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GAJAH

Journal of the Asian Elephant Specialist Group
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The journal is intended as a medium of communication on issues that concern the management and conservation of Asian elephants both in the wild and in captivity. It is a means by which everyone concerned with the Asian elephant (*Elephas maximus*), whether members of the Asian Elephant Specialist Group or not, can communicate their research results, experiences, ideas and perceptions freely, so that the conservation of Asian elephants can benefit. All articles published in *Gajah* reflect the individual views of the authors and not necessarily that of the editorial board or the Asian Elephant Specialist Group.

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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>.

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Cover

Camera trap photo of a wild elephant in Dong Nai, Vietnam
Photo by Dong Nai FPD, Viet Nam
(See articles on page 4 and 45)

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Editorial

Jennifer Pastorini (Editor)

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The 51st issue of *Gajah* includes four research articles and one short communication. Three papers are about human-elephant conflict in India, Vietnam and Sri Lanka. Two publications deal with health issues in captive elephants in India.

Cao Thi Ly and co-authors experimented with different crops in Vietnam. They identified crops that were less consumed by elephants than were traditional crops. Nilanjana Das Chatterjee and Mrinmay Mandal studied the human-elephant conflict in the Panchet Forest Division, West Bengal, India, by doing a habitat analysis and interviewing 1000 residents. T.G.S.L. Prakash and co-authors assessed the overall level of human-elephant conflict in Sri Lanka. They found changes over time in different areas, which were probably related to differences in management actions and developmental activity. In the fourth research article, Yaduraj Khadpekar *et al*. describe how they successfully treated intestinal impaction in a captive elephant in India.

In the Short Communication Vimalraj P. Govindan and co-authors report on the treatment of a chronic purulent temporal adenitis in a captive elephant in India. Regular care was needed for more than five months to finally reduce the swelling.



In News and Briefs Sandeep K. Tiwari and Vivek Menon give a detailed report on the Asian Elephant Specialist Group (AsESG) meeting held in Sabah in December 2019. The meeting was attended by 148 people from all range states and gave a perfect opportunity to exchange ideas and learn about many aspects of elephant conservation. Sandeep K. Tiwari also informs us about the discussions regarding elephants held at the CITES CoP18 in Switzerland in August 2019.

Christian Schiffmann shares first experiences with the newly developed online monitoring tool for body condition scores, which is now widely used in European zoos. Mai Nguyen Thi and Hoa Tran Thi describe the event "Dance for Kindness to Elephants and Wildlife", which took place in November 2019 in Vietnam. An impressive 5000 students participated in the large-scale Freezemob and Flashmob.

This issue of *Gajah* also presents abstracts from 67 scientific publications and glimpses of 23 newspaper articles on Asian elephants.

Vivek Menon, the Chair of the AsESG, tells us in his note about the successful AsESG meeting and elaborates on the progress of all the AsESG working groups. He also attended the SSC Steering Committee Meeting, where the AsESG got awarded the "SSC Chair's Citation of Excellence".

During the AsESG meeting the editorial board had the unique chance to meet up and discuss issues related to *Gajah* (see photo). I am most grateful to all authors for sharing their work with us and providing insights into elephant-related events that took place. Wildlife Reserves Singapore Group generously funded the costs for printing and mailing the hard copies of *Gajah*.

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Notes from the Chair IUCN SSC Asian Elephant Specialist Group

Vivek Menon

Chair's e-mail: vivek@wti.org.in

Dear Members

I hope this finds you well and that you and your family are safe from the COVID19 pandemic that has taken a big toll on humanity and has severely impacted our life.

As many of you are aware, we have had a very successful 10th meeting of the Asian Elephant Specialist Group (AsESG) at Kota Kinabalu, Sabah, Malaysia from 4th to 6th December 2019, which already feels like a lifetime ago (please read the report of this on page 33). Many people and organisations contributed to the successful hosting of the meeting and I have several sets of people to thank. I would like to convey my sincere thanks to the Government of Sabah and Sabah Wildlife Department for jointly hosting the meeting and the hospitality extended to the delegates. I would specially like to thank Datuk Christina Liew, Hon'ble Deputy Chief Minister of Sabah State Government and Minister of Tourism, Culture and Environment for taking keen interest in organising the meeting. I would also like to thank Mr Augustine Tuuga, our own member Dr Sen Nathan and their colleagues from the Sabah Wildlife Department for hosting the meeting and the warm hospitality. Our AsESG members from Sabah, Dr Benoit Goossens, Dr Nurzhafarina Othman and Dr Marc Ancrenaz for all their help and leading few of the technical discussions during the Sabah session. Also a special thank you to all of you who took part and made it the largest meet of our group ever with 148 people, including government representatives from all 13 range countries. I would also like to convey my sincere thanks to our donors; majorly Elephant Family and International Fund for Animal Welfare (IFAW) who were the principal sponsors and Ms Nilanga Jayasinghe for support from WWF (US and International) and Dr Martha Fischer from Saint Louis Zoo.

Based on the outcome of the various working groups formed earlier and the meeting in Sabah, the six working groups that have finalized their outcome documents are being dissolved. All working group documents finalized will be peer reviewed and uploaded on AsESG website and could also be published in Gajah. I would request all the members of the groups that have not completed their outcome document especially the convenors to please focus on getting it done as soon as possible, preferably by June 2020. Based on the recommendations of the AsESG meeting in Sabah, we are forming at least two more working groups: Working group on Borneo elephants and working group for drafting the national action plan for conservation of elephants in Peninsular Malaysia.

The AsESG has successfully submitted the assessment of the Asian elephant (expect subspecies *Elephas maximus sumatranus*) to the Red List Authorities in September 2019. Based on the assessment, we have received few comments from the Red List Authorities including the suggestion to review the document. The same has been completed and the final document will be submitted soon.

AsESG is also working with the governments of Lao PDR and India for the preparation of their National Elephant Conservation Action Plans. The technical committee constituted by Project Elephant, Ministry of Environment, Forest and Climate Change, Government of India to draft the plan includes three AsESG members and had its first meeting on 26th November 2019. This will be followed by regional meetings for further inputs.

I attended the SSC Steering Committee Meeting as well as the SSC Leadership Meeting at Abu Dhabi from 6th to 10th October 2019, where I

spoke and chaired few parallel sessions. Few other AsESG members also participated at the meeting.

I am happy to inform that the AsESG is in the top four among 160 specialist groups and has been awarded the SSC Chair's Citation of Excellence for its outstanding contribution in delivering the species strategic plan for the 2017–2018 period.

We have also been active in promoting the AsESG internationally. The proposal by the Indian Government for listing of *Elephas maximus* in the appendix I of the Convention on Migratory Species (CMS) will be taken up for discussion at the CMS CoP13 meeting. The AsESG assisted the ministry in preparation of the proposal. At the same convention, the AsESG, along with the Ministry of Environment, Forest and Climate Change, Wildlife Institute of India, CMS, IUCN and Wildlife Trust of India, will be organizing a side event to discuss on "Elephant conservation beyond borders" that will have speakers from the Indian Ministry, AsESG, Bhutan and Bangladesh.

The Elephant Reintroduction Foundation, Thailand and AsESG were hosting the Elephant Reintroduction Workshop in Bangkok from 5th to 7th February 2020.

The AsESG has published a paper on "Population status of Asian elephants *Elephas maximus* and key threats" in the International Zoo Yearbook 2019.

I thank you all for sincerely contributing to the research and conservation of the species and helping the AsESG in working towards its overall aim of promoting long-term conservation of the Asian elephant.

Vivek Menon
Chair AsESG, IUCN SSC



Research Article *Gajah 51 (2020) 4-9*

A Pilot Study of Cultivating Non-Preferred Crops to Mitigate Human-Elephant Conflict in the Buffer Zone of Yok Don National Park, Vietnam

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Abstract. We assessed implementing intercropping with annual and perennial non-preferred crops to mitigate human-elephant conflict in the buffer zone of Yok Don National Park. Annual and perennial crops were intercropped in four experimental models in three areas. Eleven households implemented experimental plots. Another 11 plots with traditional crops were selected as controls. The experimental crops did well and were not consumed by elephants but the control plots suffered elephant damage. The income from experimental annual crops was lower than from traditional crops. However, once the perennial crops reach harvesting, the income is expected to be equal to or higher than that obtained by traditional crops, without worries about raiding by elephants. The pilots are being monitored and evaluated for long-term feasibility.

Introduction

Community participation is an important aspect of effective human-elephant conflict (HEC) mitigation (Gunyardi *et al*. 2017). Community-based approaches have been piloted by a number of HEC mitigation projects including the "Elephants and Bees Project" in Kenya (King *et al*. 2017) and community-based crop guarding in Indonesia (Gunaryadi *et al*. 2017). Planting thorny plant species such as agave, cacti and bougainvillea as biological fences has been tried out in Sri Lanka but has proven unsuccessful (Fernando *et al*. 2008). Similarly planting mauritius thorn in African countries has been ineffective (Parker *at al*. 2007). Chilli fences have been constructed by farmers around Mikumi National Park in Tanzania (Chang'a *et al*. 2016). Alternative crops have been tried in African and Asian countries (Parker & Osborn 2006; Gross *et al*. 2016, 2017; Wahed *et al*. 2016).

We propose non-preferred crop cultivation as a method of reducing HEC in the Yok Don National Park buffer zone. We initiated a pilot study to assess its feasibility in January 2018. The objectives of the study were to identify areas with HEC and assess the possibility of intercropping with long- and short-term non-preferred crops, in the buffer zone of Yok Don.

Materials and methods

Study area

Yok Don National Park (YDNP) with a 115,545 ha area, is located in the Dak Lak Province in the Central Highlands of Vietnam. It is bounded in the north by Ea Bung and Cu M'Lan communes of Ea Sup District, in the south by Ea Po and Dak Wil communes of Cu Jut district of Dak Nong province, in the west by the Cambodian border, and on the east by provincial road No. 1 and the Srepok River. The buffer zone of the park covers an area of 133,890 ha. It includes seven communes in three districts of Dak Lak and Dak Nong provinces, situated to the north, south, and east of the park. The Drang Phok village is located inside the park. The buffer zone at its widest is about 26 km and at its narrowest is about 1.6 km. The study area was the farming areas of the Drang Phok village and the neighbouring villages in the buffer zone belonging to the Krong Na commune, Buon Don district, Dak Lak province, amounting

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to approximately 336 ha (Fig. 1). The climate of YDNP is dry and hot with two distinct seasons. The rainy season is from May to November with a rainfall of about 76% of the annual rainfall. The dry season is from December to April.

Around 70–100 wild Asian elephants (*Elephas maximus*) are resident in the park (Dak Lak Elephant Conservation Centre 2018), making it the largest elephant population in the country, representing around 75% of the elephants in Vietnam. The Krong Na commune was farmed by the M'Nong, Ede and Lao ethnic minority groups, who faced crop damage by elephants.

Field deployment

A workshop for 14 stakeholders, consisting of rangers, technical staff of YDNP, head of Dak Lak Elephant Conservation Centre (DECC), head of the Agriculture Agency of Buon Don District, Krong Na commune leaders and heads of villages, was held in YDNP on 9th March 2018 (Fig. 2). They were informed of the research and their cooperation requested.



Figure 2. Stakeholders workshop in YDNP.

Secondary data was obtained from reports on farming, elephant tracking data using SMART, documents in YDNP, elephant tracking and annual DECC reports, reports on economic and social development and crop damage reports in Krong Na commune people's committee.

Discussions were held with nine groups of 40 participants each, consisting of leaders, technical staff and forest rangers, to identify elephant distribution, movement and areas of HEC. Interviews were conducted with occupants from 15 households who suffered losses, about the occurrence of elephants and damage, and farming practices.

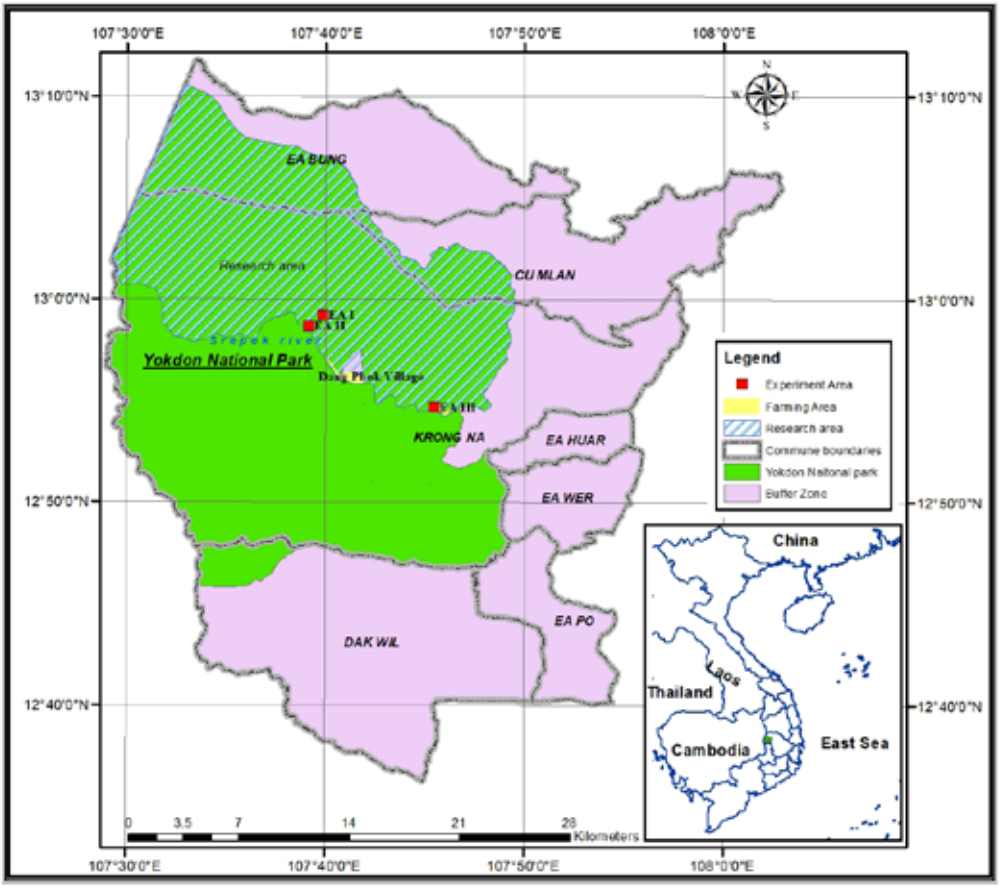


Figure 1. Map of Yok Don National Park and study sites.

Based on the results, three areas for implementing the pilot models were identified.

Two group discussions were held with the participation of 20 households from Drang Phok, Ea Mar, Ea Rong and Buon Don villages, to design pilots based on Participatory Technique Development (Fig. 3).

Pilots were set up in the three areas with 1–3 intercropping models in plots of 1600 m^2 repeated 2–3 times in each pilot. Pilot models were planted in June 2018 (Fig. 4). The growth of annual crops was measured once a month and at harvest. Growth of perennial crops was measured every three months. At each survey elephant sign and HEC incidents were also recorded.

Results

Elephants were present over the entire park. Six farming areas had damage from elephants (Fig. 5). Elephant herds and males were observed in the farming areas during the rainy season and caused damage in areas I – III and VI. In the dry season, there were only 1–2 males and they caused damage in areas II – VI.

Experiment areas

In the areas selected for the pilots, people cultivated annual crops such as corn, rice and cassava once a year. There were differences in HEC levels and farming practices between the areas. Experimental area (EA) I had several sugarcane fields. There were no protective fences and damage by elephants was common. Single elephants and herds occurred every year. Crop damage in particular fields ranged from 60–100%. Five of seven households did not cultivate for three years from 2015–2017 because of elephants. EA II had sugarcane and cashew cultivations. Several farms had simple barriers but elephants still caused damage. Single males occurred every year and sometimes elephant herds. Crop losses ranged from 30–50%. Two of ten households did not cultivate from 2015–2016 due to elephants. Many fields were also not cultivated because the productivity of crops was not high. EA III had cashew, coffee and banana cultivations. Temporary fences protected farms and YDNP rangers helped drive away elephants. Single males appeared regularly every year. Crop damage was less than 30%. Households continued cultivating, but were afraid of elephant raiding. Some fields were uncultivated because the productivity of crops was not high.

Crop species and experimental models

Annual crops selected were taro (*Colocasia esculenta*), turmeric (*Cuscuma longa*), chili (*Capsicum* sp.) and eggplant (*Solanum* sp.). Perennial crops selected were teak (*Tectona grandis*), tamarind (*Tamarindus indica*), pomelo (*Citrus maxima*) and jujube (*Ziziphus mauritiana*). Four experimental models were designed with a perennial crop + annual crop/s with replicates planted in 1600 m^2 plots. Eleven households were selected to deploy the experimental models. One household in EA I implemented two models (Table 1).

The combination of tamarind + taro and tumeric (M) was chosen by 8 households in all three EAs because tamarind has wide adaptability, its care is simple, does not need irrigation in the dry season and has a good market. As the models of



Figure 3. Discussion in Drang Phok village



Figure 4. Providing the seedings to the farmers.

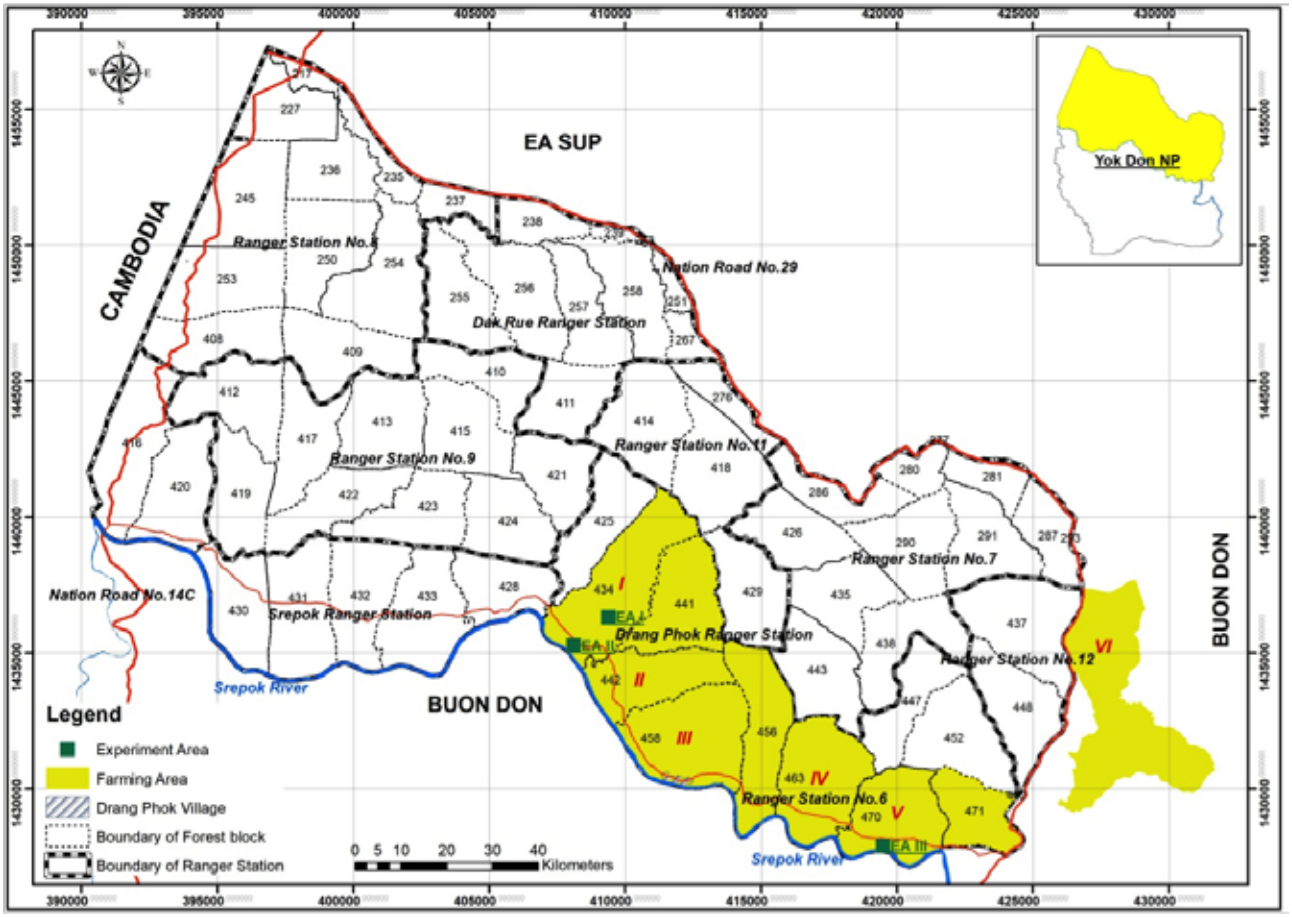


Figure 5. Map of farming areas and experiment areas.

pomelo (B) or jujube (Ta) + chilli and eggplant required more tending and required irrigation, their implementation was only possible in EA III (one household each). The model with teak (T) was selected only by two households with fields in EA I because of issues with soil suitability.

Eleven control plots were set up adjacent to the experimental plots, with previously cultivated crops such as cassava and corn. Two of the control plots had huts and banana plants. There was no difference between experimental and control plots with regard to fences or guarding.

Perennial crops

After 13 months from planting, the average survival rate of teak was 87%, pomelo 93%, jujube 86% and tamarind 70 ± 31.2%. The average height of teak was 211.5 cm, pomelo 129.9 cm, jujube 143.8 cm and tamarind 67.1 ± 19.6 cm. The average diameter at the base of teak was 39.1 mm, pomelo 31.9 mm, jujube 20.8 mm and tamarind 16.4 ± 5.4 mm.

The estimated time from planting to harvest for teak is around 12 years, for tamarind and

Table 1. Intercropping models, number of plots and area planted in the three EAs.

EA	Model	Crops	# plots	Area (m^2)	# households
I	T	teak + taro	2	3,200	2
I	M	tamarind + taro, turmeric	4	6,400	4
II	M	tamarind + taro, turmeric	3	4,800	3
III	M	tamarind + taro, turmeric	3	4,800	1
III	B	pomelo + chilli, eggplant, turmeric	3	4,800	1
III	Ta	jujube + chilli, eggplant	3	4,800	1
Total			18	28,800	11

pomelo 5 years and jujube 4 years. The expected income per 1000 m^2 of tamarind is about US$ 226, pomelo about US$ 250 and jujube about US$ 227. For teak, the total expected income at harvest is about US$ 4348, so the average income will be US$ 362 per year.

Annual crops

Cultivation times (planting to harvest) for taro was 6 months, turmeric 7–8 months, eggplant and chilli 2 months. The average survival of taro was 90 ± 6.1%, chilli 85 ± 7.1%, eggplant 90 ± 7.1% and turmeric 65 ± 20.8%. The average yields per ha obtained were taro 6.4 ± 0.0 tons, turmeric 6.8 ± 4.0 tons, eggplant 6.9 ± 0.3 tons, chilli 1.8 ± 0.0 tons. The average income per 1000 m^2 of cultivation was taro US$ 174, turmeric US$ 53 ± 52.3, eggplant US$ 44 ± 6.7, and chilli US$ 50 ± 5.3.

For traditional crops, time from planting to harvest were; corn 4 months, cassava 6 months or one year, rice 3–5 months depending on the variety, sugarcane 12 months but harvested for 3 years then replanted. The average yields reached per ha were, cassava 6.2 tons, corn 5 tons, rice 6.5 tons and sugarcane 50 tons. The average income per 1000 m^2 of cultivation was cassava US$ 450, corn US$ 600, rice US$ 35, and sugarcane US$ 217.

If raided by elephants, fields of corn, sugarcane and rice are usually almost completely damaged and cassava fields damaged 20–80%. In the last three years cassava has also been infected with leaf mosaic virus, with many households suffering 100% damage.

Elephant occurrence and damage in EAs

Over 14 months (June 2018 – August 2019) elephant herds and individual males occurred nine times near and in EA I. On three occasions they raided the control plots, consuming corn, rice and cassava. The experimental plots were not broken into. In EA II, elephants appeared twice, once a herd of over 20 individuals and once a single male. Both times they entered the control plots planted with sugarcane and cassava, but did not break into the experimental plots. Lone males came twice to EA III during the dry season, both times breaking into the control plots and destroying a hut and consuming bananas and corn. They passed through the experimental models III.B and III.Ta bending and breaking some branches of pomelo and jujube in their paths, but it did not affect tree growth and they did not consume any crops.

Discussion

Our results suggest that both the planted perennial and annual crops did well under the conditions of cultivation and care by local people in the study area. The income from experimental annual crops was initially low, but they were not raided by elephants. Therefore, in view of the risk of raiding traditional crops, the experimental crops could be a viable alternative. Moreover, the plan is for intercropping with short-term crops only in the first 5–6 years of the models, to take advantage of land and space while waiting for maturing of the perennial crops. When the perennial crops are harvested, the households will have a high income, equal to or higher than that obtained by traditional crops over the same period, without worries about being raided by elephants. Considering that many fields were not cultivated due to fear of destruction by elephants, cultivation of non-preferred crops is a viable alternative.

We found that there was no depredation of the experimental crops, but that elephants broke into the control plots with traditional crops. Some damage occurred in the experimental plots due to elephants moving through them and breaking or bending branches of pomelo and jujube trees. However this did not negatively impact growth of the trees. The short-term crops taro, turmeric, chilli and eggplant were completely unaffected by elephants. According to Fernando *et al.* (2008) in Sri Lanka, teak was not previously eaten by elephants, but when teak plantations became abundant, elephants began eating the bark, uprooting and destroying many teak trees. Therefore, monitoring the experiment models inter-cropped with teak will be continued to assess the long-term viability.

The experimental models are still being monitored and evaluated for feasibility, especially in the case of the long-term crops. If it is concluded that the tested non-preferred crops are a viable alternative, then it could be applied to farms that have been severely damaged by elephants and those not cultivated because of elephants. The cultivation of crops such as rice and corn are long-standing practices of the local people, both as a source of food and income. Similarly cassava is planted because of the simplicity of its cultivation and the product can be sold on the spot. Therefore the local farmers may not give up planting of traditional crops immediately. Completely giving up traditional crops will require time and should be attempted in association with land use planning that takes into account the status and level of HEC in each locality. In addition, there is also a need for mechanisms, policies and coordination of stakeholders to support farmers throughout the process.

Acknowledgements

We would like to thank the Vietnam Ministry of Education and Training (MoET) and Tay Nguyen University for giving me the opportunity for this research. We are thankful to the Yokdon National Park, Elephant Conservation Centre in Daklak Province, People's Committee of Krong Na commune, the head and households of Drang Phok village and others in Krong Na commune, technical staffs and rangers of Yokdon NP for all coordinating and supporting us in the field research activities.

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Research Article *Gajah 51 (2020) 10-15*

Human-Elephant Conflict in Panchet Forest Division, Bankura, West Bengal, India

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Abstract. Anthropogenic perturbation in the form of agriculture and settlement expansion results in loss of natural forest habitat, biodiversity and fragmentation of corridors. The disproportionate sharing of forest resource and shrinkage of the sojourn ground creates food scarcity for wild animals and forces them to move to a new habitat. During this migration human-animal conflict becomes a common issue in the corridors and edges in between. Such a typical situation of human-elephant conflict has been happening in the Panchet Forest Division of Bankura District, West Bengal, India. This paper aims to assess the causes and consequences arising from this elephant migration event.

Introduction

Unprecedented growth of human population in West Bengal is responsible for degradation and decline of forest cover from 40% a century ago to 19% in 2015 (Department of Forest 2017). Agricultural and settlement expansion results in loss and fragmentation of natural habitats as well as biodiversity loss. Human disturbance may cause animals to shift their home ranges and venture into areas, which were previously not occupied by them. Such a situation has been seen in the Panchet Forest Division (PFD) of Bankura District, West Bengal, India.

In south West Bengal, Asian elephants (*Elephas maximus*) were abundant in the dense Sal forests of Midnapore district and adjoining areas in the early 1900s (O' Malley 1911). However, by 1955, no resident herds of elephants were found and elephants became rare due to forest degradation (Palit 1991; Malhotra 1995). A few scattered individuals occurred in the hilly region of Ajodhya hill and Bandwan range of Purulia District (situated in the western border of the study area). In 1976 a herd of 42 elephants moved from Dalma area (Fig. 1) to Purulia District and stayed there for 20 days. They caused damage to paddy and killed two people (Shahi 1980). Since the 1980s elephant migration into west Bengal became more frequent. In 1987 a herd of 50 elephants from southern Bihar moved to West Bengal after the wet season and stayed through the winter season (Sukumar 2003). Since 1988 elephants ventured into Bishnupur subdivision under Bankura District located in the central part of PFD after crossing Silabati River. Since 1995, the elephant herd crossed river Darkeswar and moved towards the Northern Forest Division of Bankura District. They extended their territory to Bankura North Forest Division in 1999. Around the same time another herd entered into the PFD area crossing Damodar River to Burdwan District.

There are about 3–4 herds consisting of about 15–70 elephants that come each year into the PFD. A group of elephants now also stay throughout the year. Elephant movement into West Bengal may have been aided by the success of forestry projects in West Bengal under which large patches of degraded forest have regenerated into dense forest (Datye & Bhagwat 1995). These forest patches provide corridors for movement and shelter to elephants but are often surrounded by populated villages with paddy and water sources, leading to conflict. As a result, human-elephant conflict (HEC) has become a severe issue in the PFD area (Das Chatterjee 2016). The objectives of this study were to document human-elephant conflict, its consequences and discuss possible measures to combat the situation in the PFD.

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Methods

Study area

The PFD was previously known as the Panchet Soil Conservation Division, which was established in 1966. The objective behind its formation was soil conservation in the upper Damodar catchment. The name was derived from 'Panchet', a place where the Damodar river originates. In 1995, the division was reorganised and converted into a Territorial Division incorporating the eastern portion of Bankura District. It was excluded from the Soil Conservation Circle and included under the Central Circle of Forest, West Bengal, and named as the Panchet Forest Division (Das Chatterjee 2016; PFD Report). It is one of three Forest Divisions of Bankura District and extends between 22°53'N to 23°12'N latitude and 87°03'E to 87°42'E longitude. It covers an area of 355.62 km^2. Administratively it is divided into 5 Forest Ranges and 21 Forest Beats (Fig. 2). The legal status of forests of this division is mainly 'protected forest' (Table 1).

The PFD area is part of the Chhotanagpur plateau and is located where the plateau descends to the alluvial flats of Damodar basin. Hence the slope and relative relief gradually decreases towards the east, from the hills in the west.

Average annual rainfall is around 1320 mm. The highest rainfall occurs during the months of June – August and lowest from November – January. The average temperature is high during April – May and is about 38ºC and low in December – January, around 15ºC.

The forests of PFD are of the tropical dry deciduous type. The forest composition consists of sal (*Shorea robusta*) and associated tropical deciduous species such as; peasal (*Pterocarpus marsupium*), kend (*Diospyros melanoxylon*), mahul (*Madhuka latifolia*), kusum (*Schleichera trijuga*), karam (*Adina cordifolia*), asan (*Terminalia tomentosa*), bahera (*Terminalia belerica*), rahara (*Soyamuga febrifuga*) and dhaw (*Anogeissus latifolia*).

Table 1. Sstatus and extent of forests in the PFD.

Legal status	Area in km^2
Reserved forest	0.929
Protected forest	335.110
Un classed forest	7.617
Non-forest land	0.002

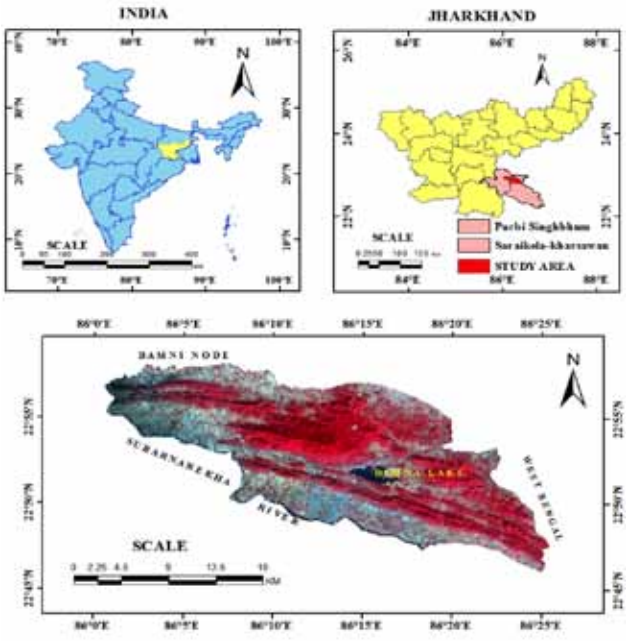


Figure 1. Map of Dalma Wildlife Sanctuary..

There are 236 villages that come under the Panchet Forest Division (Das Chatterjee 2016). Agriculture is the economic base of the majority of people of PFD. A large percentage of people in the study area belong to Scheduled Castes (SC) or Scheduled Tribes (ST) communities. The SCs and STs are officially designated groups of disadvantaged people in India. They are socially marginalized and economically poor. They depend on collection of forest products or agriculture. Agriculture was the main economic activity in the PFD.

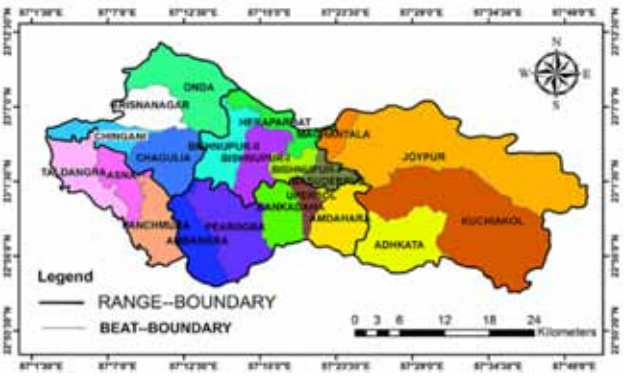


Figure 2. Map of Forest Beats with range and division boundaries of PFD.

Data collection

Landuse and forest cover change data was derived from LISS-III and LISS-IV satellite images of 2006 and 2013 from National Remote Sensing Centre, Hyderabad. Information on elephant movement and HEC was obtained from records kept by the Forest offices. ERDAS IMAGINE 9.2 and ArcMap 10.2.1 software was used for making maps.

Villages affected by HEC were identified based on the records. A questionnaire survey was conducted in the 50 most affected villages. Twenty households per village were sampled giving a total of 1000 sampled households. We enquired about livelihood patterns, movements of elephants and damages caused by them, awareness of conservation, compensation and the role of the Forest Department in mitigating the conflict.

Results and discussion

Elephant movement patterns

An increasing trend of the number of elephants entering the PFD area was seen (Fig. 3). Initially only the Dalma herd came to South West Bengal but after 2010 another herd came from Mayurjharna elephant reserve area in Purulia District. The number of elephants from Dalma were110 in 2012 and 35 from Mayurjharna. Depredation by the Mayurjharna elephants was more severe in comparison to the Dalma herd.

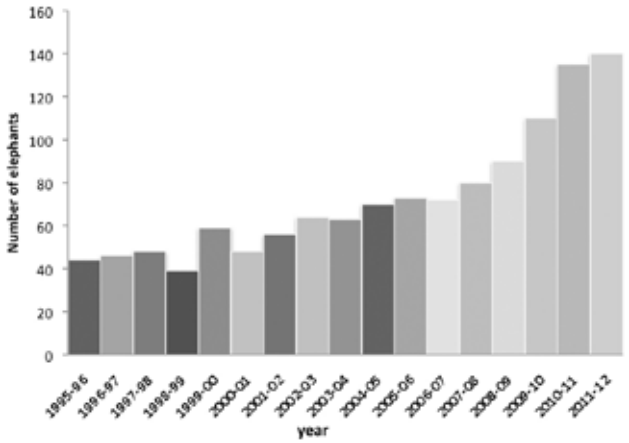


Figure 3. Number of elephants moving into PFD by year.

Along with increasing number of elephants, their duration of stay in PFD also increased (Fig. 4). Initially the elephants came just after the rainy season in late September and early October and returned to Dalma in January. With time it changed to about one third of the elephants staying for two to three months at Dalma and spending the remaining time in South West Bengal. This pattern was also observed by Kulandaivel (pers. comm.). By the end of the study period some elephants had become resident. In 2015 there were 6 to 12 resident elephants in PFD (Department of Forest 2015).

Elephant's movement pattern and habitat quality

Elephant movement pattern in PFD is presumably determined by the availability of fodder and water in the fragmented forest patches. The surveys suggested that elephants preferred sal forests where undergrowth was high. Increased undergrowth restricts people's movements in the forest and hence these areas are less disturbed. More undergrowth also provides ample fodder. Elephants also preferred forest patches, which are nearer to water sources.

Socio-economic background and its relation to human-elephant conflict

Demographic characteristics

About 92.6% of the population lived in a rural setting and earned their livelihood from agriculture. The economic condition of most of the people was below poverty level.

The level of education in the PFD was poor (Fig. 5) consequently they had few work opportunities

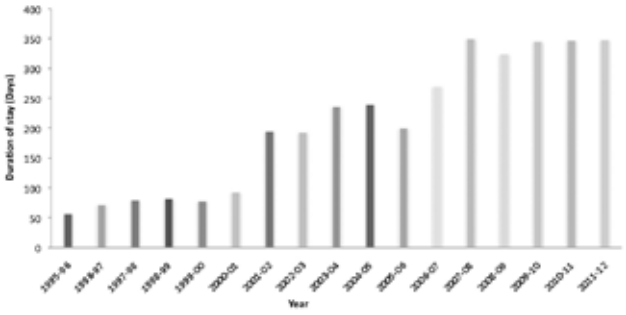


Figure 4. Duration of stay of elephants in the PFD, by year.

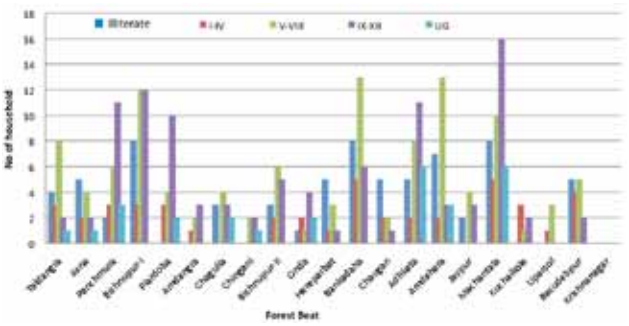


Figure 5. Educational level in PFD by Forest Beat.

and had to depend on activities like agricultural work and collection of fodder and NTFPs from nearby forest areas. Poor education level (most of them have not completed their elementary school education) may also be responsible for lack of awareness and many did not claim compensation as they were unaware of the procedure. This increased their grievances against the Forest Department.

The population density varied in different Forest Beats and was higher in villages near urban centres and in the eastern part of the study area and lower in the western part (Fig. 6).

Soil in the study area was characterized by unfertile lateritic red soil in the western part and alluvium in the eastern part. Unfertile land was a major factor for the dependence of villagers on forest resources.

More agricultural activity was seen in the eastern and north-eastern part. As a result settlement and population density was high in the eastern and northern part. Dense agricultural areas were more prone to HEC.

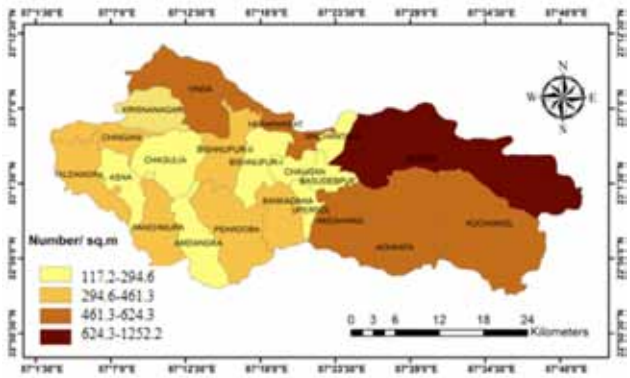


Figure 6. Population density map of PFD.

Livelihood pattern

The main livelihood was from agriculture based activities. Livelihoods were based on cultivation or working as unskilled manual labourers. Average size of an agricultural holding was 0.16–0.64 ha, which is very small. These small holdings and home gardens were the main sources of staple food. A large portion of the population depended on the forest for their livelihood, collecting fuel wood and NTFPs such as medicinal plants, sal leaves, honey, mushrooms, barks, roots and tubers.

Landuse pattern

The landuse was human dominated. Agricultural land in 2006 and 2013 respectively were 36% and 35%, settlements 21% and 23%, open forest 22% and 23% and dense forest 11% and 10% of the total area (Fig. 7). Though the total area under forest cover improved due to social forestry programmes, dense forest areas decreased resulting in reduction of forest core area (Fig. 8).

Agriculture

Agriculture consisting of 36% of the area was the dominant land use. Most of the agricultural lands were single cropped while the north-eastern part was characterised by double cropping. Agricultural pattern was associated with movement of elephants.

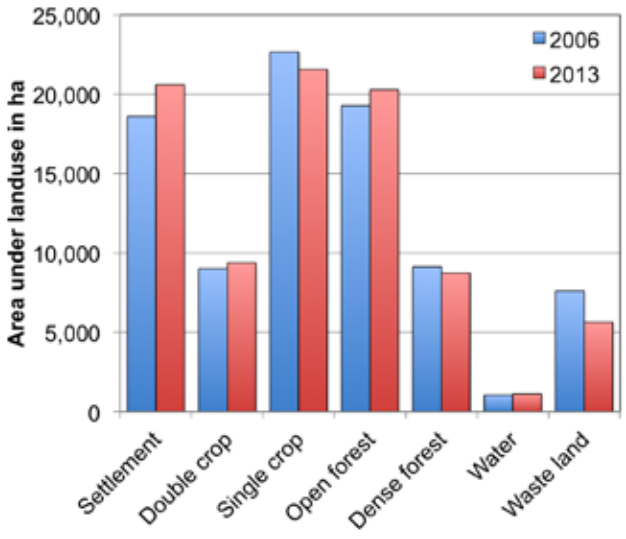


Figure 7. Landuse category extents in PFD in 2006 and 2013.

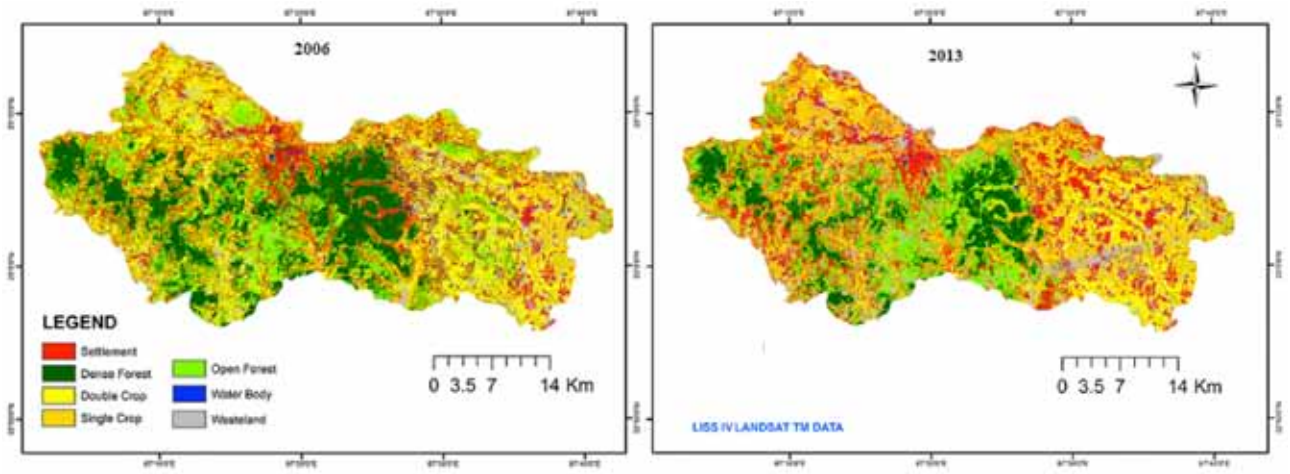


Figure 8. Landuse change detection map of PFD between 2006 and 2013.

The entry route of Dalma elephants to PFD during 2006–2013 remained the same but extension to the eastern part increased.

Settlements

The elephant habitat of PFD was surrounded by human settlements. The settlements were mainly rural with a few urban centres. In some cases settlements were situated within forest areas. Conversion of forest land into agricultural land and encroachment by settlements in the forest fringe areas were common. Elephant depredation of crops stored in granaries or houses caused property damage in addition to loss of crops (Figs. 9 & 10). Country liquor was another attraction for which elephants ventured into settlements within the forest areas.

Elephant attacks on humans

Most persons killed or injured by wild animals were due to elephants. Deaths increased in the harvesting season when elephants raided crop fields. Conflict was high from September to December and January to April. Most human injury and deaths by elephants were caused by single bulls. Deaths occurred in the villages when there were no crops in the fields. Initially there were hardly any cases of human injury and death but since 2007 the events have increased (Fig. 11). Injuries and deaths due to elephants commonly occurred when people entered elephant habitat, encroached elephant corridors or in defending crops from elephants. Such incidents occurred mostly in the evening or at night.

Human-elephant conflict mitigation

Communities in the affected areas of PFD used simple and low cost techniques such as beating on drums or tin cans, firecrackers, fireballs and torches to chase elephants. Firecrackers and kerosene were usually supplied by the Forest Department but was insufficient. Use of firecrackers, fireballs and torches were

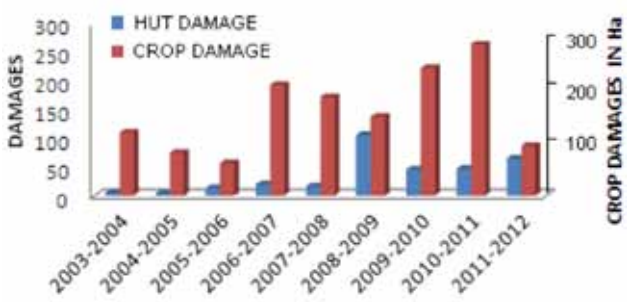


Figure 9. Damage caused by elephants in PFD.



Figure10. Hut damaged by elephant.

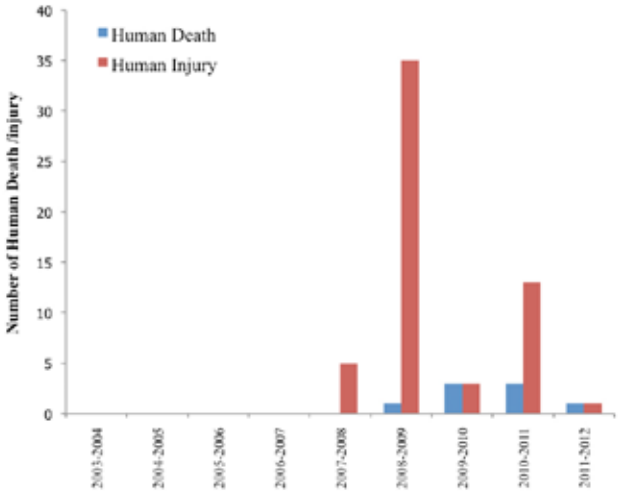


Figure 11. Death and injury caused by elephants in PFD (Source: PFD).

commoner in villages near Forest Beat or Range offices. In distant villages, throwing stones and shooting with bow and arrow was more common. Elephants injured by people became more aggressive, attacked humans and caused more damage to life and property.

In some instances the Forest Department tried to redirect the movement of elephants through use of 'koonkie' elephants. However in such instances, hundreds of villagers gathered in front of the route and threw stones and crackers towards the herd. As a result often the herd divided into smaller groups and the situation became uncontrollable. The lack of awareness of the people regarding elephant behaviour was one of the main hindrances in managing conflict.

In some cases villagers with the help of the Forest Department constructed electric fences or trenches. The cost of constructing electric fences around the small fragmented forest patches was not cost effective. Stealing of fence material was another problem in their management. Improvement of habitat quality within the forest and awareness generation may be effective in combating the situation.

Acknowledgements

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Research Article *Gajah 51 (2020) 16-25*

Human-Elephant Conflict in Sri Lanka: Patterns and Extent

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Abstract. Human-elephant conflict (HEC) has become a serious socio-economic and conservation problem in Sri Lanka. We assessed the overall level of HEC in the country during 2010–2019 and the patterns of conflict in relation to administrative districts. Globally, Sri Lanka had the highest annual elephant deaths and second highest human deaths, due to HEC. Male mortality was higher in both elephants and people. Conflict has greatly increased in intensity and geographic extent from that reported previously. The highest conflict has shifted from the Northwest to the East and North-Central areas, with the Northwest showing a decline in conflict. The changes in different areas were probably related to differences in management actions and developmental activity. Further increase in HEC is likely in the Eastern, North-Central and Northern regions.

Introduction

Asian elephants (*Elephas maximus*) are listed as 'endangered' and human-elephant conflict (HEC) poses a serious challenge to their conservation in Sri Lanka as well as the rest of the range. The density of elephants in Sri Lanka is the highest among range countries with around 10–20% of the global Asian elephant population occupying less than 2% of the global range (Leimgruber *et al*. 2003; Fernando & Pastorini 2011). Of the 13 Asian elephant range countries, the human population density in Sri Lanka is third highest, behind Bangladesh and India (Fernando & Pastorini 2011). The high densities of elephants and people in Sri Lanka have contributed to a high level of HEC in the country, which has become a major conservation, socio-economic and political issue.

The Department of Wildlife Conservation (DWC) is the agency mainly responsible for mitigating HEC in Sri Lanka. Sri Lanka is divided into several administrative regions by the DWC and most previous studies of HEC have been based on these regions (eg. Zubair *et al*. 2005; Fernando *et al*. 2011; Haturusinghe & Weerakoon 2012). However, the number of regions and their boundaries change from time to time. For example the number of regions varied between six and eleven in the period 2010–2018 (see DWC Performance reports).

The frequent changes in the extent and boundaries of DWC regions makes it difficult to assess changes in HEC with time. Also, effective HEC mitigation requires that people and agencies responsible for people's welfare and development become the main stakeholders of HEC mitigation (Fernando 2015). Such an approach requires allocating resources through the development and administrative sectors. Therefore, we analysed HEC based on the administrative sectors in Sri Lanka.

Methodology

Administratively, Sri Lanka is hierarchically divided into 9 provinces, 25 districts, and 331 Divisional Secretariat (DS) divisions. Data on human deaths, elephant deaths, human injuries, and property damages due to HEC from 2010–2018 and the total number of human and elephant deaths in 2019 were obtained from the DWC under provisions of the Right to Information Act No. 12 of 2016 (Right to Information Commis-

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sion of Sri Lanka 2018). Monthly data on human and elephant deaths and annual human injury and property damage data was available at Divisional Secretariat level. Gender of human victims was available for 2010–2018 and age for 2012, 2014, 2015, and 2016. Gender of elephants that died was available for 2010–2014. Funds expended by the DWC for main HEC mitigation initiatives were gleaned from annual performance reports of the DWC.

Analysis of Variance (ANOVA) was conducted to assess significance of variation in HEC related factors between months in a year, years, districts, and gender. As human deaths and injuries, and elephant deaths were of a similar scale and low in number, they were lumped together for analysis. Property damages were analysed separately as they were almost a magnitude greater. Minitab 14 statistical software and Microsoft Excel 2010 were used in statistical analyses and graphical presentation. Maps were prepared using ArcGIS software.

Results

Country-wide analyses

A total of 14,516 HEC incidents were recorded in the country during 2010–2019. There were a total of 807 human deaths (Fig. 1), 579 human injuries and 10,532 property damages caused by elephants and 2631 elephant deaths (Fig. 2). The 2631 elephant deaths include those at the Elephant Transit Home and those where the DS division was not recorded.

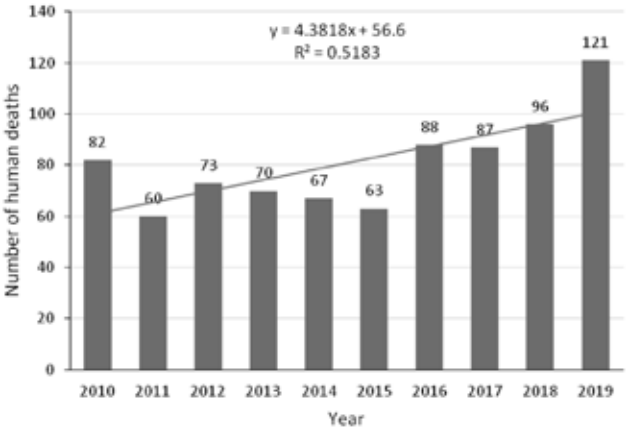


Figure 1. Annual human deaths.

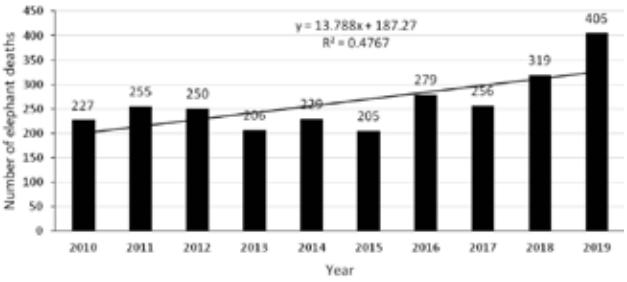


Figure 2. Annual elephant deaths.

Human and elephant deaths did not vary significantly between months of the year. Of 686 human deaths from 2010–1018, in 673 the gender was recorded with 581 being male and 92 female. Significantly more men than women died from the conflict ($F = 191.53$; $p < 0.001$). The mean age of male victims was 52 years (range 4–90 years) and the mean age of females was 53 years (range 7–80 years) (Fig. 3). Of 1167 elephant deaths, in 1033 the sex was identified, consisting of 690 males and 343 females. The male bias was significant ($F = 71.40$; $p < 0.001$).

HEC mitigation by the DWC

Annual expenditure by the DWC for the main HEC mitigation activities is given in Table 1. A total of 2402 km of new electric fences were constructed by the DWC between 2010–2018 (Table 2). A total of 86 multi-day elephant drives were conducted in the same period with the intention of eliminating elephants from a given area. In addition to such drives, the DWC conducted innumerable short duration drives to 'chase' elephants from a given locality, for which no data were available.

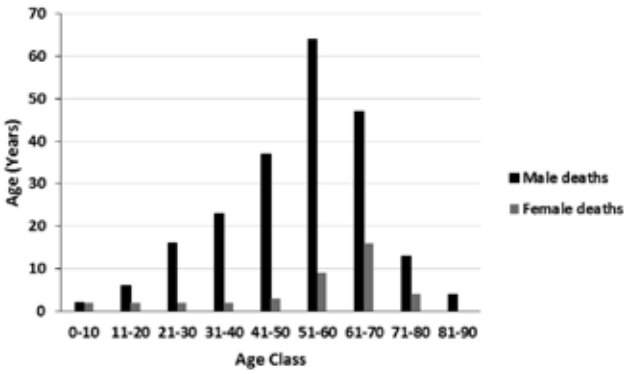


Figure 3. Human deaths due to HEC, by gender and age group.

Table 1. Funds spent (in US$) annually for selected HEC mitigation activities by the DWC.

Year	Elephant thunders	Compensation	Capture translocation	Elephant drives	Total
2010	193,636	214,757	42,131	54,477	505,001
2011	228,117	139,587	1,996	25,990	395,690
2012	240,922	119,408	34,370	33,406	428,106
2013	268,308	172,016	12,196	29,325	481,845
2014	323,189	166,528	16,908	63,125	569,750
2015	420,589	142,580	10,588	40,873	614,630
2016	480,126	123,178	24,669	53,721	681,694
2017	383,952	141,451	23,240	35,441	584,084
2018	714,568	245,431	53,779	54,243	1,068,021

Provincial level analyses

HEC occurred in eight of the nine provinces. HEC incidents showed (human deaths and injuries, and elephant deaths combined) varying intensities between provinces with the North-Central and Eastern provinces showing the highest and Sabaragamuwa the lowest levels (Fig. 4).

Property damages recorded had a similar pattern to HEC incidents represented by injury and death except in the Uva province, which had a relatively higher incidence of property damage (Fig. 5).

The incidence of HEC within a given province varied annually, with increasing trends in some and decreasing trend in others (Figs. 6 & 7). The provinces with the highest HEC incidents as represented by injury and death also showed a recent and rapid increase in the number of incidents (Fig. 6). In contrast, the provinces with the highest property damages showed a recent decrease in the number of incidents (Fig. 7).

Table 2. Length (in km) of new electric fences erected and number of elephant drives conducted by the DWC annually.

Year	Electric fences	Elephant drives
2010	343	11
2011	213	5
2012	232	8
2013	343	10
2014	179	9
2015	226	8
2016	287	16
2017	488	9
2018	91	10

District level analysis

HEC occurred in 19 districts as indicated by both the property damage data and combined data (Figs. 8 and 9). A comparatively high number of HEC incidents were shown by both sets of data in Anuradhapura, Polonnaruwa and Ampara districts while Badulla district had a disproportionately high number of property damages (Figs. 8 and 9).

DS division level analysis

Human deaths due to HEC were reported from 112 DS divisions and elephant deaths from 131 DS divisions, indicating the occurrence of HEC over much of the dry zone (Fig. 10). The mean number of DS divisions reporting human deaths in a given year was 44 (range 35–52) and elephant

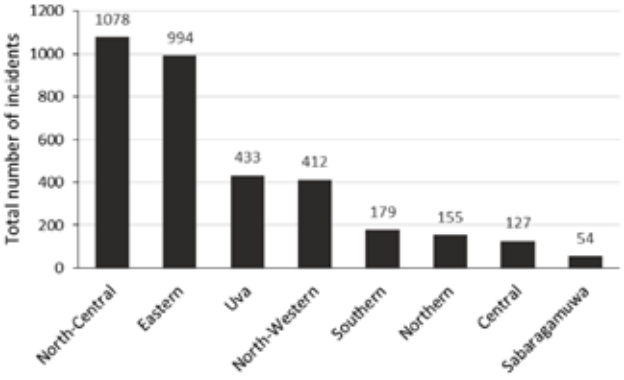


Figure 4. Total number of HEC incidents by province.

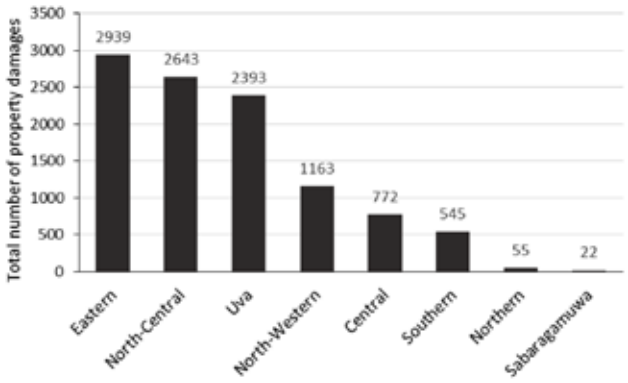


Figure 5. Total number of reported property damages by province.

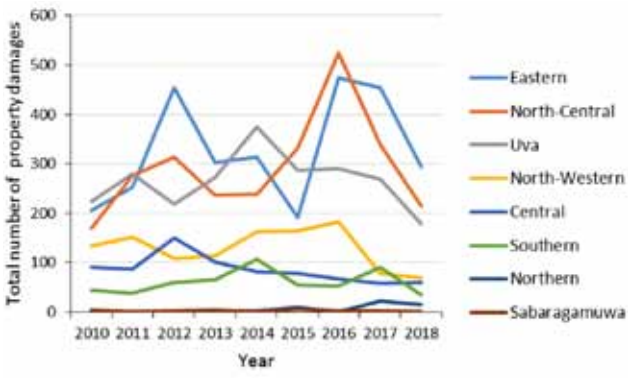


Figure 7. Annually reported property damages by province.

deaths 78 (range 68–86). The number of DS divisions reporting human deaths and elephant deaths in a given year showed an increasing trend (Fig. 11).

Discussion

The study showed that HEC was very widespread in Sri Lanka. The intensity of HEC varied between geographic areas and between years but appeared to be increasing in overall intensity and extent.

The annual human death rate due to HEC from 2010–2019 was 81. In India, currently it is about 571 (Ganesh 2019). In Bangladesh the annual human mortality was 37 (Islam *et al*. 2011), Nepal 18 (Acharya *et al*. 2016), Myanmar 12 (Leimgruber *et al*. 2011), Indonesia 2 (Azmi & Gunaryadi 2011), Sabah (Borneo) 1–2 (Alfred *et al*. 2011), and Peninsular Malaysia 1 (Saaban *et al*. 2011). Thus the number of human deaths due to HEC in Sri Lanka is less than in India but higher than in other Asian elephant range countries. Per capita, Sri Lanka has the highest HEC induced human mortality by far, as the Indian population is 63 times that of Sri Lanka. While HEC is comparatively less in Africa, Kenya has the highest level of HEC in Africa, with around 25 human deaths per year caused by elephants (Shaffer *et al*. 2019). Therefore, Sri Lanka has the second highest number of annual human deaths and the highest per capita death rate from HEC globally.

The average human death rate due to HEC in Sri Lanka was 71 from 2005–2010 (Fernando *et al*. 2011) and 54 from 1992–2001 (Perera 2009). Therefore, the human death rate has increased by about 14% from the previous decade and by about 50% from two decades ago. As the number of deaths in 2019 reached 121, human deaths from HEC appear to be markedly increasing. Annual human mortality in India was 225 from 1998–2001, around 400 in 2011 (Baskaran *et al*. 2011) and 571 between 2015–2018 (Ganesh 2019). Thus human deaths in India increased by around 43% from a decade ago and 153% from

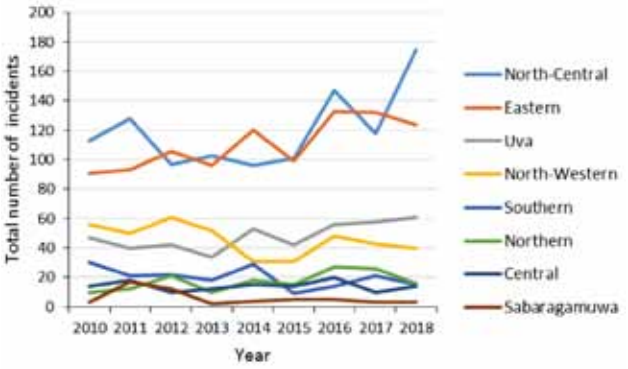


Figure 6. Annual number of HEC incidents by province.

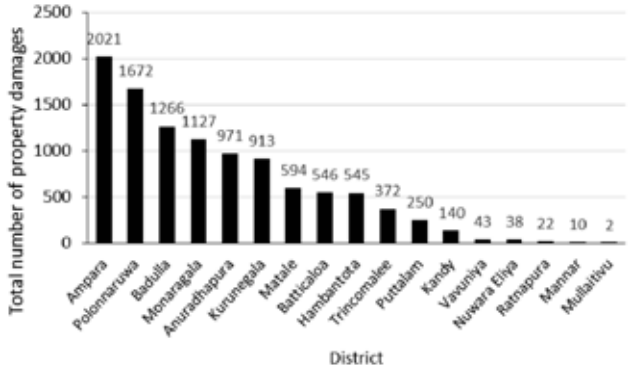


Figure 8. Total number of property damages by district.

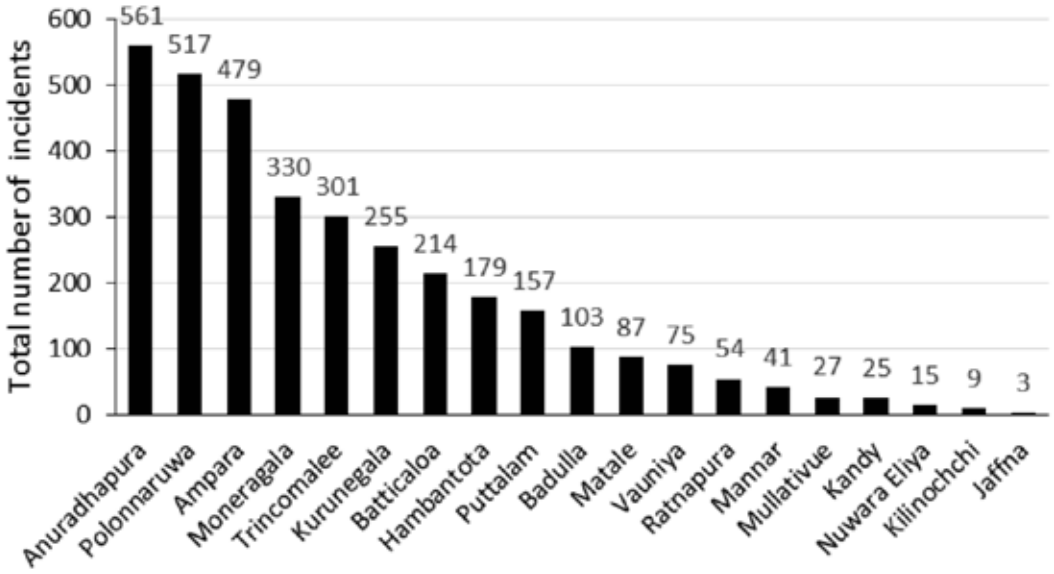


Figure 9. Total number of HEC incidents by district.

two decades ago. The rate of increase in Sri Lanka was less than in India but both show acceleration, symptomatic of the escalation of HEC across the range.

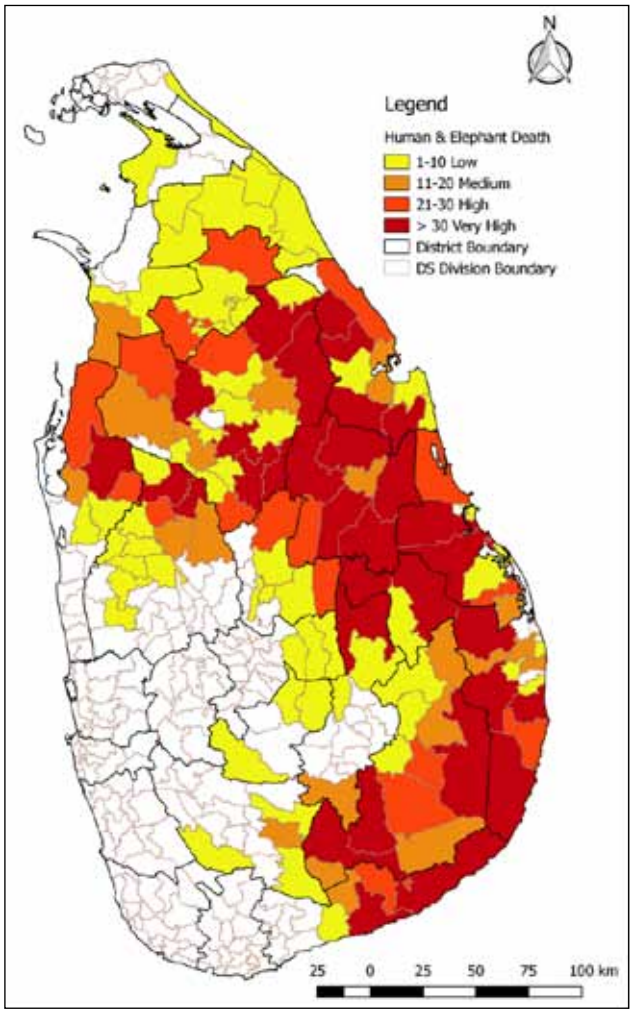


Figure 10. DS divisions with human and elephant deaths.

Annual death rates in Sri Lanka due to motor accidents are over 3000 (Ministry of Transport & Civil Aviation 2019), drowning over 900 (WHO 2014) and snakebites about 400 (Ediriweera *et al*. 2016). While comparatively less in contrast to other causes of accidental deaths, deaths caused by HEC often cause public protests, attracting much media attention. The reaction to human deaths from elephants, appears to be out of proportion to the extent, hence unacceptable psycho-sociologically.

Many deaths due to HEC are caused by irresponsible behaviour of people, such as approaching wild elephants while inebriated, harassing elephants and unnecessarily chasing them. Most human deaths due to HEC are preventable if appropriate precautions are taken. Mass media plays a major role in drawing attention to HEC and shaping public reaction to it. Therefore media should report incidents of HEC responsibly with elucidation and reportage of actual reasons and circumstances causing incidents, rather than sensationalizing them.

While human injuries caused by elephants were similar in scale to deaths, incidents of property damage were more than an order of magnitude greater. Since many cases of property damage are presumably not reported, the actual numbers are likely to be much higher. Most property damage by elephants and some human deaths are related to raiding of grain stored in houses. Alternatives

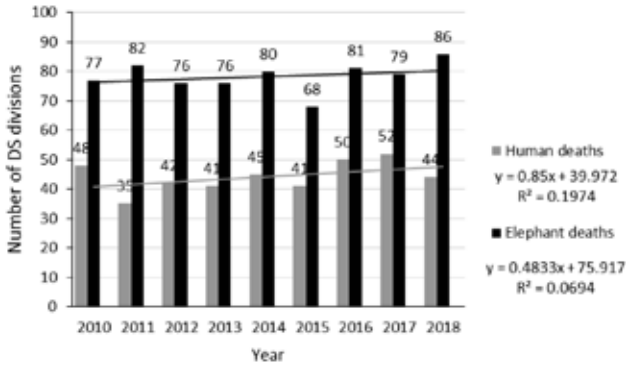


Figure 11. Number of DS divisions reporting human and elephant deaths by year.

to such storage such as sale of the harvest and purchasing the daily requirement, or protection of settlements with electric fences would help prevent such incidents. Purchase of grain by the government at a higher price from areas with elephants could encourage farmers not to store grain in their houses.

We found an annual elephant death rate of 263 from 2010–2019. In 2005–2010 the elephant death rate was 200 (Fernando *et al*. 2011) and in 1992–2001 it was 137 (Perera 2009). Therefore, the elephant death rate has increased by about 31% from the previous decade and by about 92% from two decades ago. The elephant death rate shows an extremely high increase recently, exceeding 300 for the first time in 2018 and 400 just a year after. The deaths in 2019 are double the average from a decade ago. Annual elephant death rates in India are around 124 (Ganesh 2019), Sabah (Borneo) 10–16 (Alfred *et al*. 2011), Indonesia 9 (Azmi & Gunaryadi 2011), Bangladesh 4 (Islam *et al*. 2011), and Malaysia 1 (Saaban *et al*. 2011). In Kenya the annual death rate of elephants is 50–120 (Shaffer *et al*. 2019). Therefore, the highest number of annual elephant deaths globally, is reported from Sri Lanka.

Comparatively many more elephants than people get killed due to HEC in Sri Lanka with a ratio of human to elephant deaths of around 0.30. A similar situation is observed in Kenya, Indonesia and Sabah with respective ratios of 0.2–0.5, 0.2, and 0.06–0.2. In contrast, a higher proportion of human deaths per elephant death occur in India (4.6), Bangladesh (9.25), and Malaysia (1.43). The difference between the two groups is probably due to the interaction of many factors, including attitudes of people towards killing of elephants, access to and use of methods that result in elephant deaths, penalties for killing elephants and their implementation, and behaviour of elephants.

Human deaths and elephant deaths showed an increasing trend within the study period and a major increase from levels reported two decades ago. Annual expenditure on the main activities conducted for HEC mitigation by the DWC increased by around 110% within the same period. On average 267 km of new electric fences were erected annually in addition to maintenance of existing fences, which currently stands at around 4500 km. An annual average of 10 major elephant drives were conducted by the DWC during the study period. Whether the lack of a tangible impact of this increasing expenditure and effort in HEC mitigation is due to the ineffectiveness and inappropriateness of the HEC mitigation methods used (Fernando 2015), or increased conflict due to continued development in areas with elephants is not clear. It is likely that both factors play a part.

HEC has a strong association with Agriculture (Santiapillai *et al*. 2010), which predicts higher HEC incidents during cultivation periods. Sri Lanka has two agricultural seasons. The main season 'Maha' is during the North East monsoon from November to February and the secondary season 'Yala' is from May to August but may vary between years and regions. However, we did not find a relationship between the number of human and elephant deaths and months of the year or agricultural seasons. The lack of correlation maybe due to year-round cultivation with irrigation – especially in home gardens, raiding of perennial crops and incidents due to raiding of grain stored in houses and annual and regional variation in cultivation seasons. Additionally, incidents such as deaths occurring on roads would be unrelated to agriculture. Given that human deaths occur throughout the year, people living in areas with elephants need to be aware of elephant presence throughout the year and take adequate precautions.

Significantly more men were killed by HEC. The male: female ratio of human deaths caused by HEC is 6.3 in Sri Lanka, 4.2–4.5 in Bangladesh (Sarker *et al*. 2015; Hossen 2013) and 5.0 in Tamil Nadu, India (Karthick & Ramakrishnan 2018). In most Asian societies, there is a strong male bias in the economically active population. For example in Sri Lanka, 63.4% of those engaging in economic activities were males (Department of Census and Statistics 2018). Male bias is likely to be extreme in the case of crop guarding and confronting elephants. Men are also more likely to be outside the home after dark, be on roads and to be inebriated (Fernando *et al*. 2011). Therefore, men are more likely to encounter elephants, whether intentional or accidental, which probably explains the male bias in HEC deaths.

We found that the majority of deaths of males due to HEC were of those of working age. Such loss may have serious consequences to the families affected as it may lead to reduced income of the household and create social issues. The highest number of deaths of men was in the age category 51–60 years and in women, 61–70 years. In Bangladesh, 74% of HEC related human deaths in 1989-2012 were of those aged above 30 years (Sarker *et al*. 2015). In Tamil Nadu, India, between 2008 and 2017, the age class of 40–50 was the most affected by HEC followed by 50–60 irrespective of sex (Karthick & Ramakrishnan 2018). Therefore, the observed pattern of middle-aged mortality being the highest is similar to other countries, but with a predisposition towards the old-age group in Sri Lanka. The greater mortality of the middle-age group could be due to higher outdoor activity and the bias towards older-age groups could be due to decreased reflexes and motor impairment with age. The higher life expectancy in Sri Lanka of 73.2 compared to India's 68.0 and Bangladesh's 70.4 (Worlddata n.d.) could also have some influence on the bias towards older age in Sri Lanka.

Significantly more males were represented in elephant deaths also. The male: female ratio of elephant deaths in Sri Lanka was 2.01. A previous study recorded an even greater male bias in North-West Sri Lanka, with a ratio of 2.64 (Haturusinghe & Weerakoon 2012). In Southern India 1531 male elephants and 1189 female elephants died during 1976–2000 (Ecology Center 2019), giving a male: female ratio of 1.29. Most HEC incidents are due to male elephants (Sukumar 1991; Ekanayaka *et al*. 2011; Fernando *et al*. 2011). In India, male elephants entered cultivation about six times more frequently than members of female groups, and males and females obtained 9.3% and 1.7% respectively of their diet from crops (Sukumar 1990). Males raid crops in a high-risk high-gain strategy due to the higher palatability and nutritive value of crops compared to wild plants, obtaining extra nutrition, better growth and higher reproductive success (Sukumar & Gadgil 1988). Thus, the observed male bias in elephant deaths is largely explained by behavioural differences between the two sexes, especially in interaction with humans.

Provincial level distribution of HEC

The number of human injuries and deaths, and elephant deaths combined was highest in North-Central and Eastern provinces and the lowest in the Sabaragamuwa province, with the other provinces at intermediate levels. The highest reported property damages were from the Eastern, North-Central, and Uva provinces while the lowest was from Northern and Sabaragamuwa provinces, with some differences in the ranking of the provinces in the middle when compared with the other indicators. Thus all indicators showed a similar pattern. An analysis of elephant deaths from 1990–2000 based on DWC administrative regions, found the highest with 39% of total deaths occurring in the North-Western, the second highest with 26% in the Mahaweli region (North-Central), while the Eastern region accounted for only 11% (Haturusinghe & Weerakoon 2012). Similarly, a review of elephants and HEC in Sri Lanka from 2005–2010 found North-West and North-Central areas to have the highest conflict but predicted its escalation in the east (Fernando *et al*. 2011). The present study found that conflict has decreased in the North-West and increased markedly in the North-Central and Eastern regions.

District and DS division level distribution of HEC

HEC was very high in Anuradhapura, Polonnaruwa and Ampara and lowest in Mannar, Mullativue, Kandy, Nuwara Eliya, Kilinochchi, and Jaffna districts, as indicated by the combined data. Property damages indicated very high conflict in Ampara and Polonnaruwa, and low levels in Vavuniya, Nuwara Eliya, Ratnapura, Mannar, and Mullaitivu districts. Therefore, the indicators of HEC showed a similar pattern at the scale of districts also. Badulla and Anuradhapura were exceptions to the regular pattern. Anuradhapura recorded the highest conflict in terms of the combined data, but showed an intermediate level with regard to property damages. Badulla showed a mid-level of conflict according to the combined data but a very high level of property damage. The difference between the two data sets may indicate some anomaly in the pattern of cultivation and/or reporting from the particular districts.

More than one third of all DS divisions in Sri Lanka were subject to HEC. The number of DS divisions reporting human deaths and elephant deaths in a given year showed an increasing trend, demonstrating the continued geographic spread of the conflict. Mapping of conflict illustrated that HEC was not recorded due to elephants being absent from a number of areas including the southwest quarter, the Jaffna peninsula and a few small DS divisions in the East and North-Central regions, which were very densely populated (Fig. 10). The only areas with elephants but without HEC were some DS divisions in the North (Fig. 10). The distribution pattern of HEC observed corresponds to the distribution of elephants and HEC indicated by a grid based survey of the island (Fernando *et al*. in press).

Trends in conflict level

The present study shows that the conflict in the North-West has declined and the highest conflict is now in the North-Central and the Eastern provinces. Eastern province showed the greatest increase followed by North-Central, Uva, Northern, and Central provinces in reporting human and elephant deaths and human injuries. The North-Western, Southern, and Sabaragamuwa provinces showed a negative trend. When considering property damages, the North-Central province showed the highest increase followed by Eastern, Uva, North-Western, Southern, and Northern provinces while Central and Sabaragamuwa provinces showed a negative trend. However, a decrease in property damage was observed towards the end of the study period, particularly where the other indicators showed very high conflict. One possibility for the observed decline is the large number of elephants that have been killed in the last few years in the very high conflict areas. However, a decline in property damage was also observed in the North-West where the other indicators also showed a decrease in conflict. Therefore, the recent decline in property damage could also be a short-term phenomenon related to environmental, agricultural or socio-economic changes.

Attempts at limiting elephants to protected areas by driving them into DWC protected areas and fencing them in has been the main approach to HEC mitigation in Sri Lanka over the past 70 years or so (Fernando 2015). However, this approach has completely failed and currently over 70% of elephant range is outside protected areas (Fernando *et al*. in press). In an alternative approach, community-based electric fencing to protect villages and paddy fields has been implemented in the North-West with over 50 community-based fences being implemented by the Centre for Conservation and Research and the DWC in the past decade. In contrast, construction of electric fences on protected area boundaries by the DWC was completed in the North-Central region during the study period (Wickramasinghe AD, DWC pers. comm.). Many such linear fences were also constructed in the East. The decrease in conflict in the North-West and increase in the East and North-Central regions may have some relation to the different approaches to HEC mitigation in the respective areas.

A recent (2020) initiative of distributing guns by the government for 'HEC mitigation' in

Anuradhapura and Ampara districts, is likely to greatly escalate the conflict in those areas, with increased human deaths from elephants driven to aggression and elephant deaths from gunshot injuries.

The North, North-Central and the East were also heavily impacted by armed conflict for three decades and many villages and cultivations were abandoned and became optimal elephant habitat (Fernando *et al*. 2011). Since cessation of hostilities in 2009, resettlement of people and increasing human encroachments would also have contributed to the rapid increase in HEC (Prakash 2014).

Therefore, in addition to the continued escalation of HEC in the North-Central and Eastern regions, it is likely that HEC will significantly increase in the North in the near future.

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Research Article *Gajah 51 (2020) 26-30*

Clinical Management of Intestinal Impaction and Colic in an Asian Elephant

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Abstract. Intestinal impaction and resultant colic is a common non-infectious disease condition reported in captive Asian elephants. If not detected and treated in time, it can prove fatal for the animal. A 16-year-old female Asian elephant presented with severe colic, a distended abdomen, absent food and water intake and inability to pass dung. The case was diagnosed as intestinal impaction on clinical signs and history. It was successfully treated with the administration of NSAIDs, stool softeners, systemic fluids, antibiotics, and encouraging physical activity.

Introduction

Intestinal impaction is not an uncommon condition affecting the Asian elephant (*Elephas maximus*) in captivity (Chandrasekharan *et al*. 2009; Sarma 2011). It is a non-infectious disease condition resulting from partial or complete obstruction of the intestinal tract by undigested food material, foreign bodies or a hard faecal bolus (Dumonceaux 2006). We have examined 15 such cases in captive Asian elephants and in all of them, a hard faecal mass was the cause of impaction. It can be very painful and uncomfortable for the elephant and, if not diagnosed and treated in time, can prove fatal. Compared to other species, surgical management of intestinal impaction in elephants is difficult and challenging, because of the large visceral cavity, large intestinal volume, and higher chances of incision dehiscence. Therefore therapeutic management is the preferred mode of treatment. Here we describe one such case of intestinal impaction in an Asian elephant and its clinical management.

Case details

A sixteen-year-old female Asian elephant presented with a history of rapid bloating of the abdomen and lack of defaecation for over 7 h. The animal was reported to have fed normally on fodder of sorghum crop till evening. At around 8:30 pm, the keeper had noticed the elephant showing signs of discomfort, groaning, and with a bloated abdomen, and had immediately reported it. Clinical examination was carried out within 2 h of reporting of the case.

On observation, the elephant exhibited symptoms of tenesmus like frequent squatting and straining to expel the faeces, along with restlessness, trunk biting, frequently sitting down and standing, inappetance, an abnormal posture with hind legs spread apart, and groaning. A pear-shaped bloated abdomen was noticed on physical examination (Fig. 1). The elephant continued to exhibit symptoms such as frequent sitting and standing, changing positions, groaning, tenesmus, intermittent open mouth gaping, and restlessness, suggestive of severe colic. Analysis of CCTV footage showed that the elephant had not defecated after 1:00 pm. The rectal temperature was recorded to be normal (37.1ºC). Per-rectal examination was carried out to check for any object or faecal bolus causing obstruction in the rectum. However, the rectum was found to be empty. The condition was tentatively diagnosed as colic resulting from intestinal obstruction, and immediate treatment was initiated.

An attempt was made to administer 100 ml of antacid and anti-bloat syrup (DIGENE®, Abbott India Limited, Goa, India) orally to the elephant. But it was unsuccessful as the elephant was

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Figure 1. The pear-shaped bloated abdomen of the elephant.

reluctant to take anything orally and refused to swallow the syrup.

The body weight of the elephant was known to be 3300 kg from recent records. The non-steroidal anti-inflammatory drug meloxicam (MELONEX POWER™, Intas pharmaceuticals Ltd., Ahmedabad, India) was administered intramuscularly at a dosage of 0.1 mg/kg body weight to give relief from pain. Ceftriaxone sodium with Tazobactum (Inj. INTACEF TAZO®, Intas pharmaceuticals Ltd., Ahmedabad, India) at a dosage of 4 mg/kg was administered intravenously to avoid secondary infections from an obstructive mass and from the affected intestinal wall (Greene *et al*. 2018). An enema was given with 1800 ml liquid paraffin, by inserting a 1.3-cm-diameter flexible tube approximately 4 feet inside the rectum and injecting paraffin with a 400 ml plastic syringe connected to the tube (Fig. 2). The tube was lubricated with liquid paraffin before insertion to avoid injury to the rectal mucosa.

After the enema, the elephant was encouraged to walk and sit down and stand up a few times. Within two hours of the enema, the bloating started reducing and the elephant released some gas rectally. The frequency and intensity of colic symptoms also reduced. But signs of tenesmus persisted. Within the next two hours, the animal developed bloating again, with the recurrence of severe colic symptoms.

Enema was given again with 35 l lukewarm water mixed with 2 l of liquid paraffin. The enema mixture was kept in a plastic bucket, and a 40-watt submersible electric pump was immersed in it. The 1.3-cm-diameter flexible tube was connected to the pump. The other end of the tube was inserted about 4 feet inside the rectum. The enema mixture was administered by running the pump (Fig. 3). Approximately one third of the mixture flushed back out. However, the remaining mix was retained inside.

The animal was given a long walk of about 4 km early morning. She did not defecate during the walk but passed gas rectally, thus relieving the bloating. Fluid therapy was initiated with intravenous administration of 5.5 l of Ringer Lactate (RL, Inven Pharmaceuticals Pvt. Ltd., Dhar, India), 3.5 l of 5% Dextrose Normal Saline (DNS, Inven Pharmaceuticals Pvt. Ltd., Dhar, India), 1 l of multi-electrolytes (K-LYTE, Kunal remedies Pvt. Ltd., Lucknow, India) and 600 ml of amino acids (ASTYMIN-3, Tablets (India) Ltd., Chennai, India).

Around 10:50 am, the animal urinated. The urine volume was less than normal. The rectal temperature at this point was recorded as 36.4ºC. Blood samples were collected for lab analysis. The serum biochemistry and hematologic values were found to be normal. The PCV was 31.5%, indicating that the levels of hydration were optimal with the systemic and rectal administration of fluids (Sarma 2011). A digestive



Figure 2. The assembly of flexible tube and 400 ml syringe used for giving liquid paraffin enema.



Figure 3. The assembly of bucket, motorised pump and flexible tube used for giving lukewarm water and paraffin mixture enema to the elephant.

mixture containing 100 g ground ginger, 100 g asafoetida, 100 g ground garlic, 100 g black salt, and 500 g jaggery, was offered to the elephant, which she ate.

Around 3:30 pm (after 17.5 h of therapy), the animal started voluntarily eating a small quantity (2 kg) of fruits. She was then given 800 ml of liquid paraffin, 200 ml of a laxative syrup (CREMAFFIN, Abbott India Limited, Goa, India), and 3 ml digestive tonic (DIGIVET®, Hivet, Haryana, India) orally.

Around 6:10 pm, the elephant started eating sorghum crop fodder and at 9:50 pm she defaecated after 32 h. A single bolus was expelled, which was large, elongated, dry and hard (Fig. 4). The elephant immediately started to drink water and consume fodder normally. Intravenous administration of INTACEF TAZO was repeated along with 12 l of K-LYTE infusion. Liquid paraffin 400 ml and 3 ml of DIGIVET® tonic were given again orally. It was advised to keep the elephant separate from other elephants and allow her to take only 40 kg of sorghum crop fodder with water to drink ad-libitum. Rectal temperature was recorded as 35.8ºC.

During this second night till the next day morning at 9:30 am, the elephant defecated 5 times and drank about 60 l of water. The bloat subsided completely (Fig. 5). She was given long walks both in the morning and evening. She defecated two more times before 5:30 pm during the day. Softened surfaces and borders of the dung balls indicated efficient stool softening action of the liquid paraffin, which helped the obstructing dung mass to pass smoothly through the rectum.

The course of antibiotic and oral liquid paraffin (400 ml) once a day, and 3 ml Digivet thrice a day, was continued for the next 3 days. Oral probiotic (ECOTAS™, Intas pharmaceuticals ltd. Ahmedabad, India) at a dosage of 6 boli once a day, was given for 5 days.

Discussion

Elephants are hindgut fermenters and pass large amounts of low-quality forage through the gastrointestinal tract in a short period of time (Clauss *et al*. 2003). Fermentation and digestion mostly happens in the caecum and colon. The gastrointestinal transit time in captive Asian elephants is 21–55 h (Dierenfeld 2006). Asian Elephants usually drink 200–255 l of water a day, consuming 50–60 l at a time (Cheeran 2009).

Intestinal impaction, either complete or partial, is known to be caused by undigested food, ingestion of dirt, foreign bodies, clay, or sand that becomes impacted in the gastointestinal tract. Old elephants are prone to impaction from partially digested food due to problems in mastication resulting from worn out teeth (Greene *et al*. 2018). Consumption of large amounts of feed with high fiber content in a short period of time also causes obstruction, leading to colic. The reluctance to drink water due to the colic results



Figure 4. The first faecal bolus expelled by the elephant after 32 h without defaecation.



Figure 5. The bloat subsided after the treatment and expulsion of impacting faecal mass

in dehydration thus aggravating the intestinal stasis (Dumonceaux 2006). Cases have also been reported resulting from the consumption of large amounts of raw rice paddy (Sarma 2011). Once dehydration arises, it is followed by electrolyte imbalance, endotoxic shock, and circulatory collapse. The condition may lead to recumbency and death in the case of peracute colic.

The first vital sign noticed in intestinal impaction is a lack of defecation for a period longer than normal, which is accompanied in many cases by bloating of the abdomen. A healthy elephant defecates about 15–20 times a day (Cheeran 2009). If an elephant has not defecated for long, it maybe suffering from a serious digestive disorder, such as intestinal impaction, intussusception or volvulus. Following the lack of defecation, animal will stop feeding and show signs of colic. Based on the severity of the symptoms and duration, the colic could be per-acute (severe), acute (moderate) or chronic (mild). The typical symptoms of colic in elephants are; kicking the belly, frequently sitting down and getting up, lying down and flipping over from side to side. In severe colic, these symptoms are accompanied by frequent opening of mouth (yawning appearance) and holding and biting the trunk in the mouth. Elephants, showing such symptoms with the absence of appetite and defecation for a considerable time, could have partial or complete intestinal obstruction, volvulus or intussusception. The history is vital in differentiating between these. For example, if the animal was noted eating soil, or there was a sudden change in diet, overeating, drinking less water, etc., obstruction is likely. Elephants suffering from arthritis or lameness with reduced movement and lack of exercise may also be prone to reduced gut motility and thus impaction. On the other hand, a history of incidents such as falls, symptoms of aerophagia or sudden changes in diet may indicate volvulus or intussusception (Wiedner *et al*. 2012). In most cases, we have observed that impaction and colic occurred mainly due to factors like reduced gut movement, dehydration, or inadequate exercise, rather than from ingested items.

The first step in suspected intestinal impaction is a per-rectal examination to check for an obstructive mass in the rectum. In many cases, a large dry dung mass stuck in the anterior portion of the rectum maybe found. This mass can be slowly and gently pulled out by lubricating it with liquid paraffin. The examination also helps assess rectal motility. The administration of analgesics such as NSAIDS during initial stages of treatment helps reduce colic, and thus to calm down the elephant, which makes further treatment easier.

If the obstructive mass is not within reach during the per-rectal examination, further treatment should be carried out. In most such cases, elephants are not receptive to oral medications. Thus an enema with a stool softener should be given after administration of an NSAID. Liquid paraffin is excellent for this purpose. Intravenous fluid therapy must be initiated as soon as possible to avoid severe dehydration and for electrolyte replacement as well as for intravenous administration of medications. In elephants, the large volumes of fluid required for maintenance is a challenge. As per the recommended dose of 40–60 ml/kg/day, an adult elephant would need to be administered 120–160 l of fluids in 24 h, which is challenging under field conditions. Therefore, intravenous fluid administration can be supported by rectal administration of

fluids (Mikota 2006). Rectal administration of a lukewarm solution of oral rehydration salts such as ORS (Cipla, Mumbai, India) in water, is efficient for maintaining fluid and electrolyte balance. In cases of suspected infection, a course of systemic antibiotics needs to be given for 3 or more days depending on the time taken by the animal for recovery.

Clinical recovery is generally rapid after the elephant expels the obstructing mass, which in most cases is a large ball of dry, undigested food material. Depending on the size and quantity of the obstructing mass, and the part of the intestines it was stuck in, it may take several hours after initiation of treatment for the elephant to expel the mass. The longest time we have observed for the expulsion of an obstructing mass was 46 h. Even after complete clinical recovery, continuation of oral rehydration solution is recommended for a few days to avoid the recurrence of impaction from dehydration, especially in hot climatic conditions. During recovery, it is advisable not to put the elephant back on standard quantities of diet immediately but to give lesser quantities for the first 24 h. Routine exercise must be encouraged to promote normal gut motility. Giving exercise walks, or if that is not possible, distributing feed in different locations of the enclosure to encourage walking is a good practice (Ullrey *et al*. 1997).

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Management of Chronic Purulent Temporal Adenitis in a Captive Asian Elephant

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Introduction

Elephants have two specialized apocrine glands called temporal glands located between the eye and the ear. They are multi-lobed and can weigh up to 3 kg in males, and about 1 kg in females. They secrete a viscous, pungent liquid from a small opening above the zygomatic arch. When male elephants go into musth there is copious discharge from the glands, which may have a specific communicative functions and bio-responses related to recognizing genetic and social relationships, choosing mates, and in establishing and maintaining social order (Rasmussen & Krishnamurthy 2000). In females the glands are usually non-secretory although a small discharge may rarely occur.

Inflammation of the temporal gland is called 'temporal adenitis', which may also occur due to blockage of the opening and retention of secretions. In adenitis, the gland becomes swollen, oedematous, thick and painful. Pus may or may not be present. The gland and adjacent tissues become indurated and hard. It may get injured resulting in recurrent inflammation of the temporal region. Owing to irritation, the animal may rub or scratch the temporal region and the skin may get abraded, leading to secondary infection. Recurrent injury to the swollen gland is also possible when the animal lies down on concrete floors.

Case history

A captive female Asian elephant used for elephant back safaris for tourists, was seized and rehabilitated by the Western Circle Forest Division, Nainital, India. She had a history suggestive of temporal adenitis for the past three years. The elephant presented with a swelling in the right temporal region (Fig. 1). She was aged around 56 years, weighing 3200 kg, in good physical condition and with normal feeding activity.

On examination there was thick purulent matter with a foul smell clogging the opening of the temporal gland (Fig. 2). The swollen area was hard to the touch and she evinced pain on palpation. Based on the clinical signs, temporal adenitis was diagnosed.

Pus was collected on a sterile swab for culture and sensitivity tests, but no bacterial growth was reported after 24 h. Blood was collected for haematology (Table 1). The wound was flushed with 2% potassium permanganate solution followed by 5% povidone iodine solution and thoroughly cleaned with gauze. The wound pocket was packed with a mixture of copper sulphate and magnesium sulphate powder mixed with Iodine solution twice daily for two months, and after that once a day for three months (Fig. 3). Additionally, the elephant was given Enrofloxacin (10 mg/kg IM), Meloxicam (0.2 mg/kg IM), Chlorpheniramine Maleate (4 mg/



Figure 1. Noticeable swelling of the temporal area.

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Figure 2. Thick pus clogging the opening.



Figure 3. Wound cleaning with antiseptics.

kg IM) and Multivitamin (70 ml IM) for five days. The swelling reduced dramatically after six months of regular dressing and the wound pocket showed signs of healing with reduction in wound depth as assessed through introduction of artery forceps.

Discussion

The successful treatment of chronic purulent temporal adenitis took more than five months and proved challenging because of the site. Management was conducted using counter-irritants, antiseptics and anti-inflammatory drugs to sterilize the wound, prevent recurrence, reduce pain and promote healing.

The indurated gland in temporal adenitis may also be surgically removed under general anaesthesia which needs extensive post-operative care as suturing is not generally practiced for elephants, as wound dehiscence (rupture) is common (Fowler & Mikota 2008). Opening the swollen gland and cauterizing it with caustics like triple sulphate or draining and treating as open wound is also possible (Ajithkumar *et al*. 2009).

Table 1. Haematology values before and after treatment.

Parameters	19.8.2018	25.9.2019
WBC (x10^3/ mm)	10.9	6.8
RBC (x10^3/ mm)	2.7	2.95
PCV (%)	36.0	32.9
Platelets	4.4	8.8

We opted for the described procedure, as approval was not received for alternatives. The procedure undertaken is easily conducted under field conditions and facilities available in range state settings. Therefore it maybe preferable to other options, in treating chronic purulent temporal adenitis in similar situations.

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I would like to thank the Conservator of Forest, Divisional Forest Officers, Veterinary Officers and all other staff for giving me the opportunity for this study.

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Report on the 10th Meeting of the IUCN Asian Elephant Specialist Group

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Introduction

The 10th Meeting of the Asian Elephant Specialist Group (AsESG) was held at the Shangri La's Tanjung Aru Resort & Spa, Kota Kinabalu, Sabah, Malaysia from 4th to 6th December 2019. The meeting was jointly hosted along with the Sabah Wildlife Department. A wide range of issues including standards and guidelines for the management and welfare of elephants in the wild and in captivity, wildlife emergencies, national action plans, red-listing of Asian elephants, challenges for the conservation of elephants in Sabah, etc were discussed. The meeting was attended by 148 people including 62 AsESG members, 17 government officials from all 13 Asian elephant range countries, 3 other ex-officio members, 36 invitees from across the globe as well as 20 organizers and 10 exhibitors. The meet also provided a forum for AsESG members and young professionals to present their work. A Partners Round Table between AsESG partners and range country officials was also organized to explore the possibilities of supporting priority conservation activities of range states

The inaugural session was addressed by Mr Vivek Menon, Chairperson AsESG, Dato Abdul Kadir bin Abu Hashim, DG, Department of Wildlife and National Parks, Peninsular Malaysia and Mr Augustine Tuuga, Director Sabah Wildlife Department.

Chair's summary on AsESG's achievements

Mr Menon thanked the Government of Sabah and the Sabah Wildlife Department for hosting the meeting and presented the report of AsESG activities in the last 18 months. The 19 Working Groups worked to assess, plan and act in this Quadrennium (2016–2020); three of these have already completed their mandate by 2017. In terms of assessment the team has successfully submitted the assessment of Asian elephant (expect subspecies *Elephas maximus sumatranus*) and work on mapping the distribution of Asian elephants.

Plan

The "Elephant Conservation National Action Plan for Bhutan" has been finalised and printed in 2019. The drafts of the Sabah and Sumatra elephant conservation national action plans are ready and waiting approval of the government. Lao PDR and India, which do not have a plan, have also agreed to prepare their plans after a follow up by the AsESG secretariat and have constituted technical committees to prepare the plans.

The four Working Groups that have completed and submitted their outcome document include guidelines for creating artificial water holes in elephant habitats, guideline for welfare and use of elephants in tourism, management and care of captive elephant in musth and guidelines for the reintroduction of captive elephants in the wild as possible restocking option.



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The three Working Groups that are still working to complete their outcome documents include guidelines for best practices in addressing and mitigation human-elephant conflict, areas and mechanism of involving AsESG members to strengthen MIKE and plans to arrest the decline of the elephant population of Vietnam.

The work of the Working Group to prepare guidelines to treat, minimize and manage spread of emerging new disease, formed in July 2018, is in progress. The Working Group to prepare a plan to manage the elephant habitat affected by the Rohingya refugees in Cox's Bazar undertook a field visit in October/November 2018 and is working on the plan.

Act

Capacity building training of veterinarians from Vietnam and Cambodia on radio collaring of elephants and HEC mitigation was conducted in Kaziranga, India by AsESG-WTI from 26th November to 2nd December 2018. IFAW-WTI veterinarians went to Cambodia to assist the WWF Cambodia team in radio collaring of elephants from 26th July – 7th August 2019.

The membership advisory committee and the communications advisory group are also working on their respective mandate and will continue till the end of the quadrennial.

The editorial board of the journal Gajah has published three volumes since April 2018. One of the major hurdles has been the lack of papers for publication and the editorial board urged members to submit their work for publication.

On request of the Chair, Mr Jayantha Jayawardene has drafted the history of the AsESG.



Activities of AsESG representatives

Organized a session at the 29th International Congress for Conservation Biology (ICCB 2019) in Kuala Lumpur, Malaysia on 25th July 2019 jointly with IFAW and Elephant Family on "Challenges confronting conservation of Asian Elephants: Securing corridors as a mitigation strategy."

Organised a side event at the CITES CoP18 in Geneva on 22nd August 2019 in partnership with IFAW, Elephant Family and WWF on "Impact of poaching and illegal trade on Asian Elephants."

AsESG WCPA Transport proposed Working Group: A meeting of the proposed linear infrastructure working group with members from WCPA transport working group of connectivity conservation and the AsESG was held in Kuala Lumpur, Malaysia on 8th April to discuss the formalities and TOR.

IUCN African Elephant Specialist Group Meeting: Dr. Sandeep Kr Tiwari, program manager AsESG, attended the African Elephant Specialist Group members meeting on behalf of the AsESG in Pretoria, South Africa from 14th to 18th July 2019.

The chair attended the SSC steering committee meeting as well as the SSC leadership meeting, spoke and chaired a few parallel sessions. Other AsESG members also attended the meeting held at Abu Dhabi from 6th to 10th October 2019.

The AsESG has published a paper on "Population status of Asian elephants *Elephas maximus* and key threats" in the International Zoo Yearbook.

The AsESG is in the top 4 among the 160 IUCN SSC Specialist Groups and has been awarded the SSC Chair's Citation of Excellence for the outstanding contribution in delivering the species strategic plan for the 2017–2018 period.

Technical Working Groups

The technical Working Groups presented the outcome documents of their respective groups.

These include:

1. Red listing assessment of Asian elephants: process, challenges and way forward - Dr. A. Christy Williams
2. Mapping the distribution of Asian elephants in range states - Dr. Varun Goswami
3. Bhutan National Action Plan - Mr Namgay Wangchuk
4. Update on Sumatra National Action Plan - Dr. Wahdi Azmi and Mr Krismanko Padang
5. Update on guidelines for best practices in addressing and mitigating human elephant conflict - Dr. Alexandra Zimmermann
6. Guidelines for creating artificial water holes in elephant habitats - Prof. R. Sukumar
7. Updates on Guidelines to treat, minimize and manage spread of emerging new diseases - Dr. N.V.K. Ashraf
8. Guidelines for the effective management and care of captive elephants in musth - Dr. Janine Brown
9. Guideline for the welfare and use of captive elephants in tourism - John Edwards Robert
10. Areas and mechanism of involving AsESG members to strengthen MIKE - Dr. Shermin de Silva (in absence of Dr. N.M. Ishwar)
11. Guideline for the reintroduction of captive elephants in the wild as a possible restocking option - Dr. Shermin de Silva (in absence of Dr. Chatchote Thitaram)
12. Plan to arrest the decline of the elephant population of Vietnam - Ms Nilanga Jayasinghe (in absence of Mr Ajay Desai)
13. Managing the elephant habitat affected by Rohingya refugees in Cox's Bazar, Bangladesh and minimize the human elephant conflict - Prof. Anwarul Islam

Mr Vivek Menon concluded the technical session with following remarks:

1. Six Working Groups have finalized their outcome documents and will be dissolved; others to complete their document by June 2020
2. All Working Group documents finalized will be peer reviewed and could be published. This will also be uploaded on AsESG website and could also be published in Gajah. This could also be put for IUCN publication.
3. Two new Working Groups to be formed:
   - Working Group on Borneo Elephants
   - Working Group for drafting the National Action Plan for conservation of elephants in Peninsular Malaysia

Other meeting highlights

Datuk Christina Liew, Hon'ble Deputy Chief Minister of Sabah State Government /Minister of Tourism, Culture and Environment formally inaugurated the AsESG meeting on the second day. She thanked the Chair AsESG for organizing the IUCN AsESG Meeting 2019 in Sabah, Malaysia. Expressing her concern that about 145 elephants have died in Sabah between 2010 and 2019, she felt that this is the perfect opportunity to openly discuss and to look for pragmatic solutions to address this escalating mortality in Sabah's elephant population. Although Malaysia's last known Sumatran rhino died few weeks back, we will not let this happen with elephants and will ensure we do our best to protect this species. It is not too late to save the Bornean elephants! We must not hesitate to take drastic actions and





initiate conservation programs that will create an ultimate goal of "having a sustainable landscape to support free-ranging breeding populations of elephants in Sabah". She also emphasised on the need of planning for co-existence of elephants and humans and to work towards to change the meaning of letter "C" in HEC from conflict to co-existence.

Dato Abdul Kadir bin Abu Hashim briefed on the challenges for wildlife conservation in Peninsular Malaysia and the conservation initiatives undertaken by the government. The Department of Wildlife has established an intelligence and technical centre for wildlife crime in 2018 and has also established a cybercrime unit to deal with wildlife cases.

Mr Augustine Tuuga informed that Sabah has completed the draft for the Sabah 3rd NECAP for 2020–2030 and hopes it will be tabled in the state meeting early next month to get government support for implementation of the action plan. He expressed his concern on increasing human-elephant conflict in recent years with about 145 elephant deaths from 2010–2019, mostly due to suspected poisoning and shooting. The Sabah Wildlife Department needs to improve the intelligence network, enforcement and forensics as well as improve community driven initiatives to address the issue. He hoped the Sabah forum with diverse stakeholders will discuss on how to minimize human-elephant conflict and elephant mortality and assured of all support from the government.

The Elephant Conservation Action Plan of Bhutan recently published was released by the Chair, Director General Malaysia, Director Sabah Wildlife Department and Mr Namgay Wangchuk.

A panel discussion was held on subspecies of Asian elephants, their red listing and finalization organised with Dr. Benoit Goossens, Dr. Pruthu Fernando, Dr .T.N.C. Vidya as panellists. The discussion was facilitated by Vivek Menon. Currently three subspecies are recognised: Asian mainland (*Elephas maximus indicus*), Sri Lankan (*Elephas maximus maximus*) and Sumatran (*Elephas maximus sumatranus*) elephants. The Borneo elephants are included under Mainland. However, mtDNA haplotypes analysis indicates that Borneo elephants are genetically distinct from any other South and Southeast Asian population and have been isolated for over 300,000 years. Therefore, they should be considered as a separate subspecies. It was discussed if genetic data can be the sole criteria or if such a decision should be based on both genetic and morphometric assessments. The overall view was that the Borneo elephant is separate and could be included as subspecies or Evolutionary Significant Unit and should be red-listed. Dr. A. Christy Williams felt that we could go to national red listing to argument because they have separate CITES authorities. The chair suggested forming a Working Group for deciding if Borneo elephants should be considered as a subspecies and its red-listing.

Dr. Ben Okita, co-chair African Elephant Specialist Group, attending the AsESG meeting on special invitation, made a brief presentation on the sharing and learning from the African experience and their range of activities.

Mr Jayantha Jayawardene has drafted a brief note on the history of the AsESG, talking about its genesis, founding members, the reason for formation of the group, the various chairs and co-chairs, the major work done by the group and



contributions to elephant conservation, meetings and workshops, guidelines and manuals, Asian elephant conservation centre, role of IUCN, journals, AsESG website, logo and funding.

A dedicated session on Sabah elephant conservation was also organised to discuss the challenges confronting the conservation of elephants in Sabah and discuss mitigation plans. Four breakup groups were formed to discuss diverse issues: Connectivity (wildlife corridors); human-elephant conflict or co-existence (land sharing vs. land-sparing); zero killing of elephants and enforcement; and awareness for elephant conservation. The stakeholders who participated in the discussions included officials of the Sabah Wildlife Department and palm oil plantations, local scientists and conservationists, AsESG members, range country government officials, donors and officials of the Sabah government.

Parallel sessions on the third day

On the third day, there were three parallel sessions going on. The first was on emerging challenges for Asian elephant conservation, organized to enable the AsESG members and few invited guests to share and present their work (research and conservation) as a knowledge sharing mechanism to learn from each other's experience.

The second session was a partner's round table, which was attended by over 14 partners and donors and 13 range state officials. The partners informed of their core areas of support in terms of geography and themes. Range officials presented the priority activities from their plan for technical and financial support. This provided an opportunity for the partners to get ideas on conservation issues in Asia and the priorities in actions for the conservation of elephants in range states. This also gave them an option to choose from the basket of priority actions what they would like to support.

The third session was a workshop and capacity building training for young professionals. The session was organised to provide a forum for young researchers and conservationists working on Asian elephants, but not a member of the AsESG, to present their work to the AsESG members and range officials. Six youths from three countries presented their work. This was followed by a training program on new SMART conservation tools for monitoring Asian elephants (by Dr. Antony J. Lynam), principles of effective HEC management (by Dr. Alexandra Zimmerman) and key aspects in proposal writing (by Ms Cory Brown). This session was organised to provide them an opportunity to showcase their work and interact with experts and other members of the AsESG and also to train them on a few key aspects.

The meeting ended with concluding remarks by Mr Vivek Menon and Mr William Baya, Permanent Secretary, Ministry of Tourism, Culture and Environment. The chair felicitated all the Working Group conveners who have completed their mandate. Dr. Ben Okita, Co-Chair, AfESG was presented a memento by the Sabah Wildlife Department. Dr. Sandeep Kr Tiwari gave the vote of thanks.



Elephant Topics Discussed at the 18th Meeting of the CITES Conference of the Parties

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Introduction

CITES was established as a response to growing concerns that over-exploitation of wildlife through international trade was contributing to the rapid decline of many species of plants and animals around the world. The aim of CITES is to ensure that international trade of wild animal and plant species does not threaten their survival. CITES parties regulate wildlife trade through controls and regulations on species listed in three appendices. The 18th Meeting of the CITES Conference of the Parties (CoP18) was held in Geneva from 17th to 28th August 2019. Discussions on African and Asian elephants during the CoP18 are briefly summarized in this report (IISD Reporting Services 2019).

Report on Monitoring the Illegal Killing of Elephants (MIKE)

The CoP18 Doc.69.2 and the addendum relating to the implementation of the MIKE mandate was introduced noting that relative poaching levels in Africa remain unchanged between 2017 and 2018, with some regional variation. South Africa, Botswana and Zimbabwe expressed their confidence in the MIKE process, but Burkina Faso and Kenya, supported by many other African countries and Israel, expressed concern about the independence and transparency of the analysis and called for an open and transparent peer-review of MIKE's methodology. Committee II and the CoP noted the report.

Report on the Elephant Trade Information System (ETIS)

The document CoP18 Doc.69.3 (Rev.1) was introduced involving a comprehensive analysis of ETIS data and noted a modest decrease in illegal ivory trade activity but also cautioned that over 250 seizures were not included in the analysis.

Several transit countries such as UAE and Singapore questioned the transparency of the ETIS methodology and categorization process. China and the DRC lamented the report's neglect of their domestic efforts to combat the illegal trade in ivory. Vietnam, sharing concerns regarding the ETIS methodology, expressed disappointment that despite correspondence with the Secretariat on this issue, the report remained mostly unchanged. Angola called on Vietnam to address the role of Vietnamese-led criminal networks in the illegal African ivory trade. Committee II and the CoP noted the report.

Ivory stockpiles: Implementation of Resolution Conf. 10.10 (Rev. CoP17) on trade in elephant specimens

Burkina Faso introduced CoP18 Doc.69.4 providing an update on recent seizures and destructions of ivory stocks and stockpiles by CITES parties and suggesting a way forward on the implementation of decisions directed to the Secretariat and Standing Committee (SC) in order to secure the completion of the delayed CITES guidance for the management of ivory stockpiles before or during CoP18.

Angola, Côte d'Ivoire, the EU, Gabon, Liberia, Mali, and Niger expressed support for the proposals. Committee II accepted draft decisions and the amendments to Resolution Conf. 10.10 (Rev. CoP17).

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Outcome

The decisions (CoP18 Doc.69.4), direct the Secretariat to disseminate the practical guidance for the management of ivory stockpiles, including their disposal; and SC72 and SC73 to consider the report and recommendations of the Secretariat and determine whether any further actions are necessary in the case of parties who fail to provide annual inventories of government-held stockpiles of ivory and significant privately held stockpiles of ivory within their territory or where stockpiles are not well secured.

Implementation of Resolution Conf. 10.10 (Rev. CoP17) on the closure of domestic ivory markets

Kenya presented the document CoP18 Doc.69.5 concerning proposed amendments to Resolution Conf. 10.10 (Rev. CoP17) on the closure of domestic ivory markets and associated draft decisions on closing all remaining legal domestic ivory markets.

Gabon, Burkina Faso and other member states of the African Elephant Coalition, with support from Israel, supported the proposal and emphasized that legal domestic ivory markets drive demand, complicate enforcement efforts, and are linked to poaching and the illegal ivory trade. Namibia and other southern African countries expressed strong opposition, stressing that there was no evidence of a link between legal domestic markets and poaching. They questioned the value of re-opening the issue of domestic markets given the extensive debates and compromise achieved at CoP17. Thailand shared their success in exiting the National Ivory Action Plan (NIAP) process as evidence that the closure of all domestic markets was unnecessary.

Chile, EU, Japan, and several others noted that this proposal falls outside the scope of the Convention and might pave the way for similar restrictive measures to be adopted for the legal domestic markets of other CITES-listed species. The US also opposed the proposed amendments underscoring that focus should remain on assisting parties in effectively implementing Resolution Conf. 10.10 in its current form but acknowledged the importance of monitoring the impact of these markets. To this end, she proposed a new set of draft decisions requesting remaining parties with legal domestic ivory markets report on measures they are taking to ensure that such markets are not contributing to poaching or to the illegal ivory trade. In response to concerns voiced by South Africa and Zimbabwe on the role of the SC in these new decisions, Canada proposed a textual amendment to the draft decisions to ensure that they stay within the scope of CITES.

The Committee accepted the three new draft decisions proposed by the US, as amended by Canada.

Outcome

In the decisions (CoP18 Doc.69.5), the CoP directs:

- parties that have not closed their domestic markets for commercial trade in raw and worked ivory to report to the Secretariat for consideration of SC73 and SC74 on what measures they are taking to ensure that their domestic ivory markets are not contributing to poaching or illegal trade;
- the Secretariat to compile the reports and make them available to parties in advance of the SC meetings; and
- the SC to consider the reports and report on this matter and make recommendations, as appropriate, to CoP19.

CoP18 Prop.10: African elephant

Zambia presented the proposal (CoP18 Prop.10) to transfer its elephant (*Loxodonta africana*) population from Appendix I to Appendix II, allowing trade in ivory only for parties who will not re-export. Zambia stated this was for the benefit of conservation and local communities. Zimbabwe, South Africa, and Botswana supported the proposal stating that the population met the requirements for Appendix II. Nigeria, Gabon, Kenya, and Ethiopia opposed the document stating that this will lead to an increased trade in ivory. Japan added that they could support this proposal if the stocks sold

were only government-registered stocks and if the funds were used exclusively for elephant and community conservation programmes. Zambia proposed an annotation limiting the trade only to non-commercial hunting trophies and hides from elephants controlled as a result of human-elephant conflict, ivory, and all other specimens remaining subject to Appendix I requirements. He then requested a vote by secret ballot, which was rejected as it did not secure the votes required.

The Chair then moved to a vote, which Zambia challenged, as they preferred the debate to continue on the proposed amendment. The Committee then voted whether to reopen debate, which failed, not receiving a two thirds majority. Committee I then voted on the proposal, which was rejected with 22 in favour and 102 against.

Outcome: The CoP rejected CoP18 Prop.10.

CoP18 Prop.11: African elephant

Botswana introduced its proposal (CoP18 Prop.11) to amend annotation #2 for the populations of Botswana, Namibia, South Africa, and Zimbabwe to allow for two "one-off" sales of raw ivory from government-owned stocks. He stated that the countries had waited patiently for the nine-year ban on new proposals to end, and further that these sales will benefit communities and conservation efforts. Gabon and the EU opposed, stating that this could lead to an increase in poaching for ivory. eSwatini argued it would benefit long-term sustainable conservation of wildlife as well as local communities. Botswana called for a vote.

Committee II rejected the proposal by secret ballot, with 101 against and 23 in support. The US and the EU noted they had opposed the proposal. Antigua and Barbuda expressed support for the proposal.

Outcome: The CoP rejected CoP18 Prop.11.

CoP18 Prop.12: African elephant

Gabon introduced the proposal (CoP18 Prop.12) to include all African elephant (*L. africana*) populations in Appendix I, a step that would mean transferring the listing of the elephant populations of Botswana, Namibia, South Africa, and Zimbabwe from Appendix II to Appendix I. He noted the proposal was a response to a crisis of poaching, and was supported by 32 countries.

The EU stated that the populations of African elephants in Botswana, Namibia, South Africa, and Zimbabwe do not meet the criteria for inclusion in Appendix I, and furthermore that the views of range states should be taken into account. South Africa expressed deep concern that the listing would hamper current conservation efforts, noting that elephant populations have increased in the countries concerned.

Committee II voted on the proposal, which was not accepted, with 51 in favour and 67 against.

Outcome: The CoP rejected CoP18 Prop.12.

CoP18 Prop.13: Woolly mammoth

Israel introduced the proposal to include the woolly mammoth (*Mammuthus primigenius*) in Appendix II (CoP18 Prop.13), highlighting that trade in mammoth ivory provides a cover for illegal trade in elephant ivory.

Gabon and Ethiopia expressed support. The Russian Federation, as a range state, opposed the proposal, noting that the Convention strictly regulates species threatened with extinction, not extinct species, and that tools are available to distinguish the two. Canada, the EU, and the US opposed the proposal, noting that there is no evidence on the scale of the problem.

In absence of consensus, Israel proposed to reduce the scope by including only woolly mammoth carvings in the proposal. The Secretariat objected to that as well, noting that the Convention does not provide for the inclusion of extinct species.

Israel later announced that it would withdraw the original listing proposal and proposed instead two draft decisions, including a proposal to commission a study, subject to external funding, on trade in mammoth ivory and its role in illegal

trade in ivory. The Russian Federation and Canada expressed differing opinions for the record. Committee I adopted the draft decisions.

Outcome

CoP18 Prop.13 was withdrawn, but the CoP agreed to the draft decisions related to mammoth ivory.

AsESG side event

The AsESG, in partnership with Elephant Family, International Fund for Animal Welfare and WWF, organized a side event on the impact of poaching and illegal trade on Asian Elephants at the CITES CoP18.

Poaching is a major threat to elephants in Asia, although reliable estimates of the number of elephants killed and the quantities of ivory and other body parts collected and traded are scarce. It was traditionally believed that poaching is a relatively minor threat to Asian elephants because some males and all females lack tusks, but in reality Asian elephants are poached not only for ivory but for a variety of other products (including meat and skin). Poaching is now acknowledged as a threat to the long-term survival of some Asian elephant populations. In recent decades, selective poaching of tuskers for ivory has progressively skewed the sex ratio in several Asian elephant populations. Large-scale hunting of elephants for ivory, bush meat, skin and other products has reduced their populations significantly over a wide area in some countries.

The emerging trade of skin in southeast Asia in recent years is a major concern. Although the trade of elephant skin has been going on for over a decade but since 2014, there has been an increase in poaching and trade /sales with the main source of elephant skin being Myanmar and the products (beads / pendants, skin pieces, powder) being traded in nearby countries in southeast Asia (Elephant Family, 2018 and 2019). The trade could result in indiscriminate killing of elephants of both sexes, threatening fragile elephant populations in the region.

The event was addressed by six eminent speakers and the discussion was moderated by Mr Matthew Collis, Director International Policy, International Fund for Animal Welfare (IFAW). Issues ranging from poaching and illegal killing of elephants for ivory, elephant skin trade, live elephant trade, enforcement efforts undertaken in different range states as well as the overall illegal wildlife scenario were discussed at the conference. A large number of professionals from various organizations, institutes and range countries attended the side event.

1. Mr M.S. Negi, Addl. Director General of Forest (WL), Ministry of Environment, Forest and Climate Change, Government of India: *India's initiatives for preventing illegal trade in elephant products, especially ivory*.
2. Dato. Abdul Kadir bin Abu Hashim, Director General of Department of Wildlife and National Parks, Peninsular Malaysia: *Illegal ivory trade – Malaysian government's strategies and effort*.
3. Mr M.G.C. Sooriyabandara, Director General, Dept. of Wildlife Conservation Sri Lanka and Head CITES Management Authority: *Elephant conservation in Sri Lanka*.
4. Mr Justin Gosling, Law Enforcement and Criminal Justice Consultant: *Update on elephant poaching and trafficking in Myanmar*.
5. Mr Suraphong Chaweepak, Director of International Wildlife Trade Permission, Department of National Parks, Wildlife and Plant Conservation, Thailand: *The conservation of Thai elephants for sustainable development*.
6. Mr Masayuki Sakamoto, Executive Director, Japan Tiger and Elephant Fund: *Japan's domestic ivory market posing a potential threat to Asian elephants*.

Source

IISD Reporting Services (2019) *Summary of the 18th Meeting of the CITES Conference of the Parties: 17–28 August 2019*. Earth Negotiations Bulletin: A Reporting Service for Environment and Development Negotiations, Vol. 21 No. 101. <http://enb.iisd.org/cites/cop18/>

Experiences with the First Online Monitoring Tool for Body Condition Scores in European Zoo Elephants

Christian Schiffmann

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Besides measuring body mass, visual body condition scoring (BCS) is an established method for the assessment of an animal's physical state. For many zoo and wildlife species, corresponding protocols have been developed and proven very useful (Schiffmann *et al*. 2017). Especially in long-lived species such as elephants, the documentation of BCS changes over time is considered of higher significance than a lone-standing score at a specific point in time (Meehan *et al*. 2019; Schiffmann *et al*. 2018, 2019 and Fig. 1). Thus, regular BCS recordings and continuous documentation are recommended to facilitate longitudinal monitoring. The latter may serve as basis for analysis on the individual as well as the population level (Meehan *et al*. 2019; Schiffmann *et al*. 2019).

Such data may have the power to enhance our knowledge of the physical condition and development of elephants. However, their collection and storage imposes an additional workload for elephant-keeping institutions. Moreover, the scoring of animals by one single external expert is considered to be more reliable than scoring by the daily care staff (Stringer *et al*. 2010; Schiffmann *et al*. 2017).

With the aim to overcome these challenges and compile a comprehensive database, I established an online archive for BCS monitoring in European zoo elephants. The latter represents an additional outcome of a population-wide research project on the physical condition of European zoo elephants conducted in 2016 and 2017 (Schiffmann *et al*. 2018, 2019). After receiving the endorsement of the persons in charge for the management of African (*Loxodonta africana*) and Asian elephants (*Elephas maximus*) living in Europe, the corresponding facilities were provided with individual access to their data stored in the online archive in June 2018. The website is built upon Joomla! (www.joomla.org), one of the most frequently used content management systems in the world. The system standards allow flexible adjustments of the functions according to the

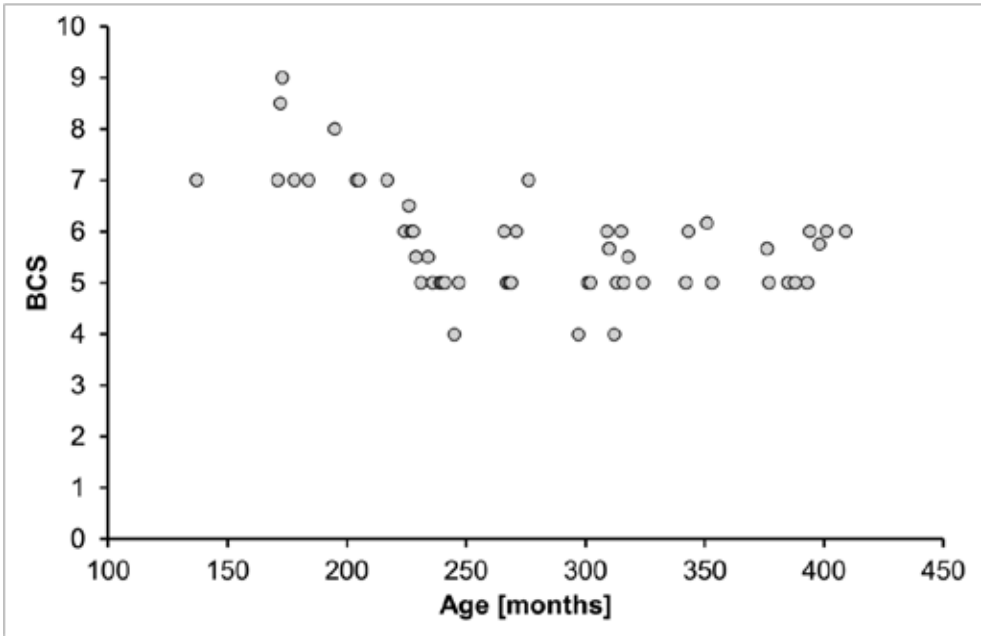


Figure 1. BCS changes over time for a female Asian elephant living in a European facility.

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specific requirements of the database. Moreover, the site has some of the most commonly used extensions for security and further functionality.

With respect to copyright issues and potential misuse, data are available exclusively for elephant-keeping facilities. When putting the archive online in June 2018 it contained 146 zoos caring for 228 African and 351 Asian elephants (altogether 579 individuals) and in total 8486 datasheets consisting of a dated pictorial document with the ascertained score (Fig. 2). On individual basis, the number of datasheets ranged from one to 79 and covered a time span of up to 40 years. I applied a modified scoring protocol based on the method by Fernando *et al*. (2009), which has recently been confirmed as most capable system available today (Chusyd *et al*. 2019). Furthermore, the filing of the underlying photographs in the archive would provide the basis for re-scoring if a more reliable protocol should emerge in the future.

Encouragingly, I received exclusively positive feedback on the tool from elephant-keeping facilities during the months following its implementation. Several holders provide current photographs of their elephants to continuously update and further extend the archive. In June 2019, one year after its implementation, the archive contained 150 zoos, 230 African and 359 Asian individuals (altogether 589 elephants) and 9024 datasheets. This means a growth rate of 6.3% during the first year or slightly over 10 new datasheets per week.

With respect to this successful start and the positive feedback from elephant-keeping facilities, I started to investigate ways to ensure the maintenance and further development of the archive in the long-term. For this, covering the running costs and expenses for regular updating and extending the archive are the most critical challenges. Ideally, this could be managed by the collective support of elephant-keeping facilities in Europe. Encouragingly, several zoos have already taken up sponsorship for the archive and I am confident that a long-term solution will be found. Data collection over the coming years would show whether the average BCS of the European zoo elephant population reaches the ideal score range (considered 5–6 in a scoring range of 0–10) soon (Fig. 3).

An online archive for BCS monitoring is a helpful management tool for zoo elephants as well as other species. Thus, I strongly recommend developing and implementation of similar archives for other zoo animals (e.g. rhinos, tapirs, wild equids, big cats) and hope that our prototype for zoo elephants may facilitate such projects.

References

Chusyd DE, Brown JL, Golzarri-Arroyo L, Dickinson SL, Johnson MS, Allison DB & Nagy



Figure 2. Each datasheet consists of an entitled and dated photograph of the individual elephant and an ascertained BCS.

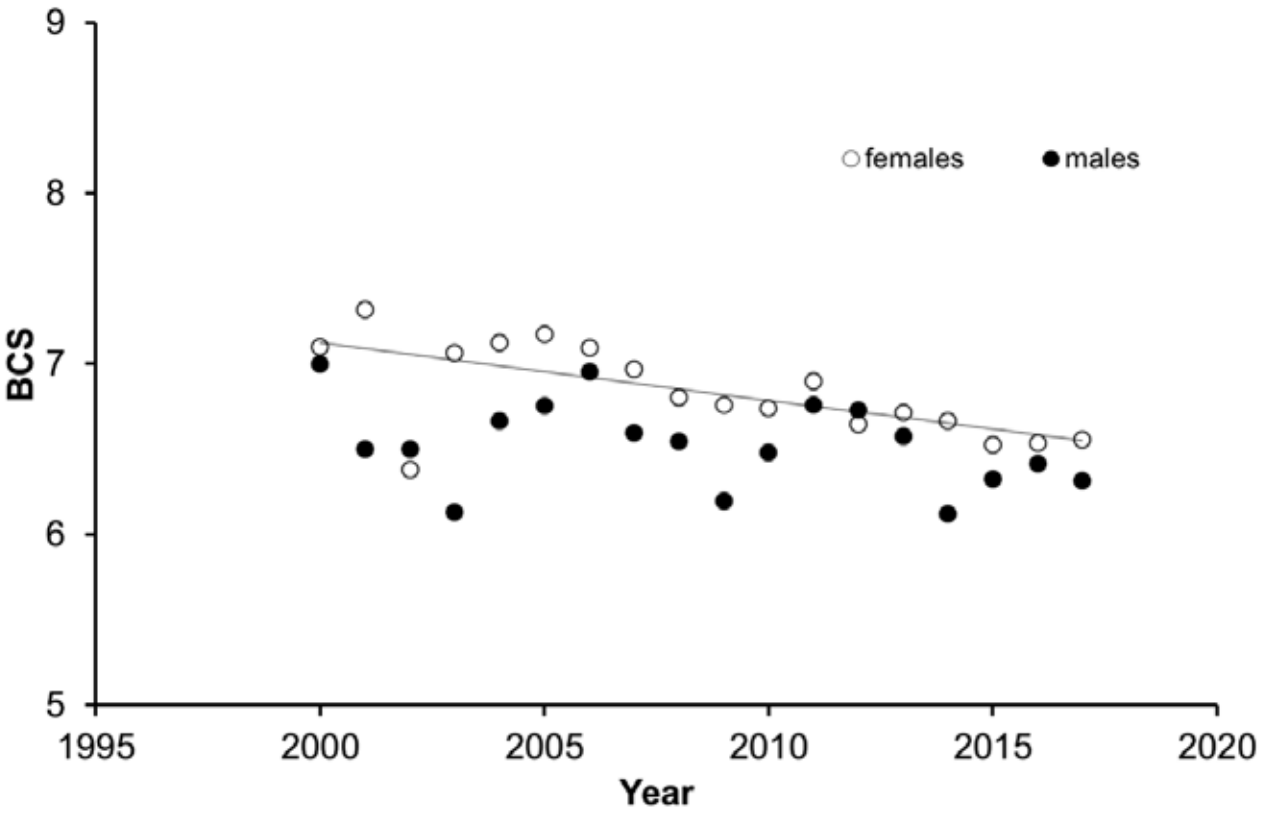


Figure 3. Archived BCSs for the European zoo elephant population enable the monitoring of the population-wide average score over years, which shows a trend towards the ideal scoring range (5-6/10) (modified from Schiffmann *et al*. 2019).

TR (2019) Fat mass compared to four body condition scoring systems in the Asian elephant (*Elephas maximus*). *Zoo Biology* **38:** 424-433.

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Schiffmann C, Clauss M, Hoby S, Codron D & Hatt J-M (2019) Body condition scores (BCS) in European zoo elephants' (*Loxodonta africana* and *Elephas maximus*) lifetimes - a longitudinal analysis. *Journal of Zoo and Aquarium Research* **7:** 74-86.

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"Dance for Kindness to Elephants and Wildlife" Event Engages Youth and Public in Ha Noi, Viet Nam

Mai Nguyen Thi[1]* and Hoa Tran Thi[2]

[1]*Humane Society International in Viet Nam*
[2]*Viet Nam Forestry Administration under Ministry of Agriculture and Rural Development*
**Corresponding author's e-mail: maitn@hsi.org*

"Dance for Kindness to Elephants and Wildlife" took place on November 24th 2019 in Ly Thai To Square by Hoan Kiem Lake in Ha Noi—which serves as both a tourist destination and a favourite place for locals to take a stroll. This event celebrated Viet Nam's wildlife and educated people as to how they can get involved in protecting wild animals, particularly elephants.

Five thousand students, ranging from primary school to university students, participated in the large-scale Freezemob and Flashmob called "Dance for Kindness to Elephants and Wildlife." During the Flashmob dance performance, the participants tried to show animals being wild, free and happy, while during the Freezemob (no or very slow movement) a series of stressed, sad, unhappy, depressed, hopeless, angry and aggressive faces illustrated animals facing challenges by human activities.

During the dance, celebrity MC Phan Anh and leaders from both the Ministry of Agriculture and Rural Development and the Ministry of Natural Resources and Environment presented the importance of wildlife and ecosystems as well as the threats they face, and importantly, how young people can change their behaviour and take meaningful actions to protect wildlife.

"Kindness to Elephants and Other Wild Animals" was another remarkable activity that was part of the event where attendees could admire photographs of wild animals taken by wildlife photographers or biologists, which were displayed along Nguyen Xi street. Sixty photographs of elephants and other wild animals were selected for display from about 100 submitted to a national competition. The photographs focused on four main themes, including: (i) the hidden beauty of nature and the role of wildlife in the ecosystem; (ii) reconciliation between human and wildlife; (iii) human activities causing wildlife losses and extinction and (iv) suggested activities that young people can do in order to combat poaching and illegal wildlife trade, thus saving the remaining elephants and other threatened species in Viet Nam for future generations.

After participating in the first two parts, attendees had the opportunity to demonstrate their feelings and commitments toward wildlife protection by engaging in a drawing competition and signing the "Wildlife Protection: Our Commitment



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and Responsibility" pledge. By the end of the event, 50 photographs of event participants were taken, to be used for subsequent communication strategies, while thousands of people signed the pledge to help wildlife and say "NO" to wildlife products.

The event comes as species throughout the country face increasing population declines. The last Javan rhino was found dead in Cat Tien National Park in Lam Dong Province, Viet Nam in April 2010. In the last two years, conservationists have warned that wild tigers are functionally extinct in Viet Nam while the elephant population is believed to be as low as less than 200 individuals, living in fragmented and poor habitats across the country. As such, this inspiring event encouraged people to appreciate the beauty of wild animals and act to protect them in their natural environment.

This event was co-organized by the Communication Center of the Ministry of Natural Resources and Environment (MONRE), the Viet Nam Youth Link Club, the Viet Nam Administration of Forestry (VN FOREST) under the Ministry of Agriculture and Rural Development (MARD), World Wildlife Fund (WWF), LOTTE Viet Nam and other organizations. Through partnership with the VN FOREST in implementing 'Humane Human Elephant Conflict Management' in Dong Nai, Humane Society International provided technical support for this meaningful event.





Video clips for your reference

https://www.facebook.com/danceforkindness.vn/
https://www.facebook.com/watch/?v=526451688199406

Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

Centre for Conservation and Research, Tissamaharama, Sri Lanka
Anthropologisches Institut, Universität Zürich, Zürich, Switzerland
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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 (2020) publications on Asian elephants.

A. Abdullah, A. Sayuti, H. Hasanuddin, M. Affan & G. Wilson
People's perceptions of elephant conservation and the human-elephant conflict in Aceh Jaya, Sumatra, Indonesia
European J. of Wildlife Research 65 (2019) e69
Abstract. No permission to print the abstract.

T.P.J. Athapattu, B.R. Fernando, N. Koizumi & C.D. Gamage
Detection of pathogenic leptospires in the urine of domesticated elephants in Sri Lanka
Acta Tropica 195 (2019) 78-82
Abstract. Leptospirosis is a globally common zoonotic infectious disease in humans and animals. This disease is caused by pathogenic spirochetes belonging to the genus *Leptospira*. The pathogen is able to survive in mammalian kidneys after infection and is excreted in urine intermittently. Pathogenic leptospires infect humans either by direct contact with infected animal urine or through contaminated soil or water. In Sri Lanka, some studies have demonstrated the involvement of animals, such as livestock species and peridomestic rats, in the transmission of leptospirosis to humans. However, none of the previous studies focused on domesticated elephants, which are in close contact with humans during cultural and religious events and bathe in rivers together with humans. If domesticated elephants act as carriers of pathogenic leptospires, it could be a major public health issue in the country. In this study, 13 healthy domesticated elephants were subjected to leptospiral DNA detection from urine samples collected on three consecutive days. Four elephants (31%) were confirmed to shed pathogenic leptospires in their urine. DNA sequencing followed by phylogenetic distance measurements revealed that all positive elephants were infected with *L. interrogans*. This study reveals the possibility that elephants act as a source of infection of leptospires to humans and recommends the screening of all domesticated elephants that are in close contact with humans for the shedding of pathogenic leptospires. © 2019 Reprinted with permission from Elsevier .

K.A. Backues & E.B. Wiedner
Recommendations for the diagnosis, treatment and management of tuberculosis, *Mycobacterium tuberculosis*, in elephants in human care
International Zoo Yearbook 53 (2019) 116-127
Abstract. African elephants *Loxodonta africana* and Asian elephants *Elephas maximus* are both susceptible to infection by *Mycobacterium tuberculosis* (Mtb). The Asian elephant has lived in close association with humans in Asian range countries for thousands of years and this close partnership is likely responsible for the exposure of the Asian elephant to this human disease. The confirmation by modern veterinary medicine of the existence of Mtb infection in elephants has only occurred recently after a testing programme was initiated in 1996 in elephant-holding facilities in the United States. At the time of writing, Mtb is recognized as a disease primarily of Asian elephants in zoos. However, recent identification of tuberculosis in several free-ranging elephants, both Asian and African, indicates that the disease may be emerging in the threatened wild populations of these species, which may further hinder the survival of wild elephants in some free-ranging populations. Ante-mortem diagnosis of the disease in

elephants is improving but remains challenging. Protecting both human and elephant health via prevention of Mtb exposure must be part of a preventative-medicine strategy wherever humans and elephants closely interact. Treatment of Mtb-infected elephants has been accomplished by many facilities with some promising results. However, many challenges remain, including the side effects of drug therapies and poor compliance to medication administration by the elephant. Inconsistent treatment may potentially result in the bacterium developing resistance to the antibiotics. A brief overview of the diagnosis, treatment and management of Mtb in elephants in human care is provided. © 2019 The Zoological Society of London.

U.S. Bechert, J.L. Brown, E.S. Dierenfeld, P.D. Ling, C.M. Molter & B.A. Schulte

Zoo elephant research: Contributions to conservation of captive and free-ranging species

International Zoo Yearbook 53 (2019) 89-115

Abstract. African elephants *Loxodonta africana* and Asian elephants *Elephas maximus* are not thriving in many captive settings and are threatened throughout their native ranges. Many zoos support in situ conservation projects and provide opportunities to conduct ex situ research in controlled settings with comparably approachable animals. Zoo elephant projects may facilitate fieldwork with free-ranging elephants (e.g. development of non-invasive sampling and analytical tools), which may then also improve the husbandry of elephants in human care. Free-ranging elephants also benefit from drug therapies and veterinary care when they are orphaned, kept as working elephants or brought in as rehabilitation cases – especially as human–elephant conflicts become more common as a result of ever-expanding human populations. Much has been learned about the basic biology and husbandry needs of elephants but, often, the more we learn, the more questions arise. There are physiological differences between African and Asian elephants, and this should affect the management of these animals. This paper will provide brief overviews of the current state of knowledge regarding the pharmacology, nutrition, reproduction, sensory biology and diseases (primarily elephant endotheliotropic herpesvirus infections) relevant to elephants with recommendations for future research. © 2019 The Zoological Society of London.

S.N. Chapman, J. Jackson, W. Htut, V. Lummaa & M. Lahdenperä

Asian elephants exhibit post-reproductive lifespans

BMC Evolutionary Biology 19 (2019) e193

Abstract. The existence of extended post-reproductive lifespan is an evolutionary puzzle, and its taxonomic prevalence is debated. One way of measuring post-reproductive life is with post-reproductive representation, the proportion of adult years lived by females after cessation of reproduction. Analyses of post-reproductive representation in mammals have claimed that only humans and some toothed whale species exhibit extended post-reproductive life, but there are suggestions of a post-reproductive stage for false killer whales and Asian elephants. Here, we investigate the presence of post-reproductive lifespan in Asian elephants using an extended demographic dataset collected from semi-captive timber elephants in Myanmar. Furthermore, we investigate the sensitivity of post-reproductive representation values to availability of long-term data over 50 years. We find support for the presence of an extended post-reproductive stage in Asian elephants, and that post-reproductive representation and its underlying demographic rates depend on the length of study period in a long-lived animal. The extended post-reproductive lifespan is unlikely due to physiological reproductive cessation, and may instead be driven by mating preferences or condition-dependent fertility. Our results also show that it is crucial to revisit such population measures in long-lived species as more data is collected, and if the typical lifespan of the species exceeds the initial study period. © 2019 The Authors.

D.E. Chusyd, J.L. Brown, L. Golzarri-Arroyo, S.L. Dickinson, M.S. Johnson, D.B. Allison & T.R. Nagy

Fat mass compared to four body condition scoring systems in the Asian elephant (*Elephas maximus*)

Zoo Biology 38 (2019) 424-433

Abstract. Captive elephant populations are not self-sustaining due to health concerns possibly related to obesity. Categorizing obesity relies on qualitative analyses like body condition scores (BCS). However, elephant indices have not been validated against measured body composition. The objective was to compare BCS systems to body composition determined by deuterium dilution in 28 zoo-kept Asian elephants. Elephants were weighed and given deuterated water orally (0.05 ml/kg). Blood was collected at ~0, 24, 120, 240, 360, and 480 hr after dosing. Photographs were taken to score the elephant based on four BCS systems (BCS_{Wemmer} [0 to 11 scoring], $BCS_{Morfeld}$ [1 to 5 scoring], $BCS_{Fernando}$ [0 to 10 scoring], $BCS_{Wijeyamohan}$ [1 to 10 scoring]). Based on regression analysis, relative fat ranged from –305 kg to 515 kg, where negative values indicate less and positive values indicate more fat than expected for the elephant's mass in this population. $BCS_{Fernando}$ was associated with relative fat ($p = .020$, $R^2 = 0.194$). Relative fat, adjusted for sex and age in the statistical model, was associated with BCS_{Wemmer} ($p = .027$, $R^2 = 0.389$), $BCS_{Fernando}$ ($p = .002$, $R^2 = 0.502$), and $BCS_{Wijeyamohan}$ ($p = .011$, $R^2 = 0.426$). Inclusion of zoo and familial relatedness resulted in all BCS systems associated with relative fat ($p \leq .015$). Only $BCS_{Fernando}$ predicted relative fat, unadjusted, suggesting it is the most capable system for practical use. Compared to absolute fat, relative fat may be more biologically relevant as greater fat relative to body mass is more likely to lead to health issues. © 2019 Wiley Periodicals, Inc.

Gregory M. Clines

Taming the tamed elephant: Ravana, aesthetics, and the generation of humor in Ravisena's Padmapurana

South Asian History and Culture 10 (2019) 309-323

Abstract. The seventh-century Digambara author Raviṣeṇa is an important figure in the history of pre-modern South Asian literature, having composed the earliest extant Jain Rāma narrative in Sanskrit, the Padmapurāṇa ('The Deeds of Padma'), a text that stands at the forefront of centuries of Jain engagement with the Rāma story. This article examines for the first time Raviṣeṇa's use of humor in constructing the character of Rāvaṇa, arguing first – with reference to both Bharata's Nāṭyaśāstra and the works of Kālidāsa – that Raviṣeṇa establishes humor by subtly undercutting common Sanskrit literary tropes, and, second, that this humor serves three interrelated purposes vis-à-vis Rāvaṇa. First, the humor foreshadows Rāvaṇa's primary character flaws that will lead to his abduction of Sītā and eventual death at the hands of Lakṣmaṇa. Second, the humor works to humanize Rāvaṇa, making him a sympathetic character to the reader. Third, the humor establishes Rāvaṇa in opposition to the calm and serious Rāma, thereby positing that, according to Raviṣeṇa, true heroism consists of controlling one's passions. © 2019 Informa UK Limited.

J. Conte, Margret J. Potoczniak, C. Mower & S.S. Tobe

ELEquant: A developmental framework and validation of forensic and conservation real-time PCR assays

Molecular Biology Reports 46 (2019) 2093-2100

Abstract. No permission to print the abstract.

S. Curtin & L. Brown

Travelling with a purpose: An ethnographic study of the eudemonic experiences of volunteer expedition participants

Tourist Studies 19 (2019) 192-214

Abstract. Purposeful travel is apparent in new modes of tourism and particularly in volunteer holidays where tourists are searching for meaningful experiences that provide a sense of physical, emotional or spiritual fulfilment. Based on a qualitative study using participant observation, this article adopted the concept of eudemonia to explore the experiences of participants on an elephant conservation expedition to Bardia National Park, Nepal. Volunteer travel is used to connect with and understand the wider world. Rather than an escape, these journeys allowed participants to experience first-hand the hardships and realities of people in other countries; creating greater perspective and making them 'better people' on their return. Feeling virtuous can only be mobilised, however, if participants felt themselves to be useful rather than a passive or ill-equipped bystander. Findings also revealed how the return home is not always

easy; that the process of re-entry can be isolating. © 2018 The Authors.

J.C. Deb, S. Phinn, N. Butt & C.A. McAlpine
Adaptive management and planning for the conservation of four threatened large Asian mammals in a changing climate
Mitigation and Adaptation Strategies for Global Change 24 (2019) 259–280
Abstract. No permission to print the abstract.

J.A. de la Torre, A.M. Lechner, E.P. Wong, D. Magintan, S. Saaban & A. Campos-Arceiz
Using elephant movements to assess landscape connectivity under Peninsular Malaysia's central forest spine land use policy
Conservation Science and Practice 1 (2019) e133
Abstract. One of the most vital and urgent global conservation challenges is to deal with the loss and fragmentation of wildlife habitats, particularly for large - bodied and wide - ranging terrestrial megafauna. The Central Forest Spine Master Plan for Ecological Linkages (CFS) was developed by the Malaysian Federal Government in 2010 to protect biodiversity and ecosystem services by securing landscape connectivity between Peninsular Malaysia's main forest blocks. Here we present an evaluation of the effectiveness of the CFS master plan to promote functional connectivity for Asian elephants, one of its focal species. The specific objectives of our study were to identify the most critical forest patches to maintain connectivity for elephants in Peninsular Malaysia, assess functional connectivity within the CFS ecological linkages, and identify alternative corridors where appropriate to enhance CFS effectiveness. We used the largest animal movement dataset in Peninsular Malaysia (220,000 GPS locations from 53 elephants) to develop models of elephant movement probability and to estimate landscape resistance using step selection functions based on landscape characteristics. According to our evaluation of 28 linkages, 57% of them provided high functional connectivity, 28% provided acceptable connectivity, and 14% provided low to no connectivity. A very important and positive finding is that the CFS linkages with the highest centrality values (i.e., the most important to maintain overall connectivity in Peninsular Malaysia) also score highly in functional connectivity (i.e., they are actually effective corridors for elephant movement). This means that an adequate CFS implementation can lead to high levels of functional connectivity among Peninsular Malaysia's main forest blocks. Based on our assessment, we recommend to conduct some revisions on the CFS plan to ensure its effectiveness. © 2019 The Authors.

B. Dhakal & B. Thapa
Residents' perceptions of human-elephant conflict: Case study in Bahundangi, Nepal
Environment, Development and Sustainability 21 (2019) 461-481
Abstract. No permission to print the abstract.

S. Dorji, R. Rajaratnam & K. Vernes
Mammal richness and diversity in a Himalayan hotspot: The role of protected areas in conserving Bhutan's mammals
Biodiversity and Conservation 28 (2019) 3277–3297
Abstract. No permission to print the abstract.

K.L. Edwards , M.A. Miller, K. Carlstead & J.L. Brown
Relationships between housing and management factors and clinical health events in elephants in North American zoos
PLoS ONE 14 (2019) e0217774
Abstract. Elephants experience a number of health issues that can contribute to their well-being and survival. In managed populations, housing conditions and management practices can influence individual health, so potential risk factors associated with morbidity or mortality should be identified to ensure the best possible standards of care. The goal of this study was to determine if the number of clinical events experienced could be a useful welfare indicator in zoo elephants, and to determine factors associated with key pathologies. We used an epidemiological approach to investigate how intrinsic (species, sex, age) and extrinsic (housing, management) factors were associated with both the total number of clinical events, and each of the four most prevalent pathology types (gastrointestinal issues, skin lesions,

lameness, foot lesions), over a 12-month period. The study included 220 (127 African; 93 Asian) elephants housed at 61 facilities across North America. More than 1100 clinical events were identified. Species and sex differences were apparent in the types of pathology encountered, and unsurprisingly, the number of clinical events was positively correlated with age. Factors relating to housing (percent time with indoor/outdoor choice, space experience inside, number of unique environments an elephant was housed in, percent time on soft substrate) and management (enrichment diversity, spread of feeding opportunities) were also related to the number of clinical events. However, relationships were often counter to our initial hypotheses, highlighting caution in assuming cause and effect from correlational analyses such as these. Other welfare indicators such as serum and fecal glucocorticoids and serum prolactin were also associated with health status, being higher or more variable in individuals with a greater number of events. This approach provides insight into housing and management factors related to the health of these species in zoos, and in some cases, may reflect management changes that have already been made to mitigate existing or anticipated health concerns.

H. Gautam, E. Arulmalar, M.R. Kulkarni & T.N.C. Vidya

NDVI is not reliable as a surrogate of forage abundance for a large herbivore in tropical forest habitat

BioTropica 51 (2019) 443-456

Abstract. Remotely sensed vegetation indices are increasingly being used in wildlife studies but field-based support for their utility as a measure of forage availability comes largely from open-canopy habitats. We assessed whether normalized difference vegetation index (NDVI) represents forage availability for Asian elephants in a southern Indian tropical forest. We found that the number of food species was a small percentage of all plant species. NDVI was not a good measure of food abundance in any vegetation category partly because of (a) small to moderate proportional abundances of food species relative to the total abundance of all species in that category (herbs and shrubs), (b) abundant overstory vegetation resulting in low correlations between NDVI and food abundance, despite a high proportional abundance of food species and a concordance between total abundance and food species abundance (graminoids), and (c) the relevant variables measured and important as food at the ground level (count and GBH) not being related to primary productivity (trees and recruits). NDVI had a negative relationship with the total abundance of graminoids, which represent a bulk of elephant and other herbivore diet, because of negative interaction with other vegetation and canopy cover that positively explained NDVI. Spatially interpolated total graminoid abundance modeled from field data outperformed NDVI in predicting total graminoid abundance, although interpolation models of food graminoid abundance were not satisfactory. Our results reject the utility of NDVI in mapping elephant forage abundance in tropical forests, a finding that has implications for studies of other herbivores also. © 2019 The Association for Tropical Biology and Conservation.

C. Good, P. Tyrrell, Z. Zhou & D.W. Macdonald

Elephants never forget, should art museums remember too? Historic ivory collections as ambassadors for conservation education

Biodiversity and Conservation 28 (2019) 1331-1342

Abstract. Ivory in art museum collections has been a contentious topic during recent years, with some parties calling for its destruction. But analysis of media reactions to the parallel strategy of burning modern ivory stockpiles may offer insight to the likely effectiveness of that course of action in museums: such burns have seemingly fallen short in sending a clear and enduring message to the intended demographics—be this consumers, dealers, poachers or traffickers. This prompts us to suggest an alternative to the destruction of museum ivory: that art museums with ivory collections take on the challenge and responsibility of imparting powerful conservation messages. This article explores the potential of ivory artworks as educational ambassadors, as well as the international reach of museums to target demographics in key ivory consumer regions such as South East Asia, and the ethical obligations of museums with ivory collections to

participate in conservation education. In placing a useful lens on these currently controversial artworks, museum ivory would be endowed with a new critical relevance as educational ambassadors for contemporary conservation issues, simultaneously offering justification for the preservation and display of these historic artworks that many museums are presently reluctant to exhibit. In highlighting the potential of museum ivory as a vehicle for conservation education we highlight the need for heightened holistic collaboration across disciplines to ensure that conservation messages reach diverse audiences in novel and impactful ways. © 2019 The Authors.

E.M. Gross, B.P. Lahkar, N. Subedi, V.R. Nyirenda, L.L. Lichtenfeld & O. Jakoby

Does traditional and advanced guarding reduce crop losses due to wildlife? A comparative analysis from Africa and Asia

Journal for Nature Conservation 50 (2019) e125712

Abstract. Crop damage caused by herbivorous wildlife species on farms located within conservation landscapes, is a driver of human-wildlife conflict (HWC). Guarding of farms, whereby farmers spend the night out in the fields, in areas adjacent to protected areas is, therefore, very common in many African and Asian countries. Furthermore, guarding is often combined with other crop protection measures, but little is known about the efficacy of these measures. We examined the effect that different traditional and advanced crop protection measures (active and passive guarding strategies, barriers and combinations of measures) had on the magnitude of damaged crops. For this, we examined the cost of crop damage caused by a total of 20 wildlife species in two African and two Asian study areas, where different protection types were applied. Data was compared with the cost of crop damage on unprotected fields. We continuously used a standardised HWC assessment scheme over six years (2009–2014), based on site observations and measurements in addition to interviews with victims. The analysis of crop damage costs revealed substantial losses, especially from that caused by elephants (*Loxodonta africana* and *Elephas maximus*) and other large herbivores, such as zebra (*Equus quagga*) and common eland (*Taurotragus oryx*). Once wildlife had entered the farms, it was found that crop protection measures by farmers were only able to reduce damage costs when applied as a communal, strategic guarding system. Surprisingly, all other traditional crop protection strategies have proven ineffective in reducing crop damage costs. Electrical fences actually increased the risk of crop damage when combined with guarding and the chasing of wildlife strategies. Therefore, we recommend reviewing the practice of traditional guarding strategies and the effectiveness of fences. Furthermore, we emphasise the need for objective evaluation of HWC mitigation strategies in the long-term. © 2019 Reprinted with permission from Elsevier.

M. Hartley, A. Wood & L. Yon

Facilitating the social behaviour of bull elephants in zoos

International Zoo Yearbook 53 (2019) 62-77

Abstract. In the wild, bull elephants socialize with conspecifics of all ages and both sexes, and young bulls develop social bonds with other elephants which will be sustained throughout their lives. Significant progress has been made towards providing an environment that facilitates social behaviour and multi-generational family structure for female elephants in zoos. However, it is more complex and challenging to build facilities and manage groups of elephants in ways that allow fission–fusion herd dynamics and give the elephants choice over their environment. For bulls, this is further complicated by their potential strength and aggressive behaviour. To advance the development of best-practice management for zoo elephants and achieve high standards of welfare, it is necessary to improve our understanding of the social and behavioural needs of bull elephants, and implement radical and innovative solutions to their care. In this paper we (1) consider how the social behaviour of bull elephants is addressed in zoos, comparing their social management with their behaviour in the wild, (2) contribute novel preliminary data about how these issues are addressed, and (3) propose some new approaches to the management of bull elephants in zoos for the future. © 2019 The Zoological Society of London.

N. Irie & M. Hiraiwa-Hasegawa

Unique numerical competence of Asian elephants on the relative numerosity judgment task

Journal of Ethology 37 (2019) 111-115

Abstract. Many animals demonstrate numerical competence even without language. However, their representation is mainly based on inaccurate quantity instead of absolute numbers. Thus, their performance on numerical tasks is affected by the distance, magnitude, and the ratio of comparisons (i.e., as distance decreases, magnitudes increase, or as ratios increase the accuracy of discrimination decreases). We report that Asian elephants' numerical representation is quite different from that of other animals. We trained three Asian elephants to use a touch-panel apparatus and one female successfully learned to use the apparatus. Next, a relative numerosity judgment task was presented on the screen and the elephant was asked to touch, with the tip of her trunk, the figures with the larger numbers of items. The numbers of items in each figure ranged from 0 to 10. We found that her performance was unaffected by distance, magnitude, or the ratios of the presented numerosities but, consistent with observations of human counting, she required a longer time to respond to comparisons with smaller distances. This study provides the first experimental evidence that nonhuman animals have cognitive characteristics partially identical to human counting. © 2019 The Authors.

Ritesh Joshi & Kanchan Puri

Train-elephant collisions in a biodiversity-rich landscape: A case study from Rajaji National Park, North India

Human-Wildlife Interactions 13 (2019) 370-381

Abstract. Linear developments like railways and highways have a negative impact on ecological processes of wildlife species at a landscape level. The impacts in terms of wildlife mortality and threat to surviving populations of species have been well-studied; however, less work has been done to understand the potential causes of train-wildlife collisions, particularly large mega-fauna such as Asian elephants (*Elephas maximus*; elephant). In this case study, we review train-elephant collisions (TECs) that occurred in Rajaji National Park (RNP) and discuss some potential causes of TECs along with mitigation measures. The RNP, located in the upper Gangetic plains of northern India, has been an elephant conservation stronghold. However, 25 elephants have been killed from 1987–2018 in TECs along 18 km of the Haridwar-Dehradun railway track, which connects the RNP with the Corbett Tiger Reserve. Most of the collisions occurred during night and in summer months. Preliminary observations suggest that the social bonds among the groups of elephants and their relatively large home ranges, coupled with the speed of the trains and sharp turning radius, appear to be related to the collisions. Based on this information, mitigation measures should include reducing the speed of the train in high-risk areas and periods as well as habitat modifications such as developing recharging natural water sources. These measures could be coordinated with railway managers and wildlife officials. Scientific studies and related outreach programs that increase awareness among local communities and railway managers about the causes, impacts, and measures could also be organized to minimize negative human-elephant interactions. © 2019 Reprinted with permission from Human-Wildlife Interactions.

U.K. Kalirathinam, S. Elangkovan, J. Kawi & F. Cabana

Sleep monitoring of an Asian elephant *Elephas maximus* calf at Night Safari, Singapore: Testing whether sleep time is a significant predictor of cortisol or the onset of positive elephant endotheliotropic herpesvirus viraemia

International Zoo Yearbook 53 (2019) 128-137

Abstract. A number of methods for measuring the welfare of elephants in human care have been used within zoological associations and rescue centres worldwide. The measurement of glucocorticoids in relation to stress has been particularly well validated. Measuring stress is especially important for Asian elephant *Elephas maximus* calves between one and 8 years of age which are highly susceptible to developing elephant endotheliotropic herpesvirus (EEHV) haemorrhagic disease. Sleep monitoring has been used as a possible means of assessing the welfare state of animals, although the efficacy of this method has not been validated. Our aim was to test whether sleep time or cortisol provided

the most significant predictor for the onset of positive EEHV blood viraemia in a 2 year-old calf at Night Safari, Singapore. Faecal samples were collected twice per week and assayed for glucocorticoids. Using closed-circuit television, the time the calf slept each night was measured between December 2017 and September 2018. Sleep was not a predictor of viraemia nor of cortisol concentration in this study. However, cortisol appeared to be related to the occurrence of viraemia. © 2019 The Zoological Society of London.

O. Ketchaisri, C. Siripunkaw & J.M. Plotnik
The use of a human's location and social cues by Asian elephants in an object-choice task
Animal Cognition 22 (2019) 907-915
Abstract. No permission to print the abstract.

R.K. Koirala, W. Ji, P. Paudel, S.C.P. Coogan, J.M. Rothman & D. Raubenheimer
The effects of age, sex and season on the macronutrient composition of the diet of the domestic Asian elephant
Journal of Applied Animal Research 47 (2019)
Abstract. Limited data are available on the relationship between seasonal diets and macronutrient and energy intake of domestic Asian elephants. The effects of age, sex and season on the nutrient composition and intake of food were investigated using 16 domesticated Asian elephants of different ages and sexes. There were no significant seasonal differences in the protein content of the major food plants. However, a seasonal variation in the intake of protein was evident. We used geometric modelling of non-protein (NP) neutral detergent fibre (NDF) and protein to examine seasonal nutrient variability within different ages, sexes and physiological states. The model suggested that most individual elephants maintained their recommended metabolizable energy intake from their diet across all seasons. However, we had anticipated less energy intake from poor diet due to less protein and higher NDF in the feeding ground during winter, pre-monsoon and monsoon seasons. Despite eating a lower variety of plants with less protein and higher NDF, elephants maintained a consistent pattern of diet intake in these seasons, suggesting that they acquired the recommended energy intake by regulating their diet, most likely through over-ingesting low-quality, non-complementary food as they did not have the opportunity to select from a variety of plants. © 2019 The Authors.

M. Lahdenperä, J. Jackson, W. Htut & V. Lummaa
Capture from the wild has long-term costs on reproductive success in Asian elephants
Proc. R. Soc. B 286 (2019) e20191584
Abstract. Capturing wild animals is common for conservation, economic or research purposes. Understanding how capture itself affects lifetime fitness measures is often difficult because wild and captive populations live in very different environments and there is a need for long-term life-history data. Here, we show how wild capture influences reproduction in 2685 female Asian elephants (*Elephas maximus*) used in the timber industry in Myanmar. Wild-caught females demonstrated a consistent reduction in breeding success relative to captive-born females, with significantly lower lifetime reproduction probabilities, lower breeding probabilities at peak reproductive ages and a later age of first reproduction. Furthermore, these negative effects lasted for over a decade, and there was a significant influence on the next generation: wild-caught females had calves with reduced survival to age 5. Our results suggest that wild capture has long-term consequences for reproduction, which is important not only for elephants, but also for other species in captivity. © 2019 The Authors.

H. Lauridsen, S. Gonzales, D. Hedwig, K.L. Perrin, C.J.A. Williams, P.H. Wrege, M.F. Bertelsen, M. Pedersen & J.T. Butcher
Extracting physiological information in experimental biology via Eulerian video magnification
BMC Biology 17 (2019) e103
Abstract. Videographic material of animals can contain inapparent signals, such as color changes or motion that hold information about physiological functions, such as heart and respiration rate, pulse wave velocity, and vocalization. Eulerian video magnification allows the enhancement of such signals to enable their detection. The purpose of this study is to demonstrate how

signals relevant to experimental physiology can be extracted from non-contact videographic material of animals. We applied Eulerian video magnification to detect physiological signals in a range of experimental models and in captive and free ranging wildlife. Neotenic Mexican axolotls were studied to demonstrate the extraction of heart rate signal of non-embryonic animals from dedicated videographic material. Heart rate could be acquired both in single and multiple animal setups of leucistic and normally colored animals under different physiological conditions (resting, exercised, or anesthetized) using a wide range of video qualities. Pulse wave velocity could also be measured in the low blood pressure system of the axolotl as well as in the high-pressure system of the human being. Heart rate extraction was also possible from videos of conscious, unconstrained zebrafish and from non- dedicated videographic material of sand lizard and giraffe. This technique also allowed for heart rate detection in embryonic chickens in ovo through the eggshell and in embryonic mice in utero and could be used as a gating signal to acquire two-phase volumetric micro-CT data of the beating embryonic chicken heart. Additionally, Eulerian video magnification was used to demonstrate how vocalization-induced vibrations can be detected in infrasound-producing Asian elephants. Eulerian video magnification provides a technique to extract inapparent temporal signals from videographic material of animals. This can be applied in experimental and comparative physiology where contact-based recordings (e.g., heart rate) cannot be acquired. © 2019 The Authors.

I. Lueders, A.-K. Oerke, T. Knauf-Witzens, D. Young & H.J. Bertschinger

Use of gonadotropin releasing hormone (GnRH) vaccines for behavioural and reproductive control in managed Asian elephant *Elephas maximus* and African elephant *Loxodonta africana* populations

International Zoo Yearbook 53 (2019) 138-150

Abstract. Object recognition is a challenging task in image processing and computer vision. In this paper, segmentation, feature extraction and classification methods are done for elephant recognition. Thresholding based segmentation technique is used for image segmentation and k-NN classifier is used for object recognition based on the shape features of the segmented image. Infrared elephant images are considered for experimentation. The database created by us for this type of object recognition includes elephant, bear, horse, pig, tiger, and cow and lion images. The recognition rate is calculated for performance evaluation. However, implementing such algorithms on software consumes more time as image sizes and bit depths grow larger. Hence this paper aims at hardware implementation of elephant recognition to reduce the computational time. The proposed hardware is prototyped inVirtex-4 xc4vlx25 FPGA using Xilinx System Generator (XSG) tool. The hardware/software co-simulation feature allows the input and output to be displayed on Matlab window while the processing is done through FPGA. The results indicate that when the category is elephant and if the recognition status is "yes", recognition rate is 100%. If the category is not an elephant and if the recognition status is "no", recognition rate is still 100% also indicates, the approach is successful in elephant recognition and the computation of segmentation algorithm and shape feature extraction (area, centroid, equivdiameter) in hardware reduces the computational time of elephant recognition by 89.65% as compared to software computation. © 2019 The Zoological Society of London.

C. Meehan, B. Greco, B. Lynn, K. Morfeld, G. Vicino, D. Orban, C. Gorsuch, M. Quick, L. Ripple, K. Fournier & D. Moore

The Elephant Welfare Initiative: A model for advancing evidence-based zoo animal welfare monitoring, assessment and enhancement

International Zoo Yearbook 53 (2019) 45-61



Abstract. The Elephant Welfare Initiative (EWI) is an effort supported by a community of member zoos with the common goal of advancing evidence-based elephant-care practices that enhance welfare. The idea for the EWI came about following the completion of a large-scale North American elephant welfare study, which demonstrated that daily practices, such as social management, enrichment and exercise, play a critical role in improving the welfare of elephants in zoos. In 2014, the Elephant Taxon Advisory Group of the Association of Zoos and Aquariums expressed an interest in building upon the results of this study to support the continued assessment of elephant programmes and implementation of enhanced management practices. The EWI is supported by a web-based system of software tools and resources. In contrast to traditional record-keeping systems, the EWI tools provide participants with real-time analysis as well as zoo- and elephant-level metrics for key welfare indicators and associated management practices. Members' data are pooled to create opportunities for benchmarking, and to leverage the collective efforts of individual organizations to address elephant welfare challenges and generate the data necessary to identify evidence-based strategies for enhanced outcomes. Future considerations include extending the EWI model to other species in managed settings, and to support transitional programmes for in situ elephant reintroduction efforts. © 2019 The Zoological Society of London.

V. Menon & S.K. Tiwari

Population status of Asian elephants *Elephas maximus* and key threats

International Zoo Yearbook 53 (2019) 17-30

Abstract. The Asian elephant *Elephas maximus* is distributed in 13 countries across South Asia and South East Asia spread over an area of 486,800 km^2 with a population of c. 48,323–51,680 in the wild and c. 15,000 in captivity. The major threats to the survival of the species are habitat shrinkage and fragmentation, human–elephant conflict, poaching and illegal trade of elephant body parts. The elephant populations of Vietnam, Sumatra and Myanmar are under great threat with only 100–130 elephants left in the wild in Vietnam. Apart from ivory, the trade of other body parts of elephants, especially the skin trade, has increased in last few years further threatening the elephant population. This trade could result in indiscriminate killing of elephants of both sexes threatening the fragile elephant population in the region. Human-elephant conflict has become a significant threat for the conservation of Asian elephants across their range of distribution and needs to be managed urgently to prevent retaliation. The welfare and care of elephants in captivity is a major concern as are the training methods used with these elephants. There is also a need to create and conform to a uniform registration system for elephants in human care to prevent illegal trade of individuals. © 2019 The Zoological Society of London.

T. Mukherjee, L.K. Sharma , M. Thakur, G.K. Saha & K. Chandra

Changing landscape configuration demands ecological planning: Retrospect and prospect for megaherbivores of North Bengal

PLoS ONE 14 (2019) e0225398

Abstract. The Gorumara National Park (GNP) is an important conservation area located in the northern region of West Bengal State, India, as it provides habitat for three megaherbivores: Indian One-horned rhinoceros (*Rhinoceros unicornis*), Asian elephants (*Elephas maximus*) and Gaurs (*Bos gaurus*). It harbours one of the last population of the one-horned rhino. In the present study, landscape change and configuration were investigated by comparing three Landsat images, from 1998, 2008 and 2018. The images were classified into six different landcover classes following standard methodology. The present study also involves evaluation of landscape and anthropogenic predictors influence on the megaherbivores of GNP, followed by future landcover simulation for the year 2028. The result shows a significant decrease in the grassland cover from 18.87 km^2 to 8.27 km^2 from 1998 to 2018, whereas the woodland cover has increased from 50.14 km^2 to 62.09 km^2 between 1998 and 2018. The landscape configuration indices such as Number of Patches (NP), Patch Density (PD), Interspersion and Juxtaposition (IJI), Aggregation Index (AI) and Mean Shape Index (SHAPE AM) indicated that the landscapes has lost complexity in the spatial placement of patches of different

Land Use and Land Cover (LULC) classes. Also, the landscape over the three decades has become uniform in terms of diversity of patches, because of earlier plantation activities by the forest managers. Result also indicated that grassland, along with its class metrics are the top predictors contributing 43.6% in explaining the spatial distribution of megaherbivores in GNP. Results from the simulated landcover of 2028 suggest a possible decline in overall grassland by 6.23% and a subsequent upsurge in woodland by 6.09% from 2018. The present result will be useful in guiding the forest management in developing habitat improvement strategies for the long-term viability of megaherbivore populations of rhino, gaur and elephant in the GNP. © 2019 The Authors.

J.N. Ngatia, T.M. Lan, Y. Ma, T.D. Dinh, Z. Wang, T.D. Dahmer & Y.C. Xu

Distinguishing extant elephants ivory from mammoth ivory using a short sequence of cytochrome b gene

Scientific Reports 9 (2019) e18863

Abstract. Trade in ivory from extant elephant species namely Asian elephant (*Elephas maximus*), African savanna elephant (*Loxodonta africana*) and African forest elephant (*Loxodonta cyclotis*) is regulated internationally, while the trade in ivory from extinct species of Elephantidae, including woolly mammoth, is unregulated. This distinction creates opportunity for laundering and trading elephant ivory as mammoth ivory. The existing morphological and molecular genetics methods do not reliably distinguish the source of ivory items that lack clear identification characteristics or for which the quality of extracted DNA cannot support amplification of large gene fragments. We present a PCR-sequencing method based on 116 bp target sequence of the cytochrome b gene to specifically amplify elephantid DNA while simultaneously excluding non-elephantid species and ivory substitutes, and while avoiding contamination by human DNA. The partial cytochrome b gene sequence enabled accurate association of ivory samples with their species of origin for all three extant elephants and from mammoth. The detection limit of the PCR system was as low as 10 copy numbers of target DNA. The amplification and sequencing success reached 96.7% for woolly mammoth ivory and 100% for African savanna elephant and African forest elephant ivory. This is the first validated method for distinguishing elephant from mammoth ivory and it provides forensic support for investigation of ivory laundering cases. © 2019 The Authors.

T. Norkaew, J.L. Brown, P. Bansiddhi, C. Somgird, C. Thitaram, V. Punyapornwithaya, K. Punturee, P. Vongchan, N. Somboon & J. Khonmee

Influence of season, tourist activities and camp management on body condition, testicular and adrenal steroids, lipid profiles, and metabolic status in captive Asian elephant bulls in Thailand

PLoS ONE 14 (2019) e0210537

Abstract. We previously found relationships between body condition and physiological function affecting health and welfare of female tourist camp elephants in Thailand, and used that approach to conduct a similar study of bull elephants in the same camps (n = 13). A body condition score (BCS) was done every other month, and fecal glucocorticoid metabolite (FGM) concentrations were measured twice monthly for 1 year. Effects of season, camp management and tourist activity on lipid profiles [total cholesterol (TC), low density lipoproteins (LDL), high density lipoproteins (HDL), triglycerides (TG)] and metabolic factors [insulin, glucose, fructosamine, glucose to insulin ratio (G:I)] were determined and correlated to measures of body condition, testosterone and FGM. Positive correlations were found between BCS and TG, between FGM and TG, HDL and glucose, and between testosterone and HDL, whereas BCS and testosterone were negatively associated with the G:I. There was a significant positive relationship between FGM and testosterone. Elevated FGM concentrations were associated with altered lipid and metabolic profiles and were higher in winter compared to summer and rainy seasons. Insulin and glucose levels were higher, while the G:I was lowest in the winter season. Strong positive associations were found between TC and HDL, LDL and HDL and glucose, and glucose and insulin. By contrast, negative relationships were found between the G:I and HDL and glucose,

and between insulin and G:I. Differences also were found between High and Low tourist season months for FGM, insulin, and G:I. Last, there was notable variation among the camps in measured parameters, which together with tourist season effects suggests camp management may affect physiological function and welfare; some negatively like feeding high calorie treats, others positively, like exercise. Last, compared to females, bull elephants appear to be in better physical health based on normal BCSs, lower insulin levels and higher G:I ratios.

L. Ong, K. McConkey, A. Solana-Mena & A. Campos-Arceiz

Elephant frugivory and wild boar seed predation of *Irvingia malayana*, a large-fruited tree, in a rainforest of Peninsular Malaysia

Raffles Bulletin of Zoology 67 (2019) 160-170

Abstract. *Irvingia malayana* is a large-fruited and large-seeded tree species of Southeast Asia. As a large-fruited tree, it interacts with large mammal consumers, which either disperse or consume its seeds. In this preliminary study, we describe functional differences between Asian elephants (*Elephas maximus*) and wild boars (*Sus scrofa*) in their interactions with the fruits of *I. malayana* in a rainforest in northern Peninsular Malaysia. We baited one camera trap under each of five fruiting *I. malayana* trees for a total of 86 camera trap nights and recorded a total of 145 independent visits from 12 vertebrate species. We recorded only two (1.4% of 145) visits by elephants, but they were the only animals to swallow *I. malayana* seeds (1.9% of 312 focal seeds). Wild boars were frequently recorded (29.7% of the animal visits), and they often acted as seed predators (consuming 24.4% of the 312 focal seeds). Besides these functional differences, an interesting temporal resource differentiation between the two species was also observed. Elephants consumed fresh fruits of one or two days old, while wild boars consumed fruits older than five days, probably when seeds could be accessed more efficiently. No animal species other than elephants was recorded to swallow the fruits of *I. malayana*, suggesting that elephants may be important dispersal vectors for this tree species in the tropical rainforest of Malaysia. © National University of Singapore.

Meera Anna Oommen

The elephant in the room: Histories of place, memory and conflict with wildlife along a southern Indian forest fringe

Environment and History 25 (2019) 269-300

Abstract. This paper traces past and present entanglements between people and elephants along a forest-agriculture fringe in Kerala's Western Ghats. In doing so, it explores the evolution of conservation-linked conflict and its problematic impacts. Over the centuries, the region's elephants have played a dominant role in its mountain landscapes: as antagonists to cultivators; as sources of ivory, labour and revenue to forest traders, local rulers and imperial administrators; and as cultural and religious icons straddling forests and countryside. Environmental protection arrangements in recent years ushered in a new elephant, a charismatic flagship beloved of conservationists, but also a key actor involved in fluctuating tensions along the forest edge. In this study, I explore long-term engagements between people and elephants by interrogating three critical phases in history, each incorporating a changing identity for the place in question: as a bountiful, ivory-rich forest at the turn of the Christian Era; as a site of capitalist production during the colonial period; and eventually as a contested conservation landscape. I show that these identities are predicated as much by extra-local processes such as migration and capitalist enterprises, as by embedded engagements with non-human agency. Contemporary conflict is, therefore, a complex ongoing narrative fuelled by a dynamic interaction between the persistence of human and animal memories as well as by multi-scale socio-political catalysts with long histories of influence. By ignoring historical contingencies and diverse discourses, contemporary conservation interventions may overlook the proverbial and sometimes literal elephant in the room. © 2019 The White Horse Press.

N. Othman, B. Goossens, C.P.I. Cheah, S. Nathan, R. Bumpus & M. Ancrenaz

Shift of paradigm needed towards improving human-elephant coexistence in monoculture landscapes in Sabah

International Zoo Yearbook 53 (2019) 161-173

Abstract. This article outlines the contemporary situation of the Bornean elephant *Elephas maximus borneensis* in Sabah (Malaysian Borneo), and focuses on the existing challenges that need to be addressed to enable people and elephants to coexist, particularly in man-made landscapes dominated by oil-palm plantations. Bornean elephants are confined mostly to Sabah, to the north-east 5% of the Borneo Island. Sabah started to expand its commercial plantation sector in the early 1980s and is the largest producer of palm oil in Malaysia, contributing c. 10% of global output for this commodity. The rapid pace of plantation expansion has resulted in the loss of the majority of lowland areas that are also needed by large mammal species to sustain breeding populations. Elephants are extreme lowland/floodplain specialists, and they still attempt to use their former and preferred habitat, which is now mostly dominated by oil-palm plantations. At the time of writing, the land-use planning system favoured by the government insufficiently incorporates the ecological and management needs for elephants across the entire landscape. This article also highlights the need for better collaboration and coordination between stakeholders to address the increasing rate of human-elephant conflicts in Sabah. © 2019 The Zoological Society of London.

M.A. Pardo, J.H. Poole, A.S. Stoeger, P.H. Wrege, C.E. O'Connell-Rodwell, U.K. Padmalal & S. de Silva

Differences in combinatorial calls among the 3 elephant species cannot be explained by phylogeny

Behavioral Ecology 30 (2019) 809-820

Abstract. Understanding why related species combine calls in different ways could provide insight into the selection pressures on the evolution of combinatorial communication. African savannah elephants (*Loxodonta africana*), African forest elephants (*Loxodonta cyclotis*), and Asian elephants (*Elephas maximus*) all combine broadband calls (roars, barks, and cries) and low-frequency calls (rumbles) into single utterances known as "combination calls." We investigated whether the structure of such calls differs among species and whether any differences are better explained by phylogenetic relationships or by socioecological factors. Here, we demonstrate for the first time that the species differ significantly in the frequency with which they produce different call combinations using data from multiple study sites. *Elephas maximus* and *L. africana* mostly produced roar–rumble combinations, whereas *L. cyclotis* produced a more even distribution of roar–rumble, rumble–roar, and rumble–roar–rumble combinations. There were also significant differences in favored structure among populations of the same species. Moreover, certain call orders were disproportionately likely to be given in particular behavioral contexts. In *L. africana*, rumble–roar–rumble combinations were significantly more likely than expected by chance to be produced by individuals separated from the group. In *E. maximus*, there was a nonsignificant trend for rumble–roar–rumbles to be given more often in response to a disturbance. Site-specific socioecological conditions appear more influential for call combination structure than phylogenetic history. © 2019 The Authors.

R. Patnaik, N. PremjitSingh, D. Paul & R. Sukumar

Dietary and habitat shifts in relation to climate of Neogene-Quaternary proboscideans and associated mammals of the Indian subcontinent

Quaternary Science Reviews 224 (2019) e105968

Abstract. Several studies have established that African proboscideans shifted their feeding strategies (browsing vs. grazing) in response to climatic and ecological changes. However, similar studies on their Indian relatives are rare. In this regard, we analysed the stable carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotope composition, hypsodonty indices (HI), and lamellae numbers of both newly recovered and existing fossil material (proboscideans and associated mammals) spanning the last ~14 Ma. We also obtained intra-tooth δ13C and δ18O values of selected extant and extinct proboscideans as well as associated mammals to understand any intra- and inter-annual variation in dietary and water intake behaviour, respectively. Our results reveal that Middle Miocene brachydont deinotheres (ex. *Deinotherium indicum*) and bunodont gomphotheres (ex. *Gomphotherium*) with few

cusp pairs were browsers living in relatively closed forests under moist conditions. By Late Miocene they continued browsing in relatively open forests. Deinotheres in the subcontinent did not survive the Late Miocene climate change that led to drier conditions and the spread of grasslands. The Late Miocene endemic forms *Stegolophodon* and *Stegodon* were browsers while the immigrant *Choerolophodon* was a mixed feeder. However, Pliocene gomphotheres such as bunodont *Anancus* and brachydont *Stegodon* adapted themselves to shrinking forests and spreading grasslands; the former sustained on grazing, whereas the latter showed flexibility in its diet ranging from browsing, mixed-feeding to pure grazing. Associated mammals such as rhinoceratids, giraffids, equids, and bovids responded in a similar manner to this climatic and ecological transition across the Late Miocene to Pliocene by shifting their diets accordingly. The Mid-Pliocene hypsodont elephantid immigrant *Elephas planifrons*, the Early Pleistocene hypsodont immigrant *E. hysudricus*, and *Elephas platycephalus*, with multiple lamellae (10–16) were also essentially grazers. Sometime around Middle Pleistocene, the giant elephantid immigrant *Palaeoloxodon namadicus*, a pure grazer, appeared on the grasslands of the subcontinent, coinciding with a shift in *E. hysudricus* diet from pure grazing to browsing. *E. hysudricus* likely gave rise to the extant *E. maximus*, a mixed feeder with higher contribution of browse to its diet. © 2019 Reprinted with permission from Elsevier.

S. Paudel, S.K. Mikota & T. Tsubota
Tuberculosis threat in Asian elephants
Science 363 (2019) 356
Abstract. none.

S. Paudel, C. Nakajima, S.K. Mikota, K.P. Gairhe, B. Maharjan, S. Subedi, A. Poudel, M. Sashika, M. Shimozuru, Y. Suzuki & T. Tsubota
Mixed *Mycobacterium tuberculosis* lineage infection in 2 elephants, Nepal
Emerging Infectious Diseases 25 (2019) 1031-1032
Abstract. Tuberculosis in elephants is primarily caused by *Mycobacterium tuberculosis*. We identified mixed *M. tuberculosis* lineage infection in 2 captive elephants in Nepal by using spoligotyping and large sequence polymorphism. One elephant was infected with Indo-Oceanic and East African–Indian (CAS-Delhi) lineages; the other was infected with Indo-Oceanic and East Asian (Beijing) lineages.

S.G. Platt, D.P. Bickford, M.M. Win & T.R. Rainwater
Water-filled Asian elephant tracks serve as breeding sites for anurans in Myanmar
Mammalia 83 (2019) 287-289
Abstract. Elephants are widely recognized as ecosystem engineers. To date, most research on ecosystem engineering by elephants has focused on *Loxodonta africana* and *Loxodonta cyclotis*, and the role of *Elephas maximus* is much less well-known. We here report observations of anuran eggs and larva in water-filled tracks (n=20) of *E. maximus* in Myanmar. Our observations suggest that water-filled tracks persist for >1 year and function as small lentic waterbodies that provide temporary, predator-free breeding habitat for anurans during the dry season when alternate sites are unavailable. Trackways could also function as "stepping stones" that connect anuran populations. © 2019 Walter de Gruyter GmbH.

S.S. Pokharel, B. Singh, P.B. Seshagiri & R. Sukumar
Lower levels of glucocorticoids in crop-raiders: Diet quality as a potential 'pacifier' against stress in free-ranging Asian elephants in a human-production habitat
Animal Conservation 22 (2019) 177-188
Abstract. Overlapping habitats and sharing of resources between elephants and people has led to intense elephant-human conflicts, especially crop depredation by elephants, across elephant-range countries. While raiding agricultural crops, elephants face numerous threats from people through chase, injury and the risk of death which could enhance the associated energetic costs, ultimately elevating their stress levels. We hypothesized that crop-raiders (in the human-production habitat) would show higher faecal glucocorticoid metabolite (fGCM) levels, a proxy of stress-response, as compared to nonraiders (in protected forests). To study this,

208 faecal samples were collected from crop-raiding elephants in a human-production habitat and 394 samples from nonraiding elephants in protected forests during 2013 and 2015. Contrary to our expectation, fGCM levels were significantly higher in nonraiding than in crop-raiding elephants of both sexes. As one of the possible factors for lower fGCM in elephants inhabiting the human-production habitat, the influence of benefits obtained from foraging here was assessed. For this, the difference in vegetation greenness (standing biomass) between the human-production habitat and the protected forests was analysed from remotely-sensed Normalized Differential Vegetation Index (NDVI), and further confirmed by measuring dietary quality (faecal nitrogen (N) content and C:N ratio as proxies for crude protein). Interestingly, higher NDVI values (greater biomass availability), higher N content and lower faecal C:N ratio (indicating higher protein content in the diet) of elephants in the human-production habitat suggested enhanced nutritional levels here as compared to protected forests. Further, there were significant correlations between faecal C:N ratio (positive) or N content (negative) and fGCM levels. These findings suggest that crop-raiding comes with the benefits of a superior quality diet which may help in reducing human-induced stress-response in elephants inhabiting or foraging within human-production habitats. © 2018 The Zoological Society of London.

S. Pokharel, P. Seshagiri & R. Sukumar

Influence of the number of calves and lactating-adult females in a herd on the adrenocortical activity of free-ranging Asian elephants

Wildlife Research 46 (2019) 679-689

Abstract. Context. Physiological stress has the potential to influence animal population persistence. The endangered Asian elephant (*Elephas maximus*) is involved in intense conflict with humans in many parts of its range, which is likely to lead to stress for individuals and groups, and population-level impacts. Thus, it is important to understand how stress levels in them are influenced by socio-ecological factors when they are not directly exposed to human-induced threats and to use this understanding to improve conservation and management strategies. Aims. The study was designed to provide baseline information on the link between socio-ecological factors and stress levels of undisturbed populations of elephants. The main aim of this study was to determine the influence of herd size, season, the number of calves and adult females present in a herd, their lactational status and body condition on the adrenocortical activity of free-ranging adult female Asian elephants living in protected forests without any direct exposure to human-induced threats, by measuring their faecal glucocorticoid metabolite (fGCM) levels. Methods. A total of 145 fresh faecal samples were collected from 123 identified adult female elephants inhabiting Bandipur and Nagarahole National Parks of southern India, between the years 2013 and 2015. We measured fGCM levels by employing a group-specific standardized 11-oxoetiocholanolone enzyme immunoassay (EIA). A Generalized Linear Mixed-effects Model (GLMM) was used to assess the influence of socio-ecological factors on fGCM levels of adult female elephants. Key results. When fGCM levels were analyzed with a GLMM, the following patterns were observed: fGCM levels were negatively correlated to the number of adult females (herd size) and positively correlated to the number of calves in a herd and active lactational status of an adult female. fGCM levels of adult female elephants were higher during the dry season and negatively correlated with body condition scores. Conclusions. The adrenocortical activity of female elephants is significantly influenced by the number of calves and adult females present in their herd, seasonality and their lactational status. Implications. It is important to consider the influence of multiple ecological and social correlates while assessing and interpreting the adrenocortical activity of Asian elephants. Our findings highlight the importance of maintaining the social structure of elephants in the wild to avoid detrimental effects on their physiological health. Insights from such assessments could be used to compare the stress in elephants which are involved in direct conflicts with humans to take appropriate management decisions for mitigating conflicts. © 2019 CSIRO.

E.E. Poor, E. Frimpong, M.A. Imron & M.J. Kelly

Protected area effectiveness in a sea of palm oil: A Sumatran case study

Biological Conservation 234 (2019) 123-130

Abstract. Despite the establishment of a national protected area system at the beginning of the 20th century to protect some of the world's most biodiverse forests, Indonesia has one of the highest deforestation rates in the world, due in part to the expansion of the global palm oil industry. The unique ecosystems of Sumatra, Indonesia provide habitat for critically endangered Sumatran tigers (*Panthera tigris sumatrae*), Sumatran elephants (*Elephas maximus sumatrensis*), and two species of orangutans (*Pongo abelii* and *Pongo tapanuliensis*). In this study, we use a matching method with generalized boosted models to determine the effectiveness of three nationally protected areas in preventing deforestation from 2002 to 2016. We also examine leakage – an increase in deforestation directly outside of protected areas relative to the wider landscape – to provide a clearer picture of the effects of agricultural expansion in this landscape. We found that Tesso Nilo National Park, with its lowland rain forest and conditions suitable for oil palm, offered the least protection from deforestation (avoided deforestation rate = 4.18%, $p < 0.05$ 95% CI [1.97% - 6.45%]). Bukit Tigapuluh National Park, which may experience some de facto protection (i.e. protection due to factors independent of policy) with its mountainous terrain and difficult access, had the highest avoided deforestation rate (26.36%, $p < 0.05$ 95% CI [24.17–28.55]), but had relatively high leakage (10.21%, $p < 0.05$ 95% CI [7.51–12.98]). The low avoided deforestation rate in Tesso Nilo could be due to high localized human population and/or other socio-economic factors we were unable to control for in this study. The quantitative evidence of deforestation and effectiveness of protected areas in this heavily modified landscape supports the need for increased enforcement around protected areas locally, and globally in other oil palm production regions. These actions are critical in the preservation of global, tropical endemic flora and fauna. © 2019 Reprinted with permission from Elsevier.

E.E. Poor, V.I.M. Jati, M.A. Imron & M.J. Kelly

The road to deforestation: Edge effects in an endemic ecosystem in Sumatra, Indonesia

PLoS ONE 14 (2019) e0217540

Abstract. Worldwide, roads are a main driver of deforestation and degradation as they increase forest access along the forest edge. In many tropical areas, unofficial roads go unreported and unrecorded, resulting in inaccurate estimates of intact forested areas. This is the case in central Sumatra, which boasts populations of critically endangered Sumatran elephants (*Elephas maximus sumatrensis*), tigers (*Panthera tigris sumatrae*) and other endemic flora and fauna that make the area globally unique. However, maps do not reflect the reality of forest loss in the area. Here we present new maps from 2002 and 2016 of digitized and ground-truthed roads in one of Sumatra's unique lowland tropical protected areas, Tesso Nilo National Park. Using our newly created roads dataset, we examine the distribution of forest with respect to distance to roads. Our data show >2,400 km of roads within the national park in 2016 –nearly a 10-fold increase from roads known in 2002. Most forest (82–99%) within Tesso Nilo falls within 100 m, 500 m, and 1000 m of road edges. Length of road increased 157% and road density increased from 1.06 km/km^2 to 2.63 km/km^2 from 2002–2016. Our results suggest that this endemic ecosystem is facing substantial threat from roads and their associated impacts. Without swift management action, such as road closures and increased enforcements by park management, this ecosystem, and its endemic wildlife, could be lost. It is imperative that protected areas worldwide more rigorously consider roads and road effects on ecosystem fragmentation in their conservation plans. © 2019 The Authors.

R.P.V.J. Rajapakse, S.P. Lawton, K.J.K. Karunathilake, B.V.P. Perera, N.T.B. Nguyen & T.H. Le

Molecular characterization of *Fasciola jacksoni* from wild elephants (*Elephas maximus maximus*) of Sri Lanka: A taxonomic evaluation

Parasitology 146 (2019) 1247-1255

Abstract. *Fasciola jacksoni* is a significant

contributor to the health and mortality of Asian elephants, particularly those in Sri Lanka. Despite the impact of fascioliasis on elephant populations, it is a neglected veterinary disease with limited taxonomic understanding. Molecular characterization and phylogenetic analysis of *F. jacksoni* were carried out to evaluate its suggested basal position in the Fasciolidae. Adult worms were collected during post-mortem of elephants, and eggs were collected from living elephants in National parks across Sri Lanka. Using the mitochondrial genes nicotinamide dehydrogenase subunit 1 (nad1) and cytochrome oxidase subunit 1 (cox1), and a partial 28S ribosomal DNA (28S rDNA), DNA sequences were generated from the *F. jacksoni* adult and egg material. Maximum likelihood (ML) phylogenetic analyses did not resolve *F. jacksoni* to be basal to the Fasciolidae. Furthermore, the ML analyses showed that the genus Fasciola was not monophyletic and that *F. jacksoni* was a sister species to the deer liver fluke Fascioloides magna. A clear framework is required to determine the taxonomic status of *F. jacksoni* and this current study provides the first detailed application of molecular techniques from multiple hosts across Sri Lanka with the production of reference DNA sequences for this important parasite. © 2019 Cambridge University Press.

L.E. Rosen, F. Olea-Popelka, S.L. Deem, R. Isaza, D. Schmitt & M. Miller

Survey of antituberculosis drug administration and adverse effects in elephants in North America

Journal of Zoo and Wildlife Medicine 50 (2019) 23-32

Abstract. Tuberculosis, caused by *Mycobacterium tuberculosis*, is a disease causing morbidity and mortality in captive elephants (*Elephas maximus* and *Loxodonta africana*) as well as free-ranging individuals. Elephants in North America diagnosed with tuberculosis are often treated with antituberculosis drugs, unlike livestock species, which has necessitated the development of treatment guidelines adapted from recommendations for humans. There are few published reports describing empirical treatment, which may be complicated by poor patient compliance, interruptions in drug administration,



and adverse effects. A survey of elephants in North America was conducted to compile information on treatment protocols, including drugs, dosages, routes of administration, serum drug concentrations, and adverse effects of antituberculosis treatment. Responses were received regarding 182 elephants, 12 of which were treated prophylactically or therapeutically with antituberculosis drugs. Treatment protocols varied among elephants, and included various combinations of isoniazid, rifampin, pyrazinamide, ethambutol, enrofloxacin, levofloxacin, and ethionamide. Serum drug concentrations also varied considerably among and within individuals. Facility staff reported 5 elephants (out of 7 treated elephants with responses) that exhibited clinical signs that may have been associated with antituberculosis drugs or treatment procedures. Anorexia, decreased water intake, constipation, depression, ataxia, limb paresis, and tremors were among the signs observed. Most adverse effects were reported to be moderate or severe, resulting in interruption of the treatment. The results from this survey provide veterinarians and elephant managers with valuable historical data to make informed clinical management decisions regarding antituberculosis therapy in elephants. © 2019 American Association of Zoo Veterinarians.

F. Sach, M. Fitzpatrick, N. Masters & D. Field

Financial planning required to keep elephants in zoos in the United Kingdom in accordance with the Secretary of State's Standards of Modern Zoo Practice for the next 30 years

International Zoo Yearbook 53 (2019) 78-88

Abstract. In June 2017, the Secretary of State's Standards of Modern Zoo Practice (SSSMZP) were updated with an appendix relating specifically to elephants (Appendix 8.8: Elephants). This update was published to bring elephant management standards in line with recognized advancing best practice. All zoos in the UK holding elephants are inspected against the new appendix, in accordance with the Zoo Licensing Act 1981, by dedicated Department for Environment, Food and Rural Affairs (Defra)-appointed inspectors. Achieving the standards set out within the new appendix will require financial investment and careful planning from all the zoos holding elephants within the UK. At the time of writing, the annual cost of keeping a breeding group of elephants at ZSL Whipsnade Zoo, UK, was calculated from data collected over the last 10 years and the financial investment required to achieve SSSMZP compliance was estimated. The commercial benefit that elephants bring to ZSL Whipsnade Zoo was also quantified using feedback from visitor surveys. The cost of keeping a breeding herd of elephants at ZSL Whipsnade Zoo was estimated at £593 021–£641 863 per year, excluding indirect staffing costs, ground rent and contributions made by the Zoological Society of London (ZSL) to field-conservation projects. Costs for achieving SSSMZP compliance will be considerably greater with substantial capital investment required. The commercial benefit was found to be extensive; with predicted significant increased visitor dwell time and secondary spend in the presence of elephants. Using ZSL Whipsnade Zoo as an example, this paper aims to consider holistically the financial costs when planning and implementing an optimum, welfare-centred, sustainable future for elephants in zoos. © 2019 The Zoological Society of London.

C. Schiffmann, J.-M. Hatt, S. Hoby, D. Codron & M. Clauss

Elephant body mass cyclicity suggests effect of molar progression on chewing efficiency

Mammalian Biology 96 (2019) 81-86

Abstract. Elephants do not replace deciduous teeth once with permanent teeth as most mammals, but replace a single cheek tooth per jaw-side five times in their lives in a process called molar progression. While this gradual process has been well-documented for the purpose of age determination, a less-considered possible side effect of this progression is that functional chewing surface fluctuates, being larger when two cheek teeth are both partially in use and smaller when only one cheek tooth is used fully. We found that body mass of both breeding and non-breeding female zoo elephants (*Elephas maximus*, *Loxodonta africana*) shows a cyclic undulation with peaks separated by many years, which is therefore unrelated to reproduction or annual seasonality. We propose variation in functional chewing surface, resulting chewing efficiency, and resulting increased food intake and/or digestive efficiency as the underlying cause. As elephants reproduce all year-round and thus are not synchronized in their molar progression pattern, climate-related fluctuations in resource availability are likely to mask this pattern in free-ranging animals. In contrast, it emerges under the comparatively constant zoo conditions, and illustrates the relevance of the dental apparatus for herbivorous mammals. The combination of variable chewing efficiency and resource availability in free-ranging elephants may render these species particularly prone to reported inter-individual fitness differences. © 2018 Deutsche Gesellschaft für Säugetierkunde.

H. Schmidt & J. Kappelhof

Review of the management of the Asian elephant *Elephas maximus* EEP: Current challenges and future solutions

International Zoo Yearbook 53 (2019) 31-44

Abstract. This article reviews the current situation in the Asian Elephant *Elephas maximus* European Association of Zoos and Aquaria Ex situ Programme (EEP). In recent years, developments in husbandry and gained knowledge about the reproductive biology of Asian elephants have contributed to increased breeding success and resulted in a mean of 15 births per year in the last 5 years. At the time of writing, the Asian elephant EEP population contains 307 individuals: 90.217 (♂♂.♀♀). Based on the life table for 1998–2018, most demographic parameters show healthy numbers [e.g. lambda (λ) = 1·025], while the population has retained 98·44% of the gene diversity. However,

this EEP is also facing multiple challenges, such as the presence of subspecies, transport barriers between some EEP participants and the societal debate about the purpose of zoos. The growing number of male elephants in the EEP population appears to be the most immediate challenge. In the short term, the authors suggest that females could be managed to conceive for the first time at 8 years of age and adhere to an interbirth interval of 7 years. This would be an attempt to decrease the reproductive rate without compromising the future reproductive potential of the population. The authors also prescribe improving facilities for elephants to allow zoos to utilize a fission–fusion housing strategy, making it possible to house the increasing number of males appropriately over the longer term. © 2019 The Authors.

P. Sharma, H. Adhikari, S. Tripathi, A.K. Ram & R. Bhattarai

Habitat suitability modeling of Asian elephant *Elephas maximus* (Mammalia: Proboscidea: Elephantidae) in Parsa National Park, Nepal and its buffer zone

Journal of Threatened Taxa 11 (2019) 14643-14654

Abstract. Asian wild elephant (*Elephas maximus*) represents one of the endangered species of large mammals in the world. The study area (Parsa National Park (PNP) and its buffer zone (BZ)) has been used as corridor and habitat by elephant. The study aims 1) to assess the suitable habitat of elephant in PNP and BZ and 2) to determine which explanatory variables better explain elephant presence in PNP. Field measurements were carried out in 67 plots for vegetation analysis. Boosted Regression Tree (BRT) was used for examining the relationship of habitat suitability of elephant and explanatory variables for example, topographic (slope, aspect, altitude), climatic (precipitation, temperature), and biotic and abiotic factors (habitat preference, ground cover, crown cover). According to the results, the habitat suitability of elephant is mainly explained by dominant species (29.6%), followed by temperature (17.1%), altitude (15.5%), habitat preference (11.4%), and precipitation (10%). The influence of the slope, ground cover, crown cover and substrate, was lowest in the study. Elephants were recorded up to 400 m a.s.l and in northeast and southeast aspect. The suitable habitats were in the forest dominated by *Acacia catechu* and *Myrsine semicerate* receiving precipitation about 300 mm in an area with a low slope (0–5 degree). Its presence was not related to forest cover and substrate condition. The model emphasis on environmental suitability and contributes to the conservation of elephant in PNP and provides the basis for more advanced habitat analysis. The result from the modeling is useful to delineate the site that required specific planning and management intervention. © 2019 The Authors.

Jacob Shell

The enigma of the Asian elephant: Sovereignty, reproductive nature, and the limits of empire

Annals of the American Association of Geographers 109 (2019) 1154-1171

Abstract. This article examines the dependency of British teak logging and shipbuilding on elephant-based labor in Burma (Myanmar) and India during the nineteenth century. Asian elephants were essential as a means of commodity extraction, offering irreplaceable forms of mobility across difficult forest terrain. At the same time, from the standpoint of colonial control, a frustrating feature of the elephants was their unwillingness to mate when in captivity, raising the issue of how to replenish this animal workforce. Practices of elephant stewardship in Burma, where trained elephants were released into the forest on a nightly basis to roam and mate, became of great interest to the very technics of empire. This release system came with a political limitation, however: The humans in the forest adept at working this system of nightly elephant releases presented challenges to colonial control, not least because of the nature of the work such people did, which occurred in a zone beyond the view of the state. These elephant tenders, and perhaps by extension the elephants themselves, were "Zomian" in J. C. Scott's sense of being spatially state-evasive—indeed, means of politically evasive mobility was the most robust use-value of the trained elephants. The case of colonial elephant logging stands as an important indicator that if an intelligent creature with irreplaceable labor power refuses to compromise sovereign control over its practices of reproduction, the creature

could force territorial and political concessions from the surrounding edifice of power. The article draws mainly on archival research and also on ethnographic fieldwork conducted between 2013 and 2017. Key Words: Burma (Myanmar), colonialism, elephants, logging, Zomia. © 2019 American Association of Geographers.

M.C. Sibarani, M. Di Marco, C. Rondinini & S. Kark

Measuring the surrogacy potential of charismatic megafauna species across taxonomic, phylogenetic and functional diversity on a megadiverse island

Journal of Applied Ecology 56 (2019) 1220-1231

Abstract. Conservation organisations and governments often use charismatic megafauna as surrogates to represent broader biodiversity. While these species are primarily selected as "flagships" for marketing campaigns, it is important to evaluate their surrogacy potential, i.e. the extent to which their protection benefits other biodiversity elements. Four charismatic megafauna species are used as surrogates in the megadiverse island of Sumatra: the Sumatran tiger *Panthera tigris sumatrae*, Sumatran elephant *Elephas maximus sumatranus*, Sumatran orangutan *Pongo abelii* and Sumatran rhinoceros *Dicerorhinus sumatrensis*. We examined how well each of these species performed in representing the distribution of all co-occurring terrestrial mammal species on the island, and the priority areas for the conservation of three facets of mammalian biodiversity (taxonomic, phylogenetic and functional). We used habitat suitability models to represent the distribution of 184 terrestrial mammal species, 160 phylogenetic groups and 74 functional trait groups. We then identified priority conservation areas using the spatial prioritisation software Zonation. We found that the habitat overlap between each of the four charismatic species and the other mammal species varied, ranging from a mean of 52% (SD = 27%) for the tiger to 2% (SD = 2%) for the rhino. Combining the four species together improved the representation levels only marginally compared to using the tiger only. Among the four charismatic megafauna species, the extent of suitable habitat of Sumatran tiger covered the highest proportion of priority conservation areas. The Sumatran tiger also outperformed most of other mammal species with similar range sizes. We found that some of the top-ranked conservation areas for taxonomic (28%), phylogenetic (8%) and functional diversity (19%) did not overlap with any of the charismatic species' suitable habitat. Synthesis and applications. Wide-ranging charismatic species can represent broader mammalian biodiversity, but they may miss some key areas with high biodiversity importance. We suggest that a combination of systematic spatial prioritisation and surrogacy analyses are important in order to determine the allocation of conservation resources in biodiversity-rich areas such as Sumatra, where an expansion of the protected area network is required. © 2019 The Authors.

S. de Silva & K. Srinivasan

Revisiting social natures: People-elephant conflict and coexistence in Sri Lanka

Geoforum 102 (2019) 182-190

Abstract. This paper examines human-wildlife conflict in and around protected areas to reflect on long-standing questions in conservation social science about protected areas and fortress thinking. It develops a more-than-human political ecology of human-elephant cohabitation and conflict in Sri Lanka to explore how changing socio-material conditions intersect to produce conservation and human-wildlife conflict in today's world. The paper's overarching argument is that fortress conservation is better understood as a relatively proximate cause of human-wildlife conflict and the other social impacts associated with the domain of conservation. Through its analyses, the paper deepens the critique of nature-society dualisms that is embedded in the appellation of 'fortress conservation' and offers insights that strengthen the reach and force of scholarship that tackles the persistent "appeal" of the "fortress" (Buscher, 2016, 115). © 2019 Reprinted with permission from Elsevier.

N. Sirikaew, S. Chomdej, S. Tangyuenyong, W. Tangjitjaroen, C. Somgird, C. Thitaram & S. Ongchai

Proinflammatory cytokines and lipopolysaccharides up regulate MMP-3 and MMP-13 production in Asian elephant (*Elephas maximus*) chondrocytes: attenuation by anti-arthritic agents

BMC Veterinary Research 15 (2019) e419

Abstract. Osteoarthritis (OA), the most common form of arthritic disease, results from destruction of joint cartilage and underlying bone. It affects animals, including Asian elephants (*Elephas maximus*) in captivity, leading to joint pain and lameness. However, publications regarding OA pathogenesis in this animal are still limited. Therefore, this study aimed to investigate the effect of proinflammatory cytokines, including interleukin-1 beta (IL-1β), IL-17A, tumor necrosis factor-alpha (TNF-α), and oncostatin M (OSM), known mediators of OA pathogenesis, and lipopolysaccharides on the expression of cartilaginous degrading enzymes, matrix metalloproteinase (MMP)-3 and MMP-13, in elephant articular chondrocytes (ELACs) cultures. Anti-arthritic drugs and the active compounds of herbal plants were tested for their potential attenuation against overproduction of these enzymes. Among the used cytokines, OSM showed the highest activation of MMP3 and MMP13 expression, especially when combined with IL-1β. The combination of IL-1β and OSM was found to activate phosphorylation of the mitogen-activated protein kinase (MAPK) pathway in ELACs. Lipopolysaccharides or cytokine-induced expressions were suppressed by pharmacologic agents used to treat OA, including dexamethasone, indomethacin, etoricoxib, and diacerein, and by three natural compounds, sesamin, andrographolide, and vanillylacetone. Our results revealed the cellular mechanisms underlying OA in elephant chondrocytes, which is triggered by proinflammatory cytokines or lipopolysaccharides and suppressed by common pharmacological or natural medications used to treat human OA. These results provide a more basic understanding of the pathogenesis of elephant OA, which could be useful for adequate medical treatment of OA in this animal. © 2019 The Authors.

C. Soundararajan, K.P. Prabhu, K. Nagarajan & T. Divya

Wound and gastric myiasis due to *Chrysomyia bezziana* and *Cobbaldia elephantis* and its pathological lesions in wild elephants in the Nilgiris hills of Tamil Nadu

Journal of Parasitic Diseases 43 (2019) 134-138

Abstract. No permission to print the abstract .

N.R. Talukdar, P. Choudhury & R.A. Barbhuiya

The importance of trans-boundary conservation of the Asiatic elephant *Elephas maximus* in Patharia Hills Reserve Forest, northeastern India

*J. of Threatened Taxa **11** (2019) 13168-13170*

Abstract. The lives of Asiatic elephants in the Patharia Hills Reserve Forest of Barak Valley, Assam are at risk. Due to serious anthropogenic pressures, human-elephant interactions have increased tremendously during recent decades. It is time conservation of the species is initiated along the Indo-Bangladesh trans-boundary line, especially their habitats and migratory corridor which can help the conservation of elephants and other species as well. © 2019 The Authors.

K. Takehana, R. Onomi, K. Hatate & N. Yamagishi

Determination of serum bone-specific alkaline phosphatase isoenzyme activity in captive Asian elephants (*Elephas maximus*) using an agarose gel electrophoresis method

Journal of Veterinary Medical Science 81 (2019) 551-554

Abstract. The bone-specific alkaline phosphatase (ALP) isoenzyme activity was measured in 51 serum samples from four captive Asian elephants (Elephas maximus) using a conventional method with wheat germ lectin precipitation and a commercial agarose gel electrophoresis (AGE) kit; the isoenzymes were designated as bone-specific ALP (BAP) and ALP isoenzyme 3 (ALP3), respectively. This study examined the suitability of the AGE kit for analyzing blood biochemistry in Asian elephants. The serum ALP3 and BAP activities were strongly positively correlated and met the evaluation criteria for agreement using Bland-Altman analysis. The results indicate that the AGE kit can be used to examine the blood biochemistry in Asian elephants instead of the conventional method. © 2019 Japanese Society of Veterinary Science.

N. Thakur, R. Suresh, G.E. Chethan & K. Mahendran

Balantidiasis in an Asiatic elephant and its therapeutic management

Journal of Parasitic Diseases 43 (2019) 186-189

Abstract. No permission to print the abstract.

C. Udomtanakunchai, P. Pongsopawijit, W. Langkaphin, S. Lawongwan & S. Tasomkan

Evaluation of the bone mineral density of Asian elephants (*Elephas maximus*) via dual-energy X-ray imaging of tails

Journal of Zoo and Wildlife Medicine 50 (2019) 375-382

Abstract. Musculoskeletal problems are one of the top five causes of disease in elephants. However, recent blood chemistry analysis is the only routine protocol for bone mineral status evaluation, with no assessment method currently available for the direct measurement of elephant bone mineral density (BMD). This work applied the the dual-energy X-ray technique (DXA) technique for bone density assessment. The elephant's tail was chosen for the analysis to avoid the radiation harm. Twelve live Asian elephants (*Elephas maximus*) comprising eight males and four females with ages in the range of 4–77 yr were investigated. The BMD was calculated based on radiographic images acquired using the DXA technique carried out at 40 kVp 2 mAs and 50 kVp 2 mAs. Blood serum analysis of total calcium (Ca), phosphorus (Phos) and alkaline phosphatase (ALP) content was conducted in parallel with the physical examination to correlate age and BMD. Analyses produced an overall mean BMD value in the range of 0.54–1.39 g/cm^2, with that of the males higher than that of the females. The BMD was found to be negatively correlated with age, Ca, and Phos, but not with ALP. In summary, the BMD analysis of an elephant's tail might be used with blood serum Ca and Phos to predict the overall bone mineral status of the animal. © 2019 American Association of Zoo Veterinarians.

B. Vincze, A. Gáspárdy, A. Biácsi, E.Á. Papp, L. Garamvölgyi, E. Sós, S. Cseh, G. Kovács, Z. Pádár & P. Zenke

Sex determination using circulating cell-free fetal DNA in small volume of maternal plasma in elephants

Scientific Reports 9 (2019) e15254

Abstract. The genetic sexing of animals having long gestation periods offers significant benefits in regard to breeding management among their populations living in captivity. In our study, a new increased-sensitivity PCR method for fetal sexing was developed and tested successfully on elephants, from only a small volume of maternal plasma. Suitable sensitivity was obtained by using short, reduced amplicon lengths with fluorescent labelling for capillary electrophoresis detection. The fundamental principle for this technique was based on the detection of two Y-specific markers (AmelY and SRY), the presence of which indicates the mother is carrying a male fetus and the absence of these markers designates a female fetus. As a reaction control, the X-chromosomal marker (PlpX) was used. To the best of our knowledge, this is the first report on this topic, confirming the presence of fetal cell-free DNA from the plasma of a pregnant captive elephant, and demonstrating a new opportunity for non-invasive assessment in fetal sex determination.

M.G. Walsh, S.M. Mor & S. Hossain

The elephant–livestock interface modulates anthrax suitability in India

Proceedings of the Royal Society B 286 (2019) e20190179

Abstract. Anthrax is a potentially life-threatening bacterial disease that can spread between wild and livestock animals and humans. Transmission typically occurs indirectly via environmental exposure, with devastating consequences for human and animal health, as well as pastoralist economies. India has a high annual occurrence of anthrax in some regions, but a country-wide delineation of risk has not yet been undertaken. The current study modelled the geographical suitability of anthrax across India and its associated environmental features using a biogeographic application of machine learning. Both biotic and abiotic features contributed to risk across multiple scales of influence. The elephant–livestock interface was the dominant feature in delineating anthrax suitability. In addition, water–soil balance, soil chemistry and historical forest loss were also influential. These findings suggest that the elephant–livestock

interface plays an important role in the cycling of anthrax in India. Livestock prevention efforts targeting this interface, particularly within anthropogenic ecotones, may yield successes in reducing ongoing transmission between animal hosts and subsequent zoonotic transmission to humans.© 2019 The Authors.

P. Wendler, N. Ertl, M. Flügger, E. Sós, C. Schiffmann, M. Clauss & J.-M. Hatt

Foot health of Asian elephants (*Elephas maximus*) in European zoos

Journal of Zoo and Wildlife Medicine 50 (2019) 513-527

Abstract. Foot problems are a common concern in elephant husbandry. Studies on this topic with sample sizes greater than 100 animals have only been carried out in North America. We investigated foot health of 243 Asian elephants (*Elephas maximus*) in 69 European institutions. During on-site visits between August 2016 and July 2017, standardized pictures were taken of each elephant's nails and pads. The pictures were analyzed with respect to pathological lesions (i.e. nail cracks, abscesses), care issues (i.e. minor abnormalities, which are easily resolvable with routine foot work), and pad structure. Of all analyzed nails and pads, 35.6% revealed varying degrees of pathological lesions, with minor nail cracks and overgrown cuticles with attachment to the nails being most frequently observed. The most lateral nail (N5) on both front feet demonstrated the highest percentage of pathological lesions, providing support to a separate study showing that the mean peak pressure of an elephant's foot occurs along the most lateral digits; however, this was not observed along the most lateral nail (N5) of the rear feet. Three (of 243) elephants did not show any pathological lesions in their feet. The most common issues requiring foot care were fissures in the nail sole. The structure of the pads was categorized in four grades reflecting the percentage of surface marked by sulci. These four grades occurred at nearly equal frequency. Pearson product moment correlations revealed no significant association between the frequency of care issues and pathological lesions per nail. Despite this finding, it may be prudent to implement husbandry protocols that could alleviate commonly observed pathological and care foot issues in captive Asian elephants. A standardized approach to evaluate elephant foot health will provide a more objective way to monitor responses to management and medical decisions and ultimately contribute to the overall wellbeing of elephants in human care. © 2019 American Association of Zoo Veterinarians.

K. Whittemore, E. Vera, E. Martínez-Nevado, C. Sanpera & M.A. Blasco

Telomere shortening rate predicts species life span

PNAS 116 (2019) 15122-15127

Abstract. Telomere shortening to a critical length can trigger aging and shorter life spans in mice and humans by a mechanism that involves induction of a persistent DNA damage response at chromosome ends and loss of cellular viability. However, whether telomere length is a universal determinant of species longevity is not known. To determine whether telomere shortening can be a single parameter to predict species longevities, here we measured in parallel the telomere length of a wide variety of species (birds and mammals) with very different life spans and body sizes, including mouse (*Mus musculus*), goat (*Capra hircus*), Audouin's gull (*Larus audouinii*), reindeer (*Rangifer tarandus*), griffon vulture (*Gyps fulvus*), bottlenose dolphin (*Tursiops truncatus*), American flamingo (*Phoenicopterus ruber*), and Sumatran elephant (*Elephas maximus sumatranus*). We found that the telomere shortening rate, but not the initial telomere length alone, is a powerful predictor of species life span. These results support the notion that critical telomere shortening and the consequent onset of telomeric DNA damage and cellular senescence are a general determinant of species life span. © 2019 the Authors.

E. Williams, A. Carter, C. Hall & S. Bremner-Harrison

Exploring the relationship between personality and social interactions in zoo-housed elephants: Incorporation of keeper expertise

Applied Animal Behaviour Science 221 (2019) 104876

Abstract. Individual animal personalities affect experiences of zoo environments, and

thus potentially welfare. Incorporating keeper knowledge of animal personality in a reliable way has great value in optimising welfare in zoo-housed animals. Assessment of animal personality has been used to predict group compatibility and social relationships in a number of species including rhinoceros, gorilla and chimpanzees, and there is potential to do the same with zoo elephants. This study identified elephant personalities using keeper ratings, and investigated the relationship between personality and social interactions in zoo elephants. Behavioural data were collected over a period of 12 months at seven study facilities (January 2016 – February 2017). Subjects were 10 African (1 male: 9 females) and 19 Asian (3 male: 16 female) elephants housed at zoos and safari parks in the UK and Ireland. Each subject was rated using an elephant personality assessment questionnaire, comprising 21 personality adjectives with a visual analogue scale. Personality assessments were completed by 27 keepers. Reliability across keepers was established for nine adjectives and a principal components analysis revealed three personality components: 'attentiveness', 'sociable' and 'engaged with the environment'. Correlations were observed between keeper scores of sociability and social interactions ($p < 0.05$). Elephants considered more sociable by keepers interacted positively with a greater proportion of elephants in the herd than less sociable elephants ($p < 0.05$). Current Secretary of States Standards of Modern Zoo Practice (SSSMZP) elephant management guidelines include the need for long-term management plans, including elephant behavioural profiles and herd compatibility assessments. The results show that sociability as identified by keepers relates to social interactions, illustrating the importance of inclusion of personality assessment in management plans. Future work should build on these findings; applying keeper ratings of elephant personality to a larger sample size, and exploring its potential as a predictive tool in compatibility assessments. Such a measure would help to increase the chance of successful social group formation contributing to positive zoo elephant welfare. © 2019 Reprinted with permission from Elsevier.

N. Wissink-Argilaga, A. Dastjerdi & F.M. Molenaar

Using in-house hematology to direct decision-making in the successful treatment and monitoring of a clinical and subsequently subclinical case of elephant endotheliotropic herpesvirus 1B

Journal of Zoo and Wildlife Medicine 50 (2019) 498-502

Abstract. A 3.5-yr-old asymptomatic female Asian elephant (*Elephas maximus*) with a high load of circulating EEHV1B DNA on qPCR on a routine blood sample, showed progressive depletion of monocytes, lymphocytes, and platelets. Twice daily IV ganciclovir, plasma transfusions, and fluid therapy coincided with a decreasing viral load, which may support potential efficacy of this antiviral drug. An increase in lymphocytes followed initial treatment and preceded the onset of clinical signs. Administration of short-acting glucocorticosteroids for two consecutive days preceded a reduction of lymphocytes, recovery and maturation of monocytes, and gradually decreasing clinical signs, illustrating the potential value of glucocorticosteroids in treatment of clinical EEHV. Three subsequent subclinical episodes with high monocyte and platelet counts did not require intervention. Decision-making was led not just by quantification of viral load and clinical signs, but more specifically by interpretation of the hematological changes using easily accessible, in-house blood smear analysis. © 2019 American Association of Zoo Veterinarians.

Y. Yin, S. Liu, Y. Sun, S. Zhao, Y. An, S. Dong & A. Coxixo

Identifying multispecies dispersal corridor priorities based on circuit theory: A case study in Xishuangbanna, Southwest China

Journal of Geographical Sciences 29 (2019) 1228-1245

Abstract. No permission to print the abstract.

L. Yon, E. Williams, N.D. Harvey & L. Asher

Development of a behavioural welfare assessment tool for routine use with captive elephants

PLoS ONE 14 (2019) e0210783

There has been much concern in recent years about the welfare of elephants in zoos across North America and Europe. While some previous studies have assessed captive elephant welfare at a particular point in time, there has been little work to develop methods which could be used for regular, routine welfare assessment. Such assessment is important in order to track changes in welfare over time. A welfare assessment tool should be rapid, reliable, and simple to complete, without requiring specialist training and facilities; welfare assessments based on behavioural observations are well suited to this purpose. This report describes the development of a new elephant behavioural welfare assessment tool designed for routine use by elephant keepers. Tool development involved: (i) identification of behavioural indicators of welfare from the literature and from focus groups with relevant stakeholders; (ii) development of a prototype tool; (iii) testing of the tool at five UK zoological institutions, involving 29 elephants (representing 46% of the total UK captive elephant population of 63 animals); (iv) assessment of feasibility and reliability of aspects of the prototype tool; (v) assessment of the validity of each element of the tool to reflect the relevant behaviour by comparing detailed behavioural observations with data from the prototype tool; (vi) assessment of known-groups criterion validity by comparing prototype tool scores in individuals with demographics associated with better or worse welfare; (vii) development of a finalised tool which incorporated all elements of the tool which met the criteria set for validity and reliability. Elements of the tool requiring further consideration are discussed, as are considerations for appropriate application and interpretation of scores. This novel behavioural welfare assessment tool can be used by elephant-holding facilities for routine behavioural welfare monitoring, which can inform adjustments to individual welfare plans for each elephant in their collection, to help facilities further assess and improve captive elephant welfare. This study provides an example of how an evidence-based behavioural welfare assessment tool for use by animal caretakers can be developed within the constraints of zoo-based research, which could be applied to a range of captive species. © 2019 The Authors.

A. Zachariah, P.K. Sajesh, S. Santhosh, C. Bathrachalam, M. Megha, J. Pandiyan, M. Jishnu, R.S. Kobragade, S.Y. Long, J-C Zong, E.M. Latimer, S.Y. Heaggans & G.S. Hayward

Extended genotypic evaluation and comparison of twenty-two cases of lethal EEHV1 hemorrhagic disease in wild and captive Asian elephants in India

PLoS ONE 13 (2018) e0202438

Abstract. Thirteen new lethal cases of acute hemorrhagic disease (HD) with typical histopathogical features were identified in young Asian elephants (*Elephas maximus indicus*) in India between 2013 and 2017. Eight occurred amongst free-ranging wild herds, with three more in camp-raised orphans and two in captive-born calves. All were confirmed to have high levels of Elephant Endotheliotropic Herpesvirus type 1A (EEHV1A) DNA detected within gross pathological lesions from necropsy tissue by multi-locus PCR DNA sequencing. The strains involved were all significantly different from one another and from nine previously described cases from Southern India (which included one example of EEHV1B). Overall, eight selected dispersed PCR loci totaling up to 6.1-kb in size were analyzed for most of the 22 cases, with extensive subtype clustering data being obtained at four hypervariable gene loci. In addition to the previously identified U48(gH-TK) and U51(vGPCR1) gene loci, these included two newly identified E5(vGPCR5) and E54(vOX2-1) loci mapping far outside of the classic EEHV1A versus EEHV1B subtype chimeric domains and towards the novel end segments of the genome that had not been evaluated previously. The high levels of genetic divergence and mosaic scrambling observed between adjacent loci match closely to the overall range of divergence found within 45 analyzed North American and European cases, but include some common relatively unique polymorphic features and preferred subtypes that appear to distinguish most but not all Indian strains from both those in Thailand and those outside range countries. Furthermore, more than half of the Indian cases studied here involved calves living within wild herds, whereas nearly all other cases identified in Asia so far represent rescued camp orphans or captive-born calves. © 2018 The Authors.

News Briefs

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1. Illegal electric fences turn jumbo killers in Kerala (India)

The Times of India – 21.6.2019

In a latest instance, the post-mortem of the carcass of a 25-year-old tusker found dead in a farmland at Kurichiad in Wayanad has revealed that the animal was electrocuted on an illegal power fence set up by a local resident. According to animal welfare organisation Heritage Animal Task Force (HATF), as many as 16 wild elephants have been electrocuted this year in the state. Forest officials said instead of the solar-powered direct current energizer fences that are supposed to be used many people are connecting their fences to the domestic power lines leading to electrocution of wild animals.

While the normal electric fence gives the animals a sharp and short shock to animals, the illegal power fences connected to 220 V domestic power lines can be fatal even to large animals like elephants. Many people have been resorting to illegal power fences as solar fences require regular maintenance and often elephants break the fences using branches of trees. Also, the farm owners keep the illegal power fences active at night by connecting it to the domestic power line, making it difficult for forest officials to detect them during inspections. "Illegal power fences are becoming one of the biggest killers of wild elephants in the state.

2. Sri Lankans charged over traffic in baby elephants

France 24 – 25.6.2019

A senior Sri Lankan conservation official was among eight people charged Tuesday in a landmark case over the capture and sale of dozens of baby elephants. Wildlife experts say about 40 calves may have been stolen from their herds during a 10-year period and sold for around $ 125,000 each. The deputy director of the Wildlife Conservation Department and seven others were charged with 33 counts of capturing and possessing baby elephants in 2014-2015.

If convicted they face up to 20 years in jail. The practice stopped when the current government came to power in January 2015 and launched a crackdown. Recovered animals were moved to a state sanctuary for elephant orphans. The super-rich consider having a baby elephant at home as the ultimate status symbol. It was also a tradition by aristocrats to keep the animals, which are paraded at Buddhist temple festivals.

The illegal trade has been blamed for the drop in the elephant population, with conservationists saying mother elephants were often killed so the calf could be taken. Elephant conflict with humans near wildlife sanctuaries has led to the deaths of 375 people in the past five years, according to official figures.

3. Elephants killed over 2,300 people in last five years: Environment Ministry (India)

The Hindu – 28.6.2019

Responding to a query in Lok Sabha, Minister of State for Environment Babul Supriyo says that last year alone, nearly 494 persons were killed by elephants. Over 2,300 people in India were killed by elephants while tigers claimed over 200 lives in the last five years. Nearly 494 persons were killed by the elephants last year alone. Minister of State (MoS) for Environment, Babul Supriyo said 2,398 people have died since 2014 up to

March 31, 2019 due to human-elephant conflict with West Bengal recording the maximum 403 deaths in last five years. West Bengal was closely followed by Nagaland where 397 persons were killed by the elephants while 349 people died in Jharkhand.

"The management of forest and wildlife is the responsibility of concerned State governments and incidence of animal-human conflicts are reported in various parts of the country from time to time. "However, the details of people who lost their lives by elephants and tigers are given. Deaths due to other wild animals are not collated by the Ministry," the Minister said in the Lower house. The Ministry also listed out the steps taken to avoid human-wildlife conflicts. It said a scheme has been initiated to augment fodder and water for wild herbivores in protected/forest areas where poor habitat is known as the cause of significant human-wildlife conflict.

4. To save the giant from extinction (Bhutan)

Kuensel – 6.8.2019

Although a charismatic species with its critical role in shaping the forest ecosystems, research concluded the Asian elephant continues to face threats of extinction globally. To maintain a viable population of elephants in an improved habitat with reduced human-elephant conflict in Bhutan, the Elephant Conservation Action Plan from 2018 to 2028 was launched on July 31. The action plan aims to prevent habitat loss and improve the existing elephant habitat conditions.

Crop raiding was found to be the most prevalent form of human-elephant conflict, causing socio-economic losses to farmers in the south. In retaliation, few elephants died as a result of food poisoning and electrocution. To curb loss of lives and crops, the action plan identified the cause of conflicts, mapped the conflict hotspots, and identified strategic action towards mitigating the conflicts.

With less than 50,000 individuals in the wild around 13 range countries, the Asian elephant is listed as an endangered species under International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Elephants are protected under Schedule I of the Forest and Nature Conservation Act of Bhutan 1995. The national elephant survey 2017 estimated a population of 678 elephants in the southern foothills.

5. Indian elephants washed away by surging rivers as floods wreak havoc in Kerala (India)

RT - 11.8.2019

Even some of the most powerful animals on the planet are falling victim to relentless flooding in southwest India, where elephants were washed away by rushing rivers in the state of Kerala. Torrential rains have caused widespread destruction in Karnataka, Kerala and Maharashtra, leaving more than 100 people dead and forcing thousands to evacuate their homes. The Kuntipuzha river, which flows through Silent Valley National Park, is one of several waterways that have burst their banks. As it raged through the park it swept away everything that stood in its path, including elephants.

Video shared on Twitter shows two or three of the majestic animals failing to fight against the rushing waters and being swept downstream. Monsoon rains, which fall from June to September, are a vital lifeline for Indian agriculture as they deliver 70% of the country's rainfall. However, they also leave a trail of death and destruction in their wake every year. Last year, Kerala experienced its worst flooding in 100 years, claiming more than 200 lives.

6. India sees alarming fall in wild jumbo population

The Asian Age - 13.8.2019

With forests being encroached in the name of infrastructure development, the intimate connection between the wildlife and diverse eco-system is constantly being disturbed. The deep wildlife crisis in the country is illustrated by the current situation of Asian elephants. Elephants enjoy the highest status of Schedule I species

in the Wildlife Protection Act of India, 1972, but unfortunately situation on the ground is completely different.

"It is disappointing that today, only about 27,000 wild elephants live in the country, as against a million a decade ago, which is a 98% fall in the population. India is home to over 50% of Asian elephants in the world, making it the last stronghold of these majestic creatures. They face the threat of shrinking forest ranges, habitat defragmentation, poaching, captivity, and anthropogenic pressure," claimed Mr Kartick Satyanarayan. "Captivity of elephants is associated with the cultural history of India and is accepted. But it masks the sad reality of illegal live elephant trade across the country. Captive elephants are found to be suffering from health issues, like foot rot, arthritis and compromised nutrition. These elephants are worked to the point of exertion and once their health problems hinder their movement, they are disposed of," he said.

The Wildlife Protection Act, 1972 forbids the capture of new calves for captivity. Access to veterinary aid is a rarity, and the Wildlife SOS has been bringing critical medical aid to distressed elephants through its mobile veterinary unit.

7. Elephants are still dying at an alarming rate in Nepal

The Kathmandu Post – 13.8.2019

Even as the world marked World Elephant Day on Monday, pledging to protect the endangered species, Nepal continues to lose its elephant population at a rate faster than any other country that is host to the Asian elephant species. The country has an estimated population of 100 to 150 elephants, but every year, two to three elephants are killed in retaliatory actions by local communities, according to Dinesh Neupane, On average, Nepal is losing two percent of its elephant population every year, he said.

What makes these deaths more dangerous is that these fatalities are not due to natural deaths or poaching. All these elephants die in retaliatory acts: when locals shoot elephants that have strayed into their property. Elephants are also electrocuted to death in electric fencing that locals put up to keep them away. Therefore, all these deaths are because of the negative interactions between elephants and humans." These 'negative interactions', or human-elephant conflicts, are a major concern for elephant conservationists in the Tarai. Migratory herds from India also enter the Nepali plains, primarily in the east.

"Only 5.4% of the elephant's historical and native habitat remains in the country. Much of their natural habitat has been fragmented due to human settlements and agricultural farmlands. We've also damaged their historical migratory routes," said Neupane. "We have 45% forest cover and six protected areas in the Tarai but the forest areas are not connected, forcing the elephants to pass via human settlements and agriculture land."

8. First-of-its-kind step! Seismic sensors, thermal cameras to check Indian Railways' train-elephant collisions (India)

Financial Express – 14.8.2019

First-of-its-kind step to save elephants! In a bid to prevent elephants from being hit by Indian Railways' trains passing through Rajaji Tiger Reserve (RTR) in Uttarakhand, authorities have come up with a plan. Soon, seismic sensors and thermal cameras will be installed near railway tracks to warn the train drivers of animal movement. This advance detection system will be installed along railway tracks passing through the reserve's 18-km Kansro range, where in the last three decades, more than two dozens animals, mostly elephants, have been killed by trains.

A total of ten seismic sensors and thermal cameras will be installed along the railway tracks at six points in the range. The advance detection system will detect the slightest movement of the animals and inform officials at the central server facility. The data from the system will be reviewed at the facility and after confirming the presence of an elephant in the range, alerts will be generated for patrolling staff, the train's loco pilot, the RTR administration and the nearest station.

The installation of the system has become all the more important following the electrification of the railway tracks passing through the range.

9. Conflict escalates between humans and elephants (China)

China Daily – 22.8.2019

When Wu Junhui visits Nanha, a community in Yunnan province, he always attracts crowds of curious villagers, whether he arrives in the small hours or during the day. Wu monitors elephants by using unmanned aerial vehicles, or drones, and the first question the residents ask him is if he has seen one animal in particular, which some villagers refer to as the "naughty one". The male Asian elephant, which Wu estimates weighs more than 2 metric tons, is worthy of its reputation. On Aug 4, it entered an urban area of Mengla county, where the Nanha community is located in Manzhuang village. Videos uploaded to the internet by local residents show the animal roaming the streets, leaving huge footprints in some unpaved areas, and even trying to climb over a low wall. These incidents are just two examples of the seemingly escalating conflict between humans and wild elephants in China.

In the past three decades, the number of elephants in China has doubled to about 300, and since 2013, they have caused more than 60 deaths and injuries. Damage to property caused by the animals from 2011 to last year is estimated at more than 170 million yuan ($ 24.2 million), according to the Yunnan Forestry and Grassland Administration. Xishuangbanna Dai autonomous prefecture, is one of the elephants' primary habitats. They can also be found in Pu'er and Lincang, Yunnan. Since 2014, the Yunnan provincial government has taken out insurance coverage against damage caused by wild animals.

Yunnan has also established 11 nature reserves with a total area of about 510,000 ha. Xiang Ruwu, head of the wildlife protection division of the Yunnan Forestry and Grassland Administration, said, "They have become important shelters for Asian elephants." Nanha lies next to the Xishuangbanna National Nature Reserve, which includes seven subreserves that cover a total of more than 240,000 ha.

10. Positive steps for Asian elephants facing skinning threat

Phys.org – 22.8.2019

Researchers say Myanmar in particular has seen a devastating uptick in elephant deaths to feed the market for body parts. While these markets for non-ivory elephant products are still poorly understood, researchers believe the main driver is demand for medicinal products. To create these products elephant skin is ground to a powder and then combined with elephant fat to produce a paste used to treat skin fungi and infections, as well as intestinal disease in people. Elephant skin is also being used to make bracelets, with the subcutaneous fat layer cured and polished into beads and worn as jewellery.

The Asian elephant is officially classified as endangered and faces a perfect storm of threats. Habitat loss and expansion of human settlements and agriculture is leading to increasing conflict and elephant deaths. New markets for elephant parts, if unchecked, will compound the dangerous environment in which the species has to survive and will push it even closer to the brink of extinction.

The good news is that yesterday/on Wednesday governments provisionally agreed to expand international controls on trade in Asian elephants. This would mean that all countries involved in trade in Asian elephants would be required to take action—including strengthening legislation and enforcement—to prevent illegal trade in their parts and derivatives.

11. Country's third elephant sanctuary will be built in Perak, says minister (Malaysia)

Malay Mail – 7.9.2019

The government will set up an elephant sanctuary on an area spanning 100 ha in Perak at a cost of about RM20 million. Minister of Water, Land and Natural Resources Dr. Xavier Jayakumar

said the move was part of an ongoing effort to conserve elephants, which were increasingly threatened due to human-elephant conflicts. "The government, in collaboration with the state government of Perak, has approved the proposal for the construction of the new sanctuary, which will be implemented under the 12th Malaysia Plan.

"A total of 1,118 complaints on human-elephant conflict have been recorded in Peninsular Malaysia between 2016 and 2018. It is estimated that there are 1,680 elephants in the peninsula, while about 2,000 are in Sabah and Sarawak. He also expressed his appreciation to the private sector, non-governmental organisations and private individuals for their help in the conservation of elephants and other wildlife and hoped that more would do the same.

EXIM Bank, for instance, sponsors RM 55,000 under its corporate social responsibility (CSR) initiative by providing two prosthetic legs for a female elephant named Elly as well as medicine and equipment for managing baby elephants.

12. Orphaned elephants find new home in Bago camp (Myanmar)

Myanmar Times – 17.10.2019

Nine orphaned elephants are now living comfortably in their new home in Winkabaw Elephant Conservation Camp in Bago Region, which used to be a logging area operated by state-run Myanmar Timber Enterprise. When the new government took over in 2016 and stopped timber production in the Bago Mountain Range, the area was converted into an elephant camp to take care of injured and ageing elephants from state-owned enterprises. Soon it has become a haven for orphaned elephants and now has nine. The latest addition is named Moe Moe Lwin, which arrived on Tuesday.

Moe Moe Lwin's mother died when she was 10 months old and she was sent to be cared for by the Myanmar Timber Enterprise in Bago Region. Moe Moe Lwin and four other orphaned elephants in the sanctuary are the offspring of domesticated elephants owned by the Myanma Timber Enterprise while the remaining four others were wild elephants that were orphaned after poachers killed their mothers. The orphaned elephants are being trained for their eventual release into the jungle when they become adult. The orphans are housed in a two hectare area within the Winkabaw Elephant Camp. It is the only camp for orphan elephants in the country.

13. There's been a series of elephant deaths in Sabah. And palm oil may be a cause (Malaysia)

Cilsos - 25.11.2019

Sometime at the end of September, anglers fishing at a river in Tawau spotted an elephant carcass floating in the river. Pictures of the carcass made went viral on social media, prompting the authorities to locate the carcass. Upon investigation of the body, the cause of death was determined to be due to some 70 shotgun wounds over the animal's face, back and legs, believed to be shot at close range. Since then, another four elephant carcasses showed up in Beluran, Kinabatangan and Lahad Datu. Except for one, all the elephants died of unnatural causes, either from being shot at, poisoned, or being trapped in a mud-filled ditch.

Oil palm plantations might be a big factor behind these elephant deaths. Including the five cases we mentioned earlier, this year alone there have been 23 elephant deaths in Sabah. This is actually a big problem, as the elephants in Sabah are from an endangered subspecies of Asian elephants called Borneo pygmy elephants. Besides being distinguishable by their gentle natures, cute baby faces, plump bellies, oversized ears and tails so long that sometimes they drag on the ground as they walk, they are only found in Borneo (mostly Sabah) with an estimated 1,500 of their kind remaining in the wild.

With the Recent Deaths, Sabah is Starting to Look Seriously into a Plan to Save their Elephants. Sabah was said to have already completed the paper work for a 10-year action plan to increase conservation efforts for their elephants, and it is planned to be presented to the Cabinet by year's

end for approval. But the government isn't the only one concerned. To minimize instances of HEC, some oil palm plantations in Kinabatangan are working together with a French environmental NGO known as HUTAN to establish an elephant corridor. The corridor, planned to link a plantation regularly visited by elephants to the Kinabatangan Wildlife Sanctuary, will involve a 100 m wide and 3 km long corridor.

14. Taming of wild elephants at Dubare camp (India)

The Deccan Herald - 25.11.2019

An elephant, captured in Chettalli, has now been released from the kraal. One of the three rogue elephants, which was confined to kraals, has now been released as it has been tamed. However, the elephant will be part of Dubare camp. The elephant was captured in Bettalli region in June this year and was being tamed by mahouts, confining it in an enclosure. The released elephant was captured during an operation carried out by the Forest Department near Coffee Board in Chettalli. The elephant was confined into the kraal for six months for training. The elephant has now turned calm and has been moving in Dubare camp and for grazing. It will be taken for a bath within a day or two, mahout Arune said.

Two other wild elephants, captured in Bandipur and Hassan, are still being confined to the kraals and are undergoing training, from the last four months. Initially, both the elephants were ferocious in nature and were making futile attempts to break the kraals. Day by day, they started responding to the mahout and are now receiving food from the hands of the mahout.

One of these elephants is a lone tusker and has been attracting the onlookers. Another wild elephant captured from Bandipur is an 18-year-old pachyderm and is now eating paddy, grass, leaves, jowar and jaggery. Veterinary officer Dr. Mujib said that the male elephants wander in search of female elephants. Among the tamed male elephants in the Dubare, one elephant has left the camp and has entered into the forest area and the officials have been making attempts to bring it back to the camp. Tamed elephants from the camp have been to the forest during earlier occasions and have returned as well, he added.

15. GPS radio collars for elephants to stop them from entering Kumbh (India)

The New Indian Express - 12.11.2019

Uttarakhand state forest department has identified 10 'rogue elephants' which will be fitted with radio collars and will be monitored 24 x 7 to prevent them from entering human populace, especially Kumbh 2021. Parag Nigam, a scientist from Wildlife Institute of India, Dehradun who attended a meeting on the issue said, "We have presentation to state government officials about possible solution. There were few points agreed upon to tackle the problem. These radio collars will be GPS fitted to get the real-time location of the pachyderms on mobile applications of forest officials from anywhere in the world.

The work is proposed to start on December 1, 2019, and to be completed in the same month. The report prepared by the state forest department indicated that the situation of elephants treading into human settlements have become a problem, especially in Haridwar district. Over 100 drones are said to be monitoring the congregation round the clock along with 1500 CCTVs. Along with the drones, the police have also planned to make use of LCD screens and face recognition cameras to monitor crowds and traffic. Routes for paddle rickshaw and auto-rickshaw will be separate to avoid traffic congestion at the site which is chosen to be at Shyampur bank of river Ganga in Haridwar.

16. Global experts meet to discuss conservation of Asian elephants (Malaysia)

New Straits Times – 4.12.2019

A group of elephant specialists from around the world will gather in the state capital for three days starting today to discuss the priorities and strategies for the conservation of Asian elephants. Dubbed as the 10th meeting of the IUCN SSC Asian Elephant Specialist Group (AsESG), the

event is jointly hosted by AsESG and the Sabah Wildlife Department.

The meeting is being organised at a resort here in Kota Kinabalu, Malaysia. AsESG members, government officials from all 13 Asian elephant range countries, special invitees from across the globe and funding agencies will attend the meeting. AsESG is a global network of specialists concerned with the study, monitoring, management, and conservation of Asian elephants in its 13 range states across Asia. They are aiming to promote the long-term conservation of Asia's elephants and the recovery of the species populations. Tomorrow, Sabah Chief Minister Mohd Shafie Apdal and his deputy Datuk Christina Liew are also expected to launch the meeting.

Following the dwindling population of elephants in Sabah, with more than 20 of them being poached or them killing each other this year, the state government is hoping to collaborate with all stakeholders in saving the species. In 2002, the elephant population in Sabah was estimated to be between 1,100 and 1,600. Sabah Wildlife Department will be doing a survey worth RM 1.5 million on pygmy elephants and orangutans for 24 months ending 2022.

17. IOCL donates ₹50 lakh for GPS collars to Koundinya elephants (India)

The Hindu - 27.12.2019

The Indian Oil Corporation Limited (IOCL) has donated ₹50 lakh to the A.P. Forest Department for tagging wild elephants in the Koundinya wildlife sanctuary with GPS collars. The sanctuary is spread over Bangarupalem, Palamaner and Kuppam mandals of Chittoor district, and is flanked by Tamil Nadu and Karnataka. Senior forest officials of Chittoor West Division said that on Thursday, a team of IOCL personnel from Chennai visited Chittoor and made a donation as part of the oil major's corporate social responsibility (CSR) outreach. Officials said that there are about 35 wild elephants in Koundinya wildlife sanctuary, split into various herds. The main objective of tagging the wild elephants with GPS collars is to track their movements and prevent them from raiding crops.

The collars, which are expensive, would be fitted to leaders of each herd. A herd is led by its oldest female elephant called a matriarch. The movement of the herds would be monitored through a separate app. Whenever a herd comes close to fields or if they cross the forest fringe areas and come close to human habitations, the GPS collars would send alerts to elephant trackers, who will rush to the spot in no time to divert the elephants towards the forest.

18. Musth does not necessarily give younger, male Asian elephants an edge (India)

The Hindu - 28.12.2019

A seven-year study of Asian elephants from Nagarahole-Bandipur, a population centred around the Kabini region, yields interesting patterns of male elephant behaviour when in musth. Hormonal levels give musth males high energy and aggression levels and this state is often correlated with a propensity to mate. In two papers published in Journal of Mammology and Gajah, the team from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, probes how this works in the Kabini population.

When an elephant is in a musth state, its urine shows increased testosterone levels. Also, temporin, a thick secretion, flows from the temporal ducts situated midway between their eyes and ears. Sometimes, the elephant dribbles urine as well. They hardly feed during musth and are more focussed on finding fertile females. They move from female to female, checking if she is fertile or not. Males enter into musth (show signs of musth) when there are in good body condition, and lost body condition over the time they are in musth because they are hardly feeding.

Moreover, males can also mate when they are not in musth (they do not have to enter musth in order to mate). Therefore, people have been interested in finding out how exactly musth helps as a reproductive strategy since it is a very

expensive strategy. One way in which musth might give an advantage is that it might help to break a "queue" so to say of which male elephant is allowed to mate. It is also possible that musth allows for males to have greater energy and to rove (roam) over larger areas, which then gives males the opportunity to sample more females than non-musth males.

Young (15-30 years old) males in musth did not have an advantage over older (over 30 years) non-musth males in terms of access to females. Old musth males had an advantage over old non-musth males, and also showed a roving strategy, which allows for searching for multiple females. Therefore, musth seems to be a roving strategy that is primarily advantageous to old males and not to young males. If the female should get pregnant, she is out of circulation for about five years, because the pregnancy lasts two years and then she is lactating for over two-and-half years.

19. Tea gardens along Bhutan border install non-lethal electric fences to keep elephant herds away (India)

News Live TV - 8.12.2019

Several tea gardens in Udalguri and Baksa districts situated near the Assam-Bhutan border have installed electric fences to keep wild elephant herds at bay as pachyderms continue to enter human settlements in search of food and water. Tea estates are adopting desperate measures to deter wild elephant herds from entering garden areas and paddy fields by installing these electric fences. These fences use non-lethal direct current through a solar-powered battery to keep elephant herds away.

Authorities of several tea gardens have covered their gardens with electric fences. Meanwhile, several villages along the Indo-Bhutan border continue to suffer from regular elephant depredation with a herd of around 70 to 80 wild elephants coming out of the Tamulpur forest range in search of food and water almost regularly and enter nearby villages. Villagers say they have been passing sleepless nights as elephant herds continue to unleash terror; destroying crops, banana plantations and razing down houses. More than 100 people have been killed in violent conflicts between men and elephants in Baksa and Udalguri districts in the past couple of years.

20. Of 41 jumbos at Koundinya, six died this year (India)

The Hindu - 30.12.2019

The Koundinya wildlife sanctuary in Chittoor district has lost six of its 41 elephants due to causes ranging from electrocution to old age in this year alone. The sanctuary, located at the tri-State junction of A.P., Tamil Nadu and Karnataka, is spread over 500 sq km and has been a safe haven for elephants for decades ever since elephants first appeared here in the 1980s. Apart from being a home to the existing 35 elephants, the sanctuary is also part of the Hosur-Krishnagiri-Koundinya elephant corridor.

Breakaway herds from the Kuppam region formed another safe haven in Seshachalam biosphere spread over the Chamala valley, Talakona reserve forest and Rajampeta division of Kadapa where they are protected from the risk of electrocution, unlike Koundinya. Apart from the risk of getting electrocuted, there are other threats faced by Koundinya elephants, such as communicable diseases, scarcity of fodder and water, and shrinking habitat due to encroachments on forest fringes and denudation.

21. Exploitation in Central Highlands robs elephant calves of first breath (Vietnam)

VN Express - 26.12.2019

No calves have survived birth since 1989 in a Central Highlands district where elephants are considered kin and buried among family members. Y Yo Ni, of the M'nong ethnic minority, wades through the mud to reach a cemetery near his home in Bhok Village of Yang Tao Commune, Lak District, Dak Lak Province in the Central Highlands of Vietnam. The 21-year-old is visiting Thong Nang, a baby elephant that died earlier this year.

The mahout is unclear why Thong Nang succumbed at birth, though he ascribes the incident to the mother being too old, heavily exploited by tourism, and confined to a small space. Five years ago, Yo Ni married and moved to Yang Tao Commune. Here, his father-in-law had made a living by providing tourist rides on a 40-year-old elephant named Bak Kham. When Bak Kham grew pregnant, she was transferred deeper into the mountain. Protected by nature, Yo Ni cared for her during the next two years.

On the morning of December 1, Bak Kham gave birth to a stillborn infant the family was unable to resuscitate, having blown air into its trunk for nearly 30 minutes. "My father-in-law couldn't let go of the corpse. He just held it and wailed. Thong Nang weighed 100 kg," Yo Ni explains. As the M'nong consider elephants kin, often cohabiting beneath the same roof, Thong Nang was interred next to Yo Ni's family ancestors.

22. Armed unit to tackle poaching (Malaysia)

The Daily Express - 27.12.2019

It was a sad year for Sabah's wildlife, which saw the death of its last known male and female Sumatran rhinos as well as continued killings of pygmy elephants. Malaysian police para-military unit, Tiger Platoon, has also been called in to assist the Wildlife Department to stop the senseless killing of the elephants. In November, the Tiger Platoon from the General Operations Force was assigned to assist relevant authorities in protecting the wildlife in the State. The special platoon is to be mobilised to conduct patrols, track down suspects and carry out joint raids with enforcement officials, including from the Wildlife and the Sabah Forestry Departments.

It also came as a shock that a syndicate had been active in Sabah smuggling pangolins worth RM 8 million in February and that the State Wildlife Department or authorities knew nothing about its operations for seven years. The 30-tonne pangolin haul was also picked up by the world's press, calling it a record. The seizure from one single raid that went unnoticed by the authorities confirmed there was massive poaching going on in Sabah. Seven pygmy elephant deaths were reported since September, in which elephant tusks were also reported missing, with some smuggled into Indonesian Kalimantan.

Two tusks involving the case in Dumpas Kalabakan were recovered. The elephant that owned the tusks was found dead with 70 shots. Its two tusks were found buried at the Kebun Koperasi Felda Umas area. A plantation manager has since been charged in court for refusing to hand over the tusks. Three others accused were also brought to court. Just a week after Sabah hosted the 10th Asian Elephant Specialist Group meeting in December, another elephant was found dead in Kinabatangan. The human-elephant conflict in Sabah attracted the attention of non-governmental organisations and its population was estimated to be down to 2,000 in the State. The pygmy elephants in Sabah are a different species compared to their Asian and African cousins.

23. Elephant terror in Kampur (India)

News Live – 27.12.2019

Man-elephant conflicts continue to be on the rise in different parts of Assam with frequent incidents of wild tuskers straying into human settlements. Residents of Kampur under Nagaon district are spending sleepless nights as a herd of wild elephant destroyed crops and houses in the area. The pachyderms entered the area on Thursday night and brought down Naren Bordoloi's house in Tetelisara, Kampur. Local people have alleged that the forest department pays no attention to their concerns despite repeated complaints to drive out the herd of wild elephants from residential areas.

Meanwhile, several people have been injured in the wake of increasing human-elephant conflicts in different parts of Assam. "We are facing a lot of problems. We cannot stay outside at night because of wild elephants' terror. They often stray into our houses and paddy fields destroying everything in their way. I request the concerned authority to take necessary steps and help us out with the ongoing elephant issue," said a local.

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 evaluated by the editorial board of *Gajah*. Peer-reviewed articles will be sent out for review. 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.

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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.

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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.

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