Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

Anthropologisches Institut, Universität Zürich, Zürich, Switzerland and Centre for Conservation and Research, Rajagiriya, Sri Lanka

H. Aupperle, A. Reischauer, F. Bach, T. Hildebrandt, F. Göritz, K. Jäger, R. Scheller, H.-J. Klaue & H.-A. Schoon

Chronic endometritis in an Asian elephant (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 107–110

Abstract. A 48-yr-old female Asian elephant with a history of pododermatitis developed recurrent hematuria beginning in 2002. Transrectal ultrasonography and endoscopic examination in 2004 identified the uterus as the source of hematuria and excluded hemorrhagic cystitis. Treatment with Desloreline implants, antibiotics, and homeopathic drugs led to an improved general condition of the elephant. In July 2005, the elephant was suddenly found dead. During necropsy, the severely enlarged uterus contained about 250 L of purulent fluid, and histopathology revealed ulcerative suppurative endometritis with high numbers of *Streptococcus equi* ssp. *zooepidemicus* and *Escherichia coli* identified on aerobic culture. Additional findings at necropsy included: multifocal severe pododermatitis, uterine leiomyoma, and numerous large calcified areas of abdominal fat necrosis. Microbiologic culture of the pododermatitis lesion revealed the presence of *Streptococcus agalactiae*, *Streptococcus equi* ssp. *zooepidemicus*, *Staphylococcus* sp., *Corynebacterium* sp., and *Entercoccus* sp. © 2008 American Association of Zoo Veterinarians.

B. Drews, R. Hermes, F. Göritz, C. Gray, J. Kurz, I. Lueders & T.B. Hildebrandt

Early embryo development in the elephant assessed by serial ultrasound examinations

Theriogenology 69 (2008) 1120–1128

Abstract. The elephant has an extraordinary long pregnancy, lasting 21 months. However, knowledge on embryo development is limited. To date, only single morphological observations of elephant embryo development associated with placentation are available, all lacking correlation to gestational age. The present study describes morphological characteristics of early embryo development in the elephant with exact biometric staging. Six pregnancies in five Asian and one African elephants with known conception dates were followed by 2D and 3D ultrasound, covering the embryonic period from ovulation to day 116 post-ovulation. The embryonic vesicle was earliest observed was on day 50 p.o. The proper embryo was not detected until day 62 p.o. Embryonic heartbeat was first observed on day 71 p.o. The allantois, which became visible as a single sacculation on day 71 p.o. was subdivided in four compartments on day 76 p.o. By day 95 p.o., head, rump, front and hind legs were clearly distinguished. Between days 95 and 103 p.o. the choriovitelline placenta was replaced by the chorioallantoic placenta. A physiological midgut herniation was transiently present between days 95 and 116 p.o. On the basis of the late appearance of the embryonic vesicle, delayed implantation in the elephant is discussed. The study provides a coherent description of elephant embryonic development, formation of the extraembryonic organs and their role in placenta formation, all of which are of interest for both comparative evolutionary studies and the improvement of assisted reproduction techniques. © 2008 Elsevier Inc. Reprinted with permission from Elsevier.

P. Fernando, E.D. Wikramanayake, H.K. Janaka, L.K.A. Jayasinghe, M. Gunawardena, S.W. Kotagama, D. Weerakoon & J. Pastorini

Ranging behavior of the Asian elephant in Sri Lanka

Mammalian Biology 73 (2008) 2-13

Abstract. We studied the ranging patterns of 10 elephants in and around the Yala protected area complex, southern Sri Lanka, using VHF radio telemetry. All tracked elephants displayed similar

ranging patterns. The observed home ranges were small (mean = 115.2±64.0 km^2) relative to reported home ranges in India, possibly in response to high habitat productivity and abundant perennial water sources. Elephants showed high fidelity to their ranges. Home ranges had relatively large core areas, suggesting intensive use of habitat. No geographically distinct seasonal ranges or migratory behavior was observed. Home range overlap was high, and territoriality was absent. Male musth ranges were considerably larger than non-musth ranges and may signify mate searching. Most elephants ranged both in and outside protected areas, suggesting that resources outside protected areas were important for their survival. Thus, translocating and restricting elephants to protected areas will be detrimental to their survival, as it limits resource access. The ranging patterns of Asian elephants suggest that conservation of the species requires their management both in and outside protected areas. © 2007 Deutsche Gesellschaft für Säugetierkunde.

B.L. Hart, L.A. Hart & N. Pinter-Wollman

Large brains and cognition: Where do elephants fit in?

Neuroscience & Biobehavioral Reviews 32 (2008) 86-98

Abstract. Among terrestrial mammals, elephants share the unique status, along with humans and great apes, of having large brains, being longlived and having offspring that require long periods of dependency. Elephants have the largest brains of all terrestrial mammals, including the greatest volume of cerebral cortex. In contrast to what one might expect from such a large-brained species, the performance of elephants in cognitive feats, such as tool use, visual discrimination learning and tests of ''insight'' behavior, is unimpressive in comparison to the performance by chimpanzees and, of course, humans. Where elephants do seem to excel is in long-term, extensive spatial-temporal and social memory. In addition, elephants appear to be somewhat unique among non-human species in their reactions to disabled and deceased conspecifics, exhibiting behaviors that are mindful of ''theory-of-mind'' phenomena. Information gleaned from studies on the neural cytoarchitecture of large brains reveals that the neurons of the cerebral cortex of elephants are much less densely populated than in large-brained primates. The interactions between cortical neurons would appear to be more global and less compartmentalized into local areas, and cortical information processing slower, than in great apes and humans. Although focused neural cytoarchitecture studies on the elephant are needed, this comparative perspective on the cortical neural cytoarchitecture appears to relate to differences in behavior between elephants and their primate counterparts. © 2007 Elsevier Ltd. Reprinted with permission from Elsevier.

N. Irie-Sugimoto, T. Kobayashi, T. Sato & T. Hasegawa

Evidence of means–end behavior in Asian elephants (*Elephas maximus*)

Animal Cognition 11 (2008) 359–365

Abstract The present study explores to what extent Asian elephants show "means–end" behavior. We used captive Asian elephants (*N* = 2) to conduct four variations of the Piagetian "support" problem, which involves a goal object that is out of reach, but rests on a support within reach. In the first condition, elephants were simultaneously presented with two identical trays serving as the "support", with the bait on one tray and the other tray left empty. In the next two conditions, the bait was placed on one tray, while additional bait was placed beside the other tray. In the last condition, both trays contained bait, but one of the trays had a small gap which prevented the elephants from reaching the reward. Subjects were required to choose and pull either tray with their trunk and to obtain the bait (i.e. goal). Results showed that one elephant performed all of the support problems significantly above chance after several sessions, suggesting that the elephant was capable of understanding that pulling the tray was the "means" for achieving the "end" of obtaining the bait. This study showed that elephants show means–end behavior when subjected to a Piagetian "support" task, and indicates that such goal-directed behavior occurs in species other than primates. © 2007 The Authors.

C. Kongrit, C. Siripunkaw, W.Y. Brockelman, V. Akkarapatumwong, T.F. Wright & L.S. Eggert

Isolation and characterization of dinucleotide

microsatellite loci in the Asian elephant (*Elephas maximus*)

Molecular Ecology Resources 8 (2008) 175–177

Abstract. The endangered Asian elephant is found today primarily in protected areas. We characterized 18 dinucleotide microsatellite loci in this species. Allelic diversity ranged from three to eight per locus, and observed heterozygosity ranged from 0.200 to 0.842 in a wild population. All loci were in Hardy–Weinberg equilibrium, but linkage disequilibrium was detected between two loci in the wild, but not in the zoo elephants. These loci will be useful for the population-level studies of this species. © 2007 Blackwell Publishing Ltd.

P. Leimgruber, B. Senior, Uga, Myint Aung, M.A. Songer, T. Mueller, C. Wemmer & J.D. Ballou

Modeling population viability of captive elephants in Myanmar (Burma): implications for wild populations

Animal Conservation 11 (2008) 198–205

Abstract. Captive Asian elephants *Elephas maximus*, used as work animals, constitute up to 22–30% of remaining Asian elephants. Myanmar has the largest captive population worldwide (~6000), maintained at this level for over a century. We used published demographic data to assess the viability of this captive population. We tested how this population can be self-sustained, how many elephants must be supplemented from the wild to maintain it, and what consequences live capture may have for Myanmar's wild population. Our results demonstrate that the current captive population is not self-sustaining because mortality is too high and birth rates are too low. Our models also suggest ~100 elephants year^{-1} have been captured in the wild to supplement the captive population. Such supplementation cannot be supported by a wild population of fewer than 4000 elephants. Given the most recent expert estimate of ~2000 wild elephants remaining in Myanmar, a harvest of 100 elephants year^{-1} could result in extinction of the wild population in 31 years. Continued live capture threatens the survival of wild and captive populations and must stop. In addition, captive breeding should be increased. These measures are essential to slow the decline and extinction of all of Myanmar's elephants. © 2008 The Zoological Society of London. Reprinted with permission from Blackwell Publishing.

L. Lin, L. Zhang, L. Feng, X. Guo, J. Zhao & J. Dao

A preliminary study on designing ecological corridors in Xishuangbanna National Nature Reserve with 3S techniques

Frontiers of Biology in China 3 (2008) 101–105

Abstract. This paper is based on the fieldwork in Xishuangbanna Natioanl Nature Reserve in Yunnan Province of China. GPS data of Asian elephants were collected and analyzed with the remote sensing satellite photos of the region to estimate the landform physiognomy of different colors. We also analyzed a series of ecological factors including altitude, landform, relief, villages and roads which affected the distribution and movement of Asian elephants. The results suggested the possibility of designing and establishing corridors in Xishuangbanna National Nature Reserve to protect the population of wild elephants in the region. © 2008 Higher Education Press and Springer-Verlag. With kind permission from Springer Science and Business Media.

C.E. Miller, C. Basu, G. Fritsch, T. Hildebrandt & J.R. Hutchinson

Ontogenetic scaling of foot musculoskeletal anatomy in elephants

Journal of the Royal Society Interface 5 (2008) 465-475

Abstract. This study quantifies the shape change in elephant manus and pes anatomy with increasing body mass, using computed tomographic scanning. Most manus and pes bones, and manus tendons, maintain their shape, or become more gracile, through ontogeny. Contrary to this, tendons of the pes become significantly more robust, suggesting functional adaptation to increasingly high loads. Ankle tendon cross-sectional area (CSA) scales the highest in the long digital extensor, proportional to body mass$^{1.08\pm0.21}$, significantly greater than the highest-scaling wrist tendon (extensor carpi ulnaris, body mass$^{0.69\pm0.09}$). These patterns of shape change relate to the marked anatomical differences between the pillar-like manus and tripod-like pes, consistent with differences in fore- and hindlimb locomotor function. The

cartilaginous predigits (prepollux and prehallux) of the manus and pes also become relatively more robust through ontogeny, and their pattern of shape change does not resemble that seen in any of the 10 metacarpals and metatarsals. Their CSAs scale above isometry proportional to body mass$^{0.73\pm0.09}$ and body mass$^{0.82\pm0.07}$ respectively. We infer a supportive function for these structures, preventing collapse of the foot pad during locomotion. © 2007 The Royal Society.

A. Moss, D. Francis & M. Esson

The relationship between viewing area size and visitor behavior in an immersive Asian elephant exhibit

Visitor Studies 11 (2008) 26-40

Abstract. Immersive exhibits are increasingly popular in zoos, being seen as benefiting both animals and visitors. Multiple, discreet viewing areas are one of the key features of immersive zoo exhibits. Small, discreet viewing areas afford the visitor a very personal and intimate experience and may promote an affiliative response between the visitor and the animals on display, thus enhancing the immersive experience. This investigation sought to determine the effect of these viewing areas on visitor behavior, particularly in exhibits where the same animals could be viewed from different-sized viewing areas. This study in the Elephants of the Asian Forest exhibit at Chester Zoo, used unobtrusive visitor tracking to investigate how visitors behave at the exhibit's different-sized viewing areas. The results show that visitors are much more likely to stop, and stay for longer, at the largest viewing areas. Furthermore, there appears to be a proportional increase in visitor interest with increasing viewing area size. These findings have implications for zoo exhibit designers, particularly on the order in which viewing areas should be positioned. © 2008 Visitor Studies Association.

C.A. Oliveira, E.C.G. Felippe & M.O.M. Chelini

Serum cortisol and progestin concentrations in pregnant and non-pregnant Asian elephants (*Elephas maximus*)

Research in Veterinary Science 84 (2008) 361–363

Abstract. Blood samples were collected during the estrous cycle (n = 3), throughout gestation (n = 3), and during the periparturient period (n = 11) to assess serum concentrations of cortisol in pregnant and non-pregnant Asian elephants whose reproductive status was being monitored by serum progestin determination. While serum cortisol concentrations remained constant throughout gestation, progestin concentrations decreased significantly ($p < 0.05$) in the second half of pregnancy, declining to undetectable levels by 3 days before calving. During the non-luteal phase of the estrous cycle serum progestins varied from undetectable levels to 100 pg/ml (53 ± 10.7 pg/ml) then increased steadily during the luteal phase (322 ± 207.5 pg/ml). There were no significant differences between serum cortisol concentrations during the luteal and those of the non-luteal phase ($p > 0.05$). The mean cortisol concentration during the estrous cycle was about twice that during pregnancy ($p > 0.05$). No substantial changes in maternal cortisol were found during the course of pregnancy or the periparturient period. © 2007 Elsevier Ltd. Reprinted with permission from Elsevier.

N.M.B. Pradhan, P. Wegge, S.R. Moe & A.K. Shrestha

Feeding ecology of two endangered sympatric megaherbivores: Asian elephant *Elephas maximus* and greater one-horned rhinoceros *Rhinoceros unicornis* in lowland Nepal

Wildlife Biology 14 (2008) 147-154

Abstract. We studied the diets of low-density but increasing populations of sympatric Asian elephants *Elephas maximus* and greater one-horned rhinoceros *Rhinoceros unicornis* in the Bardia National Park in lowland Nepal. A microhistological technique based on faecal material was used to estimate the seasonal diet composition of the two megaherbivores. Rhinos ate more grass than browse in all seasons, and their grass/browse ratio was significantly higher than that of elephants. Both species ate more browse in the dry season, with bark constituting an estimated 73% of the elephant diet in the cool part of that season. Diet overlap was high in the resource-rich monsoon season and lower in the resource-poor dry season, indicating partitioning of food between the two species in the period of resource limitation. Both species consumed

large amounts of the floodplain grass *Saccharum spontaneum*, particularly during the monsoon season. As the numbers of both species increase, intraspecific and interspecific competition for *S. spontaneum* in the limited floodplains is likely to occur. Owing to their higher grass diet and more restricted all-year home ranges within the floodplain habitat complex, rhinos are then expected to be affected more than elephants. © 2008 Wildlife Biology.

A. Ramanathan & A. Mallapur

A visual health assessment of captive Asian elephants (*Elephas maximus*) housed in India

Journal of Zoo and Wildlife Medicine 39 (2008) 148–154

Abstract. A visual health assessment and survey questionnaire was conducted on 81 Asian elephants (*Elephas maximus*) housed in 10 animal facilities throughout India between November 2004 and February 2005. The survey questionnaire consisted of 10 questions that evaluated the health of the elephants, and they were completed after visually assessing each individual elephant. The information collected was ranked on a scale that was used to statistically compare the health among the study subjects. This study documented that 43.21% of the captive elephants surveyed exhibited hyperkeratosis. A significant proportion of the elephants owned by tourist camps had poor skin condition when compared with elephants from zoos and at a forest camp. Similarly, captive-born individuals were found to have better skin condition than animals that were caught from the wild. Sixty (74.1%) of the captive elephants that were observed during this study had fissures in their footpads, 20% of which were severe. The prevalence of foot fissures was significantly higher in females. A greater proportion of elephants owned by tourist camps displayed vertical and horizontal toenail cracks in comparison with the forest camp and zoo elephants. It was noted that 76.9% of the wounded animals and 80% of those having abscesses were housed at temples and tourist camps. Also, approximately 8.5% of the captive elephant population observed during this study had eye-related problems, and they were all housed at temples and tourist camps. In conclusion, it was evident that elephants housed at temples or tourist camps exhibited poor skin condition with wounds and abscesses. These findings suggest that the overall condition of the elephants housed at tourist camps was poor compared with elephants housed at zoos and at the forest camp.

L. Ren & J.R. Hutchinson

The three-dimensional locomotor dynamics of African (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants reveal a smooth gait transition at moderate speed

Journal of the Royal Society Interface 5 (2008) 195-211

Abstract. We examined whether elephants shift to using bouncing (i.e. running) mechanics at any speed. To do this, we measured the three-dimensional centre of mass (CM) motions and torso rotations of African and Asian elephants using a novel multisensor method. Hundreds of continuous stride cycles were recorded in the field. African and Asian elephants moved very similarly. Near the mechanically and metabolically optimal speed (a Froude number (Fr) of 0.09), an inverted pendulum mechanism predominated. With increasing speed, the locomotor dynamics quickly but continuously became less like vaulting and more like bouncing. Our mechanical energy analysis of the CM suggests that at a surprisingly slow speed (approx. 2.2 ms^{-1}, Fr 0.25), the hindlimbs exhibited bouncing, not vaulting, mechanics during weight support. We infer that a gait transition happens at this relatively slow speed: elephants begin using their compliant hindlimbs like pogo sticks to some extent to drive the body, bouncing over their relatively stiff, vaulting forelimbs. Hence, they are not as rigid limbed as typically characterized for graviportal animals, and use regular walking as well as at least one form of running gait.

C. Thitaram, J.L. Brown, P. Pongsopawijit, S. Chansitthiwet, W. Wongkalasin, P. Daram, R. Roongsri , A. Kalmapijit, S. Mahasawangkul, S. Rojansthien, B. Colenbrander, G.C. van der Weijden & F.J.C.M. van Eerdenburg

Seasonal effects on the endocrine pattern of semi-captive female Asian elephants (*Elephas*

***maximus*): Timing of the anovulatory luteinizing hormone surge determines the length of the estrous cycle**

Theriogenology 69 (2008) 237–244

Abstract. Better breeding strategies for captive Asian elephants in range countries are needed to increase populations; this requires a thorough understanding of their reproductive physiology and factors affecting ovarian activity. Weekly blood samples were collected for 3.9 years from 22 semi-captive female Asian elephants in Thai elephant camps to characterize LH and progestin patterns throughout the estrous cycle. The duration of the estrous cycle was 14.6 ± 0.2 weeks (mean ± S.E.M.; n = 71), with follicular and luteal phases of 6.1 ± 0.2 and 8.5 ± 0.2 weeks, respectively. Season had no significant effect on the overall length of the estrous cycle. However, follicular and luteal phase lengths varied among seasons and were negatively correlated (r = –0.658; P < 0.01). During the follicular phase, the interval between the decrease in progestin concentrations to baseline and the anovulatory LH (anLH) surge varied in duration (average 25.9 ± 2.0 days, range 7–41, n = 23), and was longer in the rainy season (33.4 ± 1.8 days, n = 10) than in both the winter (22.2 ± 4.5 days, n = 5; P < 0.05) and summer (18.9 ± 2.6 days, n = 8; P < 0.05). By contrast, the interval between the anLH and ovulatory LH (ovLH) surge was more consistent (19.0 ± 0.1 days, range 18–20, n = 14). Thus, seasonal variation in estrous cycle characteristics were mediated by endocrine events during the early follicular phase, specifically related to timing of the anLH surge. Overall reproductive hormone patterns in Thai camp elephants were not markedly different from those in western zoos. However, this study was the first to more closely examine how timing of the LH surges impacted estrous cycle length in Asian elephants. These findings, and the ability to monitor reproductive hormones in range countries (and potentially in the field), should improve breeding management of captive and semi-wild elephants. © 2008 Elsevier Inc. Reprinted with permission from Elsevier.

N. Thongtip, J. Saikhun, S. Mahasawangkul, K. Kornkaewrat, P. Pongsopavijitr, N. Songsasen & A. Pinyopummin

Potential factors affecting semen quality in the Asian elephant (*Elephas maximus*)

Reproductive Biology and Endocrinology 6 (2008) 9.

Abstract. Background: One of the major obstacles in using artificial insemination to manage genetics of elephant population in captivity is the large variations in semen quality among ejaculates within the same and among individuals. The objectives of this study were to determine the influences of (1) age (2) seasonality (3) and circulating testosterone (SrTest), triiodothyronine (SrT3) and tetraiodothyronine (SrT4), as well as seminal (4) testosterone (SpTest), zinc (SpZn) and protein (SpTP) on semen quality in the Asian elephant. Methods: Analyses, including motility, viability and morphology were performed in semen samples collected twice monthly from 13 elephant bulls (age range, 10-to 72-years) by manual stimulation between July 2004 and June 2005. Serum samples obtained monthly were assessed for SrTest, SrT3, SrT4, and seminal plasma samples were evaluated for, SpTest, SpZn and SpTP. Results: The highest semen quality was observed at age 23 to 43 years. Percentages of progressive motility and viable sperm were lowest at age 51 to 70 years (P < 0.05); on the other hand, sperm concentration was lowest at age 10 to 19 years (P < 0.05). Percentage of sperm with normal morphology was highest at age 23 to 43 years. The levels of SrT3, SrTest, SpTest and SpZn were lowest at age 51 to 70 years, whereas SrT4 was lowest at age 23 to 43 years. Seasonality significantly affected semen characteristics in which percentage of viable sperm and cell concentration were highest during rainy season and lowest during summer months (P < 0.05). However, percentage of sperm with normal morphology was highest in summer and lowest in rainy season (P < 0.05). Seasonality significantly influenced SrTest with elevated concentrations observed in rainy season and winter (P < 0.05). Conclusion: This study indicates that age and seasonality had influence on semen characteristics in the Asian elephant. The knowledge obtained in this study will improve our understanding of the reproductive biology of this species. © 2008 Thongtip et al; licensee BioMed Central Ltd.

J.H. van der Kolk, J.P.T.M. van Leeuwen,

A.J.M. van den Belt, R.H.N. van Schaik & W. Schaftenaar

Subclinical hypocalcaemia in captive Asian elephants (*Elephas maximus*)

Veterinary Record 162 (2008) 475-479

Abstract. The hypothesis that hypocalcaemia may play a role in dystocia in captive Asian elephants (*Elephas maximus*) was investigated. The objectives of the study were to measure the total calcium concentration in elephant plasma; assess the changes in parameters of calcium metabolism during a feeding trial; investigate a possible relationship between calcium metabolism and dystocia; and assess bone mineralisation in captive Asian elephants in vivo. The following parameters were measured: total and ionised calcium, inorganic phosphorous and magnesium, the fractional excretions of these minerals, intact parathyroid hormone, 25-OH-D3 and 1,25-OH-D3. Radiographs were taken from tail vertebrae for assessment of bone mineralisation. The mean (sd) heparinised plasma total calcium concentration was 2.7 (0.33) mmol/l (n=43) ranging from 0.84 to 3.08 mmol/l in 11 Asian elephants. There was no significant correlation between plasma total calcium concentration and age. Following feeding of a calcium rich ration to four captive Asian elephant cows, plasma total and ionised calcium peaked at 3.6 (0.24) mmol/l (range 3.4 to 3.9 mmol/l) and 1·25 (0.07) mmol/l (range 1.17 to 1.32 mmol/l), respectively. Plasma ionised calcium concentrations around parturition in four Asian elephant cows ranged from 0.37 to 1.1 mmol/l only. The present study indicates that captive Asian elephants might be hypocalcaemic, and that, in captive Asian elephants, the normal plasma concentration of total calcium should actually be around 3.6 mmol/l and normal plasma concentration of ionised calcium around 1.25 mmol/l. Given the fact that elephants absorb dietary calcium mainly from the intestine, it could be concluded that elephants should be fed calcium-rich diets at all times, and particularly around parturition. In addition, normal values for ionised calcium in captive Asian elephants should be reassessed. © 2008 British Veterinary Association.

S. Varma

Spatial distribution of Asian elephant (*Elephas maximus*) and its habitat usage pattern in Kalakad–Mundanthurai Tiger Reserve, Western Ghats, southern India

Current Science 94 (2008) 501-506

Abstract. The study demonstrates the value of short term, but rapid surveys in understanding the spatial pattern of distribution of the Asian elephant (*Elephas maximus*) and its habitat usage pattern in the Kalakad–Mundanthurai Tiger Reserve, Western Ghats, southern India. Results indicated that the elephants use the habitat uniformly throughout the reserve, since encounter rates of elephant dung piles were found to be similar for most of the routes surveyed. However, data on fresh dung piles, indicative of presence of elephants at any given point of time and space, pointed to a clumped distribution. With respect to habitat use, 60% of elephant signs were recorded in the evergreen forests, 13% in grasslands and 12% in evergreen and reed belts. However, a comparison of dung density indicates a significant difference ($P < 0.0000$) across the habitats and the elephant densities appear to be more in the grasslands. The elevation of the reserve ranged from 40 to 1867 m; however, presence of elephants was limited to altitudes ranging from 300 to 1300 m, out of which 90% was restricted to altitudes ranging between 600 and 1200 m. © 2008 Current Science.

S. Varma, N.X. Dang, T. Van Thanh & R. Sukumar

The Asian elephants *Elephas maximus* of Cat Tien National Park, Vietnam: status and conservation of a vanishing population

Oryx 42 (2008) 92–99

Abstract. This study updates the status and conservation of the Endangered Asian elephant *Elephas maximus* in Cat Tien National Park, Vietnam. Line transect indirect surveys, block surveys for elephant signs, village surveys of elephant-human conflict incidents, guard-post surveys for records of sightings, and surveys of elephant food plants were undertaken during the dry and wet seasons of 2001. A minimum of 11 elephants and a maximum of 15-17 elephants was estimated for *c*. 500 km^2 of the Park and its vicinity. The elephants are largely confined to the southern boundary of the Park and make extensive use of the adjoining La Nga State Forest Enterprises.

During the dry season the elephants depend on at least 26 species of wild and cultivated plants, chiefly the fruits of cashew. Most of the villages surveyed reported some elephant-human conflict. Two adult male elephants seem to cover a large area to raid crops, whereas the family groups restrict themselves to a few villages; overall, the conflict is not serious. Since 2001 there have been no reports of any deaths or births of elephants in the Park. We make recommendations for habitat protection and management, increasing the viability of the small population, reducing elephant-human conflicts, and improving the chances of survival of the declining elephants of this Park. The Government has now approved an Action Plan for Urgent Conservation Areas in Vietnam that calls for the establishment of three elephant conservation areas in the country, including Cat Tien National Park.

E.B. Wiedner, C. Gray, P. Rich, G.L. Jacobson, R. Isaza, D. Schmitt & W.A. Lindsay

Nonsurgical repair of an umbilical hernia in two Asian elephant calves (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 248–251

Abstract. Umbilical hernias were diagnosed in two captive-born, female Asian elephant (*Elephas maximus*) calves several weeks after birth. Daily manual reduction of the hernias for 5 wk in the first case and for 5 mo in the second resulted in complete closure of the defects. Nonsurgical repair of uncomplicated, fully reducible umbilical hernias in Asian elephants can be an alternative to surgery.

L. Yon, J. Chen, P. Moran & B. Lasley

An analysis of the androgens of musth in the Asian bull elephant (*Elephas maximus*)

General and Comparative Endocrinology 155 (2008) 109–115

Abstract. During musth in bull elephants, the androgens testosterone (T), dihydrotestosterone (DHT), and androstenedione all increase significantly. Given the unusual endocrine physiology that has been discovered in female elephants, it is also possible that bull elephants produce some unusual androgens. A cell-based androgen receptor assay was used to explore this possibility using two different methods. The first method compared the level of T measured by radioimmunoassay (RIA) with the level of androgen receptor (AR) activity measured in the serum of eight bull elephants during musth and non-musth periods. A ratio was calculated for T/AR activity for non-musth and musth, to determine if there was a change in the ratio between these two states. The second method used HPLC to separate two pooled serum samples (one non-musth and one musth) into fractions using a protocol which separates known androgens into specific, previously identified fractions. Each fraction was then tested with the AR assay to determine the androgenicity of any compounds present. This was done to determine if there were any fractions which had androgenic activity but did not contain any previously identified androgens. Results from the first analysis indicated no change in the T/AR ratio between non-musth and musth states. Clearly whatever active androgens are present during musth, they increase proportionately with T. Findings from the second analysis suggested that the only bioactive androgen present in the serum of non-musth Asian bulls is a low level of T. During musth, the only bioactive androgens detected were T and DHT; of these, T was by far the predominant active androgen present. Taken together, these two analyses suggest that T is by far the predominant active androgen present during musth in Asian bull elephants, and that no previously unidentified bioactive androgen is present.

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), let us know the reference and we will consider its inclusion in the next *Gajah*.

E-mail: jenny@aim.uzh.ch