tuberculosis (TB) in elephants has been described since ancient times. However, it was not until 1996 when infection with *Mycobacterium tuberculosis* was identified in a herd of circus elephants that significant research into this disease began. The epidemiology and natural history of TB were unknown in elephants since there had been no comprehensive screening programs, and diagnostic techniques developed for cervidae and bovidae were of unknown value. And, while precepts of test and slaughter were the norm for cattle and deer, this was considered untenable for an endangered species. With no precedent for the treatment of TB in animals, treatment regimens for elephants were extrapolated from human protocols, which guided changes to the Guidelines for the Control of Tuberculosis in Elephants. In the absence of diagnostic testing to confirm cure in elephants, the efficacy of these treatment regimens is only beginning to be understood as treated elephants die and are examined postmortem. However, because of pressures arising from public relations related to elephant husbandry and the added considerations of TB infection in animals (whether real or imagined), sharing of information to aid in research and treatment has been problematic. Here we review the challenges and successes of the diagnosis of tuberculosis in elephants and discuss the natural history of the disease to put the work of Landolfi *et al.* on the immunological response to tuberculosis in elephants in perspective. © 2015 The Authors.

A.M. Moßbrucker, I. Apriyana, J. Fickel, M.A. Imron, S. Pudyatmoko, Sumardi & H. Suryadi
Non-invasive genotyping of Sumatran elephants: Implications for conservation

Tropical Conservation Science 8 (2015) 745-759

Abstract. Reliable baseline information necessary for the monitoring and conservation of Sumatran elephants is scarce. We here combine non-invasive molecular genetics methods and capture-recapture modelling to estimate elephant population size, distribution, sex ratio, and age structure for the Bukit Tigapuluh landscape in Sumatra, Indonesia. Two separate subpopulations were found, for which we estimated a population size of 99 (95% CI = [86, 125], PCCL = 38.59%) and 44 elephants (95% CI = [37, 56], PCCL = 43.18%), respectively. Low elephant densities are likely the result of patchy habitat usage and anthropogenically increased mortality, the latter assumption being supported by strong skews in both sex ratio and age structure as well as direct evidence of elephant killing. Still, the Bukit Tigapuluh landscape currently holds the largest known population of elephants in central Sumatra, representing one of the most important areas for their conservation in Indonesia. Conservation of both the elephant population and their habitat in this region should thus be of high priority. We identified several threats to the population, including (i) the risk of inbreeding and subsequent loss of genetic diversity, (ii) illegal elephant killing, and (iii) the lack of protected habitat. In order to overcome these challenges we suggest: (i) the implementation of a meta-population management program, (ii) monitoring and safeguarding elephants and improving law enforcement,

H.S. Mumby, S.N. Chapman, J.A.H. Crawley, K.U. Mar, W. Htut, A.T. Soe, H.H. Aung & V. Lummaa

Distinguishing between determinate and indeterminate growth in a long-lived mammal
BMC Evolutionary Biology 15 (2015) e214

Abstract. Background: The growth strategy of a species influences many key aspects of its life-history. Animals can either grow indeterminately (throughout life), or grow determinately, ceasing at maturity. In mammals, continued weight gain after maturity is clearly distinguishable

from continued skeletal growth (indeterminate growth). Elephants represent an interesting candidate for studying growth because of their large size, long life and sexual dimorphism. Objective measures of their weight, height and age, however, are rare. Results: We investigate evidence for indeterminate growth in the Asian elephant using a longitudinal dataset from a semi-captive population. We fit growth curves to weight and height measurements, assess sex differences in growth, and test for indeterminate growth by comparing the asymptotes for height and weight curves. Our results show no evidence for indeterminate growth in the Asian elephant; neither sex increases in height throughout life, with the majority of height growth completed by the age of 15 years in females and 21 years in males. Females show a similar pattern with weight, whereas males continue to gain weight until over age 50. Neither sex shows any declines in weight with age. Conclusions: These results have implications for understanding mammalian life-history, which could include sex-specific differences in trade-offs between size and reproductive investment. © 2015 The Authors.

H.S. Mumby, K.U. Mar, A.D. Hayward, W. Htut, Y. Htut-Aung & V. Lummaa

Elephants born in the high stress season have faster reproductive ageing

Scientific Reports 5 (2015) e13946

Abstract. Senescent declines in reproduction and survival are found across the tree of life, but little is known of the factors causing individual variation in reproductive ageing rates. One contributor may be variation in early developmental conditions, but only a few studies quantify the effects of early environment on reproductive ageing and none concern comparably long-lived species to humans. We determine the effects of 'stressful' birth conditions on lifetime reproduction in a large semi-captive population of Asian elephants. We categorise birth month into stressful vs. not-stressful periods based on longitudinal measures of glucocorticoid metabolites in reproductive-aged females, which peak during heavy workload and the start of the monsoon in June-August. Females born in these months exhibit faster reproductive senescence in adulthood and have significantly reduced lifetime

reproductive success than their counterparts born at other times of year. Improving developmental conditions could therefore delay reproductive ageing in species as long-lived as humans.

E. Ranaweerage, A.D.G. Ranjeewa & K. Sugimoto

Tourism-induced disturbance of wildlife in protected areas: A case study of free ranging elephants in Sri Lanka

Global Ecology and Conserv. 4 (2015) 625-631

Abstract. Tourism-induced disturbance is a growing concern in wildlife conservation worldwide. This case study in a key protected area in Sri Lanka, examined the behavioural changes of Asian elephants in the context of elephant watching tourism activities. Observations of different age–sex–group classes of elephants were conducted focusing on the feeding activity of elephants in the presence vs. absence of tourists. Frequency and duration of alert, fear, stress and aggressive behaviours of elephants were significantly high in the presence of tourists and these behaviours occurred at a cost of feeding time. Tourist behaviour, vehicle noise, close distances and time of the tours were closely associated with the behavioural changes of elephants. It is important to monitor tourism effects on endangered species such as Asian elephants and to take proper measures including controlled tourist behaviour and vehicle activity in protected areas in order to reduce disturbance of wildlife behaviour. © 2015 The Authors.

P.C. Reddy, I. Sinha, A. Kelkar, F. Habib, S.J. Pradhan, R. Sukumar & S. Galande

Comparative sequence analyses of genome and transcriptome reveal novel transcripts and variants in the Asian elephant *Elephas maximus*

Journal of Biosciences 40 (2015) 891-907

Abstract. The Asian elephant *Elephas maximus* and the African elephant *Loxodonta africana* that diverged 5–7 million years ago exhibit differences in their physiology, behaviour and morphology. A comparative genomics approach would be useful and necessary for evolutionary and functional genetic studies of elephants. We performed sequencing of *E. maximus* and map to *L. africana* at ~15X coverage. Through

comparative sequence analyses, we have identified Asian elephant specific homozygous, non-synonymous single nucleotide variants (SNVs) that map to 1514 protein coding genes, many of which are involved in olfaction. We also present the first report of a high-coverage transcriptome sequence in *E. maximus* from peripheral blood lymphocytes. We have identified 103 novel protein coding transcripts and 66-long non-coding (lnc)RNAs. We also report the presence of 181 protein domains unique to elephants when compared to other Afrotheria species. Each of these findings can be further investigated to gain a better understanding of functional differences unique to elephant species, as well as those unique to elephantids in comparison with other mammals. This work therefore provides a valuable resource to explore the immense research potential of comparative analyses of transcriptome and genome sequences in the Asian elephant. © 2015 Indian Academy of Sciences. With permission of Springer.

R.K. Runting, E. Meijaard, N.K. Abram, J.A. Wells, D.L.A. Gaveau, M. Ancrenaz, H.P. Possingham, S.A. Wich, F. Ardiansyah, M.T. Gumal, L.N. Ambu & K.A. Wilson

Alternative futures for Borneo show the value of integrating economic and conservation targets across borders

Nature Communications 6 (2015) e6819

Abstract. Balancing economic development with international commitments to protect biodiversity is a global challenge. Achieving this balance requires an understanding of the possible consequences of alternative future scenarios for a range of stakeholders. We employ an integrated economic and environmental planning approach to evaluate four alternative futures for the mega-diverse island of Borneo. We show what could be achieved if the three national jurisdictions of Borneo coordinate efforts to achieve their public policy targets and allow a partial reallocation of planned land uses. We reveal the potential for Borneo to simultaneously retain 50% of its land as forests, protect adequate habitat for the Bornean orangutan (*Pongo pygmaeus*) and Bornean elephant (*Elephas maximus borneensis*), and achieve an opportunity cost saving of over US\$43 billion. Such coordination

would depend on enhanced information sharing and reforms to land-use planning, which could be supported by the increasingly international nature of economies and conservation efforts. © 2015 Macmillan Publishers Limited.

J. Saarinen, A. Karme, T. Cerling, K. Uno, L. Säilä, S. Kasiki, S. Ngene, T. Obari, E. Mbua, F.K. Manthi & M. Fortelius

A new tooth wear-based dietary analysis method for Proboscidea (Mammalia)

J. of Vertebrate Paleontology 35 (2015) e918546

Abstract. Dietary analyses of herbivorous mammals are important for paleoecological reconstruction. Several methods applicable to fossil teeth have been developed lately. The mesowear method based on wear-induced occlusal shape and relief of ungulate molars has proven to be a robust method for dietary analysis. In its original form it can only be used for selenodont, plagiolophodont, and ectolophodont ungulate molars, but the principle can be extended to other kinds of tooth morphology. We introduce a new method of dietary analysis for proboscideans similar to the mesowear method, based on angle measurements from worn dentin valleys reflecting the relief of enamel ridges. The enamel ridges should be heavily worn when the abrasiveness of diet increases, resulting in lower occlusal relief and larger angles. For testing this, we compared the mesowear angles with stable carbon isotope values from dental enamel from populations of extant and fossil species from localities from Kenya and India. This enables us to compare diet and tooth wear in proboscideans, because the stable carbon isotope ratios in tropical environments provide a reliable standard for assessing the relative amounts of C4 and C3 plants in diet, and most of the C4 plants are grasses, which should be reflected in the mesowear signal. © 2015 the Society of Vertebrate Paleontology

A.H.M.R. Sarker, A. Hossen & E. Røskoft

Fatal elephant encounters on humans in Bangladesh: Context and incidences

Environment and Natural Resources Research 5 (2015) 99-108

Abstract. Here we report the context encounters of elephant attacks on humans in Bangladesh,

during the period 1989 to 2012. Attack rates significantly increased over this study period. The proportion of encounters that caused deaths or injuries differed statistically significant between the two sexes (men more deaths), age groups (elder more deaths), time of the day (more deaths during night), place of casualty (more deaths outside forests), weapon used by elephants (more deaths when elephants were using both trunk and leg) and study sites. No difference was found between seasons, elephant group size, or financial status, occupation and household size of victims. Elephant family groups were mostly responsible for attacks in the north, while single bulls were more responsible in the southeast. The place of casualty (inside or outside forests), time of the day, gender and regions were all significant in explaining the variation in encounters which resulted in human deaths or injuries. Conflict mitigation approaches including incentive-, awareness-or training programs from the forest department could help to reduce the conflict between humans and elephants in Bangladesh. © 2015 Canadian Center of Science and Education.

J. Schmidt-Burbach, D. Ronfot & R. Srisangiam
Asian elephant (*Elephas maximus*), pig-tailed macaque (*Macaca nemestrina*) and tiger (*Panthera tigris*) populations at tourism venues in Thailand and aspects of their welfare

PLoS ONE 10 (2015) e0139092

Abstract. This study focused on determining the size and welfare aspects of Asian elephant, pig-tailed macaque and tiger populations at facilities open to tourists in Thailand. Data were gathered from 118 venues through direct observations and interviews with staff. A score sheet-based welfare assessment was used to calculate scores between 1 and 10, indicating each venue's welfare situation. Factors such as freedom of movement for the animals, access to veterinary care, environmental noise quality, hygiene standards and work intensity were included in the score sheet. 1688 elephants, 371 macaques and 621 tigers were found at the venues. 89 venues exclusively kept elephants, 9 designated 'monkey schools' offered macaque shows, 4 venues kept primarily tigers, mostly for petting and photo opportunities, and the remaining venues kept a mix of these animals. A

strong imbalance in female to male gender ratios was recorded with about 4:1 for adult elephants and 1:4 for adult macaques. Severely inadequate welfare conditions were common, with 75% of macaques and 99% of tigers being kept at venues with scores less than 5. 86% of elephants were kept in inadequate conditions at venues with scores between 3 and 5, but a significant number of venues with scores above 5 were found. 4.6% of elephants were provided commendable conditions, reaching assessment scores of 8 and above. 71% of venues did not offer any sort of education about animals to visitors. This study is the first to assess welfare aspects of captive wild animals at tourism venues across Thailand. It concludes that significant concerns exist about the welfare of wild animals in the tourism sector of Thailand. Urgent attention needs to be given to address these concerns and prevent further suffering. But also to ensure the demand for wild animals doesn't have a negative impact on wild populations. © 2015 The Authors.

C. Thitaram, S. Dejchaisri, C. Somgird, T. Angkawanish, J. Brown, R. Phumphuay, S. Chomdech & D. Kangwanpong

Social group formation and genetic relatedness in reintroduced Asian elephants (*Elephas maximus*) in Thailand

Applied Animal Behaviour Science 172 (2015) 52-57

Abstract. Captive-held elephants were recruited from several parts of Thailand and released as part of a reintroduction project. Wild elephants with a herd matriarch generally contain the same matrilineal line and are genetically related. However, reintroduced elephants are less likely to be related, but are known to establish social groups. The objective of this study was to investigate the genetic relatedness and behavioural relationships of elephants reintroduced into forested areas in central and northern Thailand. Blood samples were collected from 53 elephants before release into the Sublanka (SLK) and Doi Phamuang (DPM) Wildlife Sanctuaries, and DNA was extracted for microsatellite and mitochondrial analysis. Direct observations of social bonding behaviours were done weekly for 12 months after release, and an association index (AI) calculated for each individual. The results showed a low

relatedness for both populations; the observed heterozygosity and number of mitochondrial haplotypes were 0.739 and 13 at SLK (n = 26), and 0.808 and 11 at DPM (n = 27), respectively. Across both locations, 33 elephants formed into 11 groups (range 2–6 individuals/group). The average AI and pairwise genetic relatedness of elephant groups were 0.517 ± 0.039 and 0.078 ± 0.019 , respectively, and were not correlated ($r = -0.036$; $p = 0.78$). Twenty elephants were not associated with specific groups and had average AI and pairwise genetic relatedness of 0.002 ± 0.001 and 0.047 ± 0.013 , respectively, which were not correlated ($r = -0.074$; $p = 0.491$). Several mitochondrial haplotypes were found within the same group. Thus, social bonding of the reintroduced elephants was not influenced by genetic relatedness. Rather, groups formed in association with the presence of an elephant calf. Additionally, many elephants occasionally preferred isolation. Thus, reintroduction procedures should favour introducing elephant calves, or adults with calves to increase the chance of group formation and establishment of stable elephant herds. © 2015 Reprinted with permission from Elsevier.

P.B. van den Doel, V.R. Prieto, S.E. van Rossum-Fikkert, W. Schaftenaar, E. Latimer, L. Howard, S. Chapman, N. Masters, A.D.M.E. Osterhaus, P.D. Ling, A. Dastjerdi & B. Martina

A novel antigen capture ELISA for the specific detection of IgG antibodies to elephant endotheliotropic herpes virus

BMC Veterinary Research 11 (2015) e203

Abstract. Background: Elephants are classified as critically endangered animals by the International Union for Conservation of Species (IUCN). Elephant endotheliotropic herpesvirus (EEHV) poses a large threat to breeding programs of captive Asian elephants by causing fatal haemorrhagic disease. EEHV infection is detected by PCR in samples from both clinically ill and asymptomatic elephants with an active infection, whereas latent carriers can be distinguished exclusively via serological assays. To date, identification of latent carriers has been challenging, since there are no serological assays capable of detecting seropositive elephants. Results: Here we describe a novel ELISA that

specifically detects EEHV antibodies circulating in Asian elephant plasma/serum. Approximately 80 % of PCR positive elephants display EEHV-specific antibodies. Monitoring three Asian elephant herds from European zoos revealed that the serostatus of elephants within a herd varied from non-detectable to high titers. The antibody titers showed typical herpes-like rise-and-fall patterns in time, which occur in all seropositive animals in the herd more or less simultaneously. Conclusions: This study shows that the developed ELISA is suitable to detect antibodies specific to EEHV. It allows study of EEHV seroprevalence in Asian elephants. Results confirm that EEHV prevalence among Asian elephants (whether captive-born or wild-caught) is high. © 2015 The Authors.

R. Venu, T. Thoiba Singh, R. Veeraharin, D. Rajesh & C. Srilatha

First report of *Cobboldia elephantis* (Cobbold, 1866) larvae in a free ranging wild elephant from Andhra Pradesh, India

Journal of Parasitic Diseases 39 (2015) 168-170
Abstract. Larvae of *Cobboldia elephantis* have been reported from the stomach of a free ranging wild elephant (*Elephas maximus*) while conducting post mortem examination at Palamner forest range, Chittoor district of Andhra Pradesh state, India. This is the first report of *C. elephantis* in free ranging wild elephant in Andhra Pradesh state, India. © 2013 Indian Society for Parasitology, with kind permission from Springer Science+Business Media.

S. Vijayakumar, S. Prabhu, J.E.M. Yabesh & R. Pragashraj

A quantitative ethnozoological study of traditionally used animals in Pachamalai hills of Tamil Nadu, India

J. of Ethnopharmacology 171 (2015) 51-63

Abstract. Ethnopharmacological relevance: The purpose of this study was designed to gather primary folk knowledge on different animal based therapies used by Malayalis in Pachamalai hills. This is the first ethnozoological study in Pachamalai hills; the data regarding the medicinal animals/animal products were documented and their usages were analyzed quantitatively. Methods: Data was collected following the

interviews from key informants (N1/489) and reported diseases and health complications were classified in 18 categories. Seven quantitative indexes such as informant consensus factor (FIC), fidelity level (FL), relative frequency of citation (RFC), relative importance (RI), cultural importance index (CII), index of agreement on remedies (IAR) and cultural agreement index (CAI) were used to analyze the reported animal species. Results: A total of 46 animal species belonging to 8 taxonomic groups were documented to be used in traditional medicine by Malayalis in Pachamalai hills. Animal based medicines were prepared from whole animals or their body parts or products extracted from them such as: butter, meat, milk, bones, horn, musk, skin, fin, honey, mucus, eggs, urine, excreta, hair and legs. The most encountered taxonomic group was Mammalia having 14 species. Aphrodisiac ailments (0.99), dental care ailments (0.99), endocrinal disorders ailments (0.99), hair care ailments (0.99), oncology ailments (0.99) and ortho ailments (0.99) gained the highest FIC value. *Sus scrofa domesticus* scored the highest FL (100%) for the skeleto-muscular ailments for external cause; *Lissemys punctata* had the highest RI value (2.00) due to its versatility and the highest frequency of citation (RFC=1.000). *Gallus domesticus* had the highest cultural importance (CII=8.538) and the highest CAI value (CAI=8.427). According to IAR, *Plexippus paykulli* (IAR=1.00), *Equus ferrus caballus* (IAR=1.00), *Trachypithecus johnii* (IAR=1.00), *Oecophylla samaragdina* (IAR=1.00) and *Apis indica* (0.990) had the highest agreement among the informants for being used for the same medicinal purpose. Furthermore, no side effects have been reported from the use of ABT. Conclusions: Our study revealed that Malayalis (Pachamalai hills) possess valuable knowledge on Malayalis' animal based therapies. It is believed that the present documentation will serve to record this vanishing knowledge before it is eroded completely from the island and to the scientific community. It is also anticipated that the present documentation will be fundamental to protect traditional knowledge, for the conservation and sustainable use of the rich biodiversity of Pachamalai hills for future generations and to ensure Pachamalai hills'

sovereign rights over its genetic resources and utilization by first documenting them. In addition, further experimental investigations are required to elucidate the pharmacological properties of the reported medicinal fauna of Pachmalai hills. © 2015 Reprinted with permission from Elsevier.

U. Westphal

Elephas anthropogenus

Zoologischer Anzeiger 256 (2015) 36-41

Abstract. This paper and its accompanying artwork examines the history of our perception of nature based on the example of elephants (*Elephas maximus*, *Loxodonta africana*, *Loxodonta cyclotis*). With the fall of the Roman Empire up until the late Middle Ages, elephants virtually disappeared from Western Europe. Since there was no real knowledge of how these animals actually looked, illustrators had to rely on oral, pictorial and written transmissions to morphologically reconstruct an elephant, thus, reinventing the image of an actual existing creature. This led, in most cases, to illustrations in which the most characteristic features of elephants – such as trunk and tusks – are still visible, but that otherwise completely deviate from the real appearance and physique of these animals. In this process, zoological knowledge about elephants was overwritten by its cultural significance. Based on a collection of these images I have reconstructed the evolution of the '*Elephas anthropogenus*', the man made elephant. © 2015 Reprinted with permission from Elsevier.

S. Wijeyamohan, K. Treiber, D. Schmitt & C. Santiapillai

A visual system for scoring body condition of Asian elephants (*Elephas maximus*)

Zoo Biology 34 (2015) 53-59

Abstract. A body condition score (BCS) may provide information on the health or production potential of an animal; it may also reflect the suitability of the environment to maintain an animal population. Thus assessing the BCS of Asian elephants is important for their management. There is a need for a robust BCS applicable to both wild and captive elephants of all age categories based on the minimum

and maximum possible subcutaneous body fat and muscle deposits. The visually based system for scoring the body condition of elephants presented here satisfies these criteria and is quick, inexpensive, non-invasive and user-friendly in the field. The BCS scale correlates ($P < 0.05$) with morphometric indices such as weight, girth, and skin fold measures. © 2014 Wiley Periodicals, Inc.

E. Williams, S. Bremner-Harrison, N. Harvey, E. Evison & L. Yon

An investigation into resting behavior in Asian elephants in UK zoos

Zoo Biology 34 (2015) 406-417

Abstract. Maintaining adequate welfare in captive elephants is challenging. Few studies have investigated overnight rest behaviour in zoo elephants, yet time spent resting has been identified as a welfare indicator in some species. We investigated resting behaviour in Asian elephants in UK zoos, with the aim of identifying patterns or preferences in lying rest. Details of standing (SR) and lying (LR) rest behaviour were identified by observing video footage of inside enclosures collected for 14 elephants (2 male, 12 female) housed at three UK zoos (Zoo A: 18 nights; Zoo B: 27 nights; Zoo C: 46 nights) from 16:00 to 08:30 (approximately). Elephants engaged in a mean of 58–337 min rest per night. Time of night affected mean duration of LR bouts ($P < 0.001$); longest bouts were observed between 22:01 and 06:00. Elephants showed a substrate preference when lying to rest; LR was not observed on concrete or tiled flooring. Where sand was available (to 11/14 elephants), all elephants engaged in LR on sand flooring. Only two elephants engaged in LR on rubber flooring (available to 7/14 elephants). Mean duration of rest bouts was greater when a conspecific was within two body lengths than when conspecifics were not ($P < 0.01$). Our study indicated that elephants show substrate preferences when choosing an area for rest and engage in more rest when conspecifics are in close proximity. The results of this study could be used as a basis for future studies investigating the link between rest and welfare in captive elephants. © 2015 Wiley Periodicals, Inc.