

Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

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U. Bechert, J.M. Christensen, C. Nguyen, R. Neelkant & E. Bendas

Pharmacokinetics of orally administered phenylbutazone in African and Asian elephants (*Loxodonta africana* and *Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 188–200

Abstract. The pharmacokinetic parameters of phenylbutazone were determined in 18 elephants (*Loxodonta africana* and *Elephas maximus*) after single-dose oral administration of 2, 3, and 4 mg/kg phenylbutazone, as well as multiple-dose administrations with a 4-wk washout period between trials. After administration of 2 mg/kg phenylbutazone, mean serum concentrations peaked in approximately 7.5 hr at 4.3 ± 2.02 $\mu\text{g/ml}$ and 9.7 hr at 7.1 ± 2.36 $\mu\text{g/ml}$ for African and Asian elephants, respectively, while 3 mg/kg dosages resulted in peak serum concentrations of 7.2 ± 4.06 $\mu\text{g/ml}$ in 8.4 hr and 12.1 ± 3.13 $\mu\text{g/ml}$ in 14 hr. The harmonic mean half-life was long, ranging between 13 and 15 hr and 39 and 45 hr for African and Asian elephants, respectively. There was evidence of enterohepatic cycling of phenylbutazone in Asian elephants. Significant differences ($P < 0.0001$) in pharmacokinetic values occurred between African and Asian elephants for clearance (27.9 and 7.6 ml/hr/kg, respectively), terminal half-life (15.0 and 38.7 hr, respectively), and mean residence time (22.5 and 55.5 hr, respectively) using 2-mg/kg dosages as an example. This suggests that different treatment regimens for Asian and African elephants should be used. There were no apparent gender differences in these parameters for either elephant species. © 2008 American Association of Zoo Veterinarians.

L.A. Bates, P.C. Lee, N. Njiraini, J.H. Poole, K. Sayialel, S. Sayialel, C.J. Moss, R.W. Byrne

Do Elephants Show Empathy?

Journal of Consciousness Studies 15, #10-11

(2008) 204-225

Abstract. Elephants show a rich social organization and display a number of unusual traits. In this paper, we analyse reports collected over a thirty-five year period, describing behaviour that has the potential to reveal signs of empathic understanding. These include coalition formation, the offering of protection and comfort to others, retrieving and ‘babysitting’ calves, aiding individuals that would otherwise have difficulty in moving, and removing foreign objects attached to others. These records demonstrate that an elephant is capable of diagnosing animacy and goal directedness, and is able to understand the physical competence, emotional state and intentions of others, when they differ from its own. We argue that an empathic understanding of others is the simplest explanation of these abilities, and discuss reasons why elephants appear to show empathy more than other non-primate species. © 2008 Imprint Academic.

A. Campos-Arceiz, A.R. Larrinaga, U.R. Weerasinghe, S. Takatsuki, J. Pastorini, P. Leimgruber, P. Fernando & L. Santamaría

Behavior rather than diet mediates seasonal differences in seed dispersal by Asian elephants

Ecology 89 (2008) 2684–2691

Abstract. Digestive physiology and movement patterns of animal dispersers determine deposition patterns for endozoochorously dispersed seeds. We combined data from feeding trials, germination tests, and GPS telemetry of Asian elephants (*Elephas maximus*) to (1) describe the spatial scale at which Asian elephants disperse seeds; (2) assess whether seasonal differences in diet composition and ranging behavior translate into differences in seed shadows; and (3) evaluate whether scale and seasonal patterns vary between two ecologically distinct areas: Sri Lanka’s dry monsoon forests and Myanmar’s (Burma)

mixed-deciduous forests. The combination of seed retention times (mean 39.5 h, maximum 114 h) and elephant displacement rates (average 1988 m in 116 hours) resulted in 50% of seeds dispersed over 1.2 km (mean 1222–2105 m, maximum 5772 m). Shifts in diet composition did not affect gut retention time and germination of ingested seeds. Elephant displacements were slightly longer, with stronger seasonal variation in Myanmar. As a consequence, seed dispersal curves varied seasonally with longer distances during the dry season in Myanmar but not in Sri Lanka. Seasonal and geographic variation in seed dispersal curves was the result of variation in elephant movement patterns, rather than the effect of diet changes on the fate of ingested seeds. © 2008 Ecological Society of America.

R. Clubb, M. Rowcliffe, P. Lee, K.U. Mar, C. Moss, G.J. Mason

Compromised survivorship in zoo elephants

Science 322 (2008) 1649

Abstract. We analyzed data from over 4500 elephants to show that animals in European zoos have about half the median life span of conspecifics in protected populations in range countries. This discrepancy is clearest in Asian elephants; unlike African elephants in zoos, this species' infant mortality is very high (for example, twice that seen in Burmese timber camps), and its adult survivorship in zoos has not improved significantly in recent years. One risk factor for Asian zoo elephants is being moved between institutions, with early removal from the mother tending to have additional adverse effects. Another risk factor is being born into a zoo rather than being imported from the wild, with poor adult survivorship in zoo-born Asians apparently being conferred prenatally or in early infancy. We suggest stress and/or obesity as likely causes of zoo elephants' compromised survivorship. © 2008 Reprinted with permission from AAAS.

R. Hermes, J. Saragusty, W. Schaftenaar, F. Göritz, D.L. Schmitt & T.B. Hildebrandt

Obstetrics in elephants

Theriogenology 70 (2008) 131-144

Abstract. Obstetrics, one of the oldest fields in veterinary medicine, is well described and practiced in domestic and exotic animals.

However, when providing care during elephant birth or dystocia, veterinary intervention options differ greatly from any domestic species, and are far more limited due to the dimensions and specific anatomy of the elephant reproductive tract. In addition, aging of captive elephant populations and advanced age of primiparous females make active birth management increasingly important. Intrauterine infection, uterine inertia and urogenital tract pathologies are emerging as major causes for dystocia, often leading to foetal and dam death. This paper reviews the current knowledge on elephant birth and the factors associated with dystocia. It then summarises recommendations for birth and dystocia management. As Caesarean section, the most common ultima ratio in domestic animal obstetrics, is lethal and therefore not an option in the elephant, non-invasive medical treatment, induction of the Ferguson reflex or the conscious decision to leave a retained foetus until it is expelled voluntarily, are key elements in elephant obstetrics. Surgical strategies such as episiotomy and foetotomy are sometimes inevitable in order to try to save the life of the dam, however, these interventions result in chronic post-surgical complications or even fatal outcome. Limited reliable data on serum calcium concentrations, and pharmacokinetics and effect of exogenous oestrogen, oxytocin, and prostaglandins during birth provide the scope of future research, necessary to advance scientific knowledge on obstetrics in elephants. © 2008 Reprinted with permission from Elsevier.

R. Ingomar Petersen & K.K.B. Dahl

How to keep elephants in a glass house - A new elephant house for the Copenhagen Zoo

Structural Engineering International 18 (2008) 227-229

Abstract. When the end-user is a herd of Asian elephants weighing up to 5500 kg each, extra care is needed in the design of the physical environment. Even more so when the requirement for natural daylight makes it necessary to provide the building with a glass roof. The new elephant house of the Copenhagen Zoo is intended to set a benchmark for all future housing of elephants in inner city zoos that come under the northern climate zone. The 3300 m² building with 5000

m² landscaped outdoor facilities will provide the zoo's herd of eight Asian elephants with the best in animal husbandry and welfare. For a structural engineer, the design of an elephant house is "back to first principles" in the determination of the loads and in making sure that adequate robustness is provided. Visitors to the new structure will also place a large demand on the strength of the building, as more than 1,2 million visitors will pass through the building each year. Among these will be parents with prams and school children, making it essential that the visitors' section of the building also must be able to resist considerable wear and tear. © 2008 International Association for Bridge and Structural Engineering.

R. Joshi & R. Singh

Asian elephant (*Elephas maximus*) and riparian wildlife corridors: A case study from lesser-Himalayan zone of Uttarakhand

The Journal of American Science 4 (2008) 63-75

Abstract. Developmental activities are increasingly recognized as the cause of habitat fragmentation and shrinking of wildlife corridors. This study assessed the status and importance of the Chilla – Motichur and Khara – Anjani riparian wildlife corridor in northern India. We review the potential involvement of developmental activities in the recent past, which has affected frequent movement of Asian elephant (*Elephas maximus*) within their home range. These corridors linking the Chilla forest with Motichur

forest and Shyampur forest are subjected to severe anthropogenic pressures. Livestock grazing, fuel wood collection and movement of people are the major activities observed in both corridors. These anthropogenic activities have substantially affected the movement of elephant within their home range and have led to the loss of forests connectivity. The long-term effects will include genetic isolation, habitat fragmentation within the same forest and enhancement in the human-elephant conflict in adjoining areas. Genetic isolation of elephant populations may also increase the chances of replacement of interbreeding to intra-breeding, and thereby reduce the population persistence even for wide ranging wildlife species. Additionally, minimization of all kinds of biotic pressures in the corridor areas and providing higher protection to riparian wildlife corridors are highly recommended. © 2008 The Journal of American Science.

L. Lin, L. Feng, W. Pan, X. Guo, J. Zhao, A. Luo & L. Zhang

Habitat selection and the change in distribution of Asian elephants in Mengyang Protected Area, Yunnan, China

Acta Theriologica 53 (2008) 365-374

Abstract. Elephants were confined to Mengyang Protected Area in China and their distribution range had reduced greatly compared to past records. A preliminary study of habitat selection by Asian elephants *Elephas maximus* Linnaeus, 1758 and their distribution was conducted in



Worshipping at the 'Temple of the Tooth' before the Kandy perahera, Sri Lanka (2008)
Photo by Jennifer Pastorini

Mengyang Protected Area and its surrounds using site visits and transect surveys from July 2003 to December 2006. Although no variable significantly influenced their habitat selection, elephants still showed preference for altitudes between 900 and 1200 m, gradients < 30°, and orientations to the south-east, south and south-west. Human activities, including habitat transformation and degradation, disturbance by large infrastructure and poaching were considered to be the main factors inducing elephant distribution changes. © 2008 Mammal Research Institute Polish Academy of Sciences.

A. Menargues, V. Urios & M. Mauri

Welfare assessment of captive Asian elephants (*Elephas maximus*) and Indian rhinoceros (*Rhinoceros unicornis*) using salivary cortisol measurement

Animal Welfare 17 (2008) 305-312

Abstract. The measurement of salivary cortisol allows non-invasive assessment of welfare in captive animals. We utilised this technique to test the effect of zoo opening on six Asian elephants and two Indian rhinoceros at the Terra Natura Zoological Park, Alicante, Spain, during pre-opening, opening and post-opening periods. Salivary cortisol concentrations were found to be significantly higher during the opening period than during pre- and post-opening periods for both species. This method could prove a useful tool in monitoring the success of decisions taken to improve the welfare of captive animals. © 2008 Universities Federation for Animal Welfare.

L. Ren, M. Butler, C. Miller, H. Paxton, D. Schwerda, M.S. Fischer & J.R. Hutchinson

The movements of limb segments and joints during locomotion in African and Asian elephants

The Journal of Experimental Biology 211 (2008) 2735-2751

Abstract. As the largest extant terrestrial animals, elephants do not trot or gallop but can move smoothly to faster speeds without markedly changing their kinematics, yet with a shift from vaulting to bouncing kinetics. To understand this unusual mechanism, we quantified the forelimb and hindlimb motions of eight Asian elephants (*Elephas maximus*) and seven African elephants

(*Loxodonta africana*). We used 240 Hz motion analysis (tracking 10 joint markers) to measure the flexion/extension angles and angular velocities of the limb segments and joints for 288 strides across an eightfold range of speeds (0.6–4.9 m s⁻¹) and a sevenfold range of body mass (521–3684 kg). We show that the columnar limb orientation that elephants supposedly exemplify is an oversimplification – few segments or joints are extremely vertical during weight support (especially at faster speeds), and joint flexion during the swing phase is considerable. The ‘inflexible’ ankle is shown to have potentially spring-like motion, unlike the highly flexible wrist, which ironically is more static during support. Elephants use approximately 31–77% of their maximal joint ranges of motion during rapid locomotion, with this fraction increasing distally in the limbs, a trend observed in some other running animals. All angular velocities decrease with increasing size, whereas smaller elephant limbs are not markedly more flexed than adults. We find no major quantitative differences between African and Asian elephant locomotion but show that elephant limb motions are more similar to those of smaller animals, including humans and horses, than commonly recognized. Such similarities have been obscured by the reliance on the term ‘columnar’ to differentiate elephant limb posture from that of other animals. Our database will be helpful for identifying elephants with unusual limb movements, facilitating early recognition of musculoskeletal pathology. © 2008 The Company of Biologists.

J. Siegal-Willott, R. Isaza, R. Johnson & M. Blaik

Distal limb radiography, ossification, and growth plate closure in the juvenile Asian elephant (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 320–334

Abstract. Eleven juvenile Asian elephants (*Elephas maximus*) were evaluated radiographically to determine the relative times of growth plate closure and phalangeal ossification in the bones of the distal forelimb. Specifically, the first, second, and third phalanges of the third digit (D3) were evaluated, as well as the third phalanx of digits 1, 2, 4, and 5. All elephants

were healthy at the time of examination. A retrospective evaluation of radiographs from six of the 11 juvenile elephants was also completed to augment the data set. This study reports the methods used to obtain high-quality radiographs of the distal juvenile elephant limb, ossification characteristics of the phalanges, relative times of growth plate closure within the proximal phalanges of D3, and a method for age estimation based on radiographic findings. This study will help clinicians in conducting elephant foot radiography, in evaluating foot radiographs in juvenile elephants, in recognizing normal versus pathologic change, and in estimating juvenile elephant age based on radiographic ossification characteristics and growth plate closure times. Consistent use of the proposed foot radiograph technique is recommended to facilitate foot disease recognition and as part of the annual examination of captive Asian elephants. © 2008 American Association of Zoo Veterinarians.

C. Thitaram, N. Thongtip, C. Somgird, B. Colenbrander, D.C.J. van Boxtel, F. van Steenbeek & J.A. Lenstra

Evaluation and selection of microsatellite markers for an identification and parentage test of Asian elephants (*Elephas maximus*)

Conservation Genetics 9 (2008) 921-925

Abstract. Numbers of the Asian elephants (*Elephas maximus*) population are declining due

to poaching, human-elephant conflicts, capture of wild calves for tourism and export and habitat destruction, which also may cause inbreeding in fragmented populations. In order to contribute to a reversal of this trend, we have developed an identification and parentage test by evaluation and selection of markers from 43 microsatellite loci that have been previously described for Asian or African elephants. Testing these markers on a panel of 169 Asian elephants comprising the 23 mother-offspring, 13 father-offspring and 13 parents-offspring pairs yielded 26 polymorphic markers. However, only 14 of these were found to be suitable for an analysis of molecular diversity, 12 of which will be implemented for an identification and parentage test to control the capture of wild calves in Thailand and neighboring countries. © 2008 With kind permission from Springer Science+Business Media.

If you need additional information on any of the articles in the above section, please feel free to contact me. If you are aware of a new publication on Asian elephants (in 2008 or 2009), let us know the reference and we will consider its inclusion in the next *Gajah*.

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Dressing up for the Kandy perahera, Sri Lanka (2008)

Photo by Jennifer Pastorini