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 (2011) publications on Asian elephants.

T. Angkawanish, W. Wajjwalku, A. Sirimalaisuwan, S. Mahasawangkul, T. Kaewsakhorn, K. Boonsri & V.P.M.G. Rutten

Mycobacterium tuberculosis infection of domesticated Asian elephants, Thailand

Emerging Infect. Diseases 16 (2010) 1949-1951

Abstract. Four Asian elephants were confirmed to be infected with *Mycobacterium tuberculosis* by bacterial culture, other diagnostic procedures, and sequencing of 16S-23S rDNA internal transcribed spacer region, 16S rRNA, and gyrase B gene sequences. Genotyping showed that the infectious agents originated from 4 sources in Thailand. To identify infections, a combination of diagnostic assays is essential.

P. Bapodra, T. Bouts, P. Mahoney, S. Turner, A. Silva-Fletcher & M. Waters

Ultrasonographic anatomy of the Asian elephant (_Elephas maximus_) eye

J. Zoo and Wildlife Medicine 41(2010) 409-417

Abstract. Bilateral transpalpebral ultrasonography was performed on 53 captive Asian elephants (*Elephas maximus*) in order to describe the normal ultrasonographic appearance and measurements of the Asian elephant eye. Transpalpebral ultrasonography was performed using a portable ultrasound unit and a 4-7-MHz broadband curvilinear transducer on animals housed at seven institutions in the United Kingdom and in Sri Lanka. Both males and females were included in the study and ages ranged from 14 mo to 65 yr. Ultrasonic examinations were conducted on unsedated animals, without the use of topical or local anesthesia. The ultrasonographic appearance of the globe and intraocular structures of the Asian elephant eye is similar to that in other species. Biometry measurements recorded for adult (n=41) and juvenile (n=10) Asian elephants were: axial length, 3.44±0.21 cm and 3.18±0.19 cm (mean±SD); equatorial diameter, 3.88±0.32 cm and 3.60±0.24 cm; corneal thickness, 0.17±0.02 cm and 0.16±0.02 cm; anterior segment depth, 0.45±0.08 cm and 0.36±0.07 cm; lens diameter, 1.90±0.14 cm and 1.75±0.19 cm; lens depth. 1.01±0.12 cm and 0.94±0.10 cm, and posterior segment depth, 1.82±0.17 cm and 1.72±0.15 cm, respectively. Multiple linear regression analysis indicated a significant relationship between the explanatory variables (age, sex, and height) and the dependent variables (axial length, equatorial diameter, corneal thickness, anterior segment depth, lens diameter, and lens depth). The main finding of this statistical test was that the globe increases in size as the animal ages. Transpalpebral ultrasonography was found to be an effective and practical imaging modality in the evaluation of the Asian elephant eye, without the need for chemical restraint. © 2010 American Association of Zoo Veterinarians.

J.L. Brown, D.C. Kersey & S.L. Walker

Assessment of luteinizing hormone and prolactin immunoactivity in Asian and African elephant urine using assays validated for serum

General and Comparative Endocrinology 169 (2010) 138-143

Abstract. Analysis of serum hormones is useful for timing artificial insemination (Luteinizing hormone) and diagnosing pregnancy (prolactin) in elephants. However, these tests require blood collection, which is not tolerated by all animals, and is impractical for field studies. Thus, developing a means to obtain these measures noninvasively could improve species management. Matched

urine and serum was collected from Asian and African elephants daily throughout the follicular phase and after administration of a GnRH analogue for LH determination, and in pregnant and nonpregnant females for prolactin analyses using immunoassays validated for elephant serum. Despite identifying robust increases in circulating hormone concentrations, no concomitant changes in urinary LH or prolactin immunoactivity was detected. Concentration of samples by centrifugal filtration or ethanol precipitation did not increase the ability to measure biologically relevant changes in endogenous urinary LH or prolactin immunoactivity. Sample matrix interference was ruled out following sufficient recovery of exogenous LH or prolactin added to samples, except for samples concentrated >35-fold where some interference was suspected. These results suggest that elephants either do not excrete native LH or prolactin in urine, or concentrations are too low to be measured accurately by standard immunoassay techniques that are valid for serum analyses. Thus, it does not appear feasible or economically viable to use these noninvasive tests for ovulation detection or for pregnancy diagnosis in elephants.

K.L. Campbell, J.E.E. Roberts, L.N. Watson, J. Stetefeld, A.M. Sloan, A.V. Signore1, J.W. Howatt, J.R.H. Tame, N. Rohland, T.-J. Shen, J.J. Austin, M. Hofreiter, C. Ho, R.E. Weber & A. Cooper

Substitutions in woolly mammoth hemoglobin confer biochemical properties adaptive for cold tolerance

Nature Genetics (2010) 42:536–540

Abstract. We have genetically retrieved, resurrected and performed detailed structure-function analyses on authentic woolly mammoth hemoglobin to reveal for the first time both the evolutionary origins and the structural underpinnings of a key adaptive physiochemical trait in an extinct species. Hemoglobin binds and carries O_2; however, its ability to offload O_2 to respiring cells is hampered at low temperatures, as heme deoxygenation is inherently endothermic (that is, hemoglobin-O_2 affinity increases as temperature decreases). We identify amino acid substitutions with large phenotypic effect on the chimeric β/δ-globin subunit of mammoth hemoglobin that provide a unique solution to this problem and thereby minimize energetically costly heat loss. This biochemical specialization may have been involved in the exploitation of high-latitude environments by this African-derived elephantid lineage during the Pleistocene period. This powerful new approach to directly analyze the genetic and structural basis of physiological adaptations in an extinct species adds an important new dimension to the study of natural selection.

M. Chaiklin

Ivory in world history – early modern trade in context

History Compass 8 (2010) 530-542

Abstract. Ivory was the cause of the some of the oldest trading networks in human history. It is part of our cultural landscape yet ivory has commonly only been viewed through the lens of slavery or conservation. This article takes a broad look at the place of ivory in human history, from prehistoric times to the 19th century, with emphasis on the early modern world. Ivory trade is set against the backdrop of the environmental and evolutionary history of the elephant. It decouples the commodity from its adjuncts, to encourage a better understanding of the impact of ivory.

C.J. Hemmer, M. Littmann, M. Löbermann, H. Meyer, A. Petschaelis & E.C. Reisinger

Human cowpox virus infection acquired from a circus elephant in Germany

International Journal of Infectious Diseases 14 (2010) e338-e340

Abstract. A 40-year-old Asian circus elephant developed mouth and trunk ulcers. Three weeks later, her 19-year-old animal warden noticed a vesicle on his forearm, evolving into a scab. Identical cowpox strains were isolated from lesions of the elephant and the warden. Cowpox virus could no longer be isolated after the scab disappeared, but PCR still revealed orthopox DNA. Healing was complete seven weeks later, leaving a 1 cm scar.

V. Jantou-Morris, M.A. Horton & D.W. McComb

The nano-morphological relationships between apatite crystals and collagen fibrils in ivory dentine

Biomaterials 31(2010) 5275-5286

Abstract. In this work, analytical transmission electron microscopy (TEM) was used to study the nanostructure of mineralised ivory dentine, in order to gain a clearer understanding of the relationship between the organic (collagen fibrils) and inorganic (calcium phosphate apatite crystals) components. Thin sections prepared by both focused ion beam (FIB) milling and ultramicrotomy, in the longitudinal and transverse planes, were investigated using electron energy-loss spectroscopy (EELS) in a monochromated field-emission gun scanning TEM (FEI Titan 80-300 FEGSTEM). Both low- and core-loss spectroscopy were used in the investigation, and the signals from phosphorous, carbon, calcium, nitrogen and oxygen were studied in detail. A combination of HAADF (high-angle annular dark-field)-STEM imaging and EELS analysis was used for simultaneous acquisition of both spatial and spectral information pixel by pixel (spectrum imaging). Across the collagen D banding in longitudinal sections, the relative thickness of the bright bands was significantly higher than that of the dark bands. Core-loss spectroscopy showed that the bright bands were richer in apatite than the dark bands. However, no ELNES variation was observed across the D banding. In transverse sections, significant changes in the carbon edge fine structure were observed at the interface between the extra- and intra-fibrillar regions. © 2010 Reprinted with permission from Elsevier.

Y. Jin-Long, Y. Rui, W. Deng-Hu, Y. Song-Quan, W. Ming-Shu & C. An-Chun

Simple method for detection of superficial fungal infections in Asian elephant

Journal of Food, Agriculture & Environment 8 (2010) 1225-1226

Abstract. This short communication describes the utility of the Wood's light in a practice that specializes in the evaluation of superficial fungal infections in the Asian elephant. Despite the availability of many 'high-tech' imaging and diagnostic devices designed to evaluate superficial fungal infections, the relatively simple Wood's lamp continues to be of great value. It is encouraged that we not to abandon the use of the Wood's light in wild animal clinical practice. © 2010 WFL Publisher.

R. Joshi

How social are Asian elephants *Elephas maximus*?

New York Science Journal 3 (2010) 27-31

Abstract. The aspect of social organisation is highly developed in elephants and they display a number of usual and unusual behaviours. In this article, some observations from the protected habitats of north-west India studied during 2000-2009, describing elephant's behaviour that reveals signs of sociality and understanding among the Asian elephants are assessed. Study demonstrates that an elephant is well capable to understand the physical proficiency, emotional state and intention of other fellows. Elephants also feel grief and mourn when anyone of their fellow dies. In contrast, most of the wild animals show least interest in skull of their fellows but Asian elephant (*Elephas maximus*) are very receptive towards their relatives and they approaches the skull of died fellow several times and observing them by smelling and touching with their trunk and fore feet. Sometimes they also uplift and carry the small pieces of bones to a very short distance. Besides, elephant produces several effects on the habitat, which play an important role in dynamics of forest ecosystem and in maintaining their relations with other wild animals

C. Kaulfers, F. Geburek, K. Feige & A. Knieriem

Radiographic Imaging and Possible Causes of a Carpal Varus Deformity in an Asian Elephant (*Elephas maximus*)

J. Zoo and Wildlife Medicine 41 (2010) 697-702

Abstract. The carpal region of an Asian elephant (*Elephas maximus*) with a clinically obvious varus deformity of the carpus was examined radiographically with a standard portable x-ray unit. Several dorsopalmar radiographs were taken at a short source-to-image distance, moving the beam center along the carpus. To obtain a single image of the carpal region, radiographs were

assembled digitally using a composite technique. Radiographs revealed a deviation of the limb's axis of approximately 25° in the region of distal physis of the radius and ulna and a wedge-shaped epiphysis of the ulna. Healed physitis due to trauma and subluxation of the middle carpal joint are discussed as possible causes of the deformity. The radiographic technique described proved to be helpful to evaluate a relatively large anatomic area in the carpal region of an adult Asian elephant with a varus deformity and may be an alternative tool to previously described single image radiography. © 2010 American Association of Zoo Veterinarians.

V.B. Kokshenev & P. Christiansen
Salient features in the locomotion of proboscideans revealed via the differential scaling of limb long bones
Biological Journal of the Linnean Society 100 (2010) 16-29
Abstract. The standard differential scaling of proportions in limb long bones (length against circumference) was applied to a phylogenetically wide sample of the Proboscidea, Elephantidae and the Asian (*Elephas maximus*) and African (*Loxodonta africana*) elephants. In order to investigate allometric patterns in proboscideans and terrestrial mammals with parasagittal limb kinematics, the computed slopes between long bone lengths and circumferences (slenderness exponents) were compared with published values for mammals, and studied within a framework of the theoretical models of long bone scaling under gravity and muscle forces. Limb bone allometry in *E. maximus* and the Elephantidae is congruent with adaptation to bending and/or torsion induced by muscular forces during fast locomotion, as in other mammals, whereas the limb bones in *L. africana* appear to be adapted for coping with the compressive forces of gravity. Hindlimb bones are therefore more compliant than forelimb bones, and the resultant limb compliance gradient in extinct and extant elephants, contrasting in sign to that of other mammals, is shown to be a new important locomotory constraint preventing elephants from achieving a full-body aerial phase during fast locomotion. Moreover, the limb bone pattern of African elephants, indicating a noncritical bone stress not increasing with increments in body weight, explains why their mean and maximal body masses are usually above those for Asian elephants. Differences in ecology may be responsible for the subtle differences observed *in vivo* between African and Asian elephants, but they appear to be more pronounced when revealed via mechanical patterns dictated by limb bone allometry. © 2010 The Linnean Society of London.

J.A. Landolfi, S.K. Mikota, J. Chosy, K.P. Lyashchenko, K. Giri, K. Gairhe & K.A. Terio
Comparison of systemic cytokine levels in *Mycobacterium* spp. seropositive and seronegative Asian elephants (*Elephas maximus*)
J. Zoo and Wildlife Medicine 41(2010) 445-455
Abstract. *Mycobacterium* spp. infection is an important health concern for Asian elephant (*Elephas maximus*) populations worldwide. The disease is of particular concern considering its potential to affect not only the individual animal but also herd and public health. Although elephant tuberculosis susceptibility is poorly understood, immune function alterations are central to disease pathogenesis in other species and probably affect outcome of mycobacterial infections in elephants. Measurement of immune mediator (cytokine) levels within blood samples can provide information regarding immune Function that may elucidate disease susceptibility. For this study, mRNA levels of interleukin (IL)-2, IL-4, IL-10, and IL-12; interferon (IFN)-gamma; tumor necrosis factor (TNF)-alpha;

Baby with punk hairstyle (Yala NP, Sri Lanka)
Photo by H. K. Janaka

and transforming growth factor (TGF)-beta were measured using elephant-specific, real-time reverse transcription-polymerase chain reaction (RT-PCR) assays in RNA-preserved whole blood samples from 106 Asian elephants, 15% of which were *Mycobacterium tuberculosis* complex seropositivc. The Elephant TB STAT-PAK(R) (Chembio Diagnostics, Inc., Medford, New York 11763, USA), a novel lateral flow antibody detection assay developed for specific use in elephants, was used to determine serologic status for the study. Seropositive animals had higher levels of TNF-alpha and lower levels of TGF-beta than seronegative animals; these differences between groups were statistically significant when levels were analyzed as categorical variables. Trends toward higher levels of IFN-gamma and IL-4 and slightly lower levels of IL-10 and IL-12 were noted in the seropositive group, although differences between groups were not statistically significant. Presence of other inflammatory conditions was found to be a significant confounding variable in the analysis of the relationship between tuberculosis status and TNF-alpha levels, necessitating its inclusion in statistical models. Age and sex were not found to significantly affect the relationship between tuberculosis status and any of the cytokines measured. Interleukin-2 levels were below the sensitivity of the real-time RT-PCR assay irrespective of tuberculosis status. These findings provide a foundation for future research into the immunopathogenesis of elephant tuberculosis.

W.A. Lindsay, E. Wiedner, R. Isaza, H.G.G. Townsend, M. Boleslawski & D.P. Lunn

Immune responses of Asian elephants (*Elephas maximus*) to commercial tetanus toxoid vaccine

Veterinary Immunology and Immunopathology 133 (2010) 287-289

Abstract. Although captive elephants are commonly vaccinated annually against tetanus using commercially available tetanus toxoid vaccines marketed for use in horses and livestock, no data exists to prove that tetanus toxoid vaccination produces measurable antibody titers in elephants. An ELISA test was created to measure antibody responses to tetanus toxoid vaccinations in 22 Asian elephants ranging in age from 24 to 56 years (mean age 39 years) over a 7-month period. All animals had been previously vaccinated with tetanus toxoid vaccine, with the last booster administered 4 years before the start of the study. The great majority of elephants had titers prior to booster vaccination, and following revaccination all elephants demonstrated anamnestic increases in titers, indicating that this species does respond to tetanus vaccination. Surprisingly older animals mounted a significantly higher response to revaccination than did younger animals. © 2010 Reprinted with permission from Elsevier.

J. Lorimer

Elephants as companion species: the lively biogeographies of Asian elephant conservation in Sri Lanka

Transactions of the Institute of British Geographers 35 (2010) 491-506

Abstract. This paper aims to open conversations between human and physical geographers interested in the diversity and dynamics of life and ways of ensuring their future flourishing. It brings together a revitalised human geography with recent work in biogeography to develop lively biogeographies for intradisciplinary rapprochement and collaboration. The paper outlines connections and tensions between these fields and examines the resources that they offer for new approaches to conservation geographies. The potential of lively biogeographies is illustrated through a detailed investigation of human-elephant companionship and conservation in Sri Lanka. Multidisciplinary methodologies are provided for tracing human-elephant relationships. Critically exploring examples of contemporary practice, the paper then presents three important dimensions of convivial biogeographies for Asian elephant conservation. These relate to concerns of nonhuman difference, interspecies conviviality and cosmopolitan environmentalism. In conclusion, the paper reflects on some of the challenges that emerge from this new approach to biogeography and appeals for future research and collaborations. © 2010 Royal Geographical Society (with the Institute of British Geographers).

I. Lueders, C. Niemuller, C. Gray, P. Rich & T.B. Hildebrandt

Luteogenesis during the estrous cycle in Asian elephants (*Elephas maximus*)

Reproduction 140 (2010) 777-786

Abstract. The occurrence of multiple corpora lutea (CLs) in the ovaries of the cycling and pregnant elephant, a monovulatory mammal, has driven scientific discussions during the past five decades. However, fundamental knowledge on luteogenesis is lacking. In this long-term study, CL formation and regression throughout the estrous cycle were monitored using transrectal 2D- and 3D ultrasonography in 33 captive Asian elephants. Serum or urinary progestagens (Pm) were measured to determine the reproductive cycle stage. In seven females, serum Pm and LH concentrations were directly related to ovarian events. We have found two different modalities of luteal development: one for the accessory CL (acCL) and one for the ovulatory CL (ovCL). acCLs were derived from luteinization of larger, subordinate follicles after the first anovulatory LH peak. The dominant follicle produced the largest CL after the second (ovulatory) LH peak. The first luteal tissue formation became visible ~10 days after the respective LH peak. After ovulation, it took 29.8±5.0 days for the acCLs to reach their maximum diameter, whereas the ovCL reached a significantly larger size (33.2±2.3 mm, P<0.0001) about 10–15 days later. All CLs were visible throughout the new follicular phase, with some of the larger ones still present in the subsequent luteal period. In this study, we have demonstrated that Asian elephants have evolved a novel method for luteal development and function, and by repeatedly forming two types of distinctly different CLs for every reproductive cycle, they have ensured that there will be sufficient luteal capacity for maintaining a 22-month pregnancy should conception occur. © 2010 Society for Reproduction and Fertility.

P.R. Manger, J. Hemingway, M. Haagensen & E. Gilissen

Cross-sectional area of the elephant corpus callosum: comparison to other eutherian mammals

Neuroscience 167 (2010) 815-824

Abstract. The current study reports our findings of the relationship between cross-sectional area of the corpus callosum and brain mass in over 100 eutherian mammal species. We were specifically interested in determining whether the elephant had a corpus callosum the size that would be expected for eutherian mammal with a brain mass of approximately 5000 g, or whether a different morphology had evolved. To answer this question we first analysed data from primates, other eutherian mammals and cetaceans, finding that primates and other eutherian mammals showed a positive allometric relationship between the two variables, such that larger brains had a relatively larger corpus callosum. Interestingly, primates have a slightly larger corpus callosum than other eutherian mammals, but showed a similar allometric scaling to this group. The cetaceans had a both absolutely and relatively small corpus callosum compared to other mammals and showed isometric scaling with brain mass. The six elephants studied herein had the largest absolute corpus callosums recorded to date; however, relative to the mass of their brain, the size of the corpus callosum was what would be expected of a typical eutherian mammal with a brain mass of approximately 5000 g. The data for elephants hinted at sexual dimorphism in size of the corpus callosum, with female elephants having both an absolute and relatively larger callosum than the males. If this observation is supported in future studies, the elephants will be the first non-primate species to show sexual dimorphism in this neural character. The results are discussed in both an evolutionary and functional context.© 2010 Reprinted with permission from Elsevier.

K. Meyer, J. Hummel & M. Clauss

The relationship between forage cell wall content and voluntary food intake in mammalian herbivores

Mammal Review 40 (2010) 221-245

Abstract. 1. It is generally assumed that animals compensate for a declining diet quality with increasing food intake. Differences in the response to decreasing forage quality in herbivores have been postulated particularly between cattle (ruminants) and horses (hindgut fermenters). However, empirical tests for both assumptions in herbivorous mammals are rare. 2. We collected data on voluntary food intake in

mammals on forage-only diets and related this to dietary neutral detergent fibre (NDF) content, assuming a nonlinear correlation between these measurements. Generally, the paucity of corresponding data is striking. 3. Elephants and pandas showed very high food intakes that appeared unrelated to dietary fibre content. Only in small rodents, and possibly in rabbits, was an increase in food intake on forages of higher NDF content evident. In particular, other large herbivores, including horses, followed patterns of decreasing intake with increasing forage NDF, also observed in domestic cattle or sheep. 4. For large herbivores, empirical data therefore do not - so far - support the notion that intake is increased in response to declining diet quality. However, data are in accord with the assumption that most large herbivores have an anticipatory strategy of acquiring body reserves when high-quality forage is available, and reducing food intake (and potentially metabolic losses) when only low-quality forage is available. 5. Intake studies in which the influence of digestive strategy on food intake capacity is tested should be designed as long-term studies that outlast an anticipatory strategy and force animals to ingest as much as possible. 6. We suggest that a colonic separation mechanism coupled with coprophagy, in order to minimize metabolic faecal losses, is necessary below a body size threshold where an anticipatory strategy (living off body reserves, migration) is not feasible. Future studies aimed at investigating fine-scale differences, for example between equids and bovids, should focus on non-domesticated species. © 2010 The Authors.

H.L. More, J.R. Hutchinson, D.F. Colllins, S.K.H. Aung & J.M. Donelan

Scaling of sensorimotor control in terrestrial mammals

Proc. of the Royal Society B 277 (2010) 3563-68

Abstract. Sensorimotor control is greatly affected by two factors—the time it takes for an animal to sense and respond to stimuli (responsiveness), and the ability of an animal to distinguish between sensory stimuli and generate graded muscle forces (resolution). Here, we demonstrate that anatomical limitations force a necessary trade-off between responsiveness and resolution with increases in animal size. To determine whether responsiveness is prioritized over resolution, or resolution over responsiveness, we studied how size influences the physiological mechanisms underlying sensorimotor control. Using both new electrophysiological experiments and existing data, we determined the maximum axonal conduction velocity (CV) in animals ranging in size from shrews to elephants. Over the 100-fold increase in leg length, CV was nearly constant, increasing proportionally with mass to the 0.04 power. As a consequence, larger animals are burdened with relatively long physiological delays, which may have broad implications for their behaviour, ecology and evolution, including constraining agility and requiring prediction to help control movements. © 2010 The Royal Society.

J. Pastorini, H.G. Nishantha, H.K. Janaka, K. Isler & P. Fernando

Water body use by Asian elephants in southern Sri Lanka

Tropical Conserv. Science 3 (2010) 412-422

Abstract. We assessed water-body use by elephants through monitoring elephant signs around them. Elephant footprints and dung piles were recorded at 25 water bodies fortnightly for one year. Elephants preferred perennial water bodies and avoided those with temporary human dwellings. Human activities did not significantly affect elephant use of water bodies, suggesting low incidence of activities and behavioral adaptation to them by elephants. Elephant signs at perennial water bodies increased in the dry season. The monitoring technique was able to detect differences in elephant densities in two areas and establish the presence of herds even at low densities. We conclude that outside protected areas, large perennial water bodies represent a preferred resource for elephants, and that assessing elephant signs around water bodies is a useful technique for monitoring elephant presence for management and research purposes. © 2010 The Authors.

C. Plumb

'Strange and wonderful': Encountering the elephant in Britain, 1675-1830

Journal for Eighteenth-Century Studies 33 (2010) 525-543

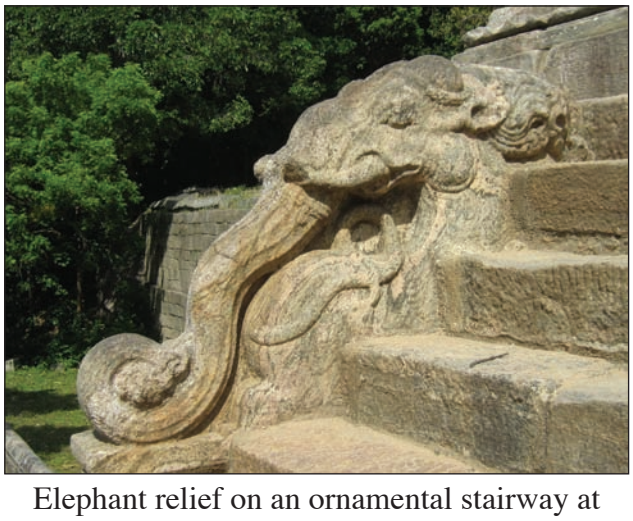
Abstract. This paper follows in the footsteps of the three live elephants that came to Britain in 1675, 1683 and 1720, before charting the changing cultural taxonomy of the elephant from the second half of the eighteenth century. The shifting understandings of what constituted an elephant's anatomy and character are significant to interpreting divergent and overlapping taxonomies in the long eighteenth century. In a period when different classification systems were rigorously debated, this paper proposes an understanding of the elephant that is not essentialist but rather understands 'species' as cultural, historically made and transformed. © 2010 British Society for 18th Century Studies.

N. Rohland, D. Reich, S. Mallick, M. Meyer, R.E. Green, N.J. Georgiadis, A.L. Roca & M. Hofreiter

Genomic DNA sequences from mastodon and woolly mammoth reveal deep speciation of forest and savanna elephants

PLosS Biology 8 (2010) e1000564

Abstract. To elucidate the history of living and extinct elephantids, we generated 39,763 bp of aligned nuclear DNA sequence across 375 loci for African savanna elephant, African forest elephant, Asian elephant, the extinct American mastodon, and the woolly mammoth. Our data establish that the Asian elephant is the closest living relative of the extinct mammoth in the nuclear genome, extending previous findings from mitochondrial DNA analyses. We also find that savanna and forest elephants, which some have argued are the same species, are as or more divergent in the nuclear genome as mammoths and Asian elephants, which are considered to be distinct genera, thus resolving a long-standing debate about the appropriate taxonomic classification of the African elephants. Finally, we document a much larger effective population size in forest elephants compared with the other elephantid taxa, likely reflecting species differences in ancient geographic structure and range and differences in life history traits such as variance in male reproductive success. © 2010 The Authors.



Elephant relief on an ornamental stairway at Yapahuwa, Sri Lanka (built in 1273)

E. Rood, A.A. Ganie & V. Nijman

Using presence-only modelling to predict Asian elephant habitat use in a tropical forest landscape: implications for conservation

Diversity and Distributions 16 (2010) 975-984

Abstract. Asian elephants, *Elephas maximus*, are threatened throughout their range by a combination of logging, large scale forest conversion and conflict with humans. We investigate which environmental factors, both biotic and abiotic, constrain the current distribution of elephants. A spatially explicit habitat model is constructed to find core areas for conservation and to assess current threats. Location: Ulu Masen Ecosystem in the province of Nanggroe Aceh Darussalam on the island of Sumatra, Indonesia. Methods: A stratified survey was conducted at 12 sites (300 transects) to establish the presence of elephants. Presence records formed the basis to model potential habitat use. Ecological niche factor analysis (ENFA) is used to describe their niche and to identify key factors shaping elephant distribution. An initial niche model was constructed to describe elephant niche structure, and a second model focused on identifying core areas only. To assess the threat of habitat encroachment, overlap between the elephants' optimal niche and the occurrence of forest encroachment is computed. Results: Elephants were recorded throughout the study area from sea level to 1600 m a.s.l. The results show that the elephant niche and consequently habitat use markedly deviates from the available environment. Elephant presence was positively related to forest cover and vegetation productivity, and elephants were largely confined to valleys. A spatially explicit model showed that elephants mainly utilize forest edges. Forest

encroachment occurs throughout the elephants range and was found within 80% of the elephants' ecological niche. Main conclusions: In contrast to general opinion, elephant distribution proved to be weakly constrained by altitude, possibly because of movement routes running through mountainous areas. Elephants were often found to occupy habitat patches in and near human-dominated areas. This pattern is believed to reflect the displacement of elephants from their former habitat. © 2010 Blackwell Publishing Ltd.

C. Santiapillai & B. Read

Would masking the smell of ripening paddy-fields help mitigate human–elephant conflict in Sri Lanka?

Oryx 44 (2010) 509-511

Abstract. Despite its small size and high human population Sri Lanka is home to c. 4400 wild Asian elephants *Elephas maximus*. Human–elephant conflict around agriculture is severe, with c. 100 elephants and c. 50 people killed annually. Elephants appear to be able to time their raiding of paddy-fields in Sri Lanka with the harvesting of the rice, as if they are responding to an olfactory trigger. It is the elephant's sophisticated chemosensory system that may hold the key to resolving human–elephant conflict. Research is required to determine the odours associated with the various development stages of rice, using gas chromatography, and to find a suitable substance that could be used to mask the specific odour of ripening rice. The use of chemosensory-based methods, if feasible, will not be a universal panacea for the mitigation of human–elephant conflict but, in combination with other methods, could reduce conflict and make it easier for farmers to harvest their crops in safety. Such a combination of methods could be useful across the range of both Asian and African elephants. © 2010 Fauna & Flora International.

C. Santiapillai, S. Wijeyamohan, G. Bandara, R. Athurupana, N. Dissanayake & B. Read

An assessment of the human-elephant conflict in Sri Lanka

Ceylon Journal of Science (Biological Sciences) 39 (2010) 21-33

Abstract. The association between man and elephant in Sri Lanka is ancient. Elephants being the largest terrestrial herbivores require relatively large areas and diversity of environments to forage. With the increase in human population density and changes in the land-use patterns, elephant habitat is being continuously reduced. As a result, much of the present day elephant range extends into and overlaps with agricultural lands resulting in conflict with man. The assessment of the human-elephant conflict was carried out from January to March 2008 through the use of a questionnaire in 100 villages selected randomly from five provinces whose combined extent is 42,559 km^2 which amounts roughly to 65% of the total land area of Sri Lanka. 65% of the respondents identified crop depredations with bull elephants, both young and old. At least 13 food items have been identified by the villagers as preferred by wild elephants in agricultural areas. Crop damage to paddy accounted for 69% of the complaints. At the same time, most of the farmers identified citrus trees as the most likely crop to be avoided by elephants. Failure to recognize the significance of the human-elephant conflict can result in a negative attitude to elephants and apathy or indifference to conservation initiatives. Although it is unlikely that the human-elephant conflict can be eliminated altogether, yet every effort must be taken to reduce it to tolerable levels.

A.H.M.R. Sarker & E. Røskaft

Human attitudes towards conservation of Asian elephants (*Elephas maximus*) in Bangladesh

International Journal of Biodiversity and Conservation 2 (2010) 316–327

Abstract. An assessment of human attitudes, particularly towards Asian elephant (*Elephas maximus*), is necessary in formulating appropriate policies for conserving such wildlife. The aim of this study is to test the extent of how the experience people have of wild elephants influences their perceptions of, and attitudes towards, them, and to identify factors influencing their attitudes towards the conservation of elephants in the wild. This study was carried out in four protected areas (PAs) in Bangladesh through in-depth interviews of men (N=193) and women (N=195). The majority of the respondents said that wild elephants caused anxiousness. The

most important factors influencing the attitudes of people towards conservation regimes for wild elephants were the distances of the people that lived from the park boundary. Forest villagers residing in northern Bangladesh (70.5%) were more likely to support the conservation of wild elephants in their nearest PA through eco-tourism than those residing in south-eastern parts of the country (43.1%). This was due to a lack of natural resources in the forests and an unemployment crisis in the northern part. The introduction of environmental studies into primary and secondary schools, and the promotion of public participation in planning, decision-making and management of PAs, has been an important aspect for the sustainability of elephant conservation in Bangladesh.. © 2010 Academic Journals.

W. Schaftenaar, C. Reid, B. Martina, J. Fickel & A.D.M.E. Osterhaus

Nonfatal clinical presentation of elephant endotheliotropic herpes virus discovered in a group of captive Asian elephants (*Elephas maximus*)

J. Zoo and Wildlife Medicine 41 (2010) 626-632

Abstract. Several different strains of elephant endotheliotropic herpes virus-1 (EEHV-1) have been identified via polymerase chain reaction (PCR) techniques in both African and Asian elephants. EEHV-1 has been identified in both cutaneous lesions in healthy African elephants and fatal cases of hemorrhagic syndrome in Asian elephants. However, until now, no EEHV-1 strain has been identified or associated with otherwise healthy Asian elephants. This article describes recurrent nonendothelial lesions associated with EEHV-1 infection in a herd of Asian elephants not exhibiting fatal hemorrhagic syndrome. Genotypes of EEHV-1 strains, based on viral DNA polymerase and glycoprotein B, associated with fatal hemorrhagic syndrome, were compared to those identified in nonendothelial lesions. The same EEHV-1 genotypes were identified in fatal cases and mucosal lesions in otherwise healthy Asian elephants in this herd. Further studies of the Asian elephant immune system and virologic studies to determine the triggers of tissue tropism are needed before any conclusion can be reached. © 2010 American Association of Zoo Veterinarians.

S. Sivilaikul, A. Jitprom, A. Kularb, K. Kornkaewrut, P. Suthanmaphinuth, S. Mahasawangkul, K. Saikhun, W. Wajjwalku & S. Thongtipsiridech

Relationship between seminal and serum calcium concentration with semen quality in the Asian elephant (*Elephas maximus*)

Thai J. Veterinary Medicine 40 (2010) 251-255

Abstract. The purpose of this study is to identify the relationship of calcium concentration in seminal plasma on elephant semen quality including of volume, concentration, pH and percentage of progressive motility, dead sperm and abnormal morphology, respectively. Semen collection and evaluation were done in 9 elephants of Thai Elephant Conservation Centre, National Elephant Institute, Forest Industry Organization at Lampang. Calcium in seminal plasma was measured by using colorimetric method. Data were analyzed by using Linear Regression. The results revealed that amount of calcium in seminal plasma was negative correlated with only percentage of progressive motility ($p< 0.05$). Ejaculates were separated into three groups based on their progressive motility percentage including of low, moderate and high-motile semen (0-5%,> 5-40% and >50%, respectively) and analyzed by using Repeated measure ANOVA. The results revealed that percentage of dead sperm and abnormal morphology and concentration of calcium in seminal plasma of all groups were significantly difference ($p< 0.05$). Percentage of dead sperm and seminal calcium concentration was highest in low-motile group ($p< 0.05$). The highest percentage of abnormal morphology was also found in the low-motile group ($p< 0.05$). However, serum calciums were not different among each group. Thus, calcium in seminal plasma may be effected to semen quality; ie progressive motility of Asian elephant. However, there are other factors that can influence elephant semen quality, thus, more information are needed to improve the better knowledge in male elephant reproductive biology.

L.M. Tana, R. Isaza, D.E. Koch & R.P. Hunter

Pharmacokinetics and intramuscular bioavailability of a single dose of butorphanol in Asian elephants (*Elephas maximus*)

J. Zoo and Wildlife Medicine 41 (2010) 418-425

Abstract. Captive Asian elephants (*Elephas maximus*) are susceptible to lameness resulting from foot and joint pain, including chronic arthritis. In the past, opioid analgesics, such as butorphanol, have been used clinically for pain management. However, dosages used in treating elephants were often extrapolated from data in horses, with no pharmacokinetic information on the specific agents used in elephant species. In this pharmacokinetic study, six adult captive Asian elephants (5 female, 1 male castrate) were administered a 0.015 mg/kg dose of butorphanol by both i.v. and i.m. routes. A complete crossover design was used with a 3-wk washout period between treatments. Serial blood samples were collected immediately prior to butorphanol administration and at 5, 10, 20, and 40 min and 1, 1.5, 2, 3, 4, 5, 6, 8, 10, and 24 h after administration. The butorphanol analysis was performed using a validated liquid chromatography mass spectrophotometric assay with a limit of quantitation of 0.025 ng/ml. The mean C-max after i.m. administration was 7.9 ng/ml, with a corresponding T-max of 40 min and t(1/2) of 7.1 h. After i.v. administration, the mean Vd(ss) was 1.4 L/kg and the mean Cl-p was 0.26 L/kg/h. Mean i.m. bioavailability was 37%. The results indicate that butorphanol used at 0.015 mg/kg i.m. or i.v. could be useful in elephants when given for pain control. © 2010 American Association of Zoo Veterinarians.

S. Thapa

Effectiveness of crop protection methods against wildlife damage: A case study of two villages at Bardia National Park, Nepal

Crop Protection 29 (2010) 1297-1304

Abstract. Conflicts due to damage caused by wildlife pose serious threats to conservation. In addition, wildlife damage incurs severe economic loss to communities living in the close vicinity of the park, affecting the livelihoods and well-being of locals. While different studies have emphasised identification and quantification of crop damage problems, studies highlighting the means used for crop protection and their effectiveness are limited. This study aimed to examine the effectiveness of means used by communities to protect their crops against wildlife. 117 households were visited at two Buffer Zone villages of Bardia National Park, Nepal. Findings suggested that crop depredation by wildlife was a function of several factors, such as the distance of the farmland from the park, the size of the crop raiding animals and the frequency of attacks on the farmland, and the type of crops. Ten different means were identified by communities which were used regularly to prevent crop damage. Households combined both traditional and modern means to guard their crop against the wild animals. Means differed according to the animals as well as crops being protected. Among all these means, Machan (i.e. watch towers) combined with other means such as throwing flaming sticks and group shouting were the most effective and safest modes of crop guarding for all kinds of animals and crops. Trench and Bio-fencing were effective mostly for deer species. However, crop guarding was an intensive process and no means were able to completely prevent crop damage. Problem animals differed according to the villages and crops being damaged, which suggests that employment of single means would be ineffective. Site-specific management strategies and economic as well as technical support from funding organisations would be most useful to minimise crop loss. In addition information exchange and learning between farmers and the park management about different mitigating means could support and prepare farmers for improvement in the means. © 2010 Reprinted with permission from Elsevier.

T.N.C. Vidya & V. Thuppil

Immediate behavioural responses of humans and Asian elephants in the context of road traffic in southern India

Biological Conservation 143 (2010) 1891-1900

Abstract. With expanding human populations, exponentially increasing motor vehicles, and public roads running through Protected Areas, road traffic is becoming an increasing concern in many countries. While studies have traditionally examined the role of highways in fragmenting and decimating animal populations, we carried out one of the first studies of the immediate behavioural responses, rather than inferring eventual consequences, of motorists and wildlife towards each other. We inspected variables such as vehicle size, type, and origin, and elephant group composition, amongst others, to study

motorist-elephant responses along highways in Mudumalai Wildlife Sanctuary, southern India. Based on 1521 motorist-elephant interactions, we found higher odds of more severe to less severe motorist response in passenger (versus goods) vehicles, visiting (versus local) vehicles, and in vehicles of particular size classes. Overall, elephant responses to vehicles increased in severity with increasing vehicle size and motorist response. Although motorists in heavy vehicles caused the least disturbance, elephants were most affected by heavy vehicles (because of their size) and generally tolerated smaller vehicles, even those that created significant disturbance. We suggest that an understanding of sensory biases of animals is important in the management of human-wildlife conflict as these could lead to the outcome of interactions being contrary to expectation. This is also one of the first uses of ordinal multinomial generalized linear models to studies of human-wildlife conflict, and we suggest its application to the data often obtained in this field. © 2010 Reprinted with permission from Elsevier.

S. Wijeyamohan, B. Read & C. Santiapillai
Obtaining accurate body weights of captive elephants in Sri Lanka
Current Science 99 (2010) 1033-1035
Abstract. none

B.C. Yates, E.O. Espinoza & B.W. Baker
Forensic species identification of elephant (Elephantidae) and giraffe (Giraffidae) tail hair using light microscopy
Forensic Science Medicine and Pathology 6 (2010) 165-171
Abstract. Here we present methods for distinguishing tail hairs of African elephants (*Loxodonta africana*), Asian elephants (*Elephas maximus*), and giraffes (*Giraffa camelopardalis*) from forensic contexts. Such hairs are commonly used to manufacture jewelry artifacts that are often sold illegally in the international wildlife trade. Tail hairs from these three species are easily confused macroscopically, and morphological methods for distinguishing African and Asian tail hairs have not been published. We used cross section analysis and light microscopy to analyze the tail hair morphology of 18 individual African elephants, 18 Asian elephants, and 40 giraffes. We found that cross-sectional shape, pigment placement, and pigment density are useful morphological features for distinguishing the three species. These observations provide wildlife forensic scientists with an important analytical tool for enforcing legislation and international treaties regulating the trade in elephant parts. © 2010 Springer Science+Business Media.

Loku Maama (collared elephant) with two friends in Kaudulla National Park (Sri Lanka)