2003

Are Captive Elephants Important to Conservation

Heidi S. Riddle

Bets Rasmussen

Dennis L. Schmitt
Missouri State University

Recommended Citation

Riddle, H. S., B. Rasmussen, and D. L. Schmitt. "Are captive elephants important to conservation." Gajah 22 (2003): 57-61.

Short Communication

Are captive elephants important to conservation?

Heidi S. Riddle, Bets Rasmussen and Dennis L. Schmitt

We dedicate this article to one of the most forward-thinking Asian scientists, Dr. V. Krishnamurthy. Dr. K was deeply committed to elephants, and grasped the importance of the recent captive and wild studies described below, as significant for the salvation of elephants. We are privileged to have worked with him.

Introduction

The value of captive elephants

Currently in North America, there are about 280 captive Asian elephants. The question is often asked: "Do captive elephants truly benefit their wild counterparts?"

We feel that the answer is yes and will present evidence from specific areas to reinforce our answer.

Captive elephants serve as good will ambassadors for their wild counterparts. Elephants capture human attention in multifaceted ways. The public and young potential scientists, are drawn to this charismatic mammal. Every day, elephants in facilities of all kinds plant important seeds of conservation in fertile minds, creating concern and raising consciousness of the world's greatest land animal. If we are to teach people the importance of conservation, we have to reach them in as many ways as possible.

Captive elephants provide an opportunity for people to learn more about elephants. Education serves conservation, and that education takes many forms. Ultimately, the more people know about elephants the more likely they are to care about what happens to them as a species. Elephants are a keystone species with important ecological interactions with other fauna and flora. The study and conservation of a keystone species allows many other smaller species to be helped. Detailed knowledge of inter-species interactions is useful to conservation efforts.

Captive elephants provide opportunities for conservation. Captive elephants raise public awareness — whether it is about the animal itself, or about the challenges facing wild elephants such as human-elephant conflict and the need to identify and support protected areas. Public awareness, in turn, helps drive important public policies on conservation and habitat protection, and also provides important opportunities for fundraising.

Financial support for conservation comes not only from people who experience captive wildlife exhibits, but also from the organizations who exhibit captive elephants. Zoos, circuses, wildlife parks and private exhibitors are uniquely able not only to communicate important conservation messages, but also to raise funds for conservation through special fundraisers, gate proceeds and even from general revenues. Member organizations from groups like the International Elephant Foundation, which comprise both commercial and non-commercial exhibitors, come together to support important conservation and scientific study projects.

Captive elephants aid in scientific study which can be applied in the field. Captive elephants help validate field techniques used in conservation. For instance, in a carefully controlled experiment using captive elephants, dung extracted DNA was compared to blood extracted DNA. These paired samples showed that dung is a source of DNA that allows reliable and noninvasive genotyping (Fernando *et al.*, 2003). Dung extracted DNA from wild elephants is a useful and important tool to answer some conservation questions, such as genetic diversity in small or isolated populations.

Captive elephants offer unique opportunities to intimately understand how these animals function. Much has been learned about elephant physiology, biology and communication by the ability to be close to captive elephants. This body of knowledge, as it increases, continues to assist with conservation management decisions.

Communication

Elephants use multimodalities of sensory information to solve their life problems. For humans to be able to decipher this

Heidi S. Riddle
Riddle's Elephant and Wildlife Sanctuary,
Post Office Box 715,
Greenbrier, Arkansas 72058, USA
E-mail: elephantsanctuary@alltel.net

Prof. L. E. L. (Bets) Rasmussen
Department of Environmental & Biomolecular Systems,
OGI School of Science & Engineering, OHSU,
20,000 NW Walker Road, Beaverton,
Oregon 97006, USA
E-mail: bets@bmb.ogi.edu

Dr. Dennis L. Schmitt
Southwest Missouri State University,
217 Karl's Hall,
901 South National Avenue,
Springfield, Missouri 65804, USA
E-mail: dennisschmitt@smsu.edu

communication it is often necessary to study one sensory modality at a time in an up-close context. Thus captive elephants allow a starting point for collecting basic information about how elephants communicate. A substantial amount of our understanding about the details of elephant communication originates from captive elephants. For example, to demonstrate that infrasound is produced by Asian elephants, it was necessary to use the sound-friendly environment of a zoo and the close proximity of a single elephant at that zoo (Payne *et al.*, 1996). Recordings proving such elephant-emitted noises opened the way for years of field research about how elephants utilize these sounds.

Olfaction is an important sense driving mammalian behavior. Our ongoing research into elephant olfaction has shown that elephants behaviorally demonstrate the extensive and precise use of their olfactory systems in complex life situations. Thus a fundamental biology question, "how do animals cope with their environment?" can be partially answered by linking specific elephant-emitted chemical compounds with elephant behaviors. For example, chemical signal mediated behaviors have been demonstrated to be female-to-female, male-to-male, female-to-male, mother-to-offspring and male-to-female (Rasmussen & Krishnamurthy, 2000).

Our understanding of how elephant olfaction works is improved by easily collecting excretions such as urine and breath, as well as secretions such as temporal gland and mucus, from living captive elephants to allow biochemical and molecular analyses. Armed with the identity of active chemical signals, we can figure out how they work, which signals are ephemeral and which ones are long lasting. In captivity we can easily and rapidly confirm these biochemical results by bioassays with living elephants at each step. Indeed, elephants exhibit observable and measurable responses to pheromones, facilitating the correlation of biochemical and behavioral events (Rasmussen *et al.*, 2003).

Our ability to link behavior and biochemistry allows more rapid understanding of the results in the real world of the animal. Two outstanding examples exist for the Asian elephant. The pre-ovulatory pheromone of the female Asian elephant was identified through work on captive elephants in North America, and was subsequently validated in the wild (Myanmar and India) through behavioral observations and biochemical analyses (Rasmussen *et al.*, 1996). A pheromone of musth male temporal gland secretion that sends varying messages to both sexes of elephant society was first identified in captive North American elephants, as was the discovery of the "honey" musth of teenage Asian males and the chemical explanation of moda musth (Rasmussen *et al.*, 2002).

In order to have the tools for better managing this endangered species, it is imperative to understand the extent of their use of chemical communication through the translation of the chemical signaling function. How pheromones work, how they affect behavior between conspecifics and how they can be used to possibly modulate elephant behavior directly begins to address some conservation issues such as crop raiding and human-elephant conflict. For instance, crop raiding by elephants is not necessarily a population problem, but might be an individual elephant problem which may be dependent on that individual's gender or hormonal state, or even the time of year. Such detailed knowledge is important if specific biochemical information, such as the identity of individual pheromones, is to be utilized in the management of wild elephants — for example in developing deterrents between cropland and crop raiding elephants. Most importantly, information about chemical communication needs to be utilized now, not twenty years from now, if it is to effectively benefit wild populations of, elephants.

Physiology and Reproduction

Elephants, both wild and captive, are a challenging animal to manage due to their great size, strength and intelligence. Carrying out detailed research into physiological parameters is simply not possible to do safely in the wild. It would be unrealistic to think about easily collecting blood samples daily, or even weekly, from a wild elephant. However, by intensely studying captive elephants to further our knowledge about biology and physiology, these captive animals do effectively contribute to conservation.

With elephants, many medical diagnostic methods, including radiography, have been limited in their scope because of the size of the animal. Since 1995, a new procedure, ultrasonography, is revolutionizing our understanding of elephant biology (Hildebrandt *et al.*, 1995, 1997). Ultrasonography offers a clear view of many internal organs of elephants therefore providing us with previously unknown intimate knowledge about elephant biology. Through ultrasonography scientists have a better understanding of important biological issues in elephants such as the timeline of ovulation, and internal physical changes that occur as elephants mature and during musth. The knowledge gained by closely studying numerous captive elephants in facilities in the West is being shared in elephant range states every year.

To successfully preserve any species, a detailed understanding of the reproductive process of the particular animal is essential. Ultrasound technology has made a significant difference to elephants by contributing new information, and this knowledge has recently allowed successful assisted reproduction techniques. While the number of elephant calves produced through Artificial Insemination (AI) may not yet be enough to significantly contribute to conservation of the species, by working toward successful and repeatable AI, our understanding of the physiological reproductive process of elephants has been, and continues to be, greatly enhanced.

Captive reproductive studies clearly help conservation decisions. For example, studies of the captive population have shown that although females may have 'normal' hormonal estrous cycles as measured in blood serum or fecal samples, some have reproductive tract pathological conditions reducing their fecundity (i.e. making them poor breeding candidates). Interestingly, these captive assessments demonstrate that these reproductive tract changes usually occur when a female has not had an opportunity to be pregnant very often. These abnormalities can only be detected by a detailed internal assessment, primarily ultrasonography (Hildebrandt *et al.*, 2000). Such information is useful in making conservation decisions on how to best preserve wild elephant populations with disproportionately high numbers of females. For instance, in an almost exclusively female population, if most of the females are older and have not had an opportunity to conceive for some time, these females may experience similar reproductive tract pathologies as seen in captive animals, thereby reducing even further the potential for pregnancy. These populations would therefore benefit from a relocation infusion of both males as well as younger reproductively active females as the best way to ensure future population growth.

Another example of our basic understanding of elephant biology being enhanced by captive elephants is in the field of endocrinology. It was discovered that elephants have two luteinizing hormone surges; one is anovulatory and occurs about 21 days prior to the second ovulatory surge. In elephants, ovulation occurs about 24 hours after the second or ovulatory luteinizing hormone surge. Elephants are the only mammal known to have this unique double luteinizing hormone surge. This significant physiological finding was possible through an intense study of captive animals, as it was discovered only by closely monitoring captive elephants by daily blood sampling throughout the estrous cycle to determine the most fertile period for AI (Brown *et al.*, 1999).

In regards to diseases, particularly those which may be shared by humans and elephants, such as tuberculosis, much has been learned from captive elephants. Captive elephants are known to contract the same strain of tuberculosis as humans (*Mycobacterium tuberculosis*), and as cattle (*M. bovis*). These various strains have been diagnosed in captive elephants, and, where necessary, effective treatment protocols have been formulated and implemented (Mikota *et al.*, 2000). These types of illnesses may also affect wild elephants and more studies are needed to understand this possibility. Having well established diagnosis and treatment plans, as studied in captive populations, will assist in any possible detection and therefore resolutions of such problems occurring in the wild. Focused studies of captive elephant pathology have also identified an elephant specific herpes virus. Although the virus is highly fatal to young, captive born Asian elephants (Richman *et al.*, 1999), it is unknown at this time how prevalent this virus is in the wild elephant populations in Asia, and what possible impact it may have on the conservation of these populations.

As the elephants' world shrinks, and the humans' world increases, such zoonotic diseases may expand. Elephants, as well as humans, may be increasingly and more quickly exposed to new virus and bacteria that jump from other species. If this were to occur, the information gleaned by years of close study of captive elephant populations in detection and treatment of diseases will be invaluable in helping to preserve wild populations of Asian elephants.

Conclusion

Helping Conservation

Elephants are centerpieces of many conservation issues. They are charismatic ecosystem engineers of economic importance yet their needs often conflict with those of humans (Sukumar, 1991). Humans, as the dominant species, have the responsibility to decide who gets what resource, when, and how much. Elephants help call attention not only to their needs, but to the requirements of other species. Therefore, an intimate knowledge about elephant habits and needs, including communicative, physiological and reproductive, is important for long-term conservation decisions.

The translation and exchange of information from captive to wild is important and needs to be rapid as time is running out for the Asian elephant. Recent exchanges of information between elephant managers, mahouts, veterinarians and research scientists from Asia and from the West have escalated, and the elephants can only benefit from such educational interactions.

Western exhibitors of captive elephants are providing increasing support of conservation projects and issues in elephant range states. In the U.S., a group of commercial and non-commercial exhibitors as well as wildlife organizations, worked for legislation to provide federal funds for Asian elephant conservation. This was the creation of the U.S. Fish and Wildlife Service administered Asian Elephant Conservation Fund which was signed into law in 1997 and continues to financially support many important elephant projects all over Asia through the use of government funds and private matching donations, many of which are provided by western exhibitors of captive elephants.

Wild areas available for elephants are shrinking daily. Due to a lack of habitat in most range states, elephants may face death or captivity as their only options. Some wild areas are in reality captive sanctuaries. As elephants around the world become more intensely managed by humans, captivity will have to expand.

Captive elephant facilities in Asia and in the West have a responsibility to promote and support elephant conservation by sharing information, by creating awareness of problems and issues facing wild elephants, and by raising financial support where possible. These facilities must also promote and support public education of these same issues. Of equal significance is the continued study of elephant biology through a variety of projects, such as the development of technology to preserve the genetic diversity of the highly endangered Asian elephant.

Captive elephants are indeed important to conservation, and to the survival of all elephants.

Acknowledgements

In the spirit of this article we acknowledge Joan Galvin whose ongoing "behind the scenes" support for captive elephants helping conservation is largely unnoticed, and who spearheaded the effort to make the U.S. Fish and Wildlife Service's Asian Elephant Conservation Fund a reality.

References

Brown. J., Schmitt, D.L., Bellem, A., Graham, L.H. & Lehnhardt, J. (1999) Hormone Secretion in the Asian Elephant (*Elephas maximus*): Characterization of Ovulatory and Anovulatory Surges. *Biology of Reproduction* **61**: 1294-1299

Fernando, P., Vidya, T.N.C., Rajapakse, C., Dangolla, A. & Melnick, D.J. (2003) Reliable Noninvasive Genotyping: Fantasy or Reality? *Journal of Heredity* **94**: 115-125

Hildebrandt, T.B. & Goeritz, F. (1995) Ultrasonography as a Tool in Zoo Animal Management. In: *Zoological Library – Research and Captive Propagation*. (eds. U. Ganzloser., J.K. Hodges & W. Kaumanns), pp. 49-58.
Filander Verlag GmbH, Furth, Germany.

Hildebrandt T.B., Goeritz. F., Pratt, N.C., Schmitt, D.L., Lehnhardt, J., Hermes, R., Quandt, S., Raath, J., West, G., & Montali, R.J. (1997) Assessment of Health and Reproductive Status in African and Asian Elephants by Transrectal Ultrasonography. *Proceedings of the American Association of Zoo Veterinarians Annual Meeting*. pp. 207-212

Hildebrandt T.B., Goeritz, F., Pratt, N.C., Brown, J.L., Montali, R.J., Schmitt, D.L., Fritsch, G. & Hermes, R. (2000) Ultrasonography of the Urogenital Tract in Elephants (*Loxodonta Africana* and *Elephas maximus*): An Important Tool for Assessing Female Reproductive Function. *Zoo Biology* **19**: 321-332

Mikota S.K., Larsen, R.S. & Montali, R.J. (2000) Tuberculosis in Elephants in North America. *Zoo Biology* **19**: 393-403

Payne K.B., Langbauer Jr, W.R. & Thomas, E.M. (1986) Infrasonic Calls of the Asian Elephant *(Elephas maximus)*. *Behavioral Ecology and Sociobiology*, **18**: 297-301

Rasmussen L.E.L., Lazar, J. &. Greenwood, D.R. (2003) Olfactory Adventures of Elephantine Pheromones. *Biochem Soc.Trans.* **31**: 137-141.

Rasmussen L.E.L., Riddle, H.S. & Krishnamurthy, V. (2002) Mellifluous Matures to Malodorous in Musth. *Nature, Lond.*, **415**: 975-76.

Rasmussen L.E.L. & Krishnamurthy, V. (2000) How Chemical Signals Integrate Asian Elephant Society: The Known and the Unknown. *Zoo Biology* **19**: 405-423.

Rasmussen L.E.L., Lee, T.D., Roelofs, W.L., Zhang, A. &. Daves, G.D. (1996) Insect Pheromone in Elephants. *Nature, Lond.*, **379**: 684.

Richman L.K., Montali, R.J., Garber, R.L., Kennedy, M.A., Lehnhard, J., Hildebrandt, T., Schmitt, D., Hardy, D., Alcendor, D.J. & Hayward, G.S. (1999) Novel Endotheliotropic Herpesvirus Fatal to Asian and African Elephants. *Science* **283**: 1171-1176

Sukumar R. (1991) The Management of Large Mammals in Relation to Male Strategies and Conflict with People. *Biological Conservation*, **55**: 93-102

Plate 1 Demonstrating ultrasound in Kerala

Plate 2 Collecting blood sample from an elephant's ear

Plate 4 Demonstrating the use of ultrasound in Kerala

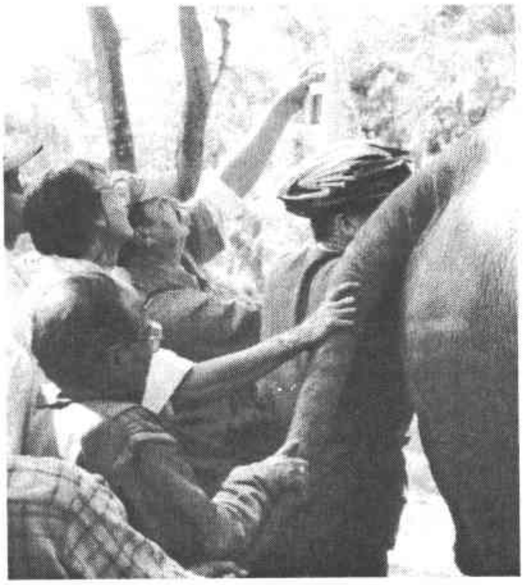

Plate 3 Collecting interdigital gland volatiles

Plate 5 Demonstrating the use of ultrasound in Assam