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Editorial Note

Gajah will be published as both a hard copy and an on-line version accessible from the AsESG web site (www.asesg.org/gajah.htm). If you would like to be informed when a new issue comes out, please provide your e-mail address. If you need to have a hardcopy, please send a request with your name and postal address by e-mail to <jenny@aim.uzh.ch>.

Cover

Tusker at Nagarahole National Park (India)
Photo by T. N. C. Vidya
(See article on page 5)

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Editorial

Jennifer Pastorini (Editor)

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Gajah 44 presents one peer-reviewed article, two research articles and six short communications. Five articles are about elephants in India, two from Sri Lanka, and Malaysia and Myanmar are represented by one publication each. Four papers deal with health issues of Asian elephants.

Manan Gupta *et al*. show that sex ratio estimates are dependant on time and whether the animals counted are individually identified or not. This is only the second *Peer-reviewed Research Article* in *Gajah*. Papers for this section have to be of a high standard and no editorial help is provided to the authors, in contrast to the other papers where an editorial board member works with the authors to improve all aspects of the manuscript.

In the *Research Articles* section, based on interviews and literature search, Lee Ee Ling and co-authors found human-elephant conflict, habitat loss and poaching to be the three main threats for Asian elephants. The second research article by Prithiviraj Fernando *et al*. conducted feeding trials, providing results on gut passage times and usefulness of microhistological faecal analyses in assessing elephant diet.

In *Short Communications*, Jean-Philippe Puyravaud and co-authors describe the behaviour of a wild elephant bull, who after successful treatment of an injury developed a relationship with humans. Nimain Palei *et al*. report on the human-elephant conflict in Odisha, India. They mention elephants running amok and causing property damage after raiding alcoholic beverages.

Zaw Min Oo and colleagues describe a successful surgery on a camp elephant in Myanmar to treat a cervico-vaginal prolapse. Waruna Suranga *et al*. studied lice on captive elephants in Sri Lanka, providing also nice photos of the lice. Jayakrushna Das and colleagues treated a tibiofibular fracture of a wild elephant calf caused by falling into a pit. Rinku Gohain describes the successful treatment of foot and nail abscesses in two captive elephants using magnesium sulphate.

The *News and Briefs* section includes a workshop report from the Elephant Conservation Group. Eleven teams from nine range countries met to discuss progress in collaborative studies. The 'Recent publications on Asian elephants' section presents abstracts of 45 papers. The 'News briefs' provide 28 news items giving a glimpse of "news-worthy" elephant issues across the range.

Vivek Menon, the chair of the Asian Elephant Specialist Group, in his note provides information about the goals of the upcoming meeting in Assam, India in November this year. There is also a meeting notice on the last page of this *Gajah*.

***Gajah* still needs your help** to be more widely distributed. We are specifically looking for organisations with people interested in Asian elephant issues. *Gajah* should float around in such agencies so that it gets a wider readership. Although *Gajah* has free internet access, we also want people who cannot go online to read it, which is why the print version of *Gajah* is mailed out for free! Please send me addresses of NGOs, government offices, universities etc., which would benefit from having *Gajah* in their staff rooms or libraries.

I am grateful to all the authors who contributed articles to this issue of *Gajah*. Big thanks go to the editorial team for their help with paper editing and working with the authors to improve the manuscripts. I also thank the reviewers of the peer-reviewed paper. This *Gajah* can be printed and mailed out entirely free of charge to its readers thanks to funding from the Wildlife Reserves Singapore Group.

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Notes from the Chair IUCN SSC Asian Elephant Specialist Group

Vivek Menon

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Dear members

In this issue of the *Gajah*, I wanted to share with you some of my ideas for our impending meet in November in Guwahati, Assam, India. I hope all of you have blocked the dates of 10-12 November and would soon be filling in the registration formalities that will kick start later this month. We are meeting after a decade or more and I feel the following thoughts of mine, modified with input from all of you can ensure that the meeting is productive and will set the tone for the next few years of active work.

The first method of contributing to a full and productive meeting is, of course, by attending all of it! I know that all of us live in a world beset with innumerable diversions, both professional and personal. I am, through this note, sending a personal plea to the membership to make this event special by attending it and thereby by playing a crucial part in setting the course forward for the group and for Asian elephant conservation.

This will not be possible without a full and well thought out agenda and preparatory papers. This is a challenge, as the time that has elapsed since we last met has been large and also much is needed to be done in terms of focussing the group onto its mandate. It is keeping this in mind that we have decided on a three day meeting that is solely focussed on the workings of the group.

To this end I have requested three members to aid me in a Working Group to set a provisional agenda for the meeting. Not wanting to impinge on this Working Groups mandate my broad idea that I wanted to share with all of you was to have one and a half days to get to know each other's work and one and half days to discuss our priorities about elephant conservation. Depending on membership attendance we can do this by having very short and to the point presentations and discussions during the first day and a half. If we have a large participation and all of us cannot speak, we can seek some representation of geographies, populations and themes.

Herd in Kaziranga National Park (Photo by Jennifer Pastorini)

The next one and a half days will be for the seven working groups to present their ideas to the whole forum and for the forum to discuss in detail and come to a conclusion about them. Please note that the working groups would have already worked for some months before coming to the meet (four groups on *Membership*, *Mandate of the Group*, *Mandate of Gajah* and the *Meeting Agenda* are already formed and this month four more are being announced on *Status of the Asian Elephant in the Wild*; *Guidelines and Policy Documents* of the group, *Captive Elephant Management* and *Human Elephant Conflict and Coexistence*). I expect the convenors of the group to give short presentations of the discussions and suggestions of the working group for us to deliberate and decide on them as a group.

Of course with Guwahati being near Kaziranga we will organise a post conference tour to the forest to see one of India's best loved and best known protected areas. Apart from our favourite animal the elephant, be prepared to see greater one horned rhinoceros, wild buffalo, swamp deer, hog deer, a panoply of birds and for the luckier ones perhaps a tiger.

I have known that on the sides of this meeting, there is an annual meet on Asian elephant conservation being organised by the Balipara Foundation in Guwahati. Those who wanted to present formal papers would be encouraged to attend this meet too so that they can share their elephant conservation issues with a broader audience.

Other than the current membership, I shall use the opportunity of the meeting to call in new members who can strengthen this group once again. The working group on membership will guide me on this post the IUCN World Conservation Congress, which hopefully many of you will be attending as well.

How wonderful it is that many of us can meet up once again after such a long time and I am really looking forward to those days in Assam, India.

Vivek Menon
Chair AsESG, IUCN SSC

Looking for rhinos early morning in Kaziranga (Photo by Ahimsa Campos-Arceiz)

Letter of Apology

Comments on: Ranjit Kumar Sahoo (2015) Population structure and distribution of Asian elephants in Dandeli-Anshi Tiger Reserve, India. Gajah 43: 10-14.

I have realized that my paper titled "Population Structure and Distribution of Asian Elephants in Dandeli-Anshi Tiger Reserve, India" recently published as a non-peer review research article in the journal *Gajah* has certain deficiencies.

This paper was from part of my MSc dissertation. For this purpose, I worked as an intern on an on-going project of the Wildlife Research and Conservation Society. The work was carried out under the guidance of Dr. Prachi Mehta and Mr. Jayant Kulkarni. I now realize that I overlooked their contribution and that they should have been co-authors on the paper.

The figures that I used in the paper were created using the data from this study. The technical support for the figures was provided by the Asian Nature Conservation Foundation staff, Bangalore. However, I did not take permission from them for the use of the images for publication.

Being a naive and inexperienced author, in my ignorance I have violated certain ethics of scientific publishing. Hence, I sincerely apologize to those mentioned above, editor of *Gajah* and the readers of the above mentioned paper. I will take utmost care to respect the ethics and honesty of the scientific community in my future work.

Ranjit Kumar Sahoo

Elephants in the Kulgi Range of the Dandeli-Anshi Tiger Reserve (top and bottom left) and elephants at the Sakrebailu elephant camp, Shimoga, Karnataka (bottom right)
Photos by Wildlife Research and Conservation Society, India

Peer-reviewed Research Article *Gajah 44 (2016) 5-15*

Short-Term Variation in Sex Ratio Estimates of Asian Elephants Due to Space Use Differences between the Sexes

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Abstract. Selective poaching of males for ivory has led to female-biased adult sex ratios in Asian elephants. Therefore, sex ratio monitoring is common, but is undertaken without examining short-term variability. We examined monthly adult sex ratios during the dry season in Nagarahole and Bandipur National Parks, southern India, using visual capture-recapture and counts of identified males and females. We found monthly differences in sex ratios because males and females used the area differently. Using sightings irrespective of identity gave less female-biased sex ratios during peak summer when censuses are usually carried out. We discuss the implications of our results for management.

Introduction

Anthropogenic disturbances such as poaching and sport hunting have affected population sex ratios in elephants (Poole & Thomsen 1989), ungulates and carnivores (Milner *et al*. 2007). Skewed sex ratios can decrease effective population sizes (Wright 1931; see Allendorf *et al*. 2008) and affect population age structure (Poole & Thomsen 1989; Barnes & Kapela 1991; Milner *et al*. 2007), population viability (Menon *et al*. 1997; Milner-Gulland *et al*. 2003), and reproduction (Ramakrishnan *et al*. 1998; Ishengoma *et al*. 2008). Therefore, sex ratios are considered integral to population monitoring and can be used to make decisions on harvests in game animals (for example, Xie *et al*. 1999) and influence the outcome of population reintroductions (Lambertucci *et al*. 2013). Population sex ratios can also be manipulated through active interventions in order to increase either the effective population size (by introducing males into a population with a female biased sex ratio) or population growth rate (by introducing females into a small population) (Wedekind 2012).

The endangered Asian elephant (*Elephas maximus*) is a species in which poaching for ivory has led to skewed sex ratios (Menon *et al*. 1997; Ramakrishnan *et al*. 1998), as only males have tusks. There are only ~41,000–52,000 Asian elephants worldwide, of which over half are found in India (Sukumar 2003). Elephant populations in India show varying sex ratios, from 1 adult male : 1.87 adult females (Williams *et al*. 2007) to 1 adult male : 79.6 adult females (Arivazhagan & Sukumar 2005; previously 1 adult male : 101 adult females in the same population, Ramakrishnan *et al*. 1998). The total number of adult male elephants in India was estimated at only 1,500 in 1997 and was thought to be declining further (Menon & Kumar 1998), making sex ratio monitoring imperative.

Moreover, the global monitoring systems set up by CITES, Monitoring the Illegal Killing of Elephants (MIKE) and Elephant Trade Information System (ETIS), are required to assess illegal killing of elephants but carcass data from Asia are limited due to poor reporting rates (Blanc *et al*. 2011) and the difficulty of detecting carcasses in forests. Sex ratios can, therefore, be used along with age structure to better understand poaching offtake (Sukumar *et al*. 1998), make decisions about translocating tuskless adult males to improve sex ratios (Ramakrishnan *et al*. 1998), trace ivory trade routes (Menon *et al*.

1997), and calculate effective population sizes and prioritize populations for conservation.

Despite the need for accurate sex ratio data, systematic study of sex ratios in Asian elephant populations has largely been lacking (but see Arivazhagan & Sukumar 2005). State forest department censuses, conducted over a few days during peak dry season, typically rely on volunteers and forest staff to obtain animal numbers through "total counts" and "block counts" (which incorrectly assume complete detection of all animals in the entire area/ blocks sampled) and to obtain age-sex structures through "waterhole counts", in which elephants are age-sex classified when they visit waterholes (Rangarajan *et al*. 2010). Rangarajan *et al*. (2010) called for a critical scientific evaluation of the methods used to obtain age-sex structures.

Our first objective was, therefore, to find out whether the adult sex ratio obtained over a few days would be representative of the adult sex ratio during the dry season or whether there was short-term variability even within the dry season. Second, sex ratios calculated during "waterhole counts" and even by researchers in the past using line transects, fixed routes, or a population survey, are usually based on the total counts of males and females observed during the study (Karanth & Sunquist 1992; Ramakrishnan *et al*. 1998; Baskaran *et al*. 2010) rather than on the estimated population sizes of males and females. Since individuals are not identified and total counts are used, sex ratios could be biased if there is differential detectability of the sexes. Therefore, our second objective was to find out how adult sex ratios based on total counts of males and females, in the absence of individual identity, compared with 1) sex ratios based on capture-recapture population estimates of the sexes or 2) sex ratios based on counts of identified males and females.

Methods

Study area

The sampling area (~100 km^2) was in the dry deciduous forest of Nagarahole National Park and Tiger Reserve (11.85304°–12.26089°N, 76.00075°–76.27996°E) and in Bandipur National Park and Tiger Reserve (11.59234°–11.94884°N, 76.20850°–76.86904°E) in southern India (Fig. 1). Nagarahole and Bandipur form part of a larger contiguous landscape that holds the largest Asian elephant population (~8500 elephants, Rangarajan *et al*. 2010) in the world. Between Nagarahole and Bandipur lies the Kabini reservoir, the receding backwaters of which support dense congregations of elephants and other herbivores, especially during the dry season (Karanth & Sunquist 1992). Sampling was carried out both in the forest and in the open areas around the backwaters in Nagarahole and along the backwaters in Bandipur.

Field methods

The field study was non-invasive in nature and field permits were obtained from the Karnataka State Forest Department. We drove along pre-selected routes in the study area (~40 km per day) and collected data on elephants. The study area has a good forest road network (Goswami *et al*. 2007) and elephants are used to tourist vehicles, allowing for maximal encounter probabilities. Elephants were aged, sexed, and identified based on a combination of ear, tail, body, and tusk/tush characteristics (Vidya *et al*. 2014). Animals were broadly age-classified as calves, juveniles, sub-adults, and adults (≥15 years old) (Vidya *et al*. 2014). The demography data for this study was obtained from 689 sightings of animals over 84

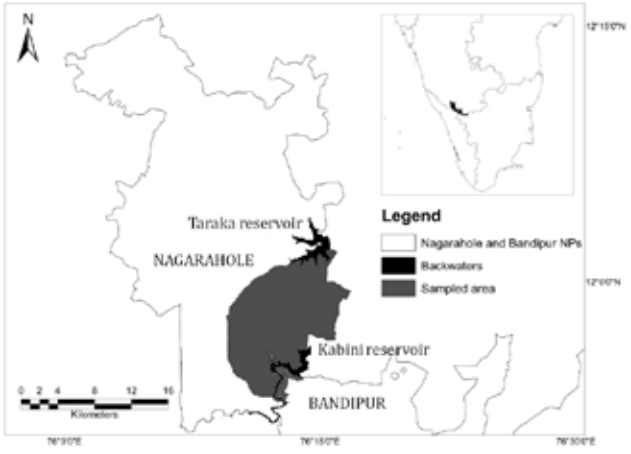

Figure 1. Map of the study area with the rough area sampled and inset of the location of the study area in southern India.

days (Table 1), with roughly equal sampling effort from ~7 am – 6 pm, between March-June 2009. These sightings comprised 2900 individuals, of which 1286 were adults (986 females and 300 males, including re-sightings of the same individuals). The present study was limited to the dry season as were previous censuses and research studies because of the logistics of sampling and low encounter rates during the monsoons.

Data analysis

In order to find out whether sex ratios based on short sampling periods were representative of sex ratio across the dry season, we calculated sex ratios based on about a week's sampling (henceforth, referred to as 'one-week-per-month') and about a month's (henceforth, referred to as 'entire month') sampling, during each month for four months. The one-week-per-month sampling was carried out between the 8th and 17th of each month (exact dates provided in Table 1). In order to address the second objective of comparing sex ratios obtained with and without individual identity, we obtained sex ratios from 1) total encounters of adult males and females during the sampling period, 2) counts of identified adult males and females, 3) capture-recapture estimates of adult male and adult female population sizes (see paragraph below).

Elephants were individually identified based on natural physical characteristics (Vidya *et al*. 2014). We used standard capture-recapture methods (Seber 1982; Williams *et al*. 2002) to estimate male and female population sizes. Multiple sightings (or captures) over a day were consolidated into one occasion (*sensu* Williams *et al*. 2002) per day. The resulting dataset contained 84 occasions (Table 1). The subset of data between the 8th and 17th of each month comprised 31 occasions.

Capture histories were constructed for identified adults, separately for each dataset, and analyzed using the program MARK (White & Burnham 1999). The assumptions of equal catchability and survival across individuals were tested using standard tests (TEST2 and TEST3) in program RELEASE (Burnham *et al*. 1987) from within MARK. The assumptions of equal survival and detection were met by the datasets of males. The assumption of equal survival across individuals was met by the one-week-per-month but not the entire month dataset of females, and both female datasets showed detection heterogeneity. This heterogeneity in female detection and survival (which comes from differences in emigration, which is treated in the test as part of survival) were probably due to the absence of geographic closure as the study area is part of a larger continuous forested landscape. Therefore, the Robust Design model (Kendall & Nichols 1995; Kendall *et al*. 1995, 1997) and POPAN formulation of the Jolly-Seber class of models (Schwarz & Arnason 1996) that do not assume geographic closure were used to estimate population parameters.

The Robust Design model involves sampling primary occasions, which are widely spaced and allow for migration, births and deaths, and secondary occasions (within each primary occasion), across which the population is effectively closed. In our analysis, the period between 8th and 17th of March, April, May and June, 2009 formed the four primary occasions of approximately equal sampling effort. Secondary occasions were days within the primary

Table 1. Sampling effort in different months during the dry season of 2009 in Nagarahole National Park and Bandipur Tiger Reserve, number of adult elephants sighted during the one-week-per-month and entire month datasets, and secondary occasions (SO) for the Robust Design analysis.

Month	# days	Entire month		One-week-per-month		Robust design analysis data	
		Total # adults	# unique adults	Total # adults	# unique adults	SO within each primary occasion (dates)	# SO (days)
March	18	212	63	95	43	8, 10, 12, 13, 14, 16, 17	7
April	19	327	108	136	60	9, 10, 11, 13,14,15,16,17	8
May	25	364	125	152	73	8, 9, 11, 12, 13,14,15,16,17	9
June	22	384	94	136	60	8, 9, 12, 13, 14, 15, 17	7

occasions and, since they were closely spaced, the closure assumption seemed to be valid for secondary occasions (Kendall & Nichols 1995). Population size for each primary occasion was estimated based on the model with the lowest AICc value. POPAN postulates the existence of a superpopulation (N^*), from which new entrants can immigrate to the study area. Therefore, in addition to recapture rates and the survival rates (also estimated in Robust Design), this model has the parameters *b*/*pent* (probability of entry). The POPAN analysis was performed using both the entire month's sampling and sampling between only the 8th and 17th of each month. Superpopulation estimates from the model with the lowest AICc value were used for further analyses. Sex ratios were calculated from estimates of population size obtained from the above methods and error terms for these sex ratios calculated using the method of propagation of errors. The error, ΔR, for any ratio, A/B, is given by the following relationship,

$$\Delta R = \frac{A}{B}\sqrt{\left(\frac{\Delta A}{A}\right)^2 + \left(\frac{\Delta B}{B}\right)^2}$$

where ΔA and ΔB are the error terms for random variables, A and B, respectively (Birge 1939). Statistical analyses were carried out using Statistica 5 (StatSoft, Inc. 1996).

Results

Sex ratios based on unique individuals sighted

The total numbers of unique adult females and adult males seen during the one-week-per-month dataset were 109 and 25, respectively, and during the entire month dataset, 153 and 31, respectively, giving rise to sex ratios of 1:4.4 (adult males : adult females) and 1:4.9 overall based on these two datasets. Sex ratios varied across months, from 1:2.9 to 1:4.8 based on the one-week-per-month dataset (Fig. 2a) and even more, from 1:2.9 to 1:5.6, based on the entire month dataset (Fig. 2b). Changes across months were consistent with the cumulative counts of males plateauing quickly compared to those of females (Fig. 3).

Robust Design

The Robust Design analysis of data on adult females yielded a model with constant survival probability, time-varying probabilities of capture and recapture set equal to each other, and movement constrained to be Markovian as the best model (Table 2). Setting capture and recapture probabilities to be equal meant that the probability of sighting an elephant was not dependent on its earlier sighting history. Estimates from this best model showed considerable monthly changes in adult female population size (Table 3).

The best model for adult males was different from the best model for females, and had capture and recapture probabilities constrained to be constant over secondary occasions, with Markovian movement and constant survival (Table 2). Based on the Robust Design, using data from one-week-per-month as the primary occasions, sex ratios were found to vary from 1:2.9 to 1:4.7 across months (Fig. 2a).

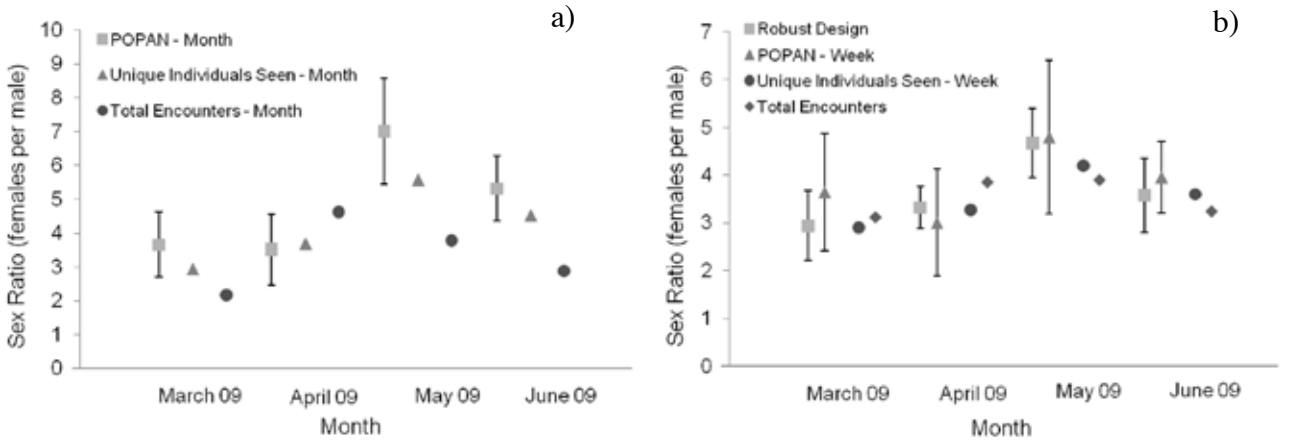

Figure 2. Monthly adult sex ratios (number of adult females per adult male) and 95% CIs calculated using different methods, based on data from a) one-week-per-month and b) the entire month.

Table 2. Results from Robust Design models for adult females and adult males. The model likelihoods, AICc, number of parameters, and deviance for various models are shown. The different models are ranked according to the AICc values calculated based on the combination of the likelihood of the model and the number of parameters: *p*: probability of initial capture, *c*: probability of recapture, *s*: survival; *N*: population size in the study area; (t): different estimate for each occasion, (.): constant estimate, (month): different estimate for each month. Movement can be modelled as null, random, or Markovian.

Sex	Model	AICc	Delta AICc	AICc Weight	Model Lik.	Num Par	Deviance
Females	s(.), p(t)=c(t), Markovian, N(Month)	743.083	0.000	0.914	1.000	37.0	860.621
	s(.), p(t)=c(t), Random, N(Month)	747.807	4.724	0.086	0.094	38.0	862.886
	s(.), p(t)=c(t), Null, N(Month)	769.901	26.819	0.000	0.000	35.0	892.314
	s(.), p(Month)=c(Month), Markovian, N(Month)	846.992	103.910	0.000	0.000	12.0	1021.733
	s(.), p(Month)=c(Month), Random, N(Month)	849.264	106.181	0.000	0.000	12.0	1024.004
	s(.), p(.)=c(.), Markovian, N(Month)	850.611	107.528	0.000	0.000	9.0	1031.707
	s(.), p(.)=c(.), Random, N(Month)	852.878	109.795	0	0	9	1033.974
	s(.), p(Month)=c(Month), Null, N(Month)	867.939	124.856	0	0	9	1049.035
	s(.), p(.)=c(.), Null, N(Month)	883.607	140.525	0	0	9	1064.704
Males	s(.), p(.)=c(.), Markovian, N(Month)	384.562	0.000	0.601	1.000	9.0	390.306
	s(.), p(.)=c(.), Random, N(Month)	385.897	1.336	0.308	0.513	9.0	391.642
	s(.), p(Month)=c(Month), Random, N(Month)	389.541	4.979	0.050	0.083	12.0	387.927
	s(.), p(.)=c(.), Null, N(Month)	390.915	6.354	0.025	0.042	9.0	396.660
	s(.), p(Month)=c(Month), Null, N(Month)	393.114	8.552	0.008	0.014	12.0	391.500
	s(.), p(Month)=c(Month), Markovian, N(Month)	393.114	8.552	0.008	0.014	12.0	391.500
	s(.), p(t)=c(t), Null, N(Month)	417.102	32.540	0	0	34	344.450
	s(.), p(t)=c(t), Markovian, N(Month)	419.901	35.339	0	0	36	338.779
	s(.), p(t)=c(t), Random, N(Month)	425.385	40.823	0	0	37	339.860

POPAN

The best model based on POPAN analysis also varied between adult females and males. The best model for adult males had constant survival, constant probability of entry, and constant capture probability based on both the one-week-per-month and entire month datasets. The best model for adult females for the one-week-per-month datasets for April and May had constant survival, constant probability of entry, and time-varying capture probabilities, the best model

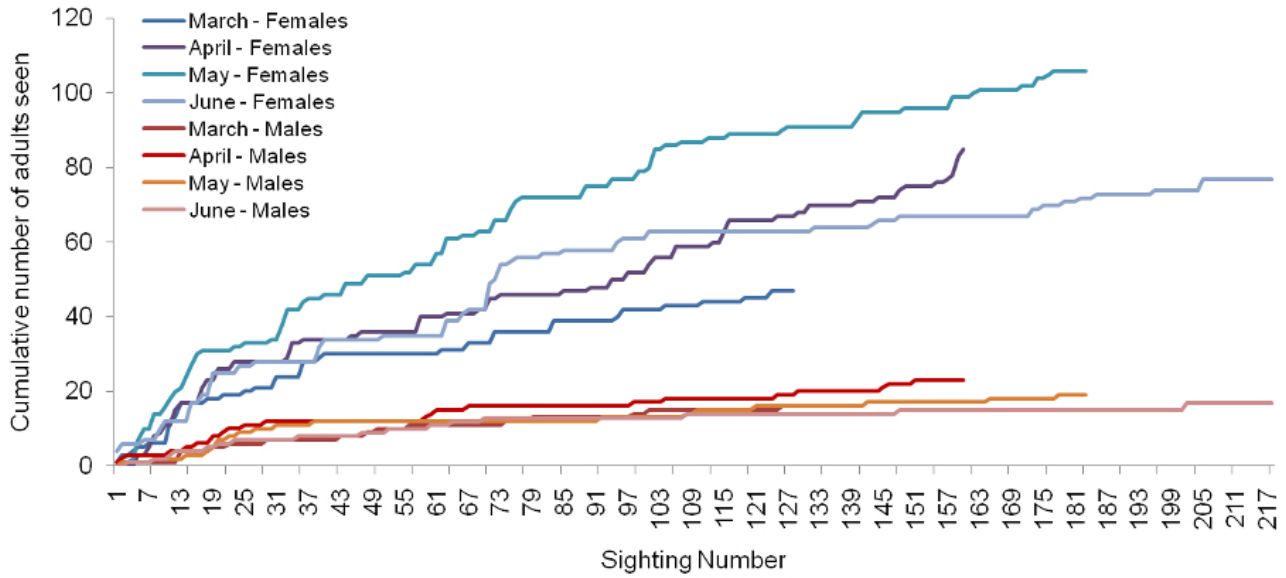

Figure 3. Cumulative counts of uniquely identified females and males in different months.

Table 3. Population size estimates (N) obtained from the respective Robust Design models with the lowest AICc for adult females and males.

Month	N	SE	Lower 95% CI	Upper 95% CI
Females				
Mar 09	35.030	2.409	32.769	43.944
Apr 09	49.058	2.276	46.832	57.236
May 09	67.201	3.939	62.358	79.032
Jun 09	50.684	2.580	48.068	59.707
Males				
Mar 09	11.904	1.272	11.117	18.007
Apr 09	14.764	0.726	14.158	17.681
May 09	14.386	0.768	14.032	18.606
Jun 09	14.170	1.386	13.186	20.336

for March had constant survival and capture probabilities, but time-varying probability of entry, and the best model for June had time-varying survival and capture probabilities, but constant probability of entry. The best models for the entire month dataset for March, May, and June showed constant survival and probability of entry but time-varying capture probabilities. The best model for the entire month data from April had constant survival but time-varying capture and entry probabilities. The sex ratios from the best model estimates (Tables 4 & 5) varied across months from 1:3 to 1:4.8 based on the one-week-per-month dataset (Fig. 2a) and from 1:3.5 to 1:7 based on the entire month dataset (Fig. 2b).

Table 4. Estimates of superpopulation size (N) from POPAN run with data from the one-week-per-month dataset (see Table 1) for each month for adult females and adult males. Superpopulation size estimates are expected to be larger than Robust Design population size estimates.

Intervals	N	SE	Lower 95% CI	Upper 95% CI
Females				
Mar 09	42.591	5.162	36.285	58.175
Apr 09	53.775	4.034	48.986	66.243
May 09	80.604	6.648	70.982	97.954
Jun 09	52.024	3.140	48.630	62.483
Males				
Mar 09	11.670	1.422	11.052	19.666
Apr 09	17.864	3.120	14.963	29.495
May 09	16.799	2.512	14.621	26.627
Jun 09	13.128	0.988	13.002	19.789

Table 5. Estimates of superpopulation size (N) from POPAN run with the entire month datasets of adult females and adult males.

Intervals	N	SE	Lower 95% CI	Upper 95% CI
Females				
Mar 09	63.741	5.931	55.532	79.847
Apr 09	105.000	7.463	94.856	125.585
May 09	147.211	10.144	131.619	172.293
Jun 09	94.704	5.569	86.697	109.324
Males				
Mar 09	17.403	1.667	16.223	24.823
Apr 09	29.816	3.972	25.362	42.671
May 09	20.960	1.894	19.399	28.625
Jun 09	17.787	1.267	17.086	24.215

Total encounters and a comparison of sex ratios

The overall sex ratio (across months combined) calculated using the total numbers of males and females encountered irrespective of individual identity was 1:3.3, as opposed to 1:4.9 based on the unique individuals sighted (see first Results paragraph). The sex ratios from total encounters were somewhat less variable over months than those calculated using other methods (Fig. 2), and varied from 1:3.1 to 1:3.9 based on the one-week-per-month dataset, and from 1:2.2 to 1:4.6 based on the entire month dataset. In May and June, total encounters gave less female-biased sex ratios than the other methods.

When sex ratios were compared across the four months, there was a significant effect of month for the one-week-per-month dataset based on the four different methods (Repeated measures ANOVA: $F_{3,9} = 8.835$, $P = 0.005$), as well as the entire month dataset based on only POPAN and number of unique individuals (Repeated measures ANOVA: $F_{3,3} = 17.039$, $P = 0.022$), as total encounters were not so variable. Post-hoc tests showed significant differences in sex ratios between March and May, and April and May (Tukey's HSD tests, $P < 0.05$) based on both the one-week-per-month and entire month datasets. We also found a significant difference between the sex ratios based on the one-week-per-month dataset and the entire month dataset (Paired *t* test using sex ratios from POPAN and the number of unique individuals, matched for the month, $t_7 =$

-3.152, $P = 0.016$), with the sex ratio being less female-biased based on the shorter time period of sampling ($mean_{week}$ = 1:3.68, $mean_{month}$ = 1:4.53).

Discussion

Sex ratios across time

In sexually dimorphic polygynous species, the adult sex ratio is seldom 1:1 because of increased mortality in males (Promislow 1992). The "natural" adult sex ratio of undisturbed populations of Asian elephants is possibly ~1:2 (males : females) (McKay 1973; Williams *et al*. 2007). Therefore, adult sex ratios in our study area were abnormally skewed, possibly because of historical poaching. We show for the first time that there was considerable variability in adult sex ratios even within months across the dry season. Therefore, sex ratios from annual or biennial censuses of 2–3 days may not be meaningful as they can differ depending on when the census was undertaken (see Figure 4). While the broader-scale adult sex ratio (from census data of Karnataka) was estimated at 1:3.7 in 2002 (Sukumar *et al*. 2002) and 1:2.2 in 2010 (Baskaran & Sukumar 2011), whether this change reflects actually improved sex ratio or local sampling issues is difficult to disentangle. We found monthly sex ratios varying from 1:2.9 to 1:5.6 (based on the number of unique individuals seen) or from 1:3.5 to 1:7.0 (based on POPAN). Doubling of sex ratios in this range of values is disconcerting because short-term estimates of sex ratio may then reach opposite conclusions about the long-term status of males in the population. This is especially a problem in populations with sex ratios that are not very skewed because small changes in sex ratio arise from large changes in actual numbers of one sex (while the opposite is true if the sex ratio is already very skewed), making the estimation of sex ratios more crucial in such populations.

Our overall sex ratio estimate from counts of identified adults was 1:4.9 (M:F), while adult sex ratios in previous studies in roughly the same study area and carried out by researchers using technically correct methods were 1:3.1 (Vidya *et al*. 2003), 1:5.8 (Arivazhagan & Sukumar 2005), and 1:4.3 (Goswami *et al*. 2007). The adult sex ratio based on the Forest Department census in Nagarahole and Bandipur combined was 1:3.6 in 2002 and 1:2.5 in 2010 (Nagarahole separately: 1:2.7 in 2002 and 1:2.1 in 2010, Bandipur separately: 1:4.5 in 2002 and 1:2.7 in 2010; Sukumar *et al*. 2002; Baskaran & Sukumar 2011). When faced with such data from different time points, it is tempting to read a pattern into it across years and make inferences about poaching. Managers may be forced to make decisions regarding patrolling and stepping up of anti-poaching efforts based on such "changes" in sex ratio, from, say, 1:3.1 to 1:5.8, which would indeed be a drastic change if these sex ratios were correct. However, since we find that short-term temporal variation over the course of months can be of the same range, it is not possible to infer patterns about long-term variation in sex ratios from the previous studies in this area. We found that over 60 days of data were required to obtain a plateauing of sex ratios (Fig. 4), although this time period may depend on when the study is started, suggesting that short-term censuses may not be reliable.

It is interesting that the short-term differences in sex ratios were brought about by sex-specific differences in space use, as evidenced by the different best models obtained from Robust Design and POPAN analyses, by adult females and males. In both analyses, the best models for females included variable capture probabilities across time, while those for males included constant capture probabilities. We found, based on field observations also, that many females entered the study area during the peak of the dry season (April-May), while there was no correspondingly high increase in the number of males (the number of unique females rose from 47 in March to 106 in May, while the number of unique males was 16 in March and 19 in May). Thus, differences in movement patterns/use of the study area caused temporal changes in sex ratios. Apart from management relevance, such variability could also be biologically significant as it can affect mating opportunities. For instance, if the proportion of females coming into oestrous remains constant across months, a larger number of available females in certain months

could increase mating opportunities for males. In general, operational sex ratios are expected to and have been found to influence various aspects of mating behaviour (Emlen & Oring 1977; see Weir *et al*. 2011 and references therein).

Sex ratios using unidentified versus identified individuals

Differences in the detectability of males and females can bias sex ratios if the total counts of females and males are used. The accuracy of such a sex ratio estimate is, therefore, likely to depend on what proportion of males and females in the population have been sampled and the true population sex ratio. While the sex ratios based on total counts were less variable across months, they were also less female-biased than sex ratios from other methods during the peak dry season, when censuses are usually carried out. This is possibly why census data tend to show less skewed adult sex ratios than longer term studies (see data in previous section). The difference in sex ratio estimates between using identified individuals and total encounters (irrespective of identity) may also be one of behaviour. Male and female elephants can respond very differently to habitats and humans (Sukumar & Gadgil 1988; Evans & Harris 2012). In our study area, we found that males remained in open areas more often than females, making repeat sightings of them more probable (average numbers of repeat sightings for males and females in open areas were 9.6 and 6.6, respectively). On the other hand, inside denser forests, adult males could be more difficult to sight because of being solitary and, possibly, even more elusive. Therefore, sex ratios in the absence of individual identification can be misleading.

Overall implications

Apart from implications for management, short-term variations in sex ratios can have significant implications for animals in terms of possibilities for interaction and mating opportunities. The extent to which mating opportunities are affected would depend on oestrous synchrony and dominance hierarchies amongst males that affect monopolizability of females. One might argue that that if sex ratio differences across months occur in a study area that is a few to several hundred square kilometres in size (a Protected Area in India, such as in our study), coordinated censuses at a larger scale might recover correct sex ratios even if carried out for a short time. However, when sex ratios are calculated using total counts, as they are during large-scale censuses, they can be quite different from the real sex ratios. We also estimated sex ratios from the

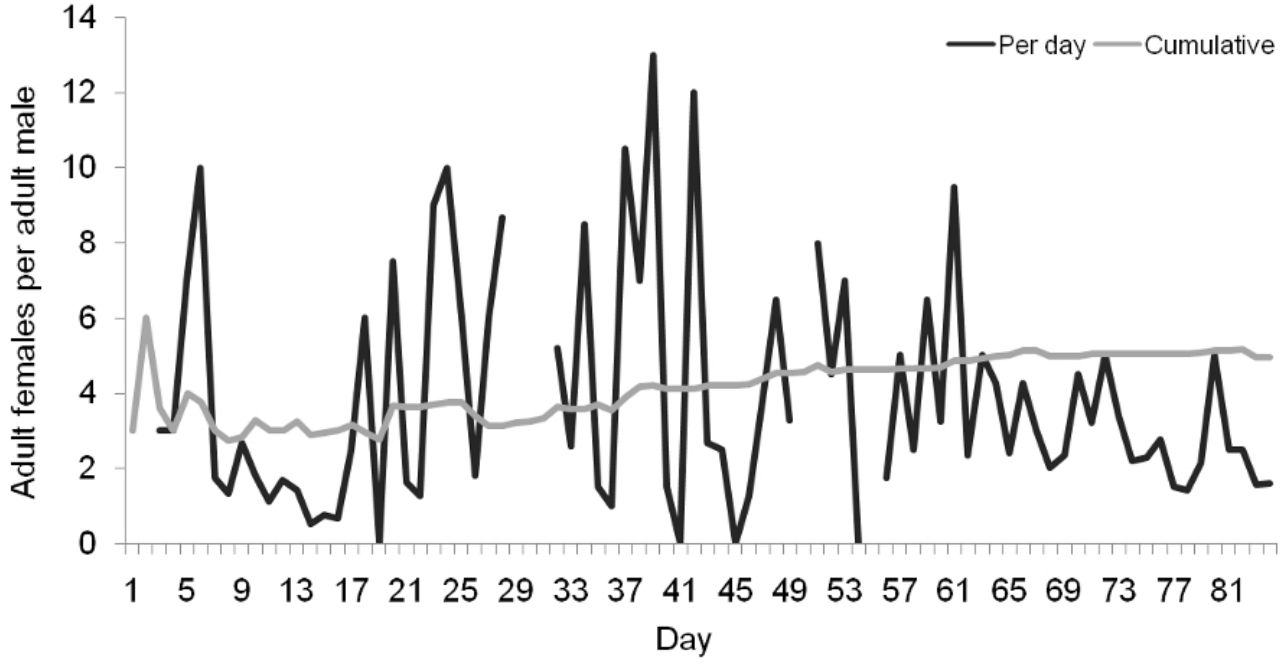

Figure 4. Daily adult sex ratio and cumulative sex ratios based on individually identified animals across the sampled days. The dashed line indicates the final sex ratio obtained (1 male : 4.9 females).

simple Lincoln-Petersen method of estimating population sizes, which can be calculated by local managers, but found the estimates to be too crude to be useful (data not shown). While short-term censuses provide estimates of numbers of animals in an area, which are important in affecting density-dependent processes, long-term studies on identified individuals that provide data on population numbers (that are similar to those from capture-recapture sampling), but additionally provide a wealth of information on other aspects of the species (Clutton-Brock & Sheldon 2010) may be the way forward in monitoring large mammal populations. However, since wildlife protection departments rarely have the time or expertise to carry out long-term, individual-based monitoring of populations, it might help if competent researchers obtain such data from at least select populations of elephants in high density areas (Rangarajan *et al*. 2010; it would be impractical to obtain detailed data from the entire 12,000 km^2 landscape). In the context of male poaching, it might be worth monitoring at least identified adult males (Goswami *et al*. 2007) rather than relying on census data or carcasses (which are very difficult to find in Asian forests). Another reason for monitoring individual males is that pubertal males disperse not just from their natal herds, but also from their natal home ranges to different locations (locational dispersal; Vidya & Sukumar 2005; Vidya *et al*. 2005). Therefore, individual turnover in an area due to dispersals could give rise to the same counts. Locational dispersal of males also implies that poaching young males can affect areas that those males would otherwise disperse to, even if there was adequate protection in those areas. If waterhole counts are undertaken, it would be important to obtain photographs so that an attempt can be made at identifying individuals rather than using total counts.

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Research Article *Gajah 44 (2016) 16-22*

A Qualitative Analysis of the Main Threats to Asian Elephant Conservation

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Abstract. In this study we identified the main threats to the conservation of Asian elephants and discuss their causes and implications. Primary data from interviews and secondary data from published articles were gathered and analysed using inductive and deductive thematic content analysis assisted by NVivo 10. Our results indicate that the three main threats for the species are human-elephant conflict, habitat loss, and poaching. The conversion of forests into plantations and human-dominated areas, including infrastructure developments, are the primary causes for human-elephant conflict and habitat loss. Meanwhile, the high demand and monetary return from ivory trade are the primary causes to illegal poaching.

Introduction

Asian elephants (*Elephas maximus*) are endangered due to the ongoing decline of their populations. The current wild Asian elephant population is estimated to be between 36,000 and 50,000 individuals (Santiapillai & Sukumar 2006). The Asian elephant has been categorised as 'endangered' in the IUCN Red List of Threatened Species since 1986 and listed in the Appendix I of CITES since 1975. The classification of 'endangered' status is being assigned to any species, which has experienced more than 50% population reduction in three generations (IUCN 2012). In forest ecosystems, elephants are excellent seed dispersers of many plant families, such as Euphorbiaseae, Poaceae, Fabaceae, Moracear, Saporaceas and Malvaceae (Campos-Arceiz & Blake 2011). The decline of Asian elephant numbers will therefore alter many plants population dynamics.

In many of the Asian elephant range states, massive destruction of forest mainly due to agricultural, industrial and infrastructure expansion has put pressure on the remaining Asian elephant population (Joshi & Singh 2007; Promsouvanh 2009). The large forest destruction pushes elephants closer to human-dominated areas. Worse still, habitat loss and fragmentation intensify the conflict between elephants and humans where both coexist in similar ranges (Leimgruber *et al*. 2011; Pradhan *et al*. 2011; Mehta & Kulkarni 2013). Although human-elephant conflict (HEC) mitigation measures have been implemented, HEC remains high in most elephant range states. Furthermore, all the 13 Asian elephant range states are classified as developing countries and are seeking more developments. Subsequently, rapid human developments are likely to continue, which may worsen the impact of HEC in the future.

In this context, it is imperative to analyse the main threats to Asian elephants and the causes and implications of the identified main threats. However, the published journal articles related to Asian elephants is scarce, especially in Southeast Asian countries like Malaysia. Here we present an analysis of the current main threats for Asian elephant populations, with a special focus in their situation in Peninsular Malaysia. Our qualitative analyses are based on interviews with key informants and the text analyses of available published information.

Methods

In this study we utilised both primary and secondary data. Primary data was collected through semi-structured interviews with 10 key informants from Malaysian government agencies and non-governmental organizations (NGOs) involved in research, law enforcement, threat mitigation, and management of Malaysian elephants. The interviews were conducted either face to face or by e-mail. The interviews were then transcribed and sent back to the interviewees for validation.

The secondary data was systematically compiled from published articles in two academic databases: Science Direct and Springer Link. Additionally, articles from the journal *Gajah* were also included because the journal is specifically devoted to Asian elephants. In order to identify relevant articles in the databases and *Gajah* we conducted systematic searches using the term 'elephant' in the title of articles published between 2004 and 2014. The search was then refined looking for the terms "Asian elephant AND *Elephas maximus*" within the results of the previous search. We further refined these results by reading the abstracts or introduction and retaining only articles relevant to the conservation of Asian elephants (e.g. we excluded articles about African elephants, elephant biology and behaviour, and other wildlife such as elephant seal and elephant fish).

The contents of both the interview transcripts and the selected journal articles were analysed with inductive and deductive thematic content analysis. In the process of analysis, the documents were uploaded into NVivo 10 (QSR International) followed by the formation of appropriate nodes (themes and subthemes) inductively (Dey 1993; Elo & Kyngäs 2008; Miyashita *et al*. 2008; Mazaheri *et al*. 2013; Kadir *et al*. 2013; Woo & Heo 2013; Fletcher *et al*. 2014; Rivera *et al*. 2015). The contextual definitions of the nodes were also included (Dey 1993; Miyashita *et al*. 2008; Mazaheri *et al*. 2013; Woo & Heo 2013). Next, the related words, phrases or sentences in the documents were highlighted and coded into respective nodes as codes in accordance to the contextual definitions. Then, all the codes were outlaid and the frequency of reoccurrence of words, phrases or sentences indicating threats to Asian elephants were calculated manually (NVivo 10 could not detect some words, phrases or sentences according to the contextual meanings). Aside from the frequency calculation, similar theme and subtheme coding and categorisation were further analysed for causes and implications of the identified main threats with highest frequencies (Dey 1993; Son 2011; Kadir *et al*. 2013; Fletcher *et al*. 2014; Rivera *et al*. 2015).

In the context of our study, HEC is defined as the negative contact between humans and elephants, which resulted from human developments. Habitat loss represents the disappearance of forests or elephant habitats. Finally, we define poaching as the illegitimate hunting activities of Asian elephants for their body parts, namely ivory, meat, tail hair, hide, feet, and trunk.

Results

Text content analyses

The analysis of the interview transcripts shows that three issues accounted for 85% (N = 276) of the reoccurrences of words or expressions referring to Asian elephant threats (Table 1). These three threats are habitat loss (38.8% of the codes), HEC (35.1%), and poaching (10.9%; Table 1). Other cited threats for Asian elephants include poor governance, public attitudes, and human population growth, among others (see Table 1 for details).

In our systematic search of articles we retained 76 journal articles relevant to the conservation of Asian elephants. The analysis of the articles text showed the same three most frequently cited threats, although in slightly different order: HEC (41.8%, N = 1887 codes), followed by habitat loss (35.4%), and poaching (11.6%; Table 1).

Human-elephant conflict (HEC)

HEC is the most commonly cited threat to Asian elephants in our analyses. Our text analyses suggest that HEC is aggravated by habitat loss in

Table 1. Frequency distribution of codes (terms) related to Asian elephant threats from text analyses of interview transcripts and journal articles.

Threats or causes	Frequency of codes			
	Interview transcripts		Journal articles	
	N	%	N	%
HEC	97	35.1	1887	41.8
Habitat loss*	107	38.8	1600	35.4
Poaching	30	10.9	522	11.6
Public attitudes	14	5.1	121	2.7
Poor governance	10	3.6	161	3.6
Population growth	6	2.2	99	2.2
Incidental encounters	6	2.2	90	2
Biological reasons	6	2.2	39	0.9
Total	276	100	4519	100

*Habitat loss in this context refers to: agricultural expansion, conversion of lowland forests into plantations, development activities, and habitat fragmentation.

Asian elephant range states. Accordingly, due to habitat loss, elephants are more likely to move into nearby areas to forage, and repeatedly encroach into plantations to raid crops (Fig. 1). HEC is aggravated by factors such as disorganized crop protection and HEC mitigation, such as lack of cooperation among farmers to mitigate HEC and protect crops, as well as by the lack of public education and awareness amongst farmers.

In addition, the lack of corridor maintenance to connect forest patches also worsens HEC. Being restricted to fragmented forest patches, elephants are more likely to wander between plantations and forests to forage. Meanwhile, the lack of public education and awareness on the importance of HEC mitigation also develops knowledge gaps within the community.

Figure 1. Elephant footprints in a paddy field in southern Sri Lanka. Photo by Jennifer Pastorini.

Our analyses also suggest that the knowledge about effective HEC mitigation and general knowledge about Asian elephants are still low, hence hampering the implementation of effective HEC mitigation and elephant conservations strategies. As mentioned by key informant 5: "When the public do not have adequate awareness and knowledge about the species, how do we want to change their mindset for the need to conserve the species?" People might not be aware of the endangered status of Asian elephants and the importance of HEC mitigation for the species conservation.

Farmers are not cooperating with each other to mitigate HEC. This is also supported by key informant 5: "Not many [people] are interested in conserving the elephants and sometimes they are treated as pest. Generally, Malaysians have no clue on why we must protect these animals, so public education or awareness in this area will be very important. Without realizing that elephants are part of our natural heritage, as we move forward there is no future for elephants amongst us in the country." Additionally, key informant 6 also mentioned that: "…low level of awareness among the general public and the government on the importance of protecting our biodiversity" makes it harder to address HEC. Therefore, the better understanding on the endangered status of Asian elephants as well as the implemented HEC mitigations is necessary.

Besides the causes of HEC, our analyses show the diversity of losses caused by HEC. The types of losses include monetary loss, property destruction, human injury and fatality, and retaliatory killing of Asian elephants. With the continuous destruction on plantations, properties, human injuries, and fatalities from HEC, farmers feel disappointed, angry, resented, and depressed towards elephants. This leads to less tolerance and willingness to endure HEC incidence among farmers. People, consequently, contribute less to the conservation of elephants. Affected farmers are more likely to retaliate by shooting, poisoning, and electrocuting these elephants to protect their crops, rather than protecting the elephants. Key informant 8 stated that retaliatory killing is one of the main threats to Asian elephants in Peninsular Malaysia; we found similar results in the analysis of journal articles content, although HEC is the leading cause to retaliatory killing.

Habitat loss

The second identified main threat to Asian elephants is habitat loss. Our analyses reveal that the repeated occurrence of habitat loss is due to large conversion of forests into plantations and human-dominated areas including infrastructure developments (e.g. roads - see Fig. 2, highways, and hydro-electric dams), as well as human settlements. The increase of human population resulted in the deforestation of forests to make way to plantations and infrastructure developments. Habitat loss and HEC are closely related. The replacement of natural habitats

Figure 2. Elephants at a road in northern Peninsular Malaysia. Photo by Yen Yi Loo.

Figure 3. Elephant poached inside the Burha-chapori Wildlife Sanctuary of Assam, India. Photo by Smarajit Ojah.

for crops results in an increase of HEC. Key informant 8 mentioned that due to deforestation 'elephants have to compete with development of huge plantation for space'.

Habitat loss has other negative impacts for Asian elephants. For example, it facilitates the access of poachers to the remaining forests. Moreover, habitat loss may disrupt migratory routes of elephants. As mentioned by key informant 4: "…elephants go to the same place every season. Improper planning of land conversion sometimes cut across their migratory routes."

Habitat loss also fragments elephant populations, which leads to low genetic exchange with other groups and populations.

Poaching

Lastly, the third major threat to Asian elephants is poaching (Fig. 3). Illegal trade of elephant parts is dominated by ivory, meat, tail hair, hide, feet, and trunk. It is very common for poachers to shoot, use poison, or electrocute the elephants. Some poachers also set up traps with elephant favourite foods such as banana and sugarcane as decoy to catch the elephants. As indicated by key informant 2: "…poaching and hunting, killing of elephants for their ivory, meat and hide…" are threatening Asian elephants. Apart from that, elephant poaching is fuelled by high demand and monetary returns from international trade. This

was also mentioned by key informant 2: "…the demand for ivory is leading to the elimination of tuskers from some populations in Asia, while the industries in China use hide for bags, shoes, belts, and other items presenting a grave threat to elephants of all ages and sexes." Poaching of males for ivory skews the population sex ratio. Key informant 8 says that illegal poaching is rare in Peninsular Malaysia. Nevertheless, key informant 9 foresees that illegal poaching might get worse in the next five to ten years in Peninsular Malaysia.

Discussion

Human population growth and the subsequent expansion of infrastructure, agriculture, and other human-dominated areas are leading to the rapid decline of Asian elephant populations. In order to implement effective Asian elephant conservation measures, it is imperative to carefully examine the species main threats and consider their causes and implications.

Conservationists in our sample recognized that human population growth has a significant impact on the severity of HEC, habitat loss, and poaching, which threaten the elephants in Asia. With the increment of human population, forest clearance has resulted in habitat loss of Asian elephants. For example, the remaining forest in Sri Lanka constitutes to approximately 20% of the total area of the country (65,000 km^2; Perera 2009). In Bangladesh, the total land covered with forest is less than 0.02 hectare per capita due to timber logging and conversion into agricultural lands (Islam *et al*. 2011).

Habitat loss often leads to the change of forest landscape, which also causes elephant's confusion in their usual movement directions, particularly routes leading to saltlicks, vegetations and water resources (Sukumar & Santiapillai 2006). Consequently, habitat loss leads to elephants' encroachments into nearby plantations, villages, railways, highways, and so on. Habitat corridors to connect forest patches could mitigate the impact of fragmentation, allowing elephants to move from one location to another (Azmi & Gunaryadi 2011).

Habitat loss and fragmentation also influences elephants' crop raiding behaviour. When natural habitats are depleted, elephants may be more inclined to raid crops in nearby plantations due to food sources reduction and the high nutritious value of crops compared with wild plants. In this context, elephants are also more likely to encroach into villages or human settlements for stored rice sacs, water, sugar, salt, and vegetables which much necessary for elephants' diet. Consequently, houses, kitchens and huts are often damaged by elephants. For example, as many as 22 houses were severely damaged by elephants in the dry season of 2004 in a small village of Sri Lanka (Campos-Arceiz *et al*. 2009).

Monetary loss due to crop raiding has adverse impact to villagers' welfare, especially for those whose livelihood depends on the crops. For example, in Karanjia Forest Division in India, a total of 46 acres of croplands were damaged by elephants between 2005 and 2006 (Sahu & Das 2012). Other subsistence activities such as the collection of forest resources are also negatively affected by HEC, hence further impacting on villagers' income and livelihood. Besides the economic cost, HEC can result in severe emotional stress, which might lead farmers to retaliate due to frustration, anger, and resentment. For instance, in India, over 200 elephants were retaliated between 2006 and 2011 via poisoning, electrocuting, and shooting by frustrated farmers (Baskaran *et al*. 2011).

The installation of physical barriers such as trenches and electric fences may be effective locally to mitigate HEC. Their monitoring and management, including long-term maintenance, is crucial for their effectiveness. Long term sustainable funding for their maintenance and monitoring is key.

Additionally, it is also important to consider the influence of negative attitudes among farmers towards willingness to spend on elephant's conservation initiatives. Sometimes, conservation initiatives may also give adverse impacts back to the species. Poor awareness on HEC and effective mitigation strategies further aggravates the conflict between people and

elephants. Farmers generally do not know how to chase elephants away from their plantations or houses effectively. Consequently, they are less prone to cooperate in the mitigation of HEC, making elephant conservation efforts less effective (Haturusinghe & Weerakoon 2012).

Poaching is another important threat identified in our study. The high demand for ivory and huge monetary returns of its trade drive elephant poaching in the region. As an example, in Cambodia, ivory is being sold for economic profit (Maltby & Bourchier 2011). Illegal poaching of elephants in countries like Malaysia is not high but might increase in the coming years. Additionally, snare traps set to capture smaller mammals may also injure elephants (Maltby & Bourchier 2011; Saaban *et al*. 2011). Because only male elephants have tusks, poaching for ivory has skewed the male to female sex ratio of some populations (Sukumar & Easa 2006; Sukumar & Santiapillai 2006; Baskaran *et al*. 2011).

Here we have identified three main threats to Asian elephants: HEC, habitat loss, and poaching. We also identified the complex relationships between the three main threats identified. Public participation should be integrated into education on Asian elephant conservation, likewise as to shorten the knowledge gap in addition to improving current public awareness. Moreover, further work on legislation enforcement is needed to tackle poaching and illicit elephant trade. Reducing the effect of HEC, habitat loss, and poaching of Asian elephants may ease the further decline of Asian elephant's population.

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Elephants next to a road in northern Peninsular Malaysia. Photo by Yen Yi Loo.

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Research Article *Gajah 44 (2016) 23-29*

Diet Component Estimation in Asian Elephants by Microhistological Faecal Analysis

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Abstract. We report on the gut passage times of dicot and monocot fodder in Asian elephants and the utility of microhistological faecal analysis for the quantitative evaluation of diet in elephants. A feeding trial was conducted with three domesticated elephants and faecal samples analyzed using a point quadrat method. Gut passage times in elephants were found to be comparable to that reported for ruminants, but with a shorter 'time of elimination'. The percent epithelial fragment occurrence of each forage class in the faeces accurately reflected its percent dry weight in the diet. We conclude that microhistological faecal analysis is a valid method for studying forage class variation in the diet of elephants.

Introduction

Studies on the feeding behaviour of Asian elephants (*Elephas maximus*) have employed direct observations (McKay 1973; Vancuylenberg 1977; Sukumar 1989), feeding site inspection (Ishwaran 1983; Mueller-Dombois 1971; Dhakal & Ojha 1995), isotope studies (Sukumar & Ramesh 1992; Codron *et al*. 2011), and microhistological analysis (De Boer *et al*. 2000; Steinheim *et al*. 2005; Pradhan *et al*. 2008).

Free-ranging Asian elephants mostly inhabit poor-visibility habitat, display aggressive or avoidance behaviours to close approach by human observers, and are largely nocturnal (Fernando 1997), limiting the utility of direct observations. Feeding site inspection is of limited applicability because enumeration of food items once they have been removed is difficult, allows only qualitative analysis, and can be confounded by feeding of other animals. Isotope analysis only provides a graze:browse ratio. Faecal microhistological analysis overcomes many drawbacks of the other techniques, and could provide detailed information on diet composition, and its individual, temporal, and spatial variation.

A number of studies have been conducted on gut passage times of elephants using seeds and beads as markers (Dudley 1999; Weerasinghe *et al*. 1999; Campos-Arceiz *et al*. 2008). We failed to find any studies reporting gut passage times for fodder, or assessing the applicability of microhistological faecal analysis to elephants, in the published literature. Knowledge of gut passage times and any introduced bias is important in interpreting results of microhistological faecal analysis. Elephants consume both grass and browse and their diet consists of leafy and woody components. The relative proportions of forage class and component in the diet may vary seasonally and by habitat, which has implications for digestibility and nutritional value of consumed fodder, hence habitat suitability. Knowledge of the relative contribution to diet of elephants from different forage types and components, and their individual, temporal and seasonal variation is of interest both in the study of their feeding ecology and in managing habitat for elephants.

The objectives of this study were to assess 1) the gut passage times for fodder 2) the utility of microhistological faecal analysis for the quantitative evaluation of diet composition, and

3) the 'woody' component when consuming a mainly leafy diet and its variation with major forage types.

Methods

The study was conducted at the 'Millenium Elephant Foundation' in Kegalle, Sri Lanka, using three captive elephants. The study animals were one male and two female elephants, aged 11, 30 and 50 years respectively. All three were in good health throughout the study period. Their regular day routine consisted of being tethered in place, interacting with tourists, taking them on short rides, and being taken to the river and bathed twice a day. Little food was consumed during the day. They were tethered in place at the end of the day and provisioned with coconut palm fronds supplemented with grass or dicot fodder, which they consumed through the night. This pattern of feeding and activity was preserved during the entire experiment to prevent any effect on digestion, induced by a sudden change in the feeding or activity pattern.

Feeding experiment

The three elephants were provided with an exclusive diet of coconut palm (*Cocos nucifera*) fronds for 5 days, an experimental feed of measured quantities of dicot, grass and coconut palm fronds over 3 days, and again an exclusive coconut palm frond diet for 5 days. The dicot component in the experimental feed consisted mostly of cut branches of jackfruit (*Artocarpus integrafolia*) and a few of breadfruit (*Artocarpus atilis*), of which the elephants stripped the branches and consumed mainly the leaves. A few of the smaller twigs and some pieces of bark stripped from the larger branches were also consumed. As sufficient quantities of single species stands of grass were not available, the grass component of the experimental feed consisted of about 10 graminoid species. The elephants were provided with whole coconut palm fronds, which they stripped, consuming mainly the leafy part.

The experimental feed of dicot, grass and coconut palm fronds was given at 18:00 h on all three days, and a 'day' was defined as starting at that time and extending for 24 hours. At 8:00 h each morning after an experimental feed, unconsumed fodder was weighed and the amount consumed estimated. As the interval between pre- and post-feeding forage weight determinations was relatively cool with humidity levels approaching saturation, loss of weight due to desiccation was assumed to be minimal. Only coconut palm fronds were given during the day and the amount consumed was similarly estimated and added to that day's diet. The mean daily moist weight of fodder consumed by an elephant over the three days of experimental feed was 89.1 ± 14.63 kg, with the mean percentage of grass and dicot in the diet being 21.39 ± 4.57% and 21.62 ± 5.90% respectively.

To estimate dry weight for each fodder class, a correction factor was derived by sun-drying two 1 kg samples from each type of fodder to complete desiccation. The younger female and the male were noted to have consumed a small amount of dicot fodder on one of their walks, on the day prior to the start of the experimental feed. Consequently, values for their diets on that day were excluded from the analysis.

Sample collection

The study elephants produced 4–6 dung piles during the day and approximately the same in the night. Each pile consisted of 4–7 discrete boli. In an adult, a bolus is approximately 45–55 cm in circumference and 10–15 cm in height. Samples were collected by breaking off a piece of a bolus (approximately 100 g), placing it in a screw-cap container and adding 70% ethanol. Samples were stored at ambient temperature.

Based on a pilot study, dung samples were collected from two days prior to the commencement to five days after cessation of the experimental feed. Five samples were collected per day per elephant. As the elephants were tethered in one place throughout night, all dung piles produced in the night accumulated in one heap. Therefore, samples one and two were collected at 8:00 h the next morning from a bolus at the bottom and top respectively of the overnight heap of dung. Samples three, four and five were collected from

a random bolus in the dung pile deposited closest to 10:00, 14:00 and 18:00 h respectively.

Sample preparation

A subsample of about 20 g was taken from each sample, placed in a 50 ml plastic tube and boiling water added to 40 ml. The tube was capped and agitated until the dung was broken up, and then left standing for 30 min with occasional agitation.

Removal of large items (Storr 1960) has been reported to decrease bias. Elephant dung contains a large macroscopic component with individual pieces of bark, woody fibres etc. measuring many cm in length. Therefore, the slurry was filtered through a 2.5 mm sieve to exclude the macroscopic fraction. As fragments smaller than 0.1 mm cannot be conclusively identified (Martin 1955) and sampling from a relatively homogeneous size fraction reduces bias (Chamrad & Box 1964), the filtrate was washed using a 0.2 mm sieve, obtaining a fragment size range of 0.2–2.5 mm.

The fragments were re-suspended in 3 ml of water, and an equal volume of domestic bleach solution (sodium hypochlorite) was added to clear the fragments of pigment that would impair identification (Williams 1969; Vavra & Holechek 1980). The suspension was left standing for approximately 30 min until all particulate residue was visibly bleached. The residue was again rinsed with water employing the 0.2 mm sieve to remove the bleach, and a scraping taken with a spatula for analysis.

Microscopic identification

The scraping was placed in a counting chamber with a 1 mm grid, water added, and the fragments dispersed over the counting surface at a density precluding significant overlap (Bartolome *et al*. 1995). The chamber was overlaid with a coverslip and scanned systematically at 100 X under an optical microscope. A point quadrat method was used to control for different fragmentation rates of components by counting only the fragments overlapping cross points of the grid (Takatsuki 1978). A minimum of 100 total fragments were identified and enumerated by fragment class at each count.

Reference slides of epithelium from fodder species were made to facilitate identification of epithelial fragments in dung, which were identified on the basis of density, size and shape of epidermal cells, structural peculiarities of the cell wall, and cellular inclusions (Martin 1955; Zyznar & Urness 1969). Mesophyll and fragments without a recognizable architecture were not counted. Fragments were scored as ‘grass’, ‘coconut’, ‘dicot’, and ‘woody’.

Analysis

Throughput time was estimated as the difference between the time of first ingestion of a particular item and the time of collection of the first sample with the presence of the item, as determined by microhistological analysis. Elimination time was similarly estimated as the time between the last ingestion and the last sample of dung with the item.

The actual ingestion of a food item could have taken place anytime between provision of the experimental feed at 18:00 h and its clearing the next morning at 8:00 hr. Therefore, the time of ingestion was taken as the midpoint of this period with an error of ± 7 h for calculation of the times of throughput and elimination. Although it would have been preferable to reduce the possible variation in time of ingestion by providing access to the food for only one hour, this was not done in order to preserve the regular pattern of feeding.

To test the relationship of percent dry weight of each food class in the diet to its percent epithelial fragment occurrence in the dung, the mean of the five daily samples for each of the forage classes on a given 'day' was taken to represent the value for that 'day' for a particular elephant. Correlation analyses were carried out by pairing the daily values for dung with daily values for food 24 h prior to compensate for throughput time, and to test the relationship of different forage classes to the ‘woody’ fragment component in the dung, by pairing the values for woody fragments in dung with the values for each class of food.

Results

For grasses, throughput time in the three elephants was 20–41 h and the elimination time 29–88 h. For dicots, the throughput time was 24–38 h and elimination time 78–99 h.

The variation of percent epithelial fragments of each forage class in dung reflected the variation of percent dry weight of the corresponding forage class in the diet, with the estimates from dung initially lagging behind the diet proportions, then equalling or exceeding them (Fig. 1). The major portion of both grasses and dicots appeared in the faeces approximately one day after first ingestion and was eliminated by approximately two days after last ingestion, with almost all being eliminated by the fourth day after last ingestion (Fig. 1).

The percent dry weight in the diet of each food class was significantly correlated ($p < 0.001$) with the corresponding percent fragment occurrence in dung. The coefficients of determination for the three food classes were: coconut, $r^2 = 0.836$; dicots, $r^2 = 0.826$; and grass, $r^2 = 0.897$.

The woody fraction in dung was maintained at a conserved level throughout the experiment (mean daily percentage of woody fragments in dung = 43.28% ± 6.98), and showed a weak but statistically significant correlation with food class in diet; positive with coconut and negative with dicot and grass (coconut, $r^2 = 0.248$; dicot, $r^2 = 0.264$; and grass $r^2 = 0.188$; $p < 0.05$). Therefore, although the elephants stripped both the coconut fronds and dicot branches and mainly consumed the leafy portion, more 'woody' material appears to have been ingested in the case of coconut fronds.

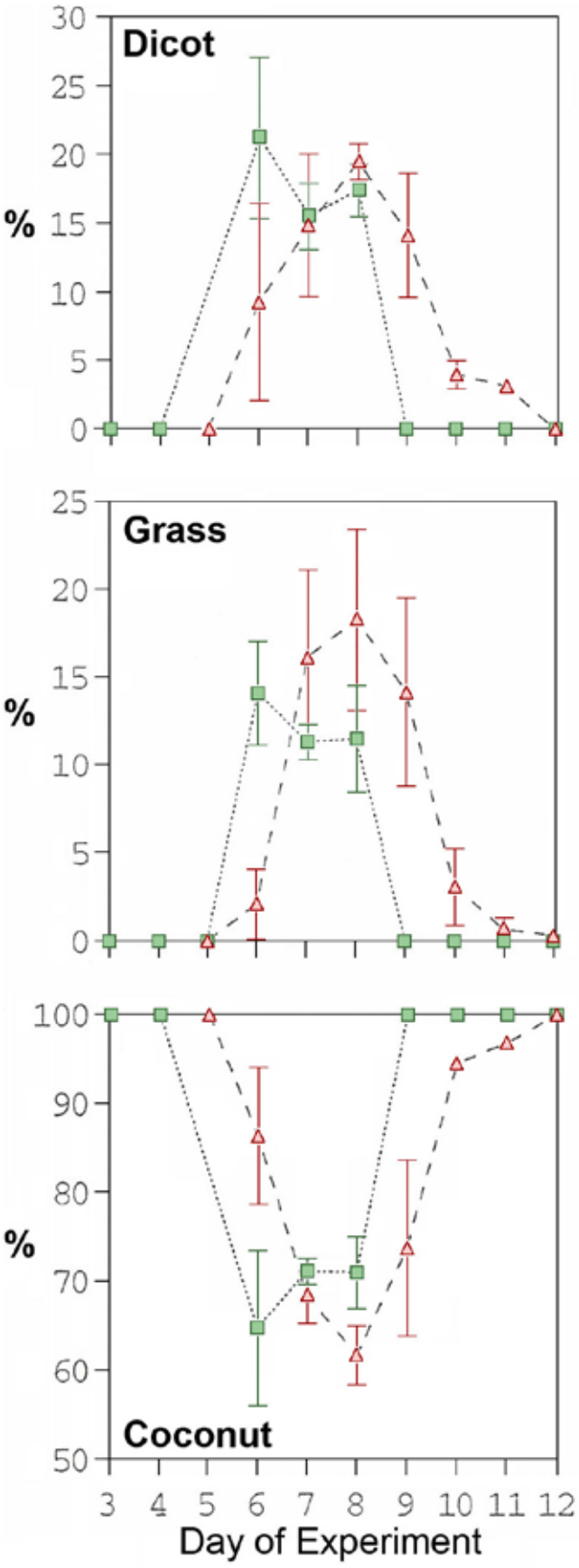

Figure 1. Variation of percentage epithelial fragments in dung (red triangles) and percentage dry weight in food (green squares) during the feeding experiment, by forage class.

Discussion

Gut passage times

Grasses – Stewart (1967) reported values ranging from 20–34 h for times of throughput for different species of grass fed to two grazing ruminants, a wildebeest (*Connochaetes taurinus*) and a buffalo (*Syncerus caffer*), and a grazing non ruminant, a

zebra (*Equus burchellii*), observing no difference between the ruminants and the non-ruminant. Takatsuki (1978) reported a throughput time of "about two days" for grass in a ruminant, Sika deer (*Cervus nippon*), a 'mixed feeder' (consuming both grass and browse). Therefore, the value of 20–41 h throughput time for grass observed by us for elephants, is similar to that reported for other species. Stewart (1967) reported times of elimination of grasses in ruminants as 4.5–6 days and as 3 days for the zebra, and the range of 29–88 h observed by us for elephants is less than that for the two ruminants but similar to that of the zebra.

Dicots – Zyznar and Urness (1969) reported a throughput time of 36 h for mule and white tailed deer (*Odocoileus hemionus* and *O. virginianus*) based on the appearance of droppings stained with fuchsin dye, following feeding with an unspecified fodder species treated with dye. They used 17 forage species including grasses, browse and forbes in their study. Voth and Black (1973) fed 20 species of browse to a mountain beaver (*Aplodontia rufa*) – a non-ruminant small mammal – and reported a value of 24 h for the time of throughput and 5 days for the time of elimination. Thus, the value of 24–38 h for throughput of dicots observed by us in elephants is similar to that reported for other species. The value of 78–99 h for elimination observed by us in elephants, is less than that reported for the beaver. Although no comparative elimination times for dicots in ruminants were available, in the view of gut passage times for grasses, it could be expected to be longer than in elephants.

A study assessing gut passage times with markers in an Asian elephant, reported throughput times, times of elimination and gut retention times respectively of 14 h, 73 h and 20.2 h for melon seeds and 17 h, 72 h and 29.2 h for plastic beads (Weerasinghe *et al*. 1999). A study using tamarind seeds reported a retention time of 39.5 h (Campos-Arceiz *et al*. 2008). Gut retention time for *Acacia erioloba* seeds in African elephants was 24.5–36 h (Dudley 1999).

Observed differences in gut passage times of grasses and dicots in the present study, and that of markers (Weerasinghe *et al*. 1999; Campos-Arceiz *et al*. 2008), suggest that fodder type and species influence gut-passage time. Therefore, only gross deviations can be considered significant in comparing results of studies using different fodder species.

Our results indicate that the dung of elephants mainly reflect the diet over days one to three, with some influence from the diet of days four to five, preceding defecation. Given that there is little difference in mean retention time with variation in dry matter intake in elephants (Clauss *et al*. 2007; Campos-Arceiz *et al*. 2008), we expect our results to be robust and characteristic of the species.

Estimation of diet components

The present study indicates that the percent epithelial fragment occurrence of diet components in the faeces of elephants is a reliable estimator of the percent dry weight of each component in the diet. Thus it demonstrates a high level of accuracy in diet assessment through microhistological faecal analysis in elephants, even without the application of correction factors.

The variation between dietary components in the biomass represented by the specific epidermal fragments (epidermal weight index) and the degree of degradation of the epidermis due to digestion (epidermal erodibility factor) were considered to be important correction factors by Bartolome *et al*. (1995). Digestion in elephants is much abbreviated compared to ruminants, and may cause less degradation of the epidermis. Therefore, for diet assessment through microhistological analysis in elephants, variation in epidermal degradation between different fodder species may be of less importance than in ruminants. While the epidermal weight index correction maybe important if there is wide variation in the ratio of leaf surface to weight between fodder species, the use of dry weight of fodder species in the comparison should reduce such variation.

The level of accuracy demonstrated in this study is adequate for the quantitative study of forage

class variation in the diet of elephants. A higher level of accuracy employing correction factors may be required for the quantitative evaluation of variation in individual fodder species in the diet.

A faecal microhistological study on the diet of free ranging elephants in Nepal, found 26% of the diet to be composed of 'woody' fragments (Steinheim *et al*. 2005). We found a higher but fairly conserved fraction, possibly due to methodological differences. We suggest that standardized faecal microhistological analysis can provide useful comparative information on the proportion of leafy vegetation in the diet, and its seasonal and spatial variation in free-ranging elephants.

The present study demonstrates the robustness of microhistological analysis of dung in analyzing diet composition variation in elephants and we conclude that it is a valid, reliable, and useful technique for the purpose.

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Can a Wild Asian Elephant Change Its Interaction Patterns with Humans?

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Rivaldo has become an iconic Asian elephant (*Elephas maximus*) in the Sigur Region, Nilgiris Biosphere Reserve, India (Fig. 1). Rivaldo is featured on panels of the Tamil Nadu Forest Department (Fig. 2) and his romanticized adventures have appeared several times in national newspapers. He was named after the world famous Brazilian footballer Rivaldo because he enjoys, like many other elephants, to kick around old tires. We noted his presence for more than 15 years ago when he was wild and shy.

Feeding wild elephants is prohibited, but Rivaldo became habituated to being fed with fruits (jackfruits, coconuts, watermelons, etc.) and sugarcane from around 2008. With time, tourists, local people and even high-ranking administrative officials insisted on offering food to the elephant. In January 2013 Rivaldo lost 30 cm of his trunk, by a country bomb set out to kill wild boar in a nearby field, according to local sources.

Because Rivaldo was familiar with humans, he was easy to handle. He got veterinary treatment at the premises of a conservation trust (or Trust later in the text) without him being restrained. Even though the Trust does not have barriers and the elephant was free to move, he never wandered far and followed Forest Department guards to receive his food and treatment from the Trust's veranda. In the beginning he was given fodder tied to a pole, but later could be hand-fed by a veterinary assistant. He was provided over 100 kg of fodder per day, sugarcane and fruits with concealed antibiotics. It was not sure at that time, whether the elephant could recover.

Not only was Rivaldo seriously handicapped, he could also turn rowdy when food was not forthcoming. Fearing that he would be taken into captivity because of his behaviour, we asked Dame Daphne Sheldrick, who is one of the top elephant rehabilitation experts, for her opinion. Her answer was grim: In Africa, elephants fed by humans are considered a permanent irreversible danger and are killed.

After his trunk healed, Rivaldo was a constant visitor to the Trust's premises. He waited every afternoon for the jeep that came around 4:00 pm with fodder. At some point, the veterinary assistant decided he was fit to survive on his own, and developed a plan to wean him from his daily rations by feeding him occasionally far from the house. Then the feeding stopped completely. The elephant would spend up to five hours around the house, presumably waiting for any motor rumbling that could signal the promise of a free meal. The now rare visitors coming by vehicle would invariably be greeted by Rivaldo. He eventually figured that cars contained food and could be ripped open if needed.

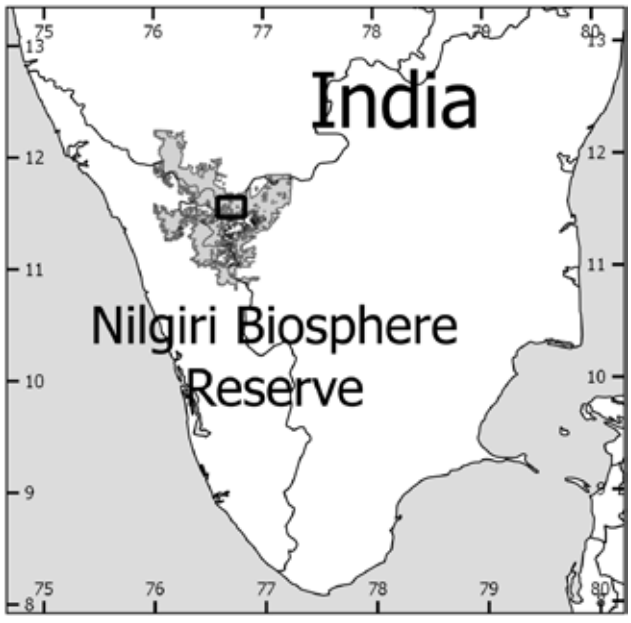

Figure 1. Study location.

Figure 2. Rivaldo, the emblematic elephant before his trunk was severed.

During the period when no food was provided and natural fodder was limited because of the dry season, he would shake the roof of the Trust's veranda probably to get attention. As no attention was provided, he would stand still and silent two meters away from the house, ears spread and looking inside whenever a shutter was open. Any human noise would provoke a hit to the roof. For six months, silence had to be maintained whenever Rivaldo was around and his visits were accompanied by some loud knocks on the roof. Little by little his behaviour started to change. His stopovers became less frequent and shorter. When he visited, he just checked the surroundings. Rivaldo would stay for a few minutes and leave.

We noted Rivaldo's visits from the 20th April 2013 to the 23rd June 2015, a time when his interactions with humans considerably diminished. We were not present every day and the observations were made on an ad-hoc basis for a total of 76 days. We ran a linear model through the observations (Fig. 3) and a non-parametric smoother (Fig. 4) through successive days of observation. The linear model had no other purpose than to highlight a trend, with no attempt to predict elephant behaviour. In the same manner, smoothers are useful for detecting humps when no particular statistical model can be applied.

In both cases, the frequency of visits diminished with time. Visits intrinsically display temporal autocorrelation. The smoother shows a plateau at the start and humps whenever the elephant tended to be in the vicinity. In June 2015, his visits had become rarer, shorter and his behaviour was no longer persistent.

The trend we report here needs to be validated with further studies. It nevertheless carries the hope that Asian elephants are adaptable enough to change their behaviour and go back to their natural feeding patterns after having been fed by humans.

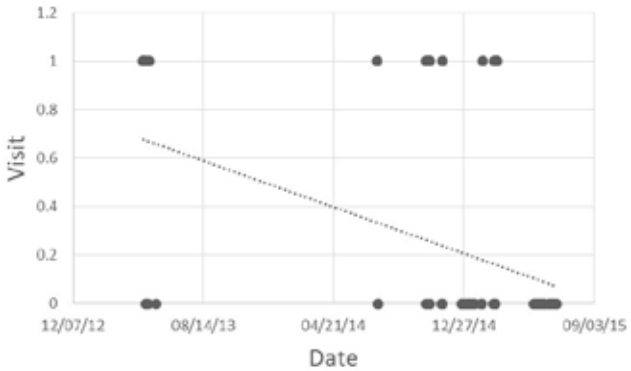

Figure 3. Linear regression line though observations from 20th April 2013 to 23rd June 2015.

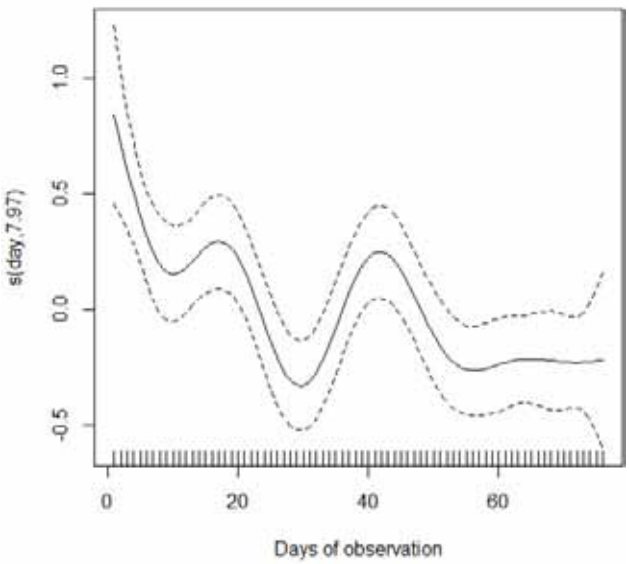

Figure 4. Non-parametric smoother through successive days of observations.

Figure 5. Rivaldo being treated.

Rivaldo got injured again in August 2015 by a wild tusker. He had four open and septic wounds and was treated again in the Trust's property by the Tamil Nadu Forest Department (Fig. 5). He would come daily at around 4:00 pm or alternatively, the forest guards would bring him to the house from the nearby jungle. The veterinary assistant and forest service's personnel cleaned his wounds for a month in September 2015 without restraining him in any way. Daily, the elephant was mostly given sugar cane and cereal balls with jaggery (unrefined sugar) to divert his attention during the procedures.

Rivaldo was fed by people for years, which enabled the Forest Department personnel to provide medical care without having to restrain him. Being fed by the Forest Department did not add much to habituation but probably helped save his life. The elephant did not create problems except for damage to the Trust's roof, and we are not aware of anyone in the region suffering from Rivaldo's presence. On the whole, Rivaldo's behaviour remained mild and particularly tolerant of humans.

After being treated for his trunk injury, we hoped that Rivaldo would go back to the wild, which he almost did. However, weak implementation of the law regarding the ban on feeding wildlife and motives such as profit, superstition and sensationalism has resulted in continued feeding, encouraging Rivaldo and some of his companions to venture into village interiors. From the forest check posts, wastelands, resorts to village interiors, Rivaldo was till recently, given rice, bread and sweets. We heard from several sources that some local people even climbed on his back to cut leafy branches from trees. Rivaldo had become a solid source of revenue that provoked internecine rivalries between vested interests, which even led to the murder of a forest guard.

In case of any incident involving Rivaldo resulting in injury or death of humans, the elephant would be taken into captivity and another statistic would be added to the growing database of 'attacks by elephants'. Thus, in this instance, we are basically in a potential human-elephant conflict situation, with the onus of its resolution being entirely with the people.

Acknowledgements

The authors thank Prithiviraj Fernando for useful suggestions to improve the manuscript.

Figure 6. Rivaldo after his trunk was severed.

Human-Elephant Conflict in Baripada Forest Division, Odisha, India

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Introduction

Around 50% the world population of Asian elephants (*Elephas maximus*) are in India. Elephant range in India consists of 11 Elephant Reserves covering an area of about 110,000 km^2 in the north-east, central, north-west, and south (Bist 2002). In the past elephants occurred over the entire peninsula. The Asian elephant is categorized as endangered by the IUCN Red List (IUCN 2015), listed on Appendix I of CITES and Schedule I of the Indian Wildlife (Protection) Act. The explosion of human population in twentieth century India has generated a growing conflict between man and elephant. Although life and property of human beings suffer losses due to this conflict, it also contributes considerably to the decline of elephant populations across their entire range. Elephant distribution and their sources of shelter, food and water have shrunk and now overlap with expanding human-use areas.

The area of the State of Odisha is 155,707 km^2, comprising 4.7% of the country's total area. It is divided into 30 districts, all of which have elephants (Fig. 1) except Jagatsinghpur and Kendrapada. Odisha held 1954 elephants in 2015 (2015 census Odisha Forest Department), which is about 72% of the eastern and 7% of the Indian population. Around 50% of elephants in Odisha use 12 of the 19 Wildlife Sanctuaries, while the rest move outside the sanctuaries, and are largely responsible for causing human elephant conflict.

Methods

Study area

Baripada Forest Division is situated in northern Odisha between 22° 33' 45" and 21° 17' 0" N and 85° 45' 30" and 87° 13' 15" E (Fig. 2), spreading over an area of 1642.42 km^2 and is bounded on the north by the Singhbhum Medinapur District, on the south by Balasore District, west by Keonjhar District, and on the east by Balasore and Medinapur Districts of West Bengal. May is the hottest month with a maximum temperature of about 48ºC and December the coldest with a minimum temperature of about 7ºC.

Baripada Forest Division is divided into eight ranges, all of which have elephants. Out of these Betnati and Bangiriposi ranges are low conflict zones. Deuli and Rasgovindapur have high conflict. Pithabata, Dukura, Kaptipada and Udala have a medium level of human-elephant conflict. Baripada Forest Division harboured 68

Figure 1. Elephants in the Baripada Forest Division during the year 2013.

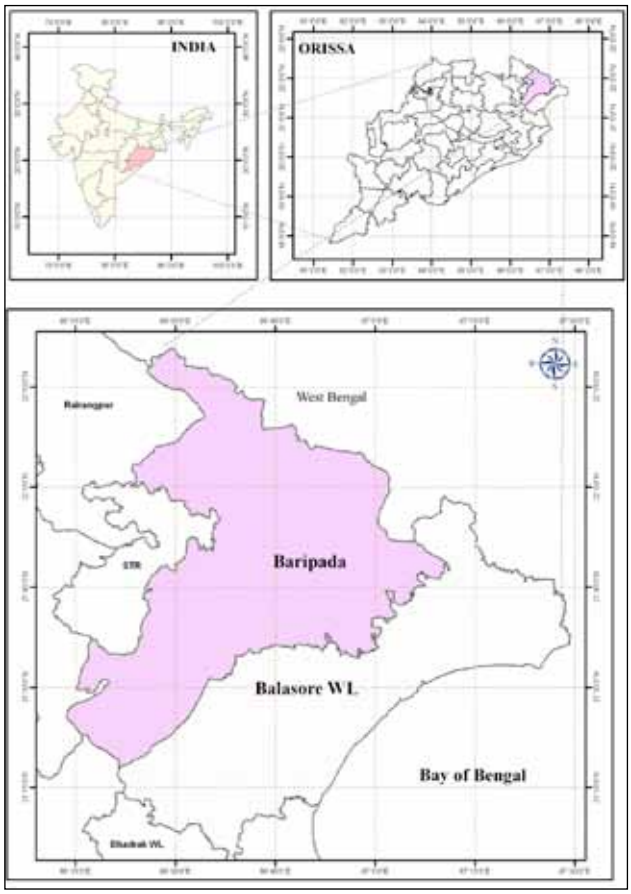

Figure 2. Map of Baripada Forest Division.

elephants in 2015, consisting of 4 adult males, 20 adult females, 10 sub-adult males, 20 sub-adult females, 3 juveniles and 11 calves (Palei & Rath 2015).

Methodology

Data was obtained from conflict records from 2001 to 2014 from the eight Forest Ranges of Baripada. Crop damage information was collected from 64 villages located in and around Baripada through questionnaires. The data was verified through field visits to specific sites and by conducting informal discussions with government officials and local people. Rapid assessments were carried out using focus groups, and field visits conducted to assess elephant damage, and to observe habitat types.

Results and discussion

Human death and injury

A total of 16 cases of human death and 15 cases of injury by elephants were reported in the period 2000 to 2014 (Fig. 3). Of these, 9 deaths occurred in the winter, 4 in the summer and 3 in the monsoon season. The high deaths in winter may be related to increased outdoor activity in winter, such as non-timber forest product collection in forests during that time.

The highest number of human deaths was reported in 2011-12. Out of the 31 human death and injury cases, 42% occurred in agricultural areas, 35% in forest areas and 23% close to villages.

Crop damage

Elephants damaged 2984 acres of paddy out of 368,362 acres paddy cultivation in the study area during the period 2000-2014 (Fig. 4). Other crops damaged included banana, jackfruit, pineapple, coconut, sugarcane, cauliflower, cabbage, bamboo and jute. The highest number of crop depredations occurred in the year 2010-2011. Highest crop damage was recorded from September to December (Fig. 5), which is the harvesting season. During the months of July and August, crop damage was moderate and in the

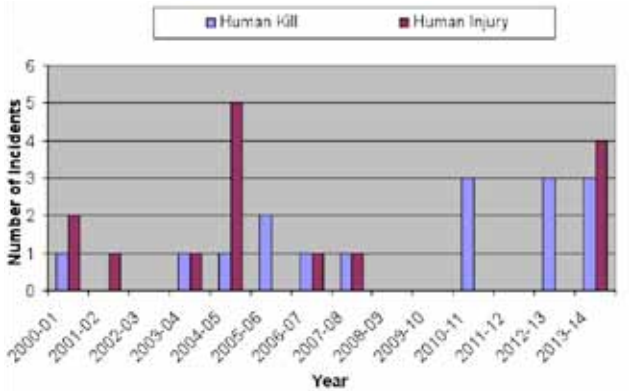

Figure 3. Human death and injury during the period 2000 to 2014.

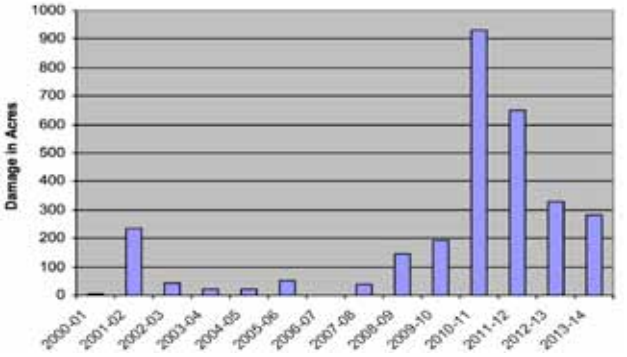

Figure 4. Crop damages during the period 2000 to 2014.

other months it was less. More crop damage was recorded outside the protected area, where there was extensive agriculture. In some instances crop damages increased because of unruly behaviour of the public who gathered in the thousands to see elephants and prevented their movement to the forest.

House and property damage

During the study period 888 houses were damaged out of 390,835 households in the study area, with 658 being partly damaged and 230 being completely damaged. The highest numbers of houses were damaged during 2012. Most damages occurred in December after harvesting, when stored grain was the target. In 70% of cases, houses with stored paddy and brewed rice were damaged. Highest household and property damages were caused by adult males (60%), followed by herds (25%) and single adult females (15%). Elephants raided tribal houses for rice beer, brewed rice and local country liquor made with Mahua flowers. After drinking the brew they ran amok destroying fields and breaking houses.

Human-elephant conflict could be prevented by minimizing habitat disturbance and adjustment of agricultural practices. Villagers should avoid cultivating rice near elephant habitat and should grow crops of lesser attraction to elephants. Authorities should earmark areas with high elephant presence for elephant conservation, even though they may be good agricultural areas. Areas where chances of elephant depredation are less could be chosen for agricultural use.

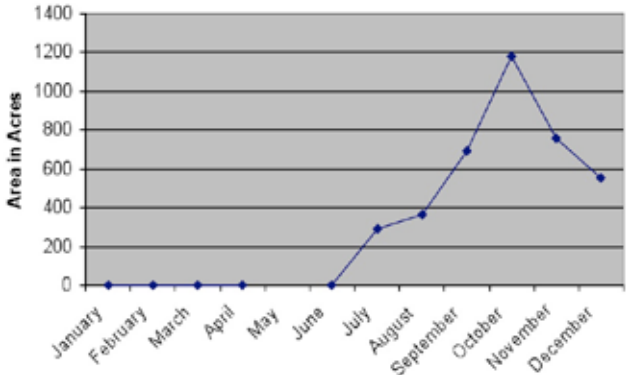

Figure 5. Monthly crop damage during the period 2000 to 2014.

Acknowledgements

We are thankful to the Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, Odisha Forest Department for facilitating this study. We thank the Regional Chief Conservator of Forests, Baripada Circle and Divisional Forest Officers of Baripada Forest Division and the front line field staff for their co-operation. Thanks also to Sandeep Ranjan Mishra, Research Fellow, Baripada Circle for cooperation.

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Surgical Treatment of a Cervico-vaginal Prolapse in an Elephant in Myanmar

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Introduction

Presently there are 2940 Asian elephants (*Elephas maximus*) managed by the Myanma Timber Enterprise (MTE) in Myanmar. All of these elephants are owned by the government and distributed around the country. Some elephants are utilized in logging and for carrying baggage from one camp to another during the rainy season. In addition, there are captive elephants in the country, which are privately owned and used in logging by private timber companies.

According to MTE records, the youngest female to give birth was 8 years old, and the oldest elephant gave birth at 46 years of age. Some females have given birth to more than six calves in their lifetime. On rare occasions females have suffered cervico-vaginal prolapse. During the last decade, MTE lost three female elephants due to this condition. As MTE field veterinarians, we tried to save them but were unsuccessful due to lack of experience and limitations in techniques and knowledge of appropriate surgical procedures.

Case study

The female elephant (Ma-3945) Myint Ngae, 47 years old, suffered a prolapse starting ten years ago. At the beginning, there was a 4-inch diameter bulge in the perineal region, which got larger year by year till it was about 22 inches in diameter. By the use of ultrasound scanning, the bulge was determined to be due to a cervico-vaginal prolapse. Consequently it was decided to treat her surgically.

Before surgery, the condition of the elephant was fit and free from any injuries, and she was eating, sleeping, and moving well. She could urinate, although it was sometimes difficult. Defecation was normal. Antibiotics and tetanus toxoid (ATT) were given pre-surgically as a preventive measure (Table 1).

Cleaning and disinfection

This is an important preparatory step for surgery. We cleaned the surgical site of all dirt using

Table 1. Pre- and post-operative medication. We gave antibiotics one week apart.

Time	Drug	Dosage
Before surgery (7 days)	Pen strep injection	12 Lakhs IM
During surgery	ATT (anti tetanus toxid)	5 ml IM
After surgery	Analgesin (anti-pain drug)	50 ml IM
	KCND	100 ml IM
	Amylite C (supportive treatment)	100 ml IV*
	Normal saline (supportive treatment)	2000 ml IV*
	Biozyme	125 g
	MOM	40 tablets
	Cetriazone (250 mg)	30 via BID IM

Figure 1. Cleaning and disinfection of the surgical site.

disinfectant soap, fresh water and 2% tincture of iodine and shaved the site (Fig. 1).

Anaesthesia

The body weight of the elephant was estimated at 2516 kg using a formula based on chest girth. For general anaesthesia we used a combination of Xylazine (2%) and Ketamine (Fig. 2). At the beginning, we gave 6 ml Xylazine (2%) (139.32 mg) combined with 1 ml Ketamine (50 mg) intramuscularly. After 10 minutes, we gave again 23.32 mg Xylazine intravenously into the ear vein. The elephant was sedated and showed a relaxed vulva and dropping of the clitoris, and very slow movement of trunk and ears. We used a local anaesthetic, lidocaine, on the line of incision. Lidocaine was given along the incision line during the operation.

Surgical procedure

Before surgery we checked the bulge by ultrasound and detected a large amount of fluid inside. We chose a dorso-ventral incision line approximately 7 inches lateral from the perineal midline, near the right hind leg (about the area over the semimembranosus and semitendinosus muscle), to avoid post-op faecal contamination (Fig. 3). The elephant stood quietly without showing any distress. Upon incision we initially encountered some fascial layers and small blood vessels and avoided much bleeding. Finally we found the prolapsed vagina inside the vestibule. The bottom of the large bulge was hard. We tried to find the fluid inside the bulge by palpation; luckily we found the opening of the urethra entering into the bladder and felt the fluid inside the bulge through it.

We initially inserted a plastic tube (about 1/4 inch diameter) and drained the fluid. The fluid consisted of urine and transudate. No adhesions were present and there was little pus. Then we inserted a larger plastic tube (1/2 inch) and drained the area again. Some small stones came out with the fluid, and the size of the bulge reduced. Finally, the bulge became quite small and we were able to reposition it through the pelvic inlet (apertura pelvis) into its normal position.

Figure 2. Preparing and injecting the anaesthesia.

Figure 3. Surgical procedure.

After pushing back the cervix and vagina, we applied a pad to apply pressure from the outside, to help prevent re-occurrence of the prolapse, by supporting the area while it healed. The pad was made with foam and wood connected with ropes and tied on the body of the elephant. The condition of the elephant was good after surgery.

Suturing

First we carefully closed the layers of vestibule, the fascia and muscle by continuous suture, using absorbable catgut. The skin was closed by continuous nylon sutures in a mattress pattern (Fig. 4). During suturing, we applied antibiotic powder (Cicatrin powder) to each layer. We applied antibiotic ointmenton on the line of incision.

Post-surgery

The elephant defecated and urinated normally after the surgery. We provided care at the elephant camp after surgery and checked her blood profile daily (Table 2). We continued to check the ropes and pad on the body of elephant. One month after surgery the healing of the incision was good and the pad and ropes remained in place.

Conclusion

In the past some female MTE elephants died due to vaginal prolapse. This is the first time in MTE that a vaginal prolapse was successfully managed surgically. Everybody (Fig. 5) was excited that finally we were successful, and we had advanced our skills in veterinary medicine and improved the welfare of elephants, while gaining useful experience. As field veterinarians working in remote areas in Myanmar, we do not have fancy equipment but we have good will, and a passion and attachment to our elephants.

Figure 4. Suturing the incision.

Table 2. Blood profile of the elephant before and after the surgery.

Time	Day	PCV[1]	TP[2]	Hgb[3]	ESR[4] (mm/min)				Differential WBC[5] count				
		[%]	[g/dl]	[g/dl]	15 min	30 min	45 min	60 min	N[6]	L[7]	M[8]	E[9]	B[10]
Before	1	32	7.8	10.3	-	-	-	-	26	4	70	0	0
	2	33	8.4	12.0	40	106	120	123	33	9	58	0	0
	3	37	8.8	12.5	6	50	87	96	24	12	64	0	0
After	1	33	9.3	11.5	30	87	101	104	36	13	51	0	0
	2	32	9.5	11.8	33	80	98	102	33	14	53	0	0
	3	33	9.0	11.0	30	85	100	105	37	13	60	0	0
	4	33	9.6	10.0	40	90	101	119	38	12	50	0	0
	5	34	8.6	8.0	45	105	115	119	31	19	49	0	1
	6	34	8.6	10.5	17	101	114	117	41	17	42	0	0
	7	36	8.8	10.0	16	97	111	114	53	27	20	0	0
	8	38	9.0	11.0	27	90	99	102	50	24	26	0	0
	9	34	8.8	12.0	39	91	100	105	40	22	38	0	0
	10	34	9.2	12.0	26	86	107	117	41	15	44	0	0

[1]PCV = packed cell value; [2]TP = total plasma protein; [3]Hgb = haemoglobin; [4]ESR = erythrocyte sedimentation rate; [5]WBC = white blood cell; [6]N = neutrophil; [7]L = lymphocytes; [8]M = monocyte; [9]E = eosinophil; [10]B = basophil.

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We would like to thank the international experts who provided valuable advice and useful criticism of the surgery. We would like to say thank you deeply to HE Union Minister, to the Permanent Secretary of the Ministry of Environmental Conservation and Forestry, to the Managing Director, and to the General Manager (Extraction) of MTE for their kind permission to do the surgery. Our especial thanks to U Moe Myint, Deputy General Manager (Admin) for his encouragement.

Figure 5. Team and patient after the successful surgery.

Morphology and Prevalence of the Louse *Haematomyzus elephantis* in Captive Asian Elephants in Sri Lanka

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Introduction

The biting louse *Haematomyzus elephantis* is only found on elephants and is more of a scavenger than a parasite (Gomez 2000; Fowler & Mikota 2006). Drought conditions are more favourable for lice and egg cases of lice (nits) can be more commonly seen attached to hair of elephants during dry periods (Fowler & Mikota 2006). Captive elephants need to be treated when they get infested with parasites including lice. *H. elephantis* has been reported from captive elephants in India (Sudan *et al*. 2015).

H. elephantis is dorso-ventrally flattened, with a segmented body. The head consists of segmented antennae and a rostrum with mandibles that are developed as biting organs. Three pairs of legs, each with five segments, emerge from the thorax. The abdomen, which has six pairs of spiracles, is the longest part of the body. Females are comparatively larger and longer (Wall & Shearer 2001).

This study was conducted to detect the prevalence of lice on Asian elephants (*Elephas maximus*) in Pinnawela Elephant Orphanage (PEO) and privately owned captive elephants, and to examine the morphology of *H. elephantis* in Sri Lanka.

Materials and methods

During March to July 2014, all 77 elephants at PEO and 15 privately owned elephants were visually examined for the presence of lice with special emphasis on skin crevices or soft skin of the ears, the throat, around the mouth, ventral surface of the trunk near its base, the abdomen and the tail. Approximately 20–30 minutes were spent examining each animal. Skin examination of an elephant for more than 20 minutes is difficult because the elephants would not keep still for long, especially for detection of lice, and therefore, early morning or late evening was used for examinations because elephants are cooperative at that time due to lower environmental temperature. On some occasions, lice on the tail were collected while the elephant was bathing and being scrubbed. An elephant was considered infected when at least one louse was found.

Samples of lice were preserved by adding 70% alcohol. In the laboratory, specimens were cleared using potassium hydroxide and were mounted on glass slides. Species identification using morphology was done according to Mullen and Durden (2002), Wall and Shearer (2001) and Yoshizawa and Johnson (2006). A binocular dissection microscope with a micrometer scale and a light microscope were used to examine and measure the specimens. Morphometric measurements including total length, length of the rostrum, head, thorax, abdomen and antennae were made on 10 male and 10 female lice.

Results

Out of the 92 elephants examined, 82 were infested with lice, giving an overall prevalence of 89%. In PEO, the prevalence was 100% and in privately owned elephants 33%. The microscopic appearance of a male and a female louse are shown in Figures 1 and 2 respectively and measurements of 10 individuals of each sex are given in Table 1.

Table 1. Morphometrics of *Haematomyzus elephantis* (mean ± SE, in mm).

Gender	Rostrum	Head	Thorax	Abdomen	Total	Antenna
Male (n = 10)	0.504 ± 0.03	0.289 ± 0.03	0.319 ± 0.03	0.931 ± 0.05	2.044 ± 0.09	0.643 ± 0.03
Female (n = 10)	0.642 ± 0.03	0.357 ± 0.04	0.367 ± 0.02	1.607 ± 0.11	2.973 ± 0.11	0.725 ± 0.02

Discussion

We found a high prevalence of lice in captive elephants in Sri Lanka. The prevalence of *H. elephantis* in wild elephants in Kruger National Park was 58% (Braack 1984) and its occurrence in captive elephants in India has been reported as rare (Sudan *et al*. 2015). Therefore a surprisingly high prevalence of lice was found in captive Sri Lankan elephants, especially at the PEO where it was 100%. The constant close physical contact among elephants at PEO could be attributed to this high prevalence.

In comparing the two groups in our study, we found the prevalence of lice in PEO elephants to be much higher than in privately owned elephants. The two groups of elephants were managed differently. Elephants at PEO do not have individual keepers, are not scrubbed individually when bathing and freely interact with each other throughout the day. Privately owned elephants have individual keepers and assistants, are bathed and scrubbed at least once daily, and are mostly kept as individual animals with little or no interaction with other elephants. Therefore, the difference in prevalence between the two groups in our study could be related to variation in management practices.

Most keepers of the elephants used in this study were unaware of elephant lice, although some stated that a biting insect could be present on the elephants. Some keepers indicated that elephant lice had bitten them, leading to mild irritation, pruritus and a local reaction. We have observed

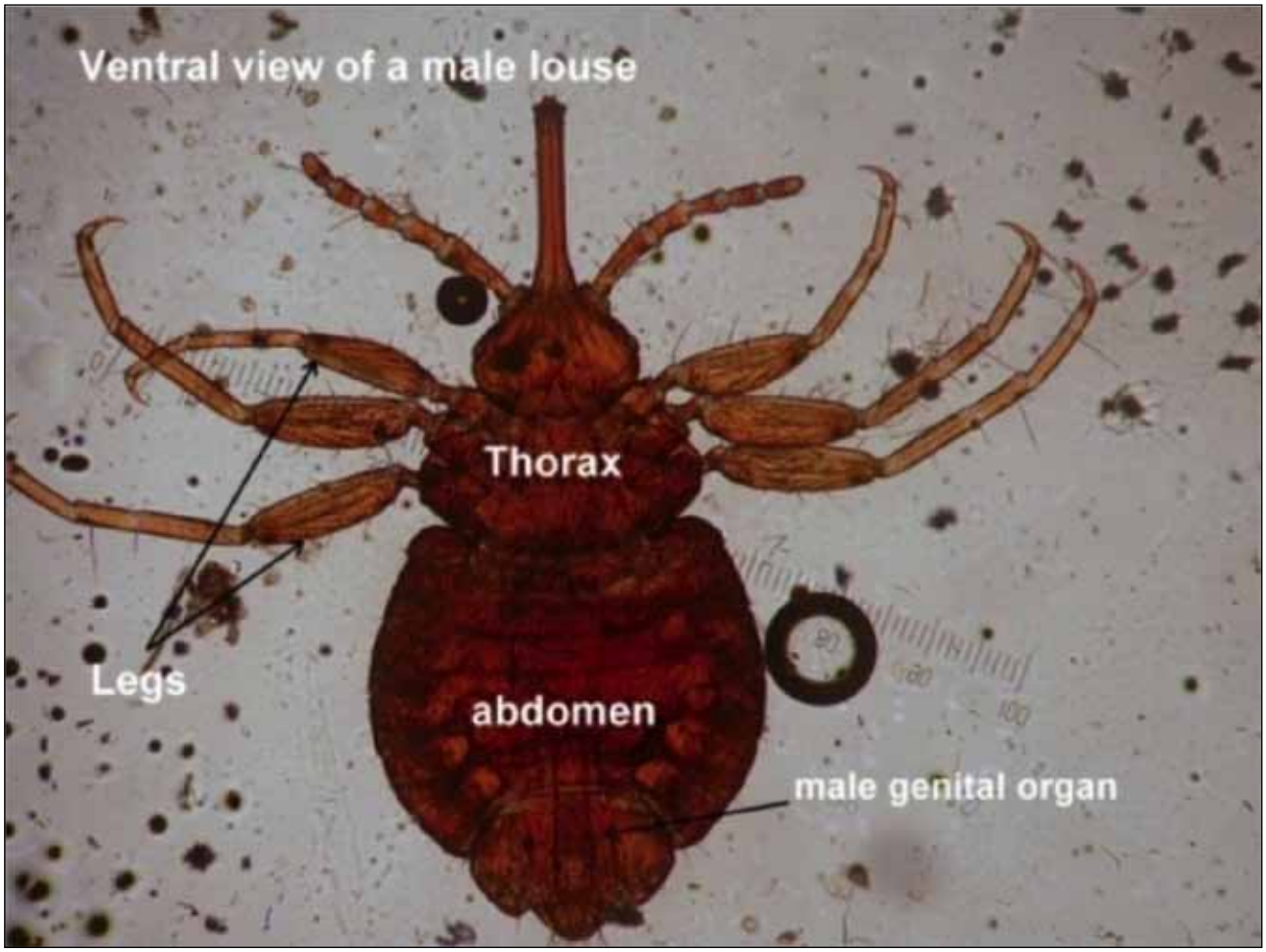

Figure 1. Male elephant louse.

some elephants infested with lice to be restless or hyper-irritable and to dash their tail against hard objects or sides of the body, which may lead to injury. We have successfully treated captive elephants infested with *H. elephantis* with pyrethrins, organic phosphates and ivermectine injections.

The morphology of the lice reported herein is in agreement with the description of *H. elephantis* in Wall and Shearer (2011). Similar species *H. porci* (pig lice) and *H. hopkinisi* (warthog lice) have a much shorter rostrum (Wall & Shearer 2001). Morphologically *H. elephantis* appears to be a sucking louse because of the rudimentary proboscis on the long rostrum, though it has been classified as a biting louse because of the strong mandible on the rostrum (Gomez 2000). It is worth examining why the mouthparts, specially the rostrum, of *H. elephantis* are longer than in any other biting louse.

Acknowledgement

We wish to thank Dr. Dilini C. Weerathunge and Dr. Lasanthika Dushyanthi of the Department of Pathobiology of the University of Peradeniya, Mr. Sanjaya Rathnayake and all elephant keepers at Pinnawela Elephant Orphanage, Mr. Sandith Samarasinghe of Millenium Elephant Foundation and all owners and keepers of privately owned elephants used in this study.

Figure 2. Female elephant louse.

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Tibiofibular Fracture and Its Management in an Asian Elephant Calf

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Introduction

Trauma is a potential cause of morbidity and mortality in young elephants. Causes of trauma to elephant calves may include aggression by other elephants and accidents. Limb fractures are unusual in elephants due to the very thick layer of muscles and tissue around bones. The limb joints are in straight lines and the legs work as columns bearing weight when standing. Long bones of elephants are without a marrow cavity and are filled with cancellous bone or 'red marrow' (Chungath 2002).

Generally fractures are immobilized by external or internal fixation. Among external applications, Plaster of Paris (POP) is commonly employed for fractures below knee and hock (O'Connor 2005; Fubini & Ducharme 2004) and it is the most suitable in case of large animals. Here we report a tibiofibular fracture in an elephant calf and its immobilization with a POP cast.

Case history

A wild Asian elephant (*Elephas maximus*) calf was found fallen into a mud pit in an open field in the Khallikote forest range around 90 km away from Bhubaneswar, Odisha. The calf belonged to a crop raiding elephant herd and had fallen into the pit at night. Being unable to rescue the calf, the herd had moved away with the onset of dawn.

Next morning, the calf was seen in the mud pit and rescued by villagers. They washed and cleaned the calf. Then they found that it was unable to stand still and there was lameness in the left hind leg (Fig. 1). The villagers prepared an indigenous medicinal paste and applied it to the affected site with a 'bamboo net' (bamboo strips tied together with rope) covering and handed over the calf to Forest Department personnel. They kept it in the open field under a tent and made him stand with a supporting bamboo pole (Fig. 2).

Diagnosis and treatment

The calf was a male about 2 months of age and weighed about 180 kg. As no field radiograph facility was available, a diagnosis of fracture was made on the following findings. The calf could only stand with support of the left hind limb (Fig. 2) and was unable to move freely and bear weight on the affected limb. There was

Figure 1. Calf showing lameness in left hind limb.

Figure 2. Elephant calf takes support on a bamboo pole.

Figure 3. Removal of faultily applied splint.

Figure 4. Showing the site of the tibiofibular fracture.

Figure 5. Recording the body temperature.

Figure 6. Measuring the heart rate.

swelling of the affected area, excessive mobility at the suspected fracture site with crepitus when the broken ends rubbed against one another and visible shortening of the affected limb. On palpation of the site, a simple complete fracture below the stifle joint (rear knee) at the proximal one third of the tibia-fibula was revealed. It was found that the bamboo net was applied below the fracture site, not providing immobilization of the fracture. So it was decided to remove it (Figs. 3 & 4) and apply external immobilization by POP cast instead.

The body temperature (Fig. 5), heart rate (Fig. 6) and respiration were recorded and appeared normal. The bamboo net along with the indigenous medicine was removed and the site cleaned, gentle hot fomentation was applied (Fig. 7) to reduce inflammation (Oo 2012).

After measuring the fracture site, bandages were prepared by impregnating twelve 6" wide pieces of gauze with 2 kg of POP powder. Topical antibiotic powder (Neosporin) was applied around the affected limb, followed by wrapping of cotton wool in a uniform manner (Fig. 8). Then the prepared POP bandages were soaked in water and applied one by one with uniform and moderate pressure to create a rigid cast covering the site. To make it stronger, the POP cast was reinforced with a bamboo splint (Fig. 9). Both the stifle and hock joints, along with the toes were covered with the POP cast.

The calf was able to bear weight on the fractured limb 30 minutes after application of the POP cast (Fig. 10). Normal saline solution, Ceftriaxone sodium and Meloxicam were given IV and calcium supplement given orally. The forest personnel were advised regarding proper care and management and maintaining a proper nutritional schedule. The calf was kept inside a restricted enclosure to minimise mobility during the healing period. The local veterinary doctor and staff were entrusted with regular check up and medication.

Figure 7. Application of hot fomentation.

Figure 8. Application of topical antibiotic powder.

Figure 9. Application of POP cast reinforced with bamboo splint.

Figure 10. Elephant calf bearing weight on fractured limb after application POP cast.

After application of the POP cast the calf was able to walk. Up to the 9th day post-treatment it was in good condition. On the 10th day the calf became ill, stopped taking food, had coughing and respiratory distress, and became recumbent. Several attempts were taken to revive the calf, but it died. Post-mortem findings revealed that the death was due to pneumonia.

Discussion

In the present case the elephant calf had fallen into a mud pit and the trauma resulted in a long bone fracture. Because of the body size and weight, immobilization of fractures and dislocations is difficult in elephants (Nayar *et al*. 2002). In the present instance as the calf was only about 180 kg body weight a POP cast with a bamboo splint was successfully used for stabilization and immobilization. Sanyathitiseree *et al*. (2001) used a fibreglass cast for the repair of a distal tibiofibular fracture of the right hind leg in an adult female Asian elephant hit by a car. Fibreglass is better than POP due to its lower weight and higher water tolerance capacity, but is not freely available in rural areas.

The final outcome of the treatment using the POP cast could not be assessed due to the premature death of the calf. However, fractures can recover with long periods of nursing and treatment. Nutritious food supplement in injured elephants is very important for their recovery. In the present case the calf was given a liquid diet by feeding bottle. Forceful feeding by untrained personnel and aspiration of fluids may have caused the pneumonia. Slow feeding with intermissions and allowing movement of the tongue by the calf during feeding may help prevent aspiration pneumonia. Feeding of newborn elephant calves should only be done by trained and experienced persons.

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Direct Application of Magnesium Sulphate in Treating Foot and Nail Abscesses in Asian Elephants

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Introduction

Veterinarians working with elephants often have limited access to modern diagnostic and treatment procedures. Hence, effective alternate therapies, which are accessible, affordable and offer ease of application, provide the most efficient answer to managing common diseases.

Foot problems potentially represent the single-most important clinical disease of captive elephants. Predisposing factors include obesity, lack of exercise, nail or sole overgrowth, improper foot care, poor hygiene, inappropriate enclosure surfaces, poor body conformation, malnutrition and secondary skeletal disorders such as degenerative joint disease. Furthermore, elephant management philosophy, disposition of elephants, facilities and competency of staff in caring for elephant's feet contribute significantly to foot health (Zuba *et al*. 2006). Limitation of free access to clean water for bathing and spraying, to twigs or posts for scratching, and inappropriate duration and type of tethering may also lead to foot ailments. The conditions of maintaining captive elephants in many facilities in Asia constantly expose elephants' feet to mud and moisture. Constant covering of feet with dirt and soil may block sweat glands around toenails, preventing drainage and causing infection. Once an infection starts, limitations of maintaining the elephant in a clean environment can result in re-contamination.

Magnesium sulphate, often referred to as Epsom salt is commonly used for whole body-soaking, foot baths, splinter removal, bee stings, sun burn and skin exfoliation in humans. It is absorbed through the skin. Its hygroscopic and anti-inflammatory effects draw out interstitial fluid, reducing oedema and tissue pressure. It improves local circulation and drainage, and thereby facilitates healing (Borle & Richa 2014).

Here I report a case study on the use of magnesium sulphate in the treatment of foot abscesses in elephants.

Case study

Two elephants with partial healing and recurring foot (Fig. 1) and nail (Fig. 2) abscesses were reported from an elephant tourist camp in Chiang Mai, Thailand. The abscesses may have formed as a consequence of arthritis from over-work during logging, causing limitation of movement due to stiffness of the carpal joints of the front legs. The stiffness or joint fixation was evidenced by inability to flex the joints during gait. The prolonged lack of movement and constant covering with mud may have blocked the sweat glands and caused infection, leading to formation of abscesses on one front leg in one elephant and both the front legs in the other. The abscesses were similar to that described by Zuba *et al*. (2006) and initially had a cauliflower-like appearance which later became a proliferative outgrowth of 'crab meat-like' tissue.

Isolation and antibiotic sensitivity tests from pus samples revealed *Klebsiella, Streptococcus, Staphylococcus* and *Pseudomonas*, sensitive to amoxicillin and clavulenic acid. Subsequently amoxicillin was injected intramuscularly (11 mg/kg) once a day for 11 days (Schmidt 1978) and phenylbutazone (1 mg/kg) given orally once a day for 7 days (Blair *et al*. 2001). Foot soaks in luke warm magnesium sulphate solution (225 g/2 L) (Fowler 2006) were conducted for 15 minutes once a day for 30 days. Antiseptic dressing,

initially with tincture of Iodine and subsequently with povidone iodine was carried out twice a day for 30 days.

As the abscesses did not heal with this treatment, after 30 days, magnesium sulphate was applied directly on the abscesses following a footbath and wound cleaning with povidone iodine. Noticeable changes with gradual shrinkage and a clearly visible opening on each abscess were evident within a week and the abscesses dried up completely in a month. These previously unnoticed openings may have remained unexposed owing to inflammation, oedema and tissue pressure but were revealed because of the drying out and shrinking of tissue caused by magnesium sulphate. This could have led to gradual drainage of foreign material, necrotic tissue and pus out of the abscesses. Simultaneous flushing with povidone iodine probably acted as an antiseptic barrier, preventing relapse and resulting in complete healing (Fig. 3). After complete healing, antiseptic scrubbing twice a day and footbaths once a day for 15 minutes were continued and there was no recurrence. Thus, direct application of magnesium sulphate without lancing was found to be successful in treating foot abscesses in elephants.

Together with administration of intramuscular antibiotics and anti-inflammatory drugs, the technique was tried out on elephants with abscesses on the back, shoulder, thigh and temporal regions using magnesium sulphate alone or mixed with glycerine. However, in contrast to the foot abscesses, it did not result in noticeable improvement after one month, and were subsequently lanced. The difference in response may have been due to the greater skin thickness and the absence of 'crab meat-like' tissue in abscesses of other regions.

Acknowledgement

I would like to thank the Faculty of Veterinary Medicine, Chiang Mai University, Thailand for encouragement and laboratory work, the Save Elephant Foundation and Prasit Moleechat of Chiang Mai, Thailand for the opportunity to work on the cases, and the mahouts Dam and Chai and all the veterinary students who helped during treatment.

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Figure 1. Foot abscess.

Figure 2. Nail abscess.

Figure 3. Appearance after a year.

Gajah 44 (2016) 48-49

Elephant Conservation Group (ECG) Workshop Report

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Background

The human-elephant conflict (HEC) is the main threat for Asian elephants throughout their range. Although much effort and resources have been expended in pursuit of its resolution, little progress has been made in the past few decades. HEC occurs over a wide range of ecological and socio-economic scenarios. One of the factors retarding effective management of HEC across different landscapes is the lack of coordination and standardization of methods in its study and mitigation, which prevents lessons learnt in one context being applied to others.

The Elephant Conservation Group (ECG) is an informal network of researchers and practitioners that work on Asian elephant conservation, initiated in 2011. One of the main objectives of ECG is to standardize methods in the study of HEC and effectiveness of its mitigation. ECG is currently composed of 11 teams representing projects in 9 Asian elephant range countries consisting of Cambodia (FFI), China (ZSL), India (WWF and NCF), Indonesia (WWF), Malaysia (MEME), Myanmar (SCBI), Nepal (BirdLife), Sri Lanka (CCR) and Thailand (ZSL and WWF). Since 2011, ECG has held three workshops in which a common research project was designed and conducted, in each of the project sites. The previous ECG workshops took place in Sri Lanka, India, and Malaysia.

Here we report on the 4th ECG workshop, which took place at 'Wildlife Reserves Singapore' (WRS), on 20-24th August 2015 and was funded by WRS. The Workshop was attended by 27 people, including members of all 11 current ECG teams and WRS staff. The workshop consisted of three days of discussions, a half-day public event and visits to WRS's Zoo, Night Safari, and River Safari.

Review of previous and ongoing work

On the first day we reviewed the results of previous and ongoing work. Each team conducted a brief presentation about their ongoing research activities. We then discussed the status and results of previous joint ECG initiatives.

Public event at WRS

On the second day, WRS and ECG held a public event called 'Elephants and us'. The event included an introduction by WRS's Dr. Sonja Luz, brief presentations by four ECG members, and a panel discussion and Q&A session with the Singaporean public. The event concluded with a lunch, where the public had a chance to interact with ECG members. The event was well attended.

New ECG projects

At the next session after intensive discussion, ECG members proposed 11 potential activities to be conducted in 2016. Each of the 11 participating teams voted for two of these activities in a ranked voting system in which each team voted for a top priority (2 points) and a second priority (1 point) activity. These points were then summed and the activities ranked based on the relative support. Four activities mustered more than 80% of support: (1) analyzing patterns of HEC-related human and elephant mortality, (2) electric fence effectiveness, (3) elephant occupancy in forested areas, and (4) study of elephant body condition.

After long deliberation, ECG members agreed to conduct two research activities in 2016; studying patterns of human and elephant mortality and conducting a comparative analysis of elephant body condition in the different landscapes where we work. The rest of the day was spent designing research methodologies and assigning timelines and responsibilities. The results of these new projects will be discussed at the 2016 annual ECG workshop.

ECG and the future of the group

ECG is a highly heterogeneous group that includes members from different organizations and organization types (e.g. NGOs, research groups). As such, it is always important to monitor where we stand as a group and where we intend to be in the future. The last half-day of the workshop was dedicated to discuss the future of ECG as a group.

So far ECG has done two main types of activites: (1) joint standardized research and (2) knowledge exchange between groups from different organizations working in diverse landscapes. It was agreed that these two types of activities should remain the core of what ECG does. However, it was also decided that ECG should address policy issues pertaining to elephant conservation. Several members suggested the importance of producing policy briefs, summarizing the state of knowledge of HEC causes, impact, and appropriate management.

In terms of the group size it was agreed that the current size of ECG is already bigger than originally intended and that the group should not grow any further in the short term. ECG members agreed that the group does not need any formal structure (such as a chair, secretary, etc).

With regard to ways to support the Asian Elephant Specialist Group, it was decided to see how the Asian Elephant Specialist Group develops after the current changes in leadership and structure, and to offer any assistance that was needed.

Funding remains the biggest challenge for a group like ECG. The group agreed that it is highly unlikely that funds can be obtained for all the current members and funding objectives should be realistic and sustainable. As a group, we decided to prioritize obtaining funds to hold an annual workshop and each member to fund its in-country research activities, while exploring the possibility of obtaining funding to support research activities across groups.

Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

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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 (2016) publications on Asian elephants.

L.M. Abegglen, A.F. Caulin, A. Chan, K. Lee, R. Robinson, M.S. Campbell, W.K. Kiso, D.L. Schmitt, P.J. Waddell, S. Bhaskara, S.T. Jensen, C.C. Maley & J.D. Schiffman
Potential mechanisms for cancer resistance in elephants and comparative cellular response to DNA damage in humans
JAMA 314 (2015) 1850-1860
Abstract. No permission to print abstract free of charge.

Y. Aihara, T. Hosaka, M. Yasuda, M. Hashim & S. Numata
Mammalian wildlife tourism in south-east Asian tropical rainforest: The case of Endau Rompin National Park, Malaysia
J. of Tropical Forest Science 28 (2016) 167-181
Abstract. Wildlife tourism is for the purpose of watching and/or encountering wildlife. In South-east Asia, mammalian wildlife tourism is less popular than in Africa. This is because mammalian wildlife tourism in South-East Asia is generally targeted at terrestrial national parks with forest fauna, as it is difficult to observe mammals in dense rainforest. To assess the potential of a South-East Asian national park for mammalian wildlife tourism, a mixed methods approach was used, 1) mammalian wildlife-based tourist attractions and 2) park use and visitor attitudes towards wildlife in Endau Rompin National Park, Peninsular Malaysia. There are potentially 149 mammalian species, including 24 threatened species, in Endau Rompin National Park. Camera trap data indicated that small and medium sized mammals do occur in these areas frequented by tourists. Footprints, nests, scratches and disturbance traces of various mammals were also observed. However, most visitors did not have high expectations regarding wildlife encounters, nor did many actually see wildlife during their stay. These results implied that animal signs and devices for indirect observation of elusive and/or rare animals were important at sites of mammalian wildlife-based tourism. Additionally, elephants could be a strong attraction for wildlife tourists, but there was concern about conflict between local people and elephants.

I. Aroch, N. Larian & N. Avni-Magen
Concentrations of free (ionized) and total calcium and magnesium in healthy captive Asian elephants (*Elephas maximus*) and effects of sample type and pH on measured free calcium and magnesium concentrations
Israel J. of Veterinary Medicine 71 (2016) 24-32
Abstract. The Asian elephant (*Elephas maximus*) is an endangered species, with an overall low reproduction rate in captivity, and a long, 22-month gestation, mostly with a single calve. Calcium and magnesium are important for the normal progression of gestation and parturition. This study measured blood total and ionized calcium (tCa and iCa, respectively) and total and ionized magnesium (tMg and iMg, respectively) in four healthy, captive Asian elephant cows in the Tisch Family Zoological Gardens, Jerusalem, every alternative month, over a 1-year period, to establish their reference intervals and examine sample pH and sample type effects on measured iCa and iMg concentrations. iCa and iMg were measured using an ion-selective electrode electrolyte analyzer. Calcium and magnesium levels in diet samples were measured. The iCa:tCa and iMg:tMg ratios were 0.44 and 0.73,

respectively. Mean iMg concentrations in whole-blood, heparinized plasma and serum were 0.58, 0.65 and 0.66 mmol/L, respectively. iCa and iMg concentrations in the three sample types were highly correlated, with no sample type effect on measured iCa concentration, but significant effect on iMg concentration, with significantly lower whole-blood levels vs. serum and plasma. Serum albumin and both tCa and tMg concentrations positively correlated. Sample pH had no effect on measured iCa or iMg levels. This study is the first to measure iMg in Asian elephants, and assess the effects of sample type and pH on the results. It was concluded that different iMg reference intervals should be established for each sample type.

N. Chai, J.L. Pouchelon, J. Bouvard, L.C. Sillero, M. Huynh, V. Segalini, L. Point, V. Croce, G. Rigaux, J. Highwood & V. Chetboul

Proposed simple method for electrocardiogram recording in free-ranging Asian elephants (*Elephas maximus*)

J. of Zoo and Wildlife Medicine 47 (2016) 6-11

Abstract. Electrocardiography represents a relevant diagnostic tool for detecting cardiac disease in animals. Elephants can present various congenital and acquired cardiovascular diseases. However, few electrophysiologic studies have been reported in captive elephants, mainly due to challenging technical difficulties in obtaining good-quality electrocardiogram (ECG) tracings, and no data are currently available for free-ranging Asian elephants (*Elephas maximus*). The purpose of this pilot prospective study was to evaluate the feasibility of using a simple method for recording ECG tracings in wild, apparently healthy, unsedated Asian elephants (n = 7) in the standing position. Successful six-lead recordings (I, II, III, aVR, aVL, and aVF) were obtained, with the aVL lead providing the best-quality tracings in most animals. Variables measured in the aVL lead included heart rate, amplitudes and duration of the P waves, QRS complexes, T and U waves, and duration of the PR, QT, and QU intervals. A negative deflection following positive P waves, representative of an atrial repolarization wave (Ta wave), was observed for five out of the seven elephants. © 2016 American Association of Zoo Veterinarians.

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

How big is it really? Assessing the efficacy of indirect estimates of body size in Asian elephants

PLoS ONE 11 (2016) e0150533

Abstract. Information on an organism's body size is pivotal in understanding its life history and fitness, as well as helping inform conservation measures. However, for many species, particularly large-bodied wild animals, taking accurate body size measurements can be a challenge. Various means to estimate body size have been employed, from more direct methods such as using photogrammetry to obtain height or length measurements, to indirect prediction of weight using other body morphometrics or even the size of dung boli. It is often unclear how accurate these measures are because they cannot be compared to objective measures. Here, we investigate how well existing estimation equations predict the actual body weight of Asian elephants *Elephas maximus*, using body measurements (height, chest girth, length, foot circumference and neck circumference) taken directly from a large population of semi-captive animals in Myanmar (n = 404). We then define new and better fitting formulas to predict body weight in Myanmar elephants from these readily available measures. We also investigate whether the important parameters height and chest girth can be estimated from photographs (n = 151). Our results show considerable variation in the ability of existing estimation equations to predict weight, and that the equations proposed in this paper predict weight better in almost all circumstances. We also find that measurements from standardised photographs reflect body height and chest girth after applying minor adjustments. Our results have implications for size estimation of large wild animals in the field, as well as for management in captive settings. © 2016 The Authors.

N. Ding, Y. Jiang, L. Han, X. Chen, J. Ma, X. Qu, Y. Mu, J. Liu, L. Li, C. Jiang & X. Huang

Bafilomycins and odoriferous sesquiterpenoids from *Streptomyces albolongus* isolated from *Elephas maximus* feces

Journal of Natural Products 79 (2016) 799-805

Abstract. From a fermentation broth of *Streptomyces albolongus* obtained from *Elephas maximus* feces, nine bafilomycins (1–9) and seven odoriferous sesquiterpenoids (10–16) were isolated. The structures of the new compounds, including three bafilomycins, 19-methoxybafilomycin C1 amide (1), 21-deoxybafilomycin A1 (2), and 21-deoxybafilomycin A2 (3), and two sesquiterpenoid degradation products, (1β,4β,4aβ,8aα)-4,8a-dimethyloctahydro-naphthalene-1,4a(2H)-diol (10) and (1β,4β,4aβ,7α,8aα)-4,8a-dimethyloctahydronaphthalene-1,4a,7(2H)-triol (11), were elucidated by comprehensive spectroscopic data analysis. The cytotoxicity activity against four human cancer cell lines and antimicrobial activities against a panel of bacteria and fungi of all compounds isolated were evaluated. Compounds 1, 7, and 8 were cytotoxic, with IC50 values ranging from 0.54 to 5.02 μM. Compounds 2, 7, 8, and 10 showed strong antifungal activity against *Candida parapsilosis*, with MIC values of 3.13, 1.56, 1.56, and 3.13 μg/mL respectively.

K.L. Edwards, J. Trotter, M. Jones, J.L. Brown, H.W. Steinmetz & S.L. Walkera

Investigating temporary acyclicity in a captive group of Asian elephants (*Elephas maximus*): Relationship between management, adrenal activity and social factors

General and Comparative Endocrinology 225 (2016) 104-116

Abstract. Routine faecal steroid monitoring has been used to aid the management of five captive Asian elephant (*Elephas maximus*) females at Chester Zoo, UK, since 2007. Progestagen analysis initially revealed synchronized oestrous cycles among all females. However, a 14- to 20-week period of temporary acyclicity subsequently occurred in three females, following several management changes (increased training, foot-care and intermittent matriarch removal for health reasons) and the initiation of pregnancy in another female. The aim of this study was to retrospectively investigate whether these management changes were related to increased adrenal activity and disruption of ovarian activity, or whether social factors may have been involved in the temporary cessation of cyclicity. Faecal samples collected every other day were analysed to investigate whether glucocorticoid metabolites were related to reproductive status (pregnant, cycling, acyclic) or management (training, foot-care, matriarch presence). Routine training and foot-care were not associated with adrenal activity; however, intensive foot-care to treat an abscess in one female was associated with increased glucocorticoid concentration. Matriarch presence influenced adrenal activity in three females, being lower when the matriarch was separated from the group at night compared to being always present. However, in the females that exhibited temporary acyclicity, there was no consistent relationship between glucocorticoids and cyclicity state. Although the results of this study do not fully explain this occurrence, the highly synchronized nature of oestrous cycles within this group, and the concurrent acyclicity in three females, raises the question of whether social factors could have been involved in the temporary disruption of ovarian activity.

P. Fernando

Managing elephants in Sri Lanka: Where we are and where we need to be

Ceylon J. of Science (Bio. Sci.) 44 (2015) 1-11

Abstract. Asian elephants are 'endangered' but come into significant conflict with humans. Sri Lanka holds an important position in relation to Asian elephants, both in terms of species conservation and human-elephant conflict (HEC) mitigation. Historical aspects of the two main conservation agencies and lack of coordination between them has prevented a landscape level holistic approach to conservation in general and elephants in particular. The primary objective of elephant management is HEC mitigation and secondarily elephant conservation. Many HEC mitigation activities are ineffective and in some cases cause its escalation and wider spread. Others are extremely detrimental to elephant conservation. Effective human-elephant conflict mitigation and elephant conservation requires a paradigm change. Elephant management needs to be based on science and evidence rather than outdated beliefs and false assumptions. Unless

immediate and effective remedial measures are taken, HEC will continue to escalate and the elephant population continue to decline.

A. Fuery, G.R. Browning, J. Tan, S. Long, G.S. Hayward, S.K. Cox, J.P. Flanagan, M.E. Tocidlowski, L.L. Howard & P.D. Ling

Clinical infection of captive Asian elephants (*Elephas maximus*) with elephant endotheliotropic herpesvirus 4

Journal of Zoo and Wildlife Medicine 47 (2016) 311-318

Abstract. Elephant endotheliotropic herpesvirus (EEHV) can cause lethal hemorrhagic disease in juvenile Asian elephants. A number of EEHV types and subtypes exist, where most deaths have been caused by EEHV1A and EEHV1B. EEHV4 has been attributed to two deaths, but as both diagnoses were made postmortem, EEHV4 disease has not yet been observed and recorded clinically. In this brief communication, two cases of EEHV4 infection in juvenile elephants at the Houston Zoo are described, where both cases were resolved following intensive treatment and administration of famciclovir. A quantitative real-time polymerase chain reaction detected EEHV4 viremia that correlated with clinical signs. High levels of EEHV4 shedding from trunk wash secretions of the first viremic elephant correlated with subsequent infection of the second elephant with EEHV4. It is hoped that the observations made in these cases—and the successful treatment regimen used—will help other institutions identify and treat EEHV4 infection in the future. © 2016 American Association of Zoo Veterinarians.

A. Fuery, J. Tan, R. Peng, J.P. Flanagan, M.E. Tocidlowski, L.L. Howard & P.D. Ling

Clinical infection of two captive Asian elephants (*Elephas maximus*) with elephant endotheliotropic herpesvirus 1B

Journal of Zoo and Wildlife Medicine 47 (2016) 319-324

Abstract. The ability of prior infection from one elephant endotheliotropic herpesvirus (EEHV) type to protect against clinical or lethal infection from others remains an important question. This report describes viremia and subsequent shedding of EEHV1B in two juvenile 4-yr-old Asian elephants within 3 wk or 2 mo following significant infections caused by the rarely seen EEHV4. High levels of EEHV1B shedding were detected in the first elephant prior to emergence of infection and viremia in the second animal. The EEHV1B virus associated with both infections was identical to the strain causing infection in two herd mates previously. High EEHV viremia correlated with leukopenia and thrombocytopenia, which was followed by leukocytosis and thrombocytosis when clinical signs started to resolve. The observations from these cases should be beneficial for helping other institutions monitor and treat elephants infected with EEHV1, the most common virus associated with lethal hemorrhagic disease. © 2016 American Association of Zoo Veterinarians.

B. Goossens, R. Sharma, N. Othman, C. Kun-Rodrigues, R. Sakong, M. Ancrenaz, L.N. Ambu, N.K. Jue, R.J. O'Neill, M.W. Bruford & L. Chikhi

Habitat fragmentation and genetic diversity in natural populations of the Bornean elephant: Implications for conservation

Biological Conservation 196 (2016) 80-92

Abstract. The Bornean elephant population in Sabah, with only 2000 individuals, is currently mainly restricted to a limited number of forest reserves. The main threats to the species' survival are population fragmentation and isolation of the existing herds. To support and help monitor future conservation and management measures, we assessed the genetic diversity and population structure of Bornean elephants using mitochondrial DNA, microsatellites and single nucleotide polymorphisms. Our results confirmed a previously reported lack of mitochondrial control region diversity, characterized by a single widespread haplotype. However, we found low but significant degree of genetic differentiation among populations and marked variation in genetic diversity with the other two types of markers among Bornean elephants. Microsatellite data showed that Bornean elephants from the Lower Kinabatangan and North Kinabatangan ranges are differentiated and perhaps isolated from the main elephant populations located in the Central Forest and Tabin Wildlife Reserve. The pairwise FST values between these sites ranged from 0.08 to 0.14 ($p < 0.001$). Data from these

markers also indicate that the Bornean elephant populations from Lower Kinabatangan Wildlife Sanctuary and North Kinabatangan (Deramakot Forest Reserve) possess higher levels of genetic variation compared to the elephant populations from other areas. Our results suggest that (i) Bornean elephants probably derive from a very small female population, (ii) they rarely disperse across current human-dominated landscapes that separate forest fragments, and (iii) forest fragments are predominantly comprised of populations that are already undergoing genetic drift. To maintain the current levels of genetic diversity in fragmented habitats, conservation of the Bornean elephants should aim at securing connectivity between spatially distinct populations.

M. Gunji, A. Takai & H. Endo

Deformations of the cervical and cranial thoracic vertebrae in a bedridden Asian elephant

Japanese Journal of Zoo and Wildlife Medicine 19 (2014) 79-86

Abstract. The present study reports an abnormality of the neck in a bedridden Asian elephant. When 1 year old, the elephant lost the ability to stand and grew up under the bedridden condition for 3.5 years. Our observations from CT scan revealed that the articular facets of the cervical and first 3 thoracic vertebrae possessed intricately rough surfaces and that the anterior articular processes of C4, C5 and C6 intruded to the adjacent processes. The articular processes were partly fused to the contiguous processes in the C5/C6 and T1/T2 zygapophyseal joints and the processes of C6 were completely coalesced with those of C7. The neck of the bedridden elephant was dorsally bent at 30.4 degrees more than that of a hyperostotic elephant. Under the bedridden condition, the nuchal ligament is contracted without the gravitational load of the head weight. This induces the dorsiflexion of the neck, and then generates a compressive force between adjacent vertebrae. The compressive force might cause the inflammation and bony destruction between the articular processes, and prompt the abnormal ossifications in the articulations through the repairing process. The abnormalities of the articular processes were identified in the attachment site of the nuchal ligament, and the vertebral fusions were distributed intensively on where the compressive force should be converged. This study concludes that a long-term lying posture under the bedridden condition might cause the over-dorsalization of the neck and the deformations of the articular processes in large mammals. © 2014 Japanese Society of Zoo and Wildlife Medicine.

A. Houssaye, K. Waskow, S. Hayashi, R. Cornette, A.H. Lee & J.R. Hutchinson

Biomechanical evolution of solid bones in large animals: A microanatomical investigation

Biological Journal of the Linnean Society 117 (2016) 350-371

Abstract. Graviportal taxa show an allometric increase of the cross-sectional area of supportive bones and are assumed to display microanatomical changes associated with an increase in bone mass. This evokes osteosclerosis (i.e. an increase in bone compactness observed in some aquatic amniotes). The present study investigates the changes in bones' microanatomical organization associated with graviportality and how comparable they are with aquatically acquired osteosclerosis aiming to better understand the adaptation of bone to the different associated functional requirements. Bones of graviportal taxa show microanatomical changes that are not solely attributable to allometry. They display a thicker cortex and a proportionally smaller medullary cavity, with a wider transition zone between these domains. This inner cancellous structure may enable to better enhance energy absorption and marrow support. Moreover, the cross-sectional geometric parameters indicate increased resistance to stresses engendered by bending and torsion, as well as compression. Adaptation to a graviportal posture should be taken into consideration when analyzing possibly amphibious taxa with a terrestrial-like morphology. This is particularly important for palaeoecological inferences about large extinct tetrapods that might have been amphibious and, more generally, for the study of early stages of adaptation to an aquatic life in amniotes. © 2015 The Linnean Society of London.

A.S. Jacob, E.J. Busby, A.D. Levy, N. Komm & C.G. Clark

Expanding the *Entamoeba* universe: New hosts yield novel ribosomal lineages†

J. of Eukaryotic Microbiology 63 (2016) 69-78

Abstract. Removing the requirement for cell culture has led to a substantial increase in the number of lineages of *Entamoeba* recognized as distinct. Surveying the range of potential host species for this parasite genus has barely been started and it is clear that additional sampling of the same host in different locations often identifies additional diversity. In this study, using small subunit ribosomal RNA gene sequencing, we identify four new lineages of *Entamoeba*, including the first report of *Entamoeba* from an elephant, and extend the host range of some previously described lineages. In addition, examination of microbiome data from a number of host animals suggests that substantial *Entamoeba* diversity remains to be uncovered. © 2015 The Authors © 2015 International Society of Protistologists.

K.K. Karanth

Wildlife in the matrix: Spatio-temporal patterns of herbivore occurrence in Karnataka, India

Environmental Management 57 (2016) 189-206

Abstract. Wildlife reserves are becoming increasingly isolated from the surrounding human-dominated landscapes particularly in Asia. It is imperative to understand how species are distributed spatially and temporally in and outside reserves, and what factors influence their occurrence. This study surveyed 7500 km^2 landscape surrounding five reserves in the Western Ghats to examine patterns of occurrence of five herbivores: elephant, gaur, sambar, chital, and pig. Species distributions are modeled spatio-temporally using an occupancy approach. Trained field teams conducted 3860 interview-based occupancy surveys in a 10-km buffer surrounding these five reserves in 2012. I found gaur and wild pig to be the least and most wide-ranging species, respectively. Elephant and chital exhibit seasonal differences in spatial distribution unlike the other three species. As predicted, distance to reserve, the reserve itself, and forest cover were associated with higher occupancy of all species, and higher densities of people negatively influenced occurrence of all species. Park management, species protection, and conflict mitigation efforts in this landscape need to incorporate temporal and spatial understanding of species distributions. All species are known crop raiders and conflict prone locations with resources (such as water and forage) have to be monitored and managed carefully. Wildlife reserves and adjacent areas are critical for long-term persistence and habitat use for all five herbivores and must be monitored to ensure wildlife can move freely. Such a large-scale approach to map and monitor species distributions can be adapted to other landscapes to identify and monitor critical habitats shared by people and wildlife. © 2015 Springer Science+Business Media. With permission of Springer.

P. Keerthipriya, R. Tewari & T.N.C. Vidya

Lateralization in trunk and forefoot movements in a population of free-ranging Asian elephants (*Elephas maximus*)

Journal of Comparative Psychology 129 (2015) 377-387

Abstract. We examined side preferences in trunk and forefoot movement during feeding in a wild population of Asian elephants. Trunk sweeping movements to pluck/uproot/gather vegetation and forefoot scuffing movements to uproot vegetation were scored in 206 individuals. We found a much stronger side preference in trunk use than in forefoot use, supporting a modified task complexity hypothesis. The forefoot and trunk appeared to be coordinated while feeding and, among individuals that had significant forefoot preferences, the proportion of right forefoot use was higher among right trunkers than left trunkers. Trunk and forefoot preferences were not dependent on individuals' social associates, and trunk preferences were also not dependent on feeding associates. There was a significant effect of individual identity on forefoot preference strength but no population-level side preference in trunk or forefoot movement, suggesting no dominant eye control over the task, which might be true of feeding-related foot movement in other herbivores also. There was no effect of age or sex on trunk or forefoot side preference or strength.

The onset of trunk side preference, however, was very early compared with that observed in other species studied and calls for a comparison of the ontogeny of side preferences in precocial and altricial species. Based on 57 mother-offspring pairs, we found that offspring trunk side preferences were independent of their mothers' preferences, suggesting that these preferences are not maternally inherited. © 2015 APA.

C. Kevrekidis & D. Mol

A new partial skeleton of *Elephas* (*Palaeoloxodon*) *antiquus* Falconer and Cautley, 1847 (Proboscidea, Elephantidae) from Amyntaio, Macedonia, Greece

Quaternary International 406 (2016) 35-56

Abstract. *Elephas* (*Palaeoloxodon*) *antiquus* is a well-known elephant species of the Middle and Late Pleistocene of Europe, but few skeletons so far have been described in detail. Here we present a detailed account of a partial skeleton in good condition from the alluvial sands of the Amyntaio coalmines, Macedonia, Greece. It represents a large male aged in its forties. Based on extant and extinct elephant specimens, the Amyntaio's elephant estimated height at the shoulder is 3.5 m and its weight close to 9 tonnes. A CT scan was performed on the deformed fifth metacarpal, which was diagnosed with osteomyelitis, probably rendering the animal lame. No signs of further biologically induced ante- or post-mortem modifications were detected. From that skeleton the first known basihyoid bone of *E. antiquus* is recovered; comparisons with homologous bones of other elephantid taxa show it has a very distinct morphology and can be used in phylogenetic studies of the Elephantidae family. © 2015 Elsevier Ltd and INQUA.

R.K. Koirala, W. Ji, A. Aryal, J. Rothman & D. Raubenheimer

Dispersal and ranging patterns of the Asian elephant (*Elephas maximus*) in relation to their interactions with humans in Nepal

Ethology Ecology & Evolution 28 (2016) 221-31

Abstract. none.

J. Kottwitz, M. Boothe, R. Harmon, S.B. Citino, J.R. Zuba, & D.M. Boothe

Results of the megavertebrate analgesia survey: Elephants and rhino

Journal of Zoo and Wildlife Medicine 47 (2016) 301-310

Abstract. An online survey utilizing Survey Monkey linked through the American Association of Zoo Veterinarians listserve examined current practices in megavertebrate analgesia. Data collected included drugs administered, dosing regimens, ease of administration, efficacy, and adverse events. Fifty-nine facilities (38 housing elephants, 33 housing rhinoceroses) responded. All facilities administered nonsteroidal anti-inflammatory drugs (NSAIDs), with phenylbutazone (0.25–10 mg/kg) and flunixin meglumine (0.2–4 mg/kg) being most common. Efficacy was reported as "good" to "excellent" for these medications. Opioids were administered to elephants (11 of 38) and rhinoceroses (7 of 33), with tramadol (0.5–3.0 mg/kg) and butorphanol (0.05–1.0 mg/kg) being most common. Tramadol efficacy scores were highly variable in both elephants and rhinoceroses. While drug choices were similar among institutions, substantial variability in dosing regimens and reported efficacy between and within facilities indicates the need for pharmacokinetic studies and standardized methods of analyzing response to treatment to establish dosing regimens and clinical trials to establish efficacy and safety. © 2016 American Association of Zoo Veterinarians.

M. Lahdenperä, K.U. Mar & V. Lummaa

Short-term and delayed effects of mother death on calf mortality in Asian elephants

Behavioral Ecology 27 (2016) 166-174

Abstract. Long-lived, highly social species with prolonged offspring dependency can show long postreproductive periods. The Mother hypothesis proposes that a need for extended maternal care of offspring together with increased maternal mortality risk associated with old age select for such postreproductive survival, but tests in species with long postreproductive periods, other than humans and marine mammals, are lacking. Here, we investigate the Mother hypothesis with longitudinal data on Asian elephants from timber camps of Myanmar 1) to determine the costs of reproduction on female age-specific mortality risk within 1 year after calving and 2) to quantify the effects of mother loss on calf

survival across development. We found that older females did not show an increased immediate mortality risk after calving. Calves had a 10-fold higher mortality risk in their first year if they lost their mother, but this decreased with age to only a 1.1-fold higher risk in the fifth year. We also detected delayed effects of maternal death: calves losing their mother during early ages still suffered from increased mortality risk at ages 3–4 and during adolescence but such effects were weaker in magnitude. Consequently, the Mother hypothesis could account for the first 5 years of postreproductive survival, but there were no costs of continued reproduction on the immediate maternal mortality risk. However, the observed postreproductive lifespan of females surviving to old age commonly exceeds 5 years in Asian elephants, and further studies are thus needed to determine selection for (postreproductive) lifespan in elephants and other comparably long-lived species.

N. Lakshminarayanan, K.K. Karanth, V.R. Goswami, S. Vaidyanathan & K.U. Karanth

Determinants of dry season habitat use by Asian elephants in the Western Ghats of India

Journal of Zoology 298 (2016) 169-177

Abstract. Large herbivores respond to seasonal changes in resource availability through habitat selection. Understanding variations in habitat choice is crucial for targeting conservation efforts, particularly for endangered, wide-ranging species, such as the Asian elephant. We assessed patterns and determinants of elephant habitat use during the dry season, a period of resource limitation in tropical deciduous forests, in the Western Ghats of Karnataka, India. We collected detection/non-detection data on elephant signs under an occupancy sampling framework, using spatially replicated surveys on foot along forest trails to estimate probabilities of habitat use by elephants. Each of our 97 sites (sampling units) was a grid cell of 11.75 km^2 area. Data were analysed using an occupancy model, which estimated detection probabilities for signs, while explicitly addressing the potential spatial dependence between sign detections on adjacent replicates. Using covariates that are likely to influence resource use, we made ecological predictions about dry season habitat use by elephants across the study area of 1850 km^2. The site-level probabilities of habitat use by elephants ranged from inline image The estimated replicate level detection probability was inline image We found that distance to rivers was the best predictor of elephant habitat use, in dry season, demonstrating the overarching importance of riparian habitats in the landscape for the species. Artificial water holes established by wildlife managers do not appear to influence elephant habitat use, which is likely a result of abundant and near-uniform distribution of such water holes across the study area. The sign survey-based occupancy modelling approach provides a basis for reliable cost-effective assessment of spatial distribution and habitat use by elephants and other large herbivores. Such assessments are essential for effective conservation management of large herbivores. © 2015 The Zoological Society of London.

J. Lassausaie, A. Bret, X Bouapao, V. Chanthavong, J. Castonguay-Vanier, F. Quet, S.K. Mikota, C. Théorêt, Y. Buisson & B. Bouchard

Tuberculosis in Laos, who is at risk: The mahouts or their elephants?

Epidemiology and Infection 143 (2015) 922-931

Abstract. Tuberculosis (TB) in elephants has the potential to infect humans and is an increasing public health concern. Lao PDR is one of the last countries where elephants are still used for timber extraction and where they live in close contact with their mahouts. There are 500 animals at work in the country, some interacting with wild herds. Although human TB prevalence is known to be high in Laos, studies on elephant TB had yet to be undertaken. From January to July 2012, screening was performed using the ElephantTB Stat-Pak assay on 80 elephants working around the Nam Pouy National Park in Sayaboury Province. This represents more than 18% of the total registered national working elephant population. Here we report that 36% of the elephants were seroreactive to the test. Of these, 31% had contacts with wild individuals, which suggests potential transmission of mycobacteria to the local wild herds. Clinical examination, chest X-rays, sputum microscopy and culture were performed on their 142 mahouts or owners. Despite high TB seroreactivity in elephants,

no participant was smear- or culture-positive for *Mycobacterium tuberculosis* or *M. bovis*, although atypical mycobacteria were isolated from 4% of participants.

M. Lev & R. Barkai

Elephants are people, people are elephants: Human–proboscideans similarities as a case for cross cultural animal humanization in recent and Paleolithic times

Quaternary International 406 (2016) 239-245

Abstract. Human and elephants shared habitats and interacted from Paleolithic times to the present day. It appears that pre-historic hunter–gatherers were wise enough to understand that elephants are cohabiters of the human race and not a product to be exploited in an uncontrolled way. The understanding of the long tradition of human and elephant relationship and kinship may change the mind-set of modern humans to lead to carry on the important relationship between man and elephant in particular, and man and nature in general, and prevent future extinctions of all species involved. This study is conducted in the spirit of the newly developed multidisciplinary study field of 'Ethnoelephantology' that studies human and elephant relationships and strives to protect the endangered species. In order to have better understanding of this unique relationship we will explore it through the study of food taboos in modern hunter–gatherers societies. More so, in this study we detected multiple striking similarities between elephant and man in several fields, such as physical, behavioral/social and conceptual. The importance of this study is in providing a new and better perspective about human and animal relationship, specifically elephants. We suggest that the physical and social uniqueness of the elephant, and its unique resemblance to man in so many aspects, alongside its pivotal role as a major food source, is what makes it appropriate for serving as a cosmological and conceptual beacon, mostly conceived in recent hunter–gatherers societies by the concept of taboo. Although detecting food taboos in the deep past are not possible, we believe that the archaeological evidence presented in this paper could indicate that human–elephant interactions in the past were complex, and were not based solely on human perception of the elephant as a food and raw material source. © 2015 Elsevier Ltd and INQUA.

P. Liu, H. Wen, L. Lin, J. Liu & L. Zhang

Habitat evaluation for Asian elephants (*Elephas maximus*) in Lincang: Conservation planning for an extremely small population of elephants in China

Biological Conservation 198 (2016) 113-121

Abstract. Fewer than 250 Asian elephants remain in China, occupying fragmented habitats of Yunnan Province. One such fragmented population of 18–23 individuals occupies the Nangunhe Nature Reserve Area in Lincang City, Yunnan Province, China. The greatest threat to the survival of this population is the loss and fragmentation of habitat. In this study, we applied an ecological niche factor analysis (ENFA) model to evaluate the habitat suitability of Lincang City for Asian elephants based on geographical factors, vegetation type, and human disturbance. Optimal, relatively suitable, and marginal habitat accounted for 0.16% (38.45 km^2), 0.61% (150.00 km^2), and 3.34% (817.26 km^2) of the total study area, whereas non-suitable habitat accounted for 95.89% (23,463.29 km^2) of this area. The marginality of Asian elephant habitat in Lincang was 1.954, indicating nonrandom selection of various eco-geographical variables in the environment. The primary factor affecting Asian elephant habitat quality was vegetation type, followed by geographical factors and human disturbance. A habitat quality map for the total distribution of Asian elephants remaining in China (i.e., Yunnan Province: Xishuangbanna, Lincang, and Pu'er) based on our current and previous study showed that just 1400.57 km^2 and 2689.62 km^2 relatively suitable and optimal habitat is available, owing to significant deforestation. In addition to reintroduction programs, conservation strategies should focus on improving the quality of marginal habitats for elephants, in parallel to placing ecological corridors through non-suitable habitat to connect all suitable habitats for this and other extremely small elephant populations in China to reduce genetic isolation and secure long-term survival for the species. © 2016 Reprinted with permission from Elsevier.

S.Y. Long, E.M. Latimer & G.S. Hayward

Review of elephant endotheliotropic herpesviruses and acute hemorrhagic disease

ILAR Journal 56 (2015) 283-296

Abstract. More than 100 young captive and wild Asian elephants are known to have died from a rapid-onset, acute hemorrhagic disease caused primarily by multiple distinct strains of two closely related chimeric variants of a novel herpesvirus species designated elephant endotheliotropic herpesvirus (EEHV1A and EEHV1B). These and two other species of Probosciviruses (EEHV4 and EEHV5) are evidently ancient and likely nearly ubiquitous asymptomatic infections of adult Asian elephants worldwide that are occasionally shed in trunk wash secretions. Although only a handful of similar cases have been observed in African elephants, they also have proved to harbor their own multiple and distinct species of Probosciviruses—EEHV2, EEHV3, EEHV6, and EEHV7—found in lung and skin nodules or saliva. For reasons that are not yet understood, approximately 20% of Asian elephant calves appear to be susceptible to the disease when primary infections are not controlled by normal innate cellular and humoral immune responses. Sensitive specific polymerase chain reaction (PCR) DNA blood tests have been developed, routine monitoring has been established, the complete large DNA genomes of each of the four Asian EEHV species have now been sequenced, and PCR gene subtyping has provided unambiguous evidence that this is a sporadic rather than epidemic disease that it is not being spread among zoos or other elephant housing facilities. Nevertheless, researchers have not yet been able to propagate EEHV in cell culture, determine whether or not human antiherpesvirus drugs are effective inhibitors, or develop serology assays that can distinguish between antibodies against the multiple different EEHV species. © 2015 Oxford University Press.

Elephant scratching at Yala NP (Sri Lanka)

D.E. Lukacs, M. Poulin, H. Besenthal, O.C. Fad, S.P. Miller, J.L. Atkinson & E.J. Finegan

Diurnal and nocturnal activity time budgets of Asian elephants (*Elephas maximus*) in a zoological park

Animal Behavior and Cognition 3 (2016) 63-77

Abstract. The diurnal and nocturnal activity time budgets of five adult female Asian elephants (*Elephas maximus*) were studied in a zoological park for two 24-hour, five 14-hour, and one 9-hour observation periods between May and June 2011. Relatively few studies have looked at detailed daytime and nighttime activity time budgets in captive Asian elephants. Continuous observation was used to measure the activity time budgets of at least one focal animal per observation period. The activity time budgets varied between animals and observation periods. The elephants spent 17-49% of the day (daylight hours) standing, 1-9% of the day walking, 19-44% of the day eating, and 1-20% of the day using enrichment items. At night, the elephants spent 29-87% of the observation period standing, 1-19% of the night eating, and 0.1-10% of the night using enrichment items. At night, elephants spent 0-45% of the observation period lying down. Variations in activity time budgets between elephants and observation periods have been observed in other studies of captive and wild elephants. Results of this observational study allow comparison between groups of captive elephants and between captive and wild elephants. Furthermore, results of this study can inform management strategies.

K. Mizuno, N. Irie, M. Hiraiwa-Hasegawa & N. Kutsukake

Asian elephants acquire inaccessible food by blowing

Animal Cognition 19 (2016) 215-222

Abstract. Many animals acquire otherwise

inaccessible food with the aid of sticks and occasionally water. As an exception, some reports suggest that elephants manipulate breathing through their trunks to acquire inaccessible food. Here, we report on two female Asian elephants (*Elephas maximus*) in Kamine Zoo, Japan, who regularly blew to drive food within their reach. We experimentally investigated this behaviour by placing foods in inaccessible places. The elephants blew the food until it came within accessible range. Once the food was within range, the elephants were increasingly less likely to blow as the distance to the food became shorter. One subject manipulated her blowing duration based on food distance: longer when the food was distant. These results suggest that the elephants used their breath to achieve goals: that is, they used it not only to retrieve the food but also to fine-tune the food position for easy grasping. We also observed individual differences in the elephants' aptitude for this technique, which altered the efficiency of food acquisition. Thus, we added a new example of spontaneous behaviour for achieving a goal in animals. The use of breath to drive food is probably unique to elephants, with their dexterous trunks and familiarity with manipulating the act of blowing, which is commonly employed for self-comfort and acoustic communication.

U. Münster

Working for the forest: The ambivalent intimacies of human–elephant collaboration in South Indian wildlife conservation

Ethnos: J. of Anthropology 81 (2016) 425-447

Abstract. This paper explores the collaboration of humans and elephants in South Indian wildlife conservation. Drawing on ethnography within the Indian forest department and among elephant handlers in Wayanad, Kerala, it highlights the largely invisible work relationship between indigenous forest labourers and captive elephants, and their essential contribution to wildlife management. Extending ethnographic attention beyond an exclusively human realm, I show that human and elephant relations have been co-constituted while working together for the forest department. Their working partnership, situated in the historical nature-cultures of logging, teak extraction, and conservation, has created ambivalent intimacies between humans and elephants, containing both mutual violence and affect. By highlighting the importance of work relationships, history, and questions of power for multi-species studies, this article argues that human–animal relations are not only shaped by individual intimacies, but also by danger, risk, and aggression, situated within a region's larger political ecology. © 2014 Taylor & Francis.

K. Nganvongpanit, J.L. Brown, K. Buddhachat, C. Somgird & C. Thitaram

Elemental analysis of Asian elephant (*Elephas maximus*) teeth using X-ray fluorescence and a comparison to other species

Biol. Trace Element Research 170 (2016) 94-105

Abstract. Elemental composition in bone of the different species has variation depending on genetic and environmental factors especially their food habitat. The aims of this study were to conduct an elemental analysis of Asian elephant teeth, both deciduous (first molar, second molar, and tusk) and permanent (molar and tusk), and compare the elemental composition of permanent teeth among 15 species, mostly mammalian. These teeth were analyzed using X-ray fluorescence at two voltages: 15 and 50 kV. In Asian elephants, deciduous tusk showed a lower Ca/Zn ratio compared to permanent tusk, because of the lack of Zn in permanent molars. Ca/Fe ratio was higher in deciduous than permanent molars. For permanent teeth, elephant molars presented a high Ca/Pb ratio but no Ca/Zn, Ca/Sr, and Zn/Fe ratios because of the lack of Zn and Sr in the samples tested. The key elemental ratios for differentiating elephant deciduous and permanent tusk were Ca/P and Ca/Zn. The considerable variation in elemental ratio data across 15 species was observed. All tooth samples contained Ca and P, which was not surprising; however, Pb also was present in all samples and Cd in a large majority, suggesting exposure to environmental contaminants. From discriminant analysis, the combination of Ca/P+Ca/Zn+Ca/Pb+Ca/Fe+Ca/Sr+Zn/Fe can generate two equations that successfully classified six (dog, pig, goat, tapir, monkey, and elephant) out of 15 species at 100 % specificity. In conclusion, determining the elemental profile

of teeth may serve as a tool to identify the tooth "type" of elephants and to potentially classify other species. © 2016 With permission of Springer.

K. Nganvongpanit, K. Buddhachat, S. Klinhom, P. Kaewmong, C. Thitaram & P. Mahakkanukrauh
Determining comparative elemental profile using handheld X-ray fluorescence in humans, elephants, dogs, and dolphins: Preliminary study for species identification
Forensic Science Internat. 263 (2016) 101-106
Abstract. Species identification is a crucial step in forensic anthropological studies. The aim of this study was to determine elemental profiles in bones from four mammal species, to be used for species discrimination. Human, elephant, dog, and dolphin bones were scanned by X-ray fluorescence (XRF); the differences in elemental profiles between species were determined using discriminant analysis. Dogs had the greatest number of elements (23), followed by humans (22) and elephants (20). Dolphins had the lowest number of elements (16). The accuracy rate of species identification in humans, elephants, dogs, and dolphins was 98.7%, 100%, 94.9%, and 92.3%, respectively. We conclude that element profiles of bones based on XRF analyses can serve as a tool for determining species. © 2016 Reprinted with permission from Elsevier.

O. Phuphisut, W. Maipanich, S. Pubampen, M. Yindee, N. Kosoltanapiwat, S. Nuamtanong, A. Ponlawat & P. Adisakwattana
Molecular identification of the strongyloid nematode Oesophagostomum aculeatum in the Asian wild elephant *Elephas maximus*
Journal of Helminthology 90 (2016) 434-440
Abstract. The transmission of zoonoses by wildlife, including elephants, is a growing global concern. In this study, we screened for helminth infections among Asian wild elephants (*Elephas maximus*) of the Salakpra Wildlife Sanctuary, Kanchanaburi, Thailand. Elephant faecal samples (45) were collected from the sanctuary grounds during January through November 2013 and assayed individually using the tetranucleotide microsatellite technique. Microscopic examination indicated a high prevalence of strongylids (93.0%) and low prevalences of trichurids (2.3%) and ascarids (2.3%). To identify the strongylid species, small subunit (SSU) rDNA sequences were amplified from copro-DNA and compared with sequences in GenBank. The generated SSU-rDNA sequences comprised five distinct haplotypes that were closely related to *Oesophagostomum aculeatum*. A phylogenetic analysis that incorporated related nematodes yielded a tree separated into two main clades, one containing our samples and human and domestic animal hookworms and the other consisting of Strongyloides. The present results indicate that *O. aculeatum* in local elephants is a potential source of helminthiasis in human and domestic animals in this wild-elephant irrupted area. © 2015 Cambridge University Press.

T. Ramesh, R. Kalle, K. Sankar & Q. Qureshi
Role of body size in activity budgets of mammals in the Western Ghats of India
Journal of Tropical Ecology 31 (2015) 315-323
Abstract. Body size in animals is an important trait affecting species niche differentiation and restricting similarity. Using camera-trap data over 2008–2010, we used photo-captures from 50 cameras spread throughout Mudumalai Tiger Reserve (Western Ghats, India) to assess the activity budgets of 21 mammal species ranging in body size from 1 kg to 2088 kg. Large carnivores were mostly cathemeral whereas small cat and civet species were purely nocturnal. Mongoose species were mainly diurnal possibly due to their terrestrial feeding habits and reduce competition with other sympatric small carnivores. All large and small-bodied herbivores were cathemeral and nocturnal respectively, whereas medium-sized herbivores were active during the day. Overall, small mammals tended to be mostly nocturnal, whereas large mammals were cathemeral mainly due to energy requirements and other ecological constraints. Body size showed significant negative relationship with mean vector length (clustering of activity in time) thus implying that the daily amount of time being active increased with body size. The shorter activity time (12 h) in small mammals resulted in higher mean vector length probably to utilize the available time to fulfil energy needs. The observed cathemeral activity in large mammals may be associated with travel over larger areas to acquire large

quantities of food therefore they are active for a longer duration. Our results clearly support the allometric relationship between body size and activity budgets in mammals and its association with niche differentiation. © 2015 Cambridge University Press.

S.J. Sander, J.L. Siegal-Willott, J. Ziegler, E. Lee, L. Tell & S. Murray

Pharmacokinetics of a single dose of metronidazole after rectal administration in captive Asian elephants (*Elephas maximus*)

J. of Zoo and Wildlife Medicine 47 (2016) 1-5

Abstract. Metronidazole is a nitroimidazole antibacterial and antiprotozoal drug with bacteriocidal activity against a broad range of anaerobic bacteria. It is a recognized treatment for elephants diagnosed with anaerobic bacterial infection or protozoal disease or exhibiting signs of colonic impaction, diarrhea, and colic. This study evaluated the pharmacokinetics of rectally administered metronidazole (15 mg/kg) in five adult female Asian elephants (*Elephas maximus*). Serum samples were collected from each animal for 96 hr after rectal administration of metronidazole. Serum concentrations of metronidazole and its primary metabolite, hydroxymetronidazole, were measured via ultraperformance liquid chromatography. Data were analyzed via a noncompartmental pharmacokinetic approach. Results indicated that serum levels of metronidazole were quantifiable at the 0.25 hr time point and absent in all elephants by the 96 hr time point. The serum peak concentration (mean ± SD, 13.15 ± 2.59 μg/ml) and area under the curve from time 0 to infinity (mean ± SD, 108.79 ± 24.77 hr × μg/ml) were higher than that reported in domestic horses after similar usage. Concurrently, the time of maximum serum concentration (mean ± SD, 1.2 ± 0.45 hr) and terminal elimination half-life (harmonic mean ± pseudo-SD, 7.85 ± 0.93 hr) were longer when compared to equine reports. Rectal administration of metronidazole was well tolerated and rapidly absorbed in all study elephants. Based on the findings in this study, metronidazole administered at a single dose of 15 mg/kg per rectum in the Asian elephant is likely to result in serum concentrations above 4 μg/ml for 8 hr and above 2 μg/ml for 24 hr after treatment is administered. Dosing recommendations should reflect the mean inhibitory concentration of metronidazole for each pathogen. © 2016 American Association of Zoo Veterinarians.

K. Seilern-Moy, K. Darpel, F. Steinbach & A. Dastjerdi

Distribution and load of elephant endotheliotropic herpesviruses in tissues from associated fatalities of Asian elephants

Virus Research 220 (2016) 91-96

Abstract. Elephant Endotheliotropic Herpesviruses (EEHVs) are the cause of a highly fatal haemorrhagic disease in elephants primarily affecting young Asian elephants (*Elephas maximus*) in both captivity and in the wild. The viruses have emerged as a significant threat to Asian elephant conservation, critically affecting overall sustainability of their population. So far insight into the pathogenesis of EEHV infections has been restricted to examination of EEHV-infected tissues. However, little is known about distribution and burden of the viruses within the organs of fatal cases, crucial elements in the understanding of the virus pathogenesis. This study was therefore undertaken to assess the extent of organ and cell involvement in fatal cases of EEHV-1A, 1B and 5 using a quantitative real-time PCR. EEHV-1 and 5 DNA were detectable in all the tissues examined, albeit with substantial differences in the viral DNA load. The highest EEHV-1A DNA load was observed in the liver, followed by the heart, thymus and tongue. EEHV-1B and 5 showed the highest DNA load in the heart, followed by tongue and liver. This study provides new insights into EEHV pathogenicity and has implications in choice of sample type for disease investigation and virus isolation. © 2016 Reprinted with permission from Elsevier.

N. Sekar, X. Giam, N.P. Sharma & R. Sukumar

How much *Dillenia indica* seed predation occurs from Asian elephant dung?

Acta Oecologica 70 (2016) 53-59

Abstract. Elephants are thought to be effective seed dispersers, but research on whether elephant dung effectively protects seeds from seed predation is lacking. Quantifying rates of seed predation from elephant dung will facilitate comparisons between elephants and

alternative dispersers, helping us understand the functional role of megaherbivores in ecosystems. We conducted an experiment to quantify the predation of *Dillenia indica* seeds from elephant dung in Buxa Reserve, India from December 2012 to April 2013. Using dung boluses from the same dung pile, we compared the number of seeds in boluses that are a) opened immediately upon detection (control boluses), b) made available only to small seed predators (<3 mm wide) for 1-4 months, and c) made available to all seed predators and secondary dispersers for 1-4 months. Using a model built on this experiment, we estimated that seed predation by small seed predators (most likely ants and termites) destroys between 82.9% and 96.4% of seeds in elephant dung between the time of defecation and the median germination date for *D. indica*. Exposure to larger seed predators and secondary dispersers did not lead to a significant additional reduction in the number of seeds per dung bolus. Our findings suggest that post-dispersal seed predation by small insects (<3 mm) substantially reduces but does not eliminate the success of elephants as dispersers of *D. indica* in a tropical moist forest habitat.

N. Sekar & R. Sukumar

The Asian elephant is amongst the top three frugivores of two tree species with easily edible fruit

Journal of Tropical Ecology 31 (2015) 385-394

Abstract. Large animal species are prone to local extirpation, but ecologists cannot yet predict how the loss of megaherbivores affects ecosystem processes such as seed dispersal. Few studies have compared the quantity and quality of seed dispersal by megaherbivores versus alternative frugivores in the wild, particularly for plant species with fruit easily consumed by many frugivorous species. In a disturbed tropical moist forest in India, we examine whether megaherbivores are a major frugivore of two tree species with easily edible, mammal-dispersed fruit. We quantify the relative fruit removal rates of Artocarpus chaplasha and Careya arborea, by the Asian elephant (*Elephas maximus*) and alternative dispersers. Through focal watches and camera trapping, we found the elephant to be amongst the top three frugivores for each tree species. Furthermore, seed transects under *A. chaplasha* show that arboreal frugivores discard seeds only a short distance from the parental tree, underscoring the elephant's role as a long-distance disperser. Our data provide unprecedented support for an old notion: megaherbivores may be key dispersers for a broad set of mammal-dispersed fruiting species, and not just fruit inaccessible to smaller frugivores. As such, the elephant may be particularly important for the functional ecology of the disturbed forests it still inhabits across tropical Asia.

P. Sinphithakkul, N. Klangkaew, P. Sanya-thitiseree, M. Giorgi, S. Kumagai, A. Poapolathep & S. Poapolathep

Pharmacokinetics of amoxicillin trihydrate in male Asian elephants (*Elephas maximus*) following intramuscular administration

Journal of Veterinary Pharmacology and Therapeutics 39 (2016) 287-291

Abstract. The purpose of this study was to investigate the pharmacokinetic characteristics of amoxicillin (AMX) trihydrate in male Asian elephants, *Elephas maximus*, following intramuscular administration at two dosages of 5.5 and 11 mg/kg body weight (b.w.). Blood samples were collected from 0.5 up to 72 h. The concentration of AMX in elephant plasma was measured using liquid chromatography electrospray ionization mass spectrometry. AMX was measurable up to 24 h after administration at two dosages. Peak plasma concentration (C_{max}) was 1.20 ± 0.39 μg/ml after i.m. administration at a dosage of 5.5 mg/kg b.w., whereas it was 3.40 ± 0.63 μg/ml at a dosage of 11 mg/kg b.w. A noncompartment model was developed to describe the disposition of AMX in Asian elephants. Based on the preliminary findings found in this research, the dosage of 5.5 and 11 mg/kg b.w. produced drug plasma concentrations higher than 0.25 mg/ml for 24 h after i.m. administration. Thereafter, i.m. administration with AMX at a dosage of 5.5 mg/kg b.w. appeared a more suitable dose than 11 mg/kg b.w. However, more studies are needed to determine AMX clinical effectiveness in elephants.

C. Somgird, P. Homkong, S. Sripiboon, J.L. Brown, T.A.E. Stout, B. Colenbrander, S. Mahasawangkul & C. Thitaram

Potential of a gonadotropin-releasing hormone vaccine to suppress musth in captive male Asian elephants (*Elephas maximus*)

Animal Reproduction Science 164 (2016) 111-20

Abstract. Musth in adult bull elephants is a period of increased androgen concentrations ranging from a few weeks to several months. For captive elephant bull management, musth presents a serious challenge because of the aggressive behavior of musth bulls toward people and other elephants. Commercially available GnRH vaccines have been shown to suppress testicular function by interrupting the hypothalamo-pituitary-gonadal (HPG) axis in many species. The aim of this study was to test the efficacy of a GnRH vaccine in elephant bulls for suppressing the HPG axis and mitigating musth-related aggressive behavior. Five adult Asian elephant bulls (22–55 years old) were immunized with a GnRH vaccine starting with an initial injection 2–4 months before the predicted musth period, and followed by three boosters at approximately 4-week intervals. Blood samples were collected twice weekly for hormone and antibody titer analysis. An increase in GnRH antibody titers was observed in all bulls after the second or third booster, and titers remained elevated for 2–3 months after the final booster. Musth was attenuated and shortened in three bulls and postponed completely in two. We conclude that GnRH vaccination is capable of suppressing symptoms of musth in adult bull elephants. With appropriate timing, GnRH vaccination could be used to control or manage musth and aggressive behavior in captive elephant bulls. However, more work is needed to identify an optimal dose, booster interval, and vaccination schedule for complete suppression of testicular steroidogenesis.

C. Somgird, S. Sripiboon, S. Mahasawangkul, K. Boonprasert, J.L. Brown, T.A.E. Stout, B. Colenbrander & C. Thitaram

Differential testosterone response to GnRH-induced LH release before and after musth in adult Asian elephant (*Elephas maximus*) bulls

Theriogenology 85 (2016) 1225-1232

Abstract. Bull elephants exhibit marked increases in testosterone secretion during musth, and studies have shown a heightened sensitivity of the testis to GnRH-stimulated testosterone production in musth compared to nonmusth males. However, activity of the hypothalamo-pituitary-gonadal axis before or soon after musth has not been studied in detail. The aim of this study was to evaluate LH and testosterone responses to GnRH challenge in nine adult Asian elephant (*Elephas maximus*) bulls during three periods relative to musth: premusth, postmusth, and nonmusth. Bulls were administered 80 μg of a GnRH agonist, and blood was collected before and after injection to monitor serum hormone concentrations. The same bulls were injected with saline 2 weeks before each GnRH challenge and monitored using the same blood collection protocol. All bulls responded to GnRH, but not saline, with an increase in LH and testosterone during all three periods. The mean peak LH (1.76 ± 0.19 ng/mL; $P < 0.001$) and testosterone (6.71 ± 1.62 ng/mL; $P = 0.019$) concentrations after GnRH were higher than the respective baselines (0.57 ± 0.07 ng/mL, 3.05 ± 0.60 ng/mL). Although basal- and GnRH-induced LH secretion were similar across the stages, evaluation of the area under the curve in GnRH-treated bulls indicated that the testosterone response was greatest during premusth (2.84 ± 0.76 area units; $P = 0.019$) compared to postmusth (2.02 ± 0.63 area units), and nonmusth (2.01 ± 0.46 area units). This confirms earlier reports that GnRH stimulates LH release and subsequent testosterone production in bull elephants. Furthermore, although the hypothalamo-pituitary-gonadal axis is active throughout the year, the testis appears to be more responsive to LH in terms of testosterone production in the period leading up to musth, compared to the nonmusth and postmusth periods. This heightened sensitivity, perhaps as a result of LH receptor up-regulation, may prime the testis for maximal testosterone production, leading to the physiological and behavioral changes associated with musth.

S.K. Swami, A. Vijay, G. Nagarajan, R. Kaur & M. Srivastava

Molecular characterization of pro-inflammatory cytokines interleukin-1β and interleukin-8 in Asian elephant (*Elephas maximus*)

Animal Biotechnology 27 (2016) 66-76

Abstract. Interleukin (IL)-1β and IL-8 are pro-inflammatory cytokines produced primarily by monocytes and macrophages in response to a variety of microbial and nonmicrobial agents. As yet, no molecular data have been reported for IL-1β and IL-8 of the Asian elephant. In the present study, we have cloned and sequenced the cDNA encoding IL-1β and IL-8 of the Asian elephant. The open reading frame (ORF) of Asian elephant IL-1β is 789 bp in length, encoded a propeptide of 263 amino acid polypeptide. The predicted protein revealed the presence of IL-1 family signature motif and an ICE cut site. Whereas, IL-8 contained 321 bp of open reading frame. Interestingly, the predicted protein sequence of 106 aa, contains an ELR motif immediately upstream of the CQC residues, common in all vertebrate IL-8 molecules. Identity levels of the nucleic acid and deduced amino acid sequences of Asian elephant IL-1β ranged from 68.48 (squirrel monkey) to 98.57% (African elephant), and 57.78 (sheep) to 98.47% (African elephant), respectively, whereas that of IL-8 ranged from 72.9% (human) to 87.8% (African elephant), and 63.2 (human, gorilla, chimpanzee) to 74.5% (African elephant, buffalo), respectively. The phylogenetic analysis based on deduced amino acid sequenced showed that the Asian elephant IL-1β and IL-8 were most closely related to African elephant. Molecular characterization of these two cytokines, IL-1β and IL-8, in Asian elephant provides fundamental information necessary to progress the study of functional immune responses in this animal and gives the potential to use them to manipulate the immune response as recombinant proteins.

V. Thuppil & R.G. Coss

Playback of felid growls mitigates crop-raiding by elephants *Elephas maximus* in southern India

Oryx 50 (2016) 329-335

Abstract. We attempted to deter crop-raiding elephants *Elephas maximus* by using playbacks of threatening vocalizations such as felid growls and human shouts. For this purpose, we tested two sound-playback systems in southern India: a wireless, active infrared beam-triggered system to explore the effects of night-time uncertainty in elephants' assessment of predatory threats, and a passive infrared motion detector-triggered system for closer-range playbacks. Using the first system, we deterred 90% of crop-raiding attempts using tiger *Panthera tigris* growls, 72.7% using leopard *Panthera pardus* growls, and 57.1% using human shouts, with no statistically significant difference among the three sounds. Using the second system, playbacks of tiger and lion *Panthera leo* growls deterred 100 and 83.3% of crop-raiding attempts, respectively, with no statistically reliable difference between the two, although video evidence indicated that elephants were more fearful of tiger growls. Our results indicate that playbacks of threatening sounds can be effective in mitigating human–elephant conflict, particularly in bolstering existing deterrent methods.

V. Vanitha, K. Thiyagesan & N. Baskaran

Prevalence of stereotypies and its possible causes among captive Asian elephants (*Elephas maximus*) in Tamil Nadu, India

Applied Animal Behaviour Science 174 (2016) 137-146

Abstract. Animals in captivity are often confined in small barren enclosures, preventing adequate exercise, and socialization with conspecifics. Captivity is also known for depriving young individuals' association with maternal relatives by weaning away from their mothers' earlier than what their peers experience in free-living populations. Such husbandry practices often lead to various welfare problems among captive animals. In India, Asian elephants are managed in captivity under various systems, for various purposes. To understand the effect of husbandry practices on the welfare of elephants, this study first time from a range country examined the prevalence of stereotypies and its possible causes among 144 captive Asian elephants managed under three captive systems—Private, Hindu Temple and Forest Department—in southern India. Occurrence of stereotypies and its possible influences by factors like age, sex, housing type

and its size, duration of chaining and access to conspecific socialization were obtained by direct observations on each elephant and from registers maintained at each facility. Among the systems, the number of elephants with stereotypies was the highest in temple system (49%) followed by private (25%) and the lowest in the forest department (7%). None of the elephants that born in or brought from the wild and managed only at the timber camps was stereotyped. But those transferred from the timber camps to the temple, private and zoo and from the zoo to the timber camps showed stereotypies. Consistent with the prevalence of stereotypies among the three systems, number of elephants managed only at the indoor enclosure and duration of chaining were the highest in temple followed by private and the least in forest department system. The proportion of elephants displaying stereotypies and the proportion of time spent on stereotypies decreased significantly with age, indicating a greater vulnerability of young individuals to stereotypies. Further, logistic regression on prevalence of stereotypies with demographic and welfare parameters revealed that stereotypies decreased significantly with age and free access to conspecific association until juvenile stage, indicating again the juveniles without conspecific association are more susceptible to develop stereotypies. Multiple regression on extent of stereotypies and various daily routines revealed that the extent increased significantly with daily rituals, resting, and marginally with feeding implying that prolonged daily rituals and resting promote its extent. It is argued that deprivation of association with maternal relatives and isolation from conspecifics result in the appearance of stereotypies among elephants in captivity, with younger individuals being more susceptible, perhaps the most active phase of their life being confined by chaining.

Collared female “Dushya” in Yala (Sri Lanka)

R. Vézina-Audette, C. Herry, P. Burns, M. Frasch, E. Chave & C. Theoret

Heart rate variability in relation to stress in the Asian elephant (*Elephas maximus*)

Canadian Veterinary Journal 57 (2016) 289-292

Abstract. This study describes a safe, reliable, and accessible means to measure heart rate (HR) and HR variability (HRV) and evaluates the use of HRV as a physiological correlate of stress in the Asian elephant. A probabilistic model indicates that HRV measurements may adequately distinguish between stressed and non-stressed elephants.

S. Wilson, T.E. Davies, N. Hazarika & A. Zimmermann

Understanding spatial and temporal patterns of human–elephant conflict in Assam, India

Oryx 49 (2015) 140-149

Abstract. Large-scale forest encroachment in Assam, India, has led to increasing levels of human–elephant conflict. Conflict mitigation is a priority for the survival of Asian elephants *Elephas maximus* throughout Asia. We analysed a 3-year dataset of elephant occurrence and related instances of human–elephant conflict, from two sites in Assam, and explored the relationships between the various effects of elephants on human communities and factors influencing the spatial and temporal occurrence of these effects (proximity to water, refuge areas and villages, and human and crop density). The landscapes at both study sites have been transformed by forest loss, with large areas converted to agriculture. Remaining forest patches, which are mostly small, disconnected and degraded, as well as tea plantations, provide refuge areas for elephants as they move through the region. We found that crop depredation and property damage caused by elephants showed well-defined seasonal trends. They also showed a clear diurnal pattern, mostly occurring between 18:00 and 22:00. Small communities within 700 m of a refuge were most affected. In the management of human–elephant

conflict in Assam we need to consider the refuge patches used by elephants as they move through the region, the peripheries of which are likely to be conflict hotspots. Small villages on the edges of refuges should be a priority for conflict mitigation assistance, with strategies taking into account seasonal and diurnal variation in elephant behaviour, as well as the socio-economic and cultural composition of communities. © 2013 Fauna & Flora International.

Y. Yakubu, B.L. Ong, Z. Zakaria, L. Hassan, A.R. Mutalib, Y.F. Ngeow, K. Verasahib & M.F.A.A. Razak

Evidence and potential risk factors of tuberculosis among captive Asian elephants and wildlife staff in Peninsular Malaysia

Preventive Veterinary Med. 125 (2016) 147-153

Abstract. Elephant tuberculosis (TB) caused by *Mycobacterium tuberculosis* is an important re-emerging zoonosis with considerable conservation and public health risk. We conducted prospective cohort and cross-sectional studies in elephants and wildlife staff respectively in order to identify potential risk factors associated with TB in captive Asian elephants and their handlers in Peninsular Malaysia. Sixty elephants in six different facilities were screened for TB longitudinally using the ElephantTB STAT-PAK and DPP VetTB assays from February 2012 to May 2014, and 149 wildlife staff were examined for tuberculosis infection using the QuantiFERON-TB Gold In-tube (QFT) assay from January to April, 2012. Information on potential risk factors associated with infection in both elephants and staff were collected using questionnaires and facility records. The overall seroprevalence of TB amongst the elephants was 23.3% (95% CI: 13.8–36.3) and the risk of seroconversion was significantly higher among elephants with assigned mahouts [p = 0.022, OR = 4.9 (95% CI: 1.3–18.2)]. The percentage of QFT responders among wildlife staff was 24.8% (95% CI: 18.3–32.7) and the risk of infection was observed to be significantly associated with being a zoo employee [p = 0.018, OR = 2.7 (95% CI: 1.2–6.3)] or elephant handler [p = 0.035, OR = 4.1 (95% CI: 1.1–15.5)]. These findings revealed a potential risk of TB infection in captive elephants and handlers in Malaysia, and emphasize the need for TB screening of newly acquired elephants, isolating sero-positive elephants and performing further diagnostic tests to determine their infection status, and screening elephant handlers for TB, pre- and post-employment. © 2016 Reprinted with permission from Elsevier.

S. Ziegler, S. Merker, B. Streit, M. Boner & D.E. Jacob

Towards understanding isotope variability in elephant ivory to establish isotopic profiling and source-area determination

Biological Conservation 197 (2016) 154-163

Abstract. We present here new isotopic data ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$, $\delta^{2}H$, and $\delta^{34}S$) from pulverised ivory powder, measured by continuous flow isotope ratio mass spectrometry from an unprecedented large dataset of 507 ivory samples, derived from 28 African and six Asian elephant range states. The aim of this study is to assess the accuracy of isotopic fingerprinting and to evaluate its forensic potential and limitations to predict the provenance of ivory of unknown origin. We constructed a nominal assignment framework for the African reference samples, consisting of 208 different sites and applied the weighted k-Nearest Neighbor Classifier with reference site as classifier and inferred the accuracy of the assignments of samples from the African elephant species to their correct provenance. Our results show that isotopic profiling of African elephant ivory works on regional scales and we were able to assign 50% of all samples within 381 km, and the majority of the remaining samples within 1154 km. Source area determination is hampered by the fact that within-site and within-individual variation in ivory is immense because elephants as ecological generalists use a wide diversity of plant resources. We propose that forest elephant diets differ more between individuals (i.e. dietary niche partitioning is more significant) than in savanna elephants where individual diets overlap more. Increasing sampling effort in order to decrease median distance of the nominal assignment framework and to better understand within-site variance of the studied isotopic systems are imperative to establish isotopic profiling in the context of law enforcement and wildlife forensics. © 2016 Elsevier.

News Briefs

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1. Rampaging elephants force Myanmar villagers into tree-top refuges

Agence France-Presse - 16.1.2016

Pushed from their forest home by encroaching farm land, wild elephants are driving fearful villagers in a Myanmar township to seek refuge in tree houses while the animals storm their rice paddies looking for food. The elephants have trampled crops, destroyed homes and even, villagers say, killed people in their path – forcing families in Kyat Chuang to build new shelters made of wood and bamboo on higher ground.

Spurred by the loss of their forest habitats, the elephants, and villagers they have been terrorising, are some of the casualties of Myanmar's alarming rate of deforestation. The country lost almost 20% of its forest cover between 1990 and 2010. Myanmar's population of wild Asian elephants is thought to be one of the largest in the region.

But the endangered species is increasingly threatened by habitat loss, a thirst for ivory, and traffickers who smuggle the animals into Thailand for the tourist industry.

2. Rare Cambodian elephant footage raises survival hopes

Agence France-Presse - 15.1.2016

Rare footage of an elephant herd roaming through Cambodia's biggest forest sanctuary signals the success of a 14-year conservation programme and raises hopes for the endangered species' survival. The camera trap footage, taken in the spectacular and remote Cardamom Mountains, shows 12 elephants, including young, grazing and lumbering through the forest.

"That several young are here indicates that the elephants are reproducing, which we think is a good sign that their environment is stable and they are not under stress," said David Emmett, CI senior vice president. Emmett said the footage was the first time so many elephants had been captured on film in the Cardamoms, which is home to about one third of Cambodia's endangered and rare species.

The Cambodian government established the Central Cardamom Protected Forest in 2002, covering roughly 400,000 hectares of pristine land in the remote southwest of the country. The conservation efforts in the Cardamoms have been regarded as a success.

There are believed to only be about 200-250 elephants in the Cardamoms, with another population of similar size in eastern Cambodia. However these are still some of the largest remaining wild populations for the endangered Asian elephant.

3. Sri Lanka destroys illegal elephant tusks

The New York Times - 26.1.2016

A group of saffron-robed monks chanted as officials crushed more than 300 elephant tusks in a seaside ceremony on Tuesday, as the new government of President Maithripala Sirisena sought to differentiate itself from its predecessor by sending a powerful message of intolerance for elephant poaching.

Sri Lanka is the first South Asian nation to publicly destroy ivory obtained through elephant poaching and the 16th country in the world to destroy confiscated elephant tusks so that they cannot be traded in the black market.

The crushed ivory weighed 1.5 tons, far less than some caches that have been destroyed. But the action was significant because Sri Lanka is a transit hub for trading in illegal ivory, which is popular in Asia as a symbol of prosperity and for use in Buddhist religious ceremonies.

The ceremonial crushing of the 359 tusks began with two minutes of silence. After the ceremony, the crushed ivory was transported to a factory in Puttalam, a district in the island's northwest, for incineration. DNA testing found that the tusks had originated in Tanzania, and the stockpile was valued at $2.6 million.

The tusks were confiscated by Sri Lankan customs officials in May 2012, en route to Dubai, in the United Arab Emirates, from Kenya. Some of the world's leading wildlife advocates attended the event, held at Galle Face Green, a large seaside park in Colombo, the Sri Lankan capital. Sri Lanka has been a party to Cites since 1979.

4. Cellphone alert shield against elephant attacks (India)

Times of India - 20.1.2016

A simple cellphone-based warning system can reduce loss of lives and crops in human-elephant conflicts zones like those in Sindhudurg and Kolhapur districts. Wildlife scientist Ananda Kumar described the work done by his Nature Conservation Foundation in devising solutions to end human-elephant conflicts through a simple crowd-sourcing based information system that gives alerts of exact location of elephant sightings to its subscribers.

The system, developed by Kumar and his team after extensive research on elephant behaviour and patterns, has managed to bring down annual fatalities to one, against the average of three deaths prior to launching the system in the tea and coffee plantations of Valparai plateau. We worked on ways that allow both to live with each other. There are no problem animals, but problem locations. During our research, we spotted a pattern in the fatal cases - of the 42 people who died in direct conflict with elephants between 2002 and 2015, 37 did not know there are elephants near them and bumped into them accidently. Besides, 72% of all conflicts happened on the roads and late in the evenings or at night.

5. Teenager killed taking selfies with elephant (India)

Gulf News - 23.1.2016

A teenager in Bihar lost his life while taking selfies with a bull elephant. The incident took place at Pandubbi village in Araria district, an eastern Bihar district bordering Nepal.

Reports said a large crowd of villagers had gathered at the village on Thursday after being informed that a wild elephant had sneaked into a maize field from Nepal. While villagers armed with traditional weapons tried to put a security ring around the field from afar to stop the tusker moving forward, Mithun Paswan, 15, along with two friends went close to the tusker in a bid to take selfies with it.

Seeing the youth furiously clicking with their mobile cameras, the elephant chased them. While his friends fled, Paswan stayed for a while trying to get better snaps and got caught by the elephant who wrapped him in its trunk. Witnesses said soon after catching the teenager, the tusker hit the boy hard on the ground several times, leaving him badly wounded. He was instantly rushed to a local primary health centre, but doctors declared him dead on arrival.

The local district administration has granted a compensation of Rs 20,000 (Dh 1085) to the victim's family and has also rushed a team of forest department officials to trap the tusker which still remains at large.

6. Unemployed, Myanmar's elephants grow antsy, and heavier

The New York Times - 30.1.2016

Dragging giant tree trunks up and down the steep hillsides of sweltering jungles is a tough job. But there is something worse, say owners

of Myanmar's logging elephants: having no job at all. Shrinking forests and a law enacted three years ago that prohibits the export of raw timber have saddled Myanmar with an elephant unemployment crisis. Hundreds of elephants have been thrown out of work, and many are not handling it well.

Elephants hold an almost mystical place in Myanmar, home to the world's largest captive elephant population. For hundreds of years, they helped extract precious teak and hardwoods from jungles that even modern machinery still cannot penetrate. Now the future of the 5500 or so wrinkled pachyderms in captivity is a major preoccupation for the government officials who oversee them.

Myanmar's leading elephant expert, Daw Khyne U Mar, estimates that there are now 2500 jobless elephants, many of them here in the jungles of eastern Myanmar, about 2.5 hours from the Thai border. That number would put the elephant unemployment rate at around 40%, compared with about 4% for Myanmar's people.

7. Wild elephant wanders onto Chinese tourist road, damages dozen cars

CRIenglish.com - 12.2.2016

A wild Asian elephant wandered onto a crowded tourist road in southwest China's Yunnan Province and damaged more than a dozen parked cars. The elephant, named "Zhusunya", left the Yexianggu (Wild Elephant Valley) scenic area in Xishuangbanna Dai Autonomous Prefecture and walked onto a major road around 4 p.m. Friday.

During its 20 minutes stay on the road, the elephant playfully ran into and trampled tourists' cars, damaging or denting 15 parked cars. Zhusunya then disappeared into the scenic area looking for food. Local policemen and scenic spot staff warned people away from the site and closed nearby roads to ensure safety and traffic after the elephant strayed onto the road.

Staff with the scenic area said wild elephants have been active since the prefecture entered its dry season. During the week-long Spring Festival holiday, tourists have seen wild elephants wandering in the area everyday. Zhusunya, a female elephant, is in heat and has had an erratic temperament recently, staff said. The scenic spot has reserved special passageways for elephant on nearby roads and arranged park staff to protect the passages. Staff said it is a rare occurrence for an elephant to deviate from the elephant trails and enter the main road.

8. Elephant tail hair sold as good luck charm to tourists in Vietnam

Tuoi Tre News - 17.2.2016

Several employees and mahouts of a tourist area in the Central Highlands province of Dak Lak have been cutting the hair off elephants' tails in order to sell it as lucky charms. It is a common situation at Buon Don Tourism Area in Dak Lak, as visitors have been offered the tail hair by several staffers. An investigation by Tuoi Tre (Youth) newspaper on February 12 and 13 revealed that many tourists were solicited by tour guides during their rides on the animals. As soon as the deal was made, the guides would ask the mahouts to cut hair from the elephants and sell it to the buyers as lucky charms.

Several souvenir stores at the facility were also selling black strings, about 20 cm in length and 2 mm in diameter, purported to be elephant tail hair, with one location even offering a whole tail for buyers to select hair from. "This tail was cut off from a dead elephant, so I can assure you that the product is real. After buying the hair, you can ask your jeweler to add it to your gold or silver rings to make them good luck charms," one of the shopkeepers said in promoting his goods. Those who questioned the authenticity of the hair opted to contact their tour guides and quickly received their response.

The mahouts were then asked to bring the elephants toward to the tourists so they picked their preferred hair as well as preparing a large nail clipper to remove the hair from the elephants once the buyers had made their decision. Over ten strings of hair were cut off from one elephant,

whose lengths were between 10 and 15 cm, and within five to ten minutes sold for VND 300,000 (US$13.41). About ten elephants are raised in the tourist area to serve as pleasure rides for visitors, and whose tail hair is all removed, according to the Tuoi Tre reporters. Two men are seen cutting the hair off an elephant's tail.

In response to the Tuoi Tre findings, the director said that he would carry out an inspection on his employees. "Our policy is to prohibit employees from selling the elephant hair. Several individuals have decided to do it to earn some extra money," Chinh explained.

The hair of elephants' tails is believed to be a good luck charm, especially in romantic relationships, following a legend that forms part of the culture of Vietnam's Central Highlands.

9. Sumatran elephant found with leg severed by rope

The Asian Age - 19.2.2016

A Sumatran elephant calf lies stricken in the jungle in Indonesia as conservationists fight to remove a rope tightly wound around its leg that almost caused the critically endangered animal to lose a limb. The youngster was spotted with another calf and their mother in a wildlife sanctuary in Bengkalis, Riau province, with their legs entangled in ropes that are believed to have come from traps set by locals, according to the Indonesian Mahout Association.

The calf lies on its side in the mud, as a rescuer holds an intravenous drip that is attached to the creature, during the operation to remove the tightly wound cord. His leg was saved but the other two elephants were not so lucky the mother lost her tail and the other calf lost a leg, according to the association, which believes the elephants were entangled for several months.

After being alerted by a group of trekkers who posted pictures on social media, local conservationists tracked down the elephants and carefully removed the ropes from their legs and treated their wounds. The operation took a week due to a lack of decent equipment and ended Friday, with all the ropes removed and the pachyderms left in the wild, according to mahout association chairman Nazaruddin.

10. Meet the people determined to save the elephants of Laos

The Telegraph - 20.2.2016

The elephant urinated in a fire-hose gush and his mahout cheered. 'See?' he said in Lao, pointing at the torrent of water darkening the red-earth road. 'It's clear!' The relief was infectious. Walking behind the elephant, Anabel Lopez, a 28-year-old conservation biologist from Madrid, grinned and gave a thumbs up. For three days, Lopez explained, the elephant had been producing red urine and the worry was that he was peeing blood – possibly the sign of a life-threatening illness.

'On the other hand,' she said, 'we put the elephant in the forest and he ate green papaya, which makes elephants pee red. We hoped it was that but we weren't sure.' Now their minds had been put at rest and the mood lightened. 'It's nice to become obsessed together and happy together,' said Lopez as we swung down the red road, part of a caravan of 12 elephants and their 60-plus human followers travelling hundreds of miles across the forested hills of landlocked Laos.

The jungle that surrounded us forms the dense green heart of Indo-China. A thousand years ago it was said to be inhabited by a million elephants, and in the 14th century this trope of plenty became the name of the first Lao kingdom: Lan Xang, Land of a Million Elephants. The idea of the elephant remains integral to the Lao people's sense of national identity: a triple-headed white elephant featured on the flag of the modern Kingdom of Laos (which ended when the Communists established the Lao People's Democratic Republic in 1975); and tourist handicrafts sold in the night markets of Luang Prabang and the capital city, Vientiane, are covered in elephant motifs.

Ninety per cent of captive elephants work in logging (thereby destroying the very habitat

they need to survive), while the rest give rides in tourist camps. Birth rates of both wild and domesticated populations have plummeted in recent decades. 'The situation in Laos is critical, not sustainable,' Lopez told me as we walked in the wake of our shambling giants. 'If we don't change things, the elephants will disappear.' Hence the Elephant Caravan, a call to action backed by regional, national and international agencies, which trumpeted through the jungles of Laos for six weeks in late 2015.

11. Road project will split jumbos, say experts (Malaysia)

The Star - 2.3.2016

Isolated Bornean elephant populations in the east coast Lower Kinabatangan will be further fragmented should a road and a bridge be built there, said a wildlife researcher. Director of Danau Girang field centre in Lower Kinabatangan Dr Benoit Goosens said the proposed project would split elephant herds in Sukau with those in Lokan and Tangkulap. Elephants, he said, would not move under a bridge or a major trunk road as evident from the construction of a bridge across the Sungai Segama in the 1980s. That bridge, he said, effectively isolated elephant populations between Batu Putih and Abai.

"Elephants will not go under the bridge due to the noise and vibration caused by passing trucks and cars and it's dangerous for them when crossing roads," said Dr Goosens, whose centre works with the Sabah Wildlife Department. State Tourism, Culture and Environment Minister Datuk Masidi Manjun had said on Monday that the Public Works Department was working out an alternative plan for the proposed bridge near Kampung Sukau. The state Cabinet, he said, had discussed the issue of the proposed bridge following concerns over wildlife conservation in Lot 3 of the Kinabatangan Wildlife Sanctuary.

Conservationists have said that the project would also create repercussions on the movements of elephants in the area where a reforestation programme under Project Relief is being carried out jointly by Nestle and Sime Darby Foundation.

12. 20 tuskers infected with tuberculosis (Nepal)

The Himalayan Times - 26.2.2016

As many as 20 elephants in national parks and wildlife reserves across the country are said to be suffering from tuberculosis. Doctor Kamal Gaire, a veterinarian at the Chitwan National Park, said of the total 220 elephants across the country, 20 are under medication for tuberculosis. The government started providing treatment to the tuskers after TB was first detected in elephants in 2005. "Though there is no record on how many elephants have died of tuberculosis, as many as six elephants died after they were found suffering from the disease," said Gaire.

According to him, the disease was detected in around 23 per cent of the total elephants across the country then. The elephants were put on medication as part of tuberculosis alleviation project, which was launched with financial assistance from Elephant Care International. "As there is no vaccination for the disease, the disease is growing among tuskers," said Gaire. The tuskers detected with the disease are given medicines for over a year. Chief conservation officer at Chitwan National Park, Ram Chandra Kandel, said elephants contracting the disease were kept under close surveillance. The disease attacks weak and old elephants, he said.

13. Alarm over elephant inbreeding (Borneo)

The Star Online - 25.2.2016

Poor connectivity between Sabah's forests may put the future of its Bornean elephant population in jeopardy. Experts believe that the state's 2,500 Bornean elephants were at risk of inbreeding in fragmented areas of its jungles as they are unable to meet elephants from other parts to mate and strengthen their gene pool. This was the main conclusion of a paper published online yesterday in the scientific journal Biological Conservation by a team of scientists.

Over the years, the clearing of land for development and the opening up of plantations have left

many forests fragmented, making it difficult for wildlife to roam without coming in conflict with humans. The study said inbreeding could occur in the future among the elephants in forested areas of Lower Kinabatangan, Upper Kinabatangan and Central Sabah if these areas are not connected.

Dr. Goosens, the lead author of the study said their teams spent several months collecting dung samples from all elephant ranges in Sabah and then analysing their DNA to provide an insight into their genetic diversity and determine the degree of population fragmentation and isolation of the existing herds.

14. Clear evidence of rise in elephant poaching (India)

Business Standard - 3.3.2016

There has been an increase in the poaching of elephants in the last few years, a wildlife body today claimed while asking people to not use products made out of the endangered species. On the occasion of World Wildlife Day, the theme of which this year is 'The Future of Elephants is in Our Hands', TRAFFIC India also said that some of the illegal ivory entering the markets could be from privately owned or "captive" elephants, which is also illegal.

"The current poaching hotspots are the similar to what they were about two decades ago, in the elephant-rich habitat of Western Ghats, spanning the states of Karnataka, Tamil Nadu and Kerala, as well as in Odisha and Assam. There is clear evidence of increase in poaching of elephants in the last few years," said Shekhar Kumar Niraj, Head of TRAFFIC India. The wildlife body said the endangered pachyderms are facing the threat of extinction in the wild in many countries, including India, with poaching for illegal trade being one of the "major drivers of its decline".

"Today, on the occasion of World Wildlife Day, we released a poster urging people to pledge never to use any parts made of elephants," the wildlife body said. It said the Asian elephant was once widely distributed across the country, including in states like Punjab and Gujarat. Currently, they are found only in 14 states, in four fragmented populations, in south, north, central and north-east India. The elephant has been accorded the highest possible protection under the Indian wildlife law through its listing under Schedule I of the Wildlife (Protection) Act, 1972, of India.

15. Malaysia's wild elephants need help

Clean Malaysia - 5.3.2016

A disturbing phenomenon has puzzled and alarmed conservationists: Wee little elephant calves are frequently found wandering abandoned and alone, without their mothers and herds. Over the past three years a total of 15 abandoned calves have been discovered near villages on the fringes of Sabah's forests or inside palm oil plantations. Every single one of the calves was too young to be able to fend for itself.

To make matters worse, the number of orphaned little jumbos has been increasing steadily, according to wildlife officials in the state. In 2013, two baby elephants needed to be rescued. The following year the number rose to three. Then last year officials in Sabah had to save a record eight infant pachyderms. And that was hardly the end of it. This February alone, Sabah's Wildlife Department needed to rescue another two baby elephants.

"I am extremely concerned about what is happening to our elephants in the wild," said William Baya, director of the Sabah Wildlife Department's Wildlife Rescue Unit. "For the past three years we have rescued 15 baby elephants, all below one year old." We should all be concerned – and not just because we care about orphaned infants. An estimated 2500 endemic Bornean pygmy elephants remain, and albeit that population may seem sufficient, it isn't. That's because Malaysia's pygmy elephants are facing a dangerous genetic bottleneck with the gene pool of the animals having shrunk at an alarming rate. This exposes wild elephants to increased risks of inbreeding and the attendant health problems.

The reason: habitat loss and forest fragmentation. As the various herds of the animals are becoming

disconnected from one another through fragmentation of their natural habitats, the chances of individuals to meet and mate with elephants from other herds are significantly reduced. That places the long-term genetic viability of this entire subspecies at risk in Sabah, according to a newly published paper. Intensive forest clearing for land development and palm oil plantations, the article explains, has driven elephant populations into dwindling habitats in Lower Kinabatangan, Upper Kinabatangan and Central Sabah, while cutting herds further off from each other. If these forested areas become entirely disconnected, their resident elephant herds will be at even greater risk of inbreeding.

16. Survey to determine elephant population (Bhutan)

Kuensel - 10.3.2016

Asian elephants, the wild giants people revere and forebode as well have long been misery for the farmers south of the country. Yet we do not know how many of them are there in the wild. Pinning down on number is essential, not only for the formulation of conservation policies, but also to help farmers protect their crops from the marauding quadrupeds.

Good news is the Department of Parks and Services launched first nationwide elephant survey on March 3 at Singye in Sarpang to mark World Wildlife Day. While International Union for Conservation of Nature estimates that there are about 200-500 elephants in Bhutan, the country lacks its precise population figure. Thus, the survey will help determine the population of elephants in Bhutan.

Park manager of the Royal Manas National Park (RMNP), Tenzin Wangchuk said as of there is no authentic figure on elephant population in Bhutan. "The main objective of the survey is to determine elephant population in Bhutan," Tenzin Wangchuk said. Forestry officials will survey the southern belt from Samtse in the southwest to Jomotsangkha in the southeast, through the protected areas such as RMNP, Phibsoo and Jomotsangkha Wildlife Sanctuaries.

17. Endangered elephant sent back to forest in southern Vietnam

Thanh Nien News - 5.4.2016

Forest rangers in the southern province of Dong Nai on Tuesday managed to bring a straying elephant back to the forest after finding it near local homes. The male adult elephant belongs to the endangered Asian elephant species. In Vietnam it has a 'critically endangered' status. "He has recently shown up around the area for a week now," an officer of the local nature conservation zone told VnExpress. "He is very friendly to humans... He's never destroyed anything." The elephant was transported during the night to minimize human contacts and released to the wild.

18. Plastic waste turns fatal for wild elephants (India)

The New Indian Express - 20.3.2016

The plastic waste littered in forest areas by tourists is taking a toll on the health of wild elephants in the State, with jumbos ingesting the non-biodegradable waste along with food. If the recent incidents are any indication, the 'plastic-free tourism' campaign conducted by various agencies over the past few years, is yet to yield the desired results.

In the latest such case, Forest Department officials recovered 50 plastic carry bags, cigarette lighter and polythene cover of packed food items from the digestive tract of an elephant that was found dead in the Kuttampuzha Range, under the Malayattoor Forest Division, recently. "The 50-year-old female elephant died of constipation, which was caused by accumulation of the plastic items in its intestine," said Kuttampuzha Forest Range officer T S Mathew, adding that the elephant was suspected to have fed on plastic waste dumped by tourists visiting the fringe areas of forest.

Veterinary experts said eating plastic waste would cause fatal damage to the body of wild animals as the waste materials block their digestive tract,

causing death due to constipation. "With the tourist inflow increasing considerably in recent years, the Forest Department has been keeping a tab on the tourists and penalising those who litter waste in forest areas. "There are provisions in the Wildlife Protection Act to charge case against such violators," said officials, adding that more stringent measures were needed to tackle the menace.

19. Thirsty elephants looking for new water sources (Thailand)

The Sunday Nation - 3.4.2016

A herd of wild elephants from Kaeng Krachan National Park has been spotted looking for water at Pa La Oo forest in Prachuap Khiri Khan's Hua Hin district, in the wake of a severe drought in the area. A helicopter survey on the park's inner forest area three days earlier had found all the creeks dried up, while small water sources in Pa La Oo and the nearby Pa Deng forest were drastically lower.

Despite the authority's operation the following day to re-fill water sources in the national park with 100,000 litres of water, between 20 and 40 elephants from the park's inner area have been seeking water at Pa La Oo and Pa Deng every evening. This prompted park chief Kamon Nuanyai to instruct officials to monitor the herd in a bid to prevent them straying into nearby farmlands, while soldiers from the 9th Infantry Division have been refilling park water sources.

20. Elephant herd rejects baby rescued in central Vietnam

Thanh Nien News - 13.4.2016

Conservationists in the Central Highlands province of Dak Lak are continuing to try and reintroduce a baby elephant they rescued from a well back to its herd despite several failed attempts. Pham Van Lang, deputy director of the Dak Lak Elephant Conservation Center, told Zing News that the two-month old calf remains at the center as they were seeking more advice from experts and higher authorities.

On March 28 the male baby was rescued after it felt into a five-meter deep well, possibly while looking for water. Local officials believe it belongs to a herd of more than 10 elephants that were heading for a nearby lake for water. "The center's staff feed him 1.5 liters of milk every two hours. At night he only sleeps if they caressed him," Lang said. Once the staff followed the herd and left the calf in its vicinity, but animals did not take him in.

Recently a group including some foreign conservationists attempted to reintroduce him to the herd but his mother still rejected him. "Maybe his mother rejected him because he carries odors because of contact with humans," Lang said. The baby belongs to one of the last few remaining herds in Dak Lak, which is home to the largest wild elephant population in Vietnam with about 60 individuals. The number of wild elephants in Vietnam has fallen from 2,000 in the 1980s to less than 100 now, mostly due to poaching and habitat loss.

21. Heat stroke kills elephant calf at Ghatshila Forest (India)

The Avenue Mail - 21.4.2016

The searing heat wave prevalent in Kolhan division took claimed the life of an elephant on Thursday. Heat stroke killed an elephant calf at the Ghatshila forest range. Carcass of the one-and-a-half-month old calf (male) was found near a hillock inside the Chekam jungle in Ghatshila forest range. Ghatshila range officer Sushil Verma said that after examination of calf they concluded that the elephant calf died of heat stroke. They found no external injury. It seems that the calf was part of a herd, which left him behind after the death. The victim was an elephant calf which died due to heat stroke. It's extremely hot in the Ghatshila forest range.

22. Lightning kills tuskers (Sri Lanka)

Agence France Presse - 9.5.2016

Four elephants, including two calves, were killed by lightning in northern Sri Lanka in one of the

worst wildlife tragedies to hit the country in years, officials said Sunday. A female elephant, aged about 25 years, and two of her calves, aged 10 months and two years, and an eight-year-old female were found dead Sunday just outside the Wilpattu wildlife sanctuary, an official said. "Villagers from neighbouring areas alerted the authorities and we carried out autopsies," wildlife surgeon Chandana Jayasinghe said.

23. Wild elephant kills 1, injures 1 in Yunnan (China)

China.org.cn - 7.6.2016

A wild Asian elephant killed a villager and injured another in southwest China's Yunnan Province, local authorities said Tuesday. Li Yunshan, a resident of Tuanjie Village, Pu'er City, was attacked by a wild Asian elephant while picking up mushrooms in a mountain forest alongside his wife Lin Youzhi, Li's son Li Shaoyi reported to the local government at around 2 p.m. Monday. The senior Li was killed instantly, while Lin suffered injuries to her face.

The site of the accident has been cordoned off, and authorities have warned local residents to stay alert. Wild Asian elephants are under state protection in China, with about 300 living mainly in Yunnan Province. Enhanced protection for wild animals has seen the mammals' number rise in recent years, but cases of clashes with humans have also increased, according to the local government. Last month, wild Asian elephants killed two villagers in Yunnan's Xishuangbanna Dai Autonomous Prefecture.

24. Jumbos on rampage at Morawewa Hospital (Sri Lanka)

Daily News - 15.6.2016

A herd of wild elephants raided the Morawewa Hospital in the wee hours on June 13 and caused heavy damages to its door and windows. Hospital MoH Dr. G. Paul Roshan in a complaint to Morawewa Police, said 11 windows and three doors were broken by the marauding elephants before the animals retreated.

A police team deployed by OIC Chief Inspector H.P.N. Kulatunga rushed to the hospital and took steps to remove valuable medical equipment, electrical items and drugs found in the rooms with damaged windows and doors to a safer place. Police also reported the incident to the wildlife office in Trincomalee. Morawewa Police are investigating.

25. Only 150 Sumatran elephants remain in Jambi (Indonesia)

Antara News - 15.4.2016

The population of wild Sumatran elephants in Jambi has plunged to only 150, according to a survey of the Jambi Natural Resources Conservation Office (BKSDA). The population might further decrease due to the rampant poaching of elephants for ivory in Jambi, Syahimin, the Jambi BKSDA chief, stated here, Thursday. The average life expectancy of Sumatran elephants is some 60 years.

Since 2013, seven elephant poaching cases have come to light, but only one case was successfully solved, and the poachers were detained. One elephant was recently found dead with its ivory missing in Tebo District, Jambi Province. In connection with the case, two people were arrested, while three others are still at large.

26. Nepal fence to keep elephants away may escalate into political row

Hindustan Times - 13.6.2016

A battery-operated fence erected by Nepal along the border to keep elephants from India away is set to snowball into a controversy with the West Bengal government writing to the Centre to raise the issue with the neighbouring country. Nepal erected the 18-km-long energised fence near the bank of Mechi river that divides the two countries with aid from international funding agencies six months ago.

West Bengal forest minister Binay Krishna Barman, who held a high-level meeting with state forest officials in Sukna in Darjeeling on

Saturday, raised objection over the fence along the international border by Nepal. Barman said the fencing blocks the natural movement of the elephants. "The state government has already written a letter to the Centre to take up the matter with the Nepal government," Barman said.

Every year hundreds of elephants migrate from the forests of Assam and West Bengal into Nepal through the Indo-Nepal border and destroy crops in the villages on both sides. The animals follow a traditional corridor to reach places like Bahundangi in eastern Nepal under Jhapa district after crossing forests of Sukna and Panighata in Darjeeling district of West Bengal.

"The elephants' corridor along the Indo-Nepal border has existed for thousands of years. If the movement of the elephants is blocked, it will create a disastrous effect in places like Kolabari and other basties under Kolabari beat of Panighata range," Bose told HT. He added that in the past 15 years, at least 20 elephants have died inside Nepal and more than 50 people have been killed on both the sides of the international border by elephants.

27. Jumbo reaches Teesta shore after 7 hrs (India)

Times of India - 17.6.2016

An elephant, which was half way through crossing the Teesta at Gajoldoba in Jalpaiguri, got stranded in the river as the water level suddenly swelled on Thursday. After being stuck for more than seven hours, the makhna could finally wade its way to the shore and then went inside a nearby forest. The rest of the herd – believed to have come out of the Kathambari forest – had managed to reach the other side into the Saraswatipur forest tract before the water rose.

"The makhna was the last one crossing the river and it got stranded near the Teesta Barrage owing to the rising water," said Bidhan Roy, a resident of the area. Some foresters suspected that the elephants was not only stuck owing to the swelling river but a possible quick sand at the spot could have also made its movement impossible. The forest department spoke to the Teesta Barrage authorities and convinced them to open three lock gates, situated nearby, to help the water recede. The opening of the lock gates did help decrease the water level but initially, it did not seem to help much owing to the continuous flow of water from the upstream.

28. Drones to track jumbos in S Bengal (India)

Times of India - 30.6.2016

The Forest Department is leaving no stone unturned to check man-elephant conflict in south Bengal. It has now decided to make the best use of technology. An unmanned aerial vehicle (UAV) that was procured for the Sunderbans will be sent to Bankura on an immediate basis to track elephants' movement. Confirming the development, chief wildlife warden Pradeep Vyas said: "The drone will be sent to Bankura soon. We are in the process of procuring another drone. At times, we identify the problem elephants, but can't track them by foot inside the forest. Here the drones will come handy."

The Forest Department has also brought five trained 'kunki' elephants from north Bengal to capture two jumbos, which were earlier declared 'rogue' by the department. Vyas said once the foresters get to know the location of the couple of jumbos with the help of the drone, the trained elephants will be pressed into service.

So, how will the drone function? The gadget, fitted with a GPS device and high-resolution camera, can stay in the air for almost 45 minutes each time. "A trial run was earlier held in the Sunderbans. Patrolling staff on the field will get the signals and access images relayed to them through the drone's receptor. Once in use, this will save time as far as wildlife management is concerned," a forester said.

State agency Webel Technology has procured the gadget on behalf of the forest department. An official said that the drone costs approximately Rs 2 lakh and its range is 4-5 km. Vyas said the state would procure four to five more such gadgets for north Bengal too.

Asian Elephant Specialist Group (AsESG)

Asian Elephant Specialist Group Convention

Guwahati, Assam, India
November 10th -12th 2016

Program Committee: Vivek Menon, Alexandra Zimmerman, Prithiviraj Fernando, Anwaruddin Choudhury, Ajay Desai

IUCN Species Survival Commission's Asian Elephant Specialist Group (AsESG) is a network of over 60 likeminded specialists from 16 countries across the globe, concerned with the study, monitoring, management, and conservation of Asian Elephants (*Elephas maximus*) in its range countries. The overall aim of the AsESG is to promote the long-term conservation of Asia's elephants and, where possible, the recovery of their populations to viable levels.

The members of AsESG are convening in November 2016, at the Taj Viavanta, Guwahati, Assam for the AsESG meeting. The convention will bring together all the members to review the current progress and also plan ahead for the way ahead for the AsESG.

Following the meeting, the members can opt from one of two separate post conference tours to Kaziranga National Park on the 13th and 14th of November or Pobitara Wildlife Sanctuary on the 13th of November.

Highlights of what is being planned for the convention are as follows:

- Report from the AsESG Chair
- Reporting of AsESG Working Groups
- Framing of AsESG Policy Statements covering Asian elephant range countries
- Discussion on framing Range Wide Action Plans for Asian elephants
- Status reports of Asian Elephants in the wild and in captivity
- Organizational matters
- Future plans

As a prelude to the meeting, the AsESG members may attend and participate in the *Asian Elephants in the Wild Conference* being hosted by the Balipara Foundation in Guwahati, November 2016. This will also be an opportunity for the AsESG members to present their work and participate in this international conference. More information can be found at <www.baliparafoundation.com>.

Instructions for Contributors

Gajah welcomes articles related to Asian elephants, including their conservation, management, and research, and those of general interest such as cultural or religious associations. Manuscripts may present research findings, opinions, commentaries, anecdotal accounts, reviews etc. but should not be mainly promotional.

All articles will be reviewed by the editorial board of *Gajah*. *Gajah* also has a peer reviewed section. Peer reviewed papers will carry a notation to that effect. Authors are requested to specify that they are submitting their paper to the "**peer reviewed section**". Word limits for submitted articles are for the entire article (title, authors, abstract, text, tables, figure legends, acknowledgements and references).

Correspondence: Readers are encouraged to submit comments, opinions and criticisms of articles published in *Gajah*. Such correspondence should be a maximum of 500 words, and will be edited and published at the discretion of the editorial board.

News and Briefs: Manuscripts on anecdotal accounts and commentaries on any aspect of Asian elephants, information about organizations, and workshop or symposium reports with a maximum of 1000 words are accepted for the "**News and Briefs**" section.

Research papers: Manuscripts reporting original research with a maximum of 5000 words are accepted for the "**Research Article**" section. They should also include an abstract (100 words max.). Shorter manuscipts (2000 words max.) will be published as a "**Short Communication**" (no abstract).

Tables and figures should be kept to a minimum. Legends should be typed separately (not incorporated into the figure). Figures and tables should be numbered consecutively and referred to in the text as (Fig. 2) and (Table 4). The lettering on figures must be large enough to be legible after reduction to final print size. Include tables and line drawings in the MS WORD document you submit. In addition, all figures must be provided as separate files in JPEG or TIFF format.

References should be indicated in the text by the surnames(s) of the author(s) with the year of publication as in this example: (Baskaran & Desai 1996; Rajapaksha *et al*. 2004)
Avoid if possible, citing references which are hard to access (e.g. reports, unpublished theses). Format citations in the 'References' section as in the following examples, writing out journal titles in full.

Baskaran N & Desai AA (1996) Ranging behavior of the Asian elephant (*Elephas maximus*) in the Nilgiri biosphere reserve, South India. *Gajah* **15:** 41-57.

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Sukumar R (1989) *The Asian Elephant: Ecology and Management*. Cambridge University Press, Cambridge, UK.

Manuscripts should be submitted by e-mail to the editor <jenny@aim.uzh.ch>. Submission of an article to *Gajah* is taken to indicate that ethical standards of scientific publication have been followed, including obtaining concurrence of all co-authors. Authors are encouraged to read an article such as: Benos *et al*. (2005) Ethics and scientific publication. *Advances in Physiology Education* **29:** 59-74.

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