GAJAH

NUMBER 42
2015

Journal of the Asian Elephant Specialist Group



GAJAH

Journal of the Asian Elephant Specialist Group
Number 42 (2015)

The journal is intended as a medium of communication on issues that concern the management and conservation of Asian elephants (*Elephas maximus*) both in the wild and in captivity. It is a means by which members of the AsESG and others can communicate their 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 AsESG. The copyright of each article remains with the author(s).

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Jayantha Jayewardene has stepped down as Editor and Dr. Arnold Sitompul has retired from the Editorial Board. We wish to sincerely thank them for their important contributions over the last eight years!.

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Editorial Note

Articles published in *Gajah* may be used, distributed and reproduced in any medium, provided the article is properly cited.

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

Cover: Adult male crossing an electric fence at night captured by camera trap in Udawalawe National Park (Sri Lanka)
Photo by Ashoka D. G. Ranjeewa
(See article on page 7)

Layout and formatting by Dr. Jennifer Pastorini
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Instructions for Contributors

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

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

Correspondence: Readers are encouraged to submit comments, opinions and criticisms of articles published in *Gajah*. Such correspondence should be a maximum of 400 words, and will be edited and published at the discretion of the editorial board.

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

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

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

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

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

Olivier RCD (1978) *On the Ecology of the Asian Elephant*. Ph.D. thesis, University of Cambridge, Cambridge, UK.

Rajapaksha RC, Mendis GUSP & Wijesinghe CG (2004) Management of Pinnawela elephants in musth period. In: *Endangered Elephants, Past Present and Future*. Jayewardene J (ed) Biodiversity & Elephant Conservation Trust, Colombo, Sri Lanka. pp 182-183.

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

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

Deadline for submission of manuscripts for the next issue of Gajah is 31. October 2015.

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Editorial

Jennifer Pastorini (Editor)

E-mail: jenny@aim.uzh.ch

In 1986 the Asian Elephant Specialist Group (AsESG) published its first newsletter. In the first editorial Lyn de Alwis commented that the group felt there was a lack of communication regarding new scientific material and technical know-how. The newsletter was to address this deficiency.

Lyn de Alwis, later together with Charles Santiapillai put together 15 newsletters in 10 years. In 1992 the newsletter switched to the name *Gajah*. In 1996 Charles Santiapillai took over the editorship, publishing 10 *Gajahs* in the next 10 years. In 2007 Jayantha Jayewardene became the editor for *Gajah*. He managed to publish two issues every year, so putting together 16 *Gajahs* in 8 years.

Over the years *Gajah* has grown in size (more articles per issue), published more regularly, and become available for free download on the AsESG website. *Gajah* now publishes research articles, short communications, news items, a compilation of abstracts from scientific papers and a selection of news clippings to inform its readership about elephant related issues.

Of course there is always room for improvement. However, as Lyn de Alwis stated in that very first editorial, all members of the AsESG need to get actively involved.



We definitely should have more news items. Reports from workshops, meetings etc. related to Asian elephants would be most welcome. If a meeting is open for all to participate, why not announce it in *Gajah*? If the workshop/meeting was only for invited attendants, you could inform other "elephant people" about its purpose and important outputs. Even if we can't go to all the meetings, we as members of the AsESG would like to hear about what is going on.

We should also have more reports from elephant events in the news section. A cultural procession where elephants play a main part, annual elephant festivals, special events with elephants etc. This could basically be a picture page with a very short text to it, explaining the event. I feel that even if some of us may not agree with the use of elephants in such contexts, we as members of the AsESG at least should hear about them.

The short communication section could also be used more widely by the AsESG members. What I find particularly lacking is, that if something new was tried out and it turned out to be a failure, it is very rarely communicated to others. Why not report in detail why and how you tried a new method and describe how it failed? Others can then (if funds are limited) avoid doing the same thing and the more adventurous ones can start improving right from the start, hopefully getting the idea working in the second attempt.

And then of course there are the research papers. Authors are encouraged to write up their work as a proper paper with introduction (why and where), methods (what exactly was done), results (what happened) and discussion (try to explain the results, compare with other studies). One of the main purposes of *Gajah* should be to encourage and build the capacity of range country scientists, managers and workers to publish their

work. Therefore the editorial team will be more than happy to help authors, who are not very experienced in writing such papers to shape up their work. Editing the English is no issue at all. So please give it a try!

We have now also introduced a peer-reviewed section for authors who need their work to be peer-reviewed. This often matters in academia when applying for new jobs. *Gajah* doesn't want to loose out on such papers. Of course, peer-reviewed papers will be held to a higher standard and the authors will have to do more work on them.

I would also encourage readers to send in comments on any articles published in *Gajah*. We are a diverse group and we do not have to hold the same view on any matter. It is good to have a lively discussion and tackle contentious issues. Scientific debate would further the cause and make the group more active.

Gajah has been struggling to get enough articles (any section) to complete the next issue. Therefore, I would like to request all members of the AsESG and our readership to submit a text or to look out for people doing something interesting on elephants and encourage them to write it up for *Gajah*. Remember that you do not have to be a member of the AsESG to publish in *Gajah*.

We are also hoping for more contributions from professional researchers. There are now so many journals out there to choose from. *Gajah's* main advantages are that it is an established journal and that it is entirely free, both for the authors and the readers. And please cite *Gajah* articles when publishing in other journals, so people who do not know about *Gajah* come across such citations and join our readership.

In short, *Gajah* should be packed with relevant news to keep the AsESG members up to date with what is happening in the "elephant world" and full of interesting articles for all scientists or conservationists working on Asian elephants. The more we know about Asian elephants, the better we can protect them!



Elephant herd in Manas National Park (India) - See article by Naba K. Nath *et al*. on page 15

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Correspondence

Comments on: Jayantha Jayewardene (2014) Editorial. Gajah 41: 1-2.

Dear Jayantha

I am writing in response to your Editorial in the most recent *Gajah*. Before I turn to the Editorial, however, I would like to once again express my thanks to you, to the *Gajah* Editorial Board, and to Hank Hammatt, our webmaster for the excellent job you have all done over the last years editing and producing *Gajah* and making the journal and individual papers therein available online. I have acknowledged your sterling efforts for *Gajah* on many occasions including in my reports to the SSC, written with Ajay Desai, on the AsESG's work (AsESG 2012, 2013) but it is of course fitting to do so again now that you are standing-down as editor.

In your editorial, you make a number of points but clearly a key point is that about communication. I accept that communication could be improved significantly and apologize for any deficiencies in this regard. I also note that communication should be a 'two-way' process. For example, Ajay's and my calls for information or comments to AsESG members have often produced very few, or in some cases, no, responses. It is also worth noting that some years ago Ajay and I proposed creating an AsESG listserv and/or a Newsletter to provide a means of fostering discussion and keeping AsESG members up to date and informed of the AsESG's activities, notable developments, etc. but the majority of the group's members were not in favour of these ideas. One way of addressing the group's communication issues might be to actively use the website's news page, another might be to consider the idea of, say, a two-monthly-update bulletin that could be emailed to all members and posted on the website. I would welcome the membership's thoughts on these ideas. Finally, I am happy to commit to a 24-hour maximum response time for those emails clearly identified in the subject line as 'important' or 'urgent'.

An important point related to communication resulting from your Editorial, and discussed in the correspondence it has generated, is the desirability for the AsESG to have a Program Officer who could handle day to day communications and otherwise assist with AsESG's work. I could not agree more, and as you and others should know because we have included reference to it in Ajay's and my reports on the AsESG's activities (please see the hyperlinks in the references listed below), we announced a couple of years ago that we were seeking funding for such a position. We have also discussed possible opportunities for support for a Program Officer and the role that officer would play with a number of AsESG members over the last two years. In any case, we sought funding for a Program Officer position and a donor agreed to fund such an officer but unfortunately there was an unexpected hiatus partly because of the fall-out from the global financial crisis. However, I am pleased to be able to say that we are now finalizing an agreement with another donor for support of a Program Officer and will begin seeking a suitable candidate in the near future.

The most important point arising from your Editorial and related correspondence, of course, concerns the nature and extent of the AsESG's work: i.e. "tangible action" for Asian elephants. Doubtless the group's work could be better communicated but one should not simply assume that because one does not know everything that is happening that little or nothing is actually happening. Much of the AsESG's work is summarized in the annual and quadrennial reports in the SSC's journal *Species*, examples of which are hyperlinked in the references listed below. I will, however, take this opportunity to highlight a few of the more important of the AsESG's recent achievements, actions, and engagements:

Two of the most important roles of specialist groups are acting as the Red List Authority for the taxa concerned and conservation planning.

The AsESG has therefore been responsible for the assessing the Red List status of Asian elephants (and many group members participated in that process) and for listing the Sumatran elephant subspecies as critically endangered in 2011 (and again quite a number of group members participated in that process). Of course listing a subspecies as critically endangered is not "a cause for celebration", which is why we wrote in our report on the 2008–2012 quadrennium: "On a more sober note, the AsESG listed Sumatran elephants (*E. m. sumatranus*) as critically endangered on *The IUCN Red List of Threatened Species* in November 2011. The primary reason for the critically endangered listing was the scale and rate of habitat loss … The AsESG has offered its help in addressing the threats to Sumatra's elephants to the Indonesian authorities."

With regard to conservation planning, the AsESG organized a workshop to draft a *Conservation Strategy for Asian Elephants* that was attended by government representatives from all range States as well as many AsESG members. Then, in an attempt to seek wider government 'buy-in' for a range-wide strategy, we adopted the process used by IUCN and others for African elephants that resulted in the widely-acclaimed African Elephant Action Plan (AEAP). Specifically, the AsESG worked with the CITES Secretariat and a number of range States to seek a mandate from the range States as well as CITES for an Asian Elephant Conservation Strategy. Thus at the last CITES Conference, Cambodia proposed such a CITES Decision (following a request from the AsESG and others) and India was ready to support it (again after requests from the AsESG) but unfortunately, due to a misunderstanding, Indonesia opposed the idea, which was ultimately dropped at that conference. Nevertheless, we have continued to have discussions with Asian elephant range State governments and with CITES and I am hopeful that the idea of replicating the success of the AEAP for Asian elephants will be given a high-level mandate at the CITES meeting in January 2016, with the intention of launching the strategy at the CITES Conference in October 2016. If we can obtain such a mandate, then AsESG members and others as appropriate will of course be involved in the preparation of the strategy. If a mandate for adopting an AEAP-like process is not forthcoming, we will have to decide on another suitable way forward in discussion with AsESG members and the range States.

Another key issue, on which the AsESG has been active, with some success, is that of the illegal live trade in Asian elephants. As you know, such trade is a significant and growing problem in Asia. The AsESG has, therefore, worked with a number of partners, including Elephant Family in particular, both at the CITES Conference in March 2013 and at the last CITES Standing Committee meeting (July 2014), to draw attention to this problem and successfully get live trade into the purview of CITES and thus provide some 'weight' to calls to address the problem. Subsequent to the 2014 CITES meeting I worked to seek funds for an investigation of the scale of the problem in Asia and the measures needed to address it. The CITES Secretariat has now contacted the AsESG to say that it will fund a consultant and is seeking our inputs into the 'TOR' for that consultant (we will be in touch with relevant Task Force leaders once we receive the TOR from CITES). Encouragingly, we also have a donor lined-up to help fund follow-up work, i.e. implementation of the consultant's recommendations (e.g. registration of captive elephants).

Questions around the issue of captive elephants more generally are also a growing concern. These issues include (1) the trend for range States to remove elephants from the wild in response to human–elephant conflict and release them in very small fenced areas which are then called 'sanctuaries' with obvious negative effects on wild populations; (2) interactions between captive elephant populations and wild elephant populations including the threat posed by capture from the wild, and the future of large under-employed captive elephant populations such as those in Myanmar – e.g. should they be reintroduced into the wild?; (3) the need for captive elephant registration standards and much-wider roll-out of elephant registration to prevent abuses including illegal trade in live elephants; and (4) other ways of monitoring and combating the illegal trade in live elephants, as discussed above. As a number of AsESG members know as

a result of on-going discussions, we are planning to hold a workshop this year or early next year to address these and other related issues, including possible IUCN position statements, the development of registration standards, and ways to promote greater 'roll-out' of registration. Several donors have already said they will fund (or are likely to fund) that workshop and/or its outputs including registration standards, and we have had discussions with the Cambodian government about their hosting the workshop. I expect to be able to provide both more details of this workshop and call for the group's inputs in the near future.

The AsESG has organized (or co-organized) a number of workshops, notably the range-wide mapping/status assessment and the strategic planning workshops in Cambodia in 2008 and the human–elephant conflict mitigation methods workshop in China in 2009, which the AsESG's HEC Task Force led on. As mentioned above, we are also planning a workshop on captive elephant issues to be held later this year or early next year in Cambodia.

The AsESG worked with the AfESG to develop the IUCN's *Elephant Database* <http://www.elephantdatabase.org/maps/asian_range> and the range data for Asian elephants are now included in and publically available from that database. Reviewing and entering all Asian elephant population status data has taken longer than I would have liked but I am hoping that the appointment of a Program Officer will facilitate that process (a likely requirement for the Program Officer will be good GIS skills).

Other notable recent achievements include the AsESG's involvement in the preparation of the annual reports to CITES on the *Status of Elephant Populations, Levels of Illegal Killing and the Trade in Ivory* from MIKE, ETIS, IUCN/SSC (AfESG & AsESG), CITES, and WCMC (CITES, IUCN/SSC AfESG & AsESG, TRAFFIC, WCMC 2011, 2012, 2014). These reports were a key influence on the CITES processes that resulted in a number of countries being instructed by CITES to produce National Ivory Action Plans (NIAPs) in 2013 and 2014 and AsESG members subsequently helped a number of countries produce their NIAPs working 'behind the scenes'.

Finally, I have been in discussions with donors and others about a high-profile campaign to put Asian elephants 'on the map': that is to say to draw attention to the threats to Asian elephants, to remind the global community that Asian elephants need help as much as, indeed more than, African elephants, and to help drive funding and political support for Asian elephant conservation. The details of that campaign (tentative title, "The Forgotten Elephant") need to be a little further developed before they are ready for sharing with the group for its inputs, however the campaign is likely to include high-profile elephant-themed public art exhibitions, films and popular articles, fund-raising events, and promotion of Asian elephant conservation in relevant political and development fora.

Turning now to the question of funding for *Gajah,* contrary to your assertion, Ajay and I have helped you secure funding for *Gajah* from donors such as Singapore Zoo and USFWS and defended you with IUCN HQ when there were disagreements over the contracts required in order for the funds to be disbursed. I am of course happy to seek funds again now and whenever needed in the future to help secure the future of *Gajah* but it is perhaps necessary to again clarify, in response to your comments about transparency and your statement that "not one cent (or rupee) has been provided by the AsESG for *Gajah*", that the AsESG does not have an annual (or any other) budget from IUCN or any other organization. We cannot just provide money for *Gajah* or any other AsESG activity, instead we have to seek funds on a project-by-project basis.

In response to accusations that the AsESG has become dysfunctional under Ajay and myself as the group's Co-chairs it is perhaps worth thinking back to the "state of play" when we took over: *Gajah* was becoming moribund (it only came out erratically, was only available in hard copy, back issues or papers in previous editions were essentially unavailable, and the group was in bad odour with the main donor for *Gajah*), there

was no AsESG website, no AsESG Task Forces, no engagement with MIKE or CITES more widely, etc., etc. Since we took on co-chairing of the AsESG: *Gajah* has become a regularly-produced high-quality journal and all the back issues (and individual papers therein) are now available as PDFs online (and as we have repeatedly acknowledged that is a great tribute to your work and to that of the editorial board and Hank Hammatt); the AsESG now has a website (and let us again acknowledge Hank's continuing efforts there) and Task Forces, which have produced, for example, reports on invasive plants in elephant habitat, elephant health protocols, and a bibliography on elephant tuberculosis. We also convened the first-ever Asian Elephant Range States' Meeting. Other activities were summarized above, including the AsESG's engagement with the AfESG, with MIKE and ETIS, and with CITES more generally. These and other activities have been all been discussed with group members, many of whom were of course involved in the activities; in addition, these activities have also been reported to the group and to the SSC and IUCN more generally (see, for example, the reports referred to above).

I would like to close by noting that there are appropriate and professional ways of raising concerns about a Specialist Group such as writing to the Chair or Co-chairs in the first instance, and allowing them a chance to reply before deciding whether to write to others such as the Chair of the SSC. Writing critical editorials in a Specialist Group's journal is certainly not an appropriate method of raising concerns: Specialist Group journals are scientific/technical journals, not newspapers, and need to treated as such by all involved in their production. Indeed, up until your last editorial you have followed such high standards and are largely responsible for building the high reputation that *Gajah* has today. I therefore found it especially sad that you closed your distinguished tenure as editor with this editorial, not so much because of its contents, but because of the way in which it was done. I am, of course, more than willing to put this behind us and work together with all of the AsESG for the good of our Specialist Group and the magnificent species for which we are responsible.

With best wishes,

Simon Hedges

Co-chair, IUCN/SSC Asian Elephant Specialist Group

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Research Article *Gajah 42 (2015) 7-14*

Camera Traps Unveil Enigmatic Crop Raiders in Udawalawe, Sri Lanka

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Abstract. We studied Asian elephants (*Elephas maximus*) entering three villages bordering the Udawalawe National Park, Sri Lanka, by placing camera traps on road openings of the boundary electric fence of the park. We identified 35 individuals that crossed the fence, all of which were males. Identified individuals were of differing age/size classes and the majority were solitary. Elephants left the park at dusk and retuned at dawn. Individual variation was observed in method and time of fence crossing. Elephants showed localized movement over the small area of the study. Our results suggest a high degree of crop raiding by males in the area and underscore the failure of current management activities in preventing human-elephant conflict.

Introduction

Human-elephant conflict (HEC) is the primary threat to the survival of Asian elephants (Fernando *et al*. 2012). Elephants have a distinct social structure with group living females and solitary males, with adult males being the main contributors to HEC (Sukumar & Gadgil 1988; Chiyo & Cochrane 2005; Fernando 2011). Crop raiding is the principal proximal cause for the conflict between humans and elephants. Elephants raid crops primarily at night (Sukumar 1989; Graham *et al*. 2009). However, all males in a population do not raid crops (Williams *et al*. 2001; Chiyo *et al*. 2011b).

Most HEC studies are based on damage evaluation through questionnaire surveys or examining pre-existing records (Fernando *et al*. 2005; Santiyapillai *et al*. 2010; Ekanayaka *et al*. 2011). A few studies have used new technology such as radio collars (Fernando *et al*. 2008; Graham *et al*. 2009) and DNA analysis (Chiyo *et al*. 2011b).

Patterns of HEC may vary between locations (Hoare 2001) and by individual elephant. Individual identification of 'problem-elephants' can provide information useful in understanding HEC and determining location specific and effective mitigation actions. Due to the difficulty in locating and observing elephants at night, it is challenging to identify crop-raiding individuals by direct observation. Thus, important aspects such as the demography of crop raiders, number of raiders and individual patterns of crop raiding, remain largely unknown.

In this study, we used infrared night vision camera traps to identify individual elephants entering three villages bordering the Udawalawe National Park, Sri Lanka.

Methods

Study area

The study area encompassed the villages of Pokunuthanna, Neraluwa and Dahaiyagala, situated at the northern border of the Udawalawe National Park (UWNP) in southern Sri Lanka. Distance between the villages were: Pokunuthanna and Dahaiyagala 3 km, Pokunuthanna and Neraluwa 1.5 km, Dahaiyagala and Neraluwa 2.7 km. UWNP covers 308 km^2 with a boundary of approximately 100 km. It is contiguous with

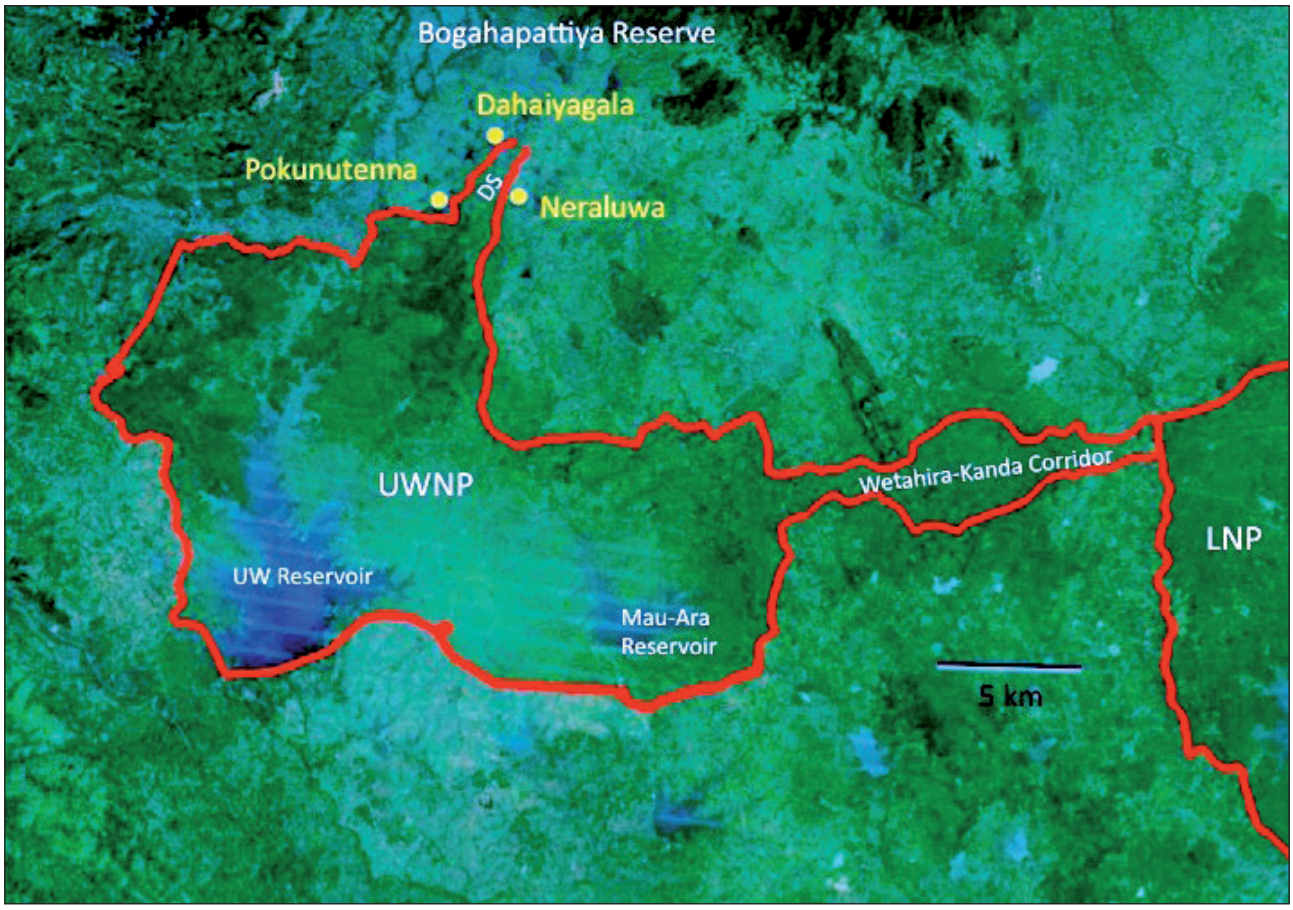


Figure 1. Map of Udawalawe National Park and study area. Red line: electric fence on park boundary. LNP: Lunugamvehera National Park. DS: Dahaiyagala Sanctuary.

the Dahaiyagala sanctuary and Bogahapattiya Forest Reserve in the north and Wetahira-Kanda corridor and Lunugamvehera National Park in the east (Fig. 1). It is used by around 1000 elephants of which around 250 are mature males (de Silva *et al*. 2011). Elephant habitat extends beyond the park boundaries to adjacent conservation and non-conservation areas.

The mean annual temperature is approximately 32ºC and the average annual rainfall is about 1329 mm. The main rainfall occurs from October to December during the northeast monsoon and some rain is received via the southwest monsoon from March to April. Two cultivation seasons "Maha" and "Yala" follow the rainfall.

The major crop in the area was paddy. Banana, coconut, mango, manioc, papaya and vegetables were also cultivated. Villagers guarded their crops using tree huts, shouting, fire crackers, hanging electric torches, and by setting up bonfires and locally made electric fences.

An electric fence built by the Department of Wildlife Conservation was located on the boundaries of the UWNP and the Dahaiyagala sanctuary (Fig. 1). The fence separated the protected area from the three study villages and lay through small forest patches in some places. Several public roads crossed the fence through the Sanctuary area. The fence had five openings related to roads, guarded by detachable electric wires.

Data collection and individual identification

The study was conducted from March 2014 to January 2015. Data was not collected during the months of September, November and December due to logistic issues. Within the study period, the cameras were deployed on a total of 38 nights. Four night vision camera traps were used. The cameras were stationed close to one of the three villages on each night of data collection. Fence road openings (Fig. 2) and elephant trails within 200 m of fence road openings, were selected



Figure 2. Road fence opening at Pokunuthanna.

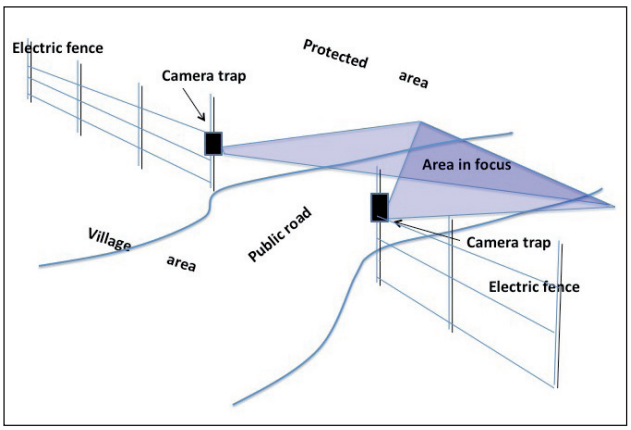


Figure 3. Camera trap setting at fence openings.

to set the camera traps. Two camera traps were set covering the fence opening (Fig. 3) and the other two camera traps were set on nearby trails. Camera traps were not set during the day as elephants did not cross the fence during daylight hours.

Camera traps were fixed at a height of 4-5 feet from the ground, facing the park, to capture frontal views of elephants leaving the park (Fig. 4). At 24:00 h, one camera was turned around to face the village, to capture returning elephants. Camera operation mode was set to take day and night pictures. A series of three consecutive still photos and a 15 second video clip were captured at each trigger. A one second interval was set between each photo, video and trigger. The cameras were in operation from 17:30 h to 6:30 h. In addition, observations were conducted from a vehicle about 80 m away from the fence openings, which also served to prevent the cameras from being stolen.

Individual elephants were identified using morphological criteria (Moss 1996; de Silva *et al*. 2011). Three age/size classes were defined for males as mature-adult, young-adult and sub-adult. Identification of mature- and young-adults was based on secondary sexual characteristics (Fernando *et al*. 2012), and sub-adults on assessed height in addition (shorter and less developed secondary sexual characteristics than young-adults). Individuals detected ≥5 times were used to study individual variation in crossing the fence and those seen ≥3 times were used to assess locational preference. Capture histories were constructed from camera trap data and observations. Date, time, method of leaving and returning, individual identity, sex, age class, group size and the village name were recorded for each capture. Elephants captured within 10 minutes of each other and moving in the same direction (in or out of the park) were considered to be associating as a group.

Method of exiting and entering the park was classified as 'opening' when an elephant crossed the fence at an unguarded road opening, as 'breaking' when the fence was crossed by bringing down fence posts or stepping on the wires. If an



Figure 4. Examples of elephants captured by the camera traps.

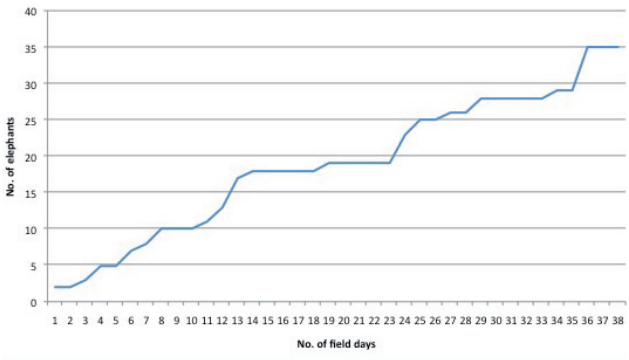


Figure 5. Cumulative number of identified individuals.

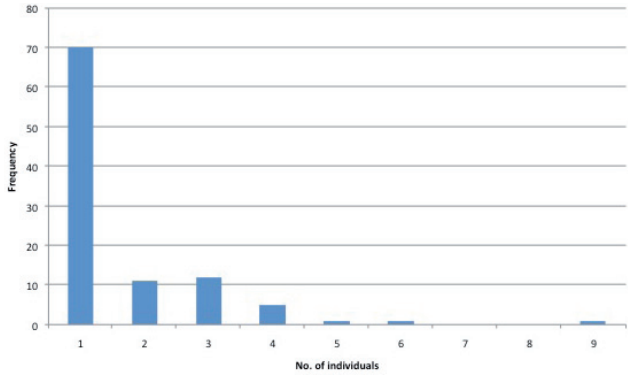


Figure 6. Group size and frequency of elephants crossing the fence.

elephant was captured only on exiting, method of entering was recorded as unknown and vice versa.

Results

Elephants were observed on 33 out of the 38 nights of data collection. A total of 192 elephant crossings were recorded with an average of 5 ± 5.33, ranging from 0 to 22 crossings per day. All crossings were by males. A total of 35 individuals were identified, of which 21 were mature-adults, 5 young-adults and 9 sub-adults. The cumulative number of the identified individuals showed continued increase throughout the study period (Fig. 5). Of elephants crossing the fence, 69% were solitary individuals and group sizes of associating individuals ranged from 2 to 9 with a mean of 3.16 ± 1.46 (Fig. 6).

Timing of leaving and returning

The earliest time elephants exited the park was 17:55 h and the latest time of entering the park was 6:06 h. The peak of elephants leaving the park was from 18:00 - 21:30 h (86%). The peak period of returning to the park was 4:00 - 6:30 h (86%) with 43% of crossings between 5:00 - 5:30 h. Elephant crossings were minimal between 23:30 - 2:30 h (Fig. 7).

Methods of leaving and returning

Elephants used several methods to cross the fence (Fig. 8). On 88% of occasions, individuals did not return from the point they exited the park that night. Of the individuals crossing the fence, 23% left the park by 'breaking', 49% through 'openings' and 28% were classified as 'unknown'. When returning, 11% entered the park by 'breaking', 32% through 'openings' and 57% were 'unknown'.

Individual variation

Six males consisting of five mature adults and one sub-adult crossed the fence five times or more. They crossed the fence a total of 60 times, with a

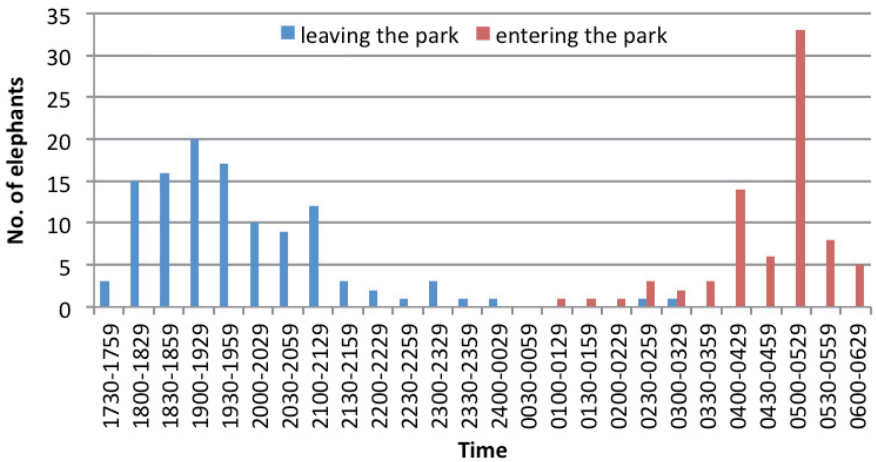


Figure 7. Elephant crossings against time.

Table 1. Method of leaving and returning to the park by selected males, as a % of total exits and entries of each individual.

	Exiting park			Entering park		
Elephant ID	Opening	Breaking	Unknown	Opening	Breaking	Unknown
M153	67	33	0	0	0	100
M155	75	8	17	58	0	42
M166	83	0	17	67	0	33
M286	27	36	36	36	36	27
M1004	40	60	0	20	0	80
M1015	66	17	17	33	0	67

mean of 10.00 ± 4.871 (range 6-17) crossings by an individual (Fig. 9, Table 1).

Thirteen individuals crossed the fence three or more times. They made a total of 70 crossings with an average of 5.38 ± 3.176 (Range 3-12) crossings by an individual. M155, M1000 and M1012 were observed at Dahaiyagala in 92%, 100% and 100% of crossings respectively. M286 (92%), M1003, M1004 and M1011 (100%) were only seen at Pokunuthanna. Six out of the eight males found at Pokunuthanna were also seen at Neraluwa and the other two also at Dahaiyagala. Two males were recorded at Neraluwa and Dahaiyagala. M1015 was seen at all three villages.

Discussion

We found that only males crossed the fence to enter the study villages. As the villages were situated next to the park fence and crop raiding was common, it can be assumed that the males crossed the fence to raid crops. Our results are consistent with previous studies on African elephants (Chiyo & Cochrane 2005) and Asian elephants (Fernando *et al*. 2005; Ekanayaka *et al*. 2011) that found only males raided crops. Crops have higher nutritional value than wild fodder (Sukumar 1989). Our findings support the hypothesis that despite high risk, males raid crops to increase body size, thereby enhancing reproductive success (Sukumar & Gadgil 1988; Chiyo *et al*. 2011a).

We identified 35 crop-raiding males, which amounts to 15% the total number of males previously identified by de Silva *et al*. (2011) in the UWNP. A study using molecular and observational techniques in Amboseli National Park, Kenya estimated that one third of the males engaged in crop raiding (Chiyo *et al*. 2011b). The cumulative number of identified males did not reach an asymptote during our study, indicating that the total number of crop raiders within the study area was higher than what was recorded. Therefore, the proportion of raiders in the Udawalawe population is likely to be much higher than in Amboseli.



Figure 8. Methods used by elephants to cross the fence. Left: Pushing a fence post. Middle: Stepping on fence wires. Right: Through unguarded road opening.

Our study was confined to 3 road openings in relation to 3 villages, and covered approximately 6 km of the park perimeter fence. There are approximately 52 villages around UWNP and the perimeter fence is around 100 km. Crop raiding is experienced in almost all villages around the park. While road openings on the fence were limited, elephants broke the fence all along its length. We also observed elephants crossing the park fence on most days of observation, throughout the year. Therefore, our study underscores the very high prevalence of raiding in the area.

We observed elephants crossing the fence to be mainly solitary, together with a few bull groups.

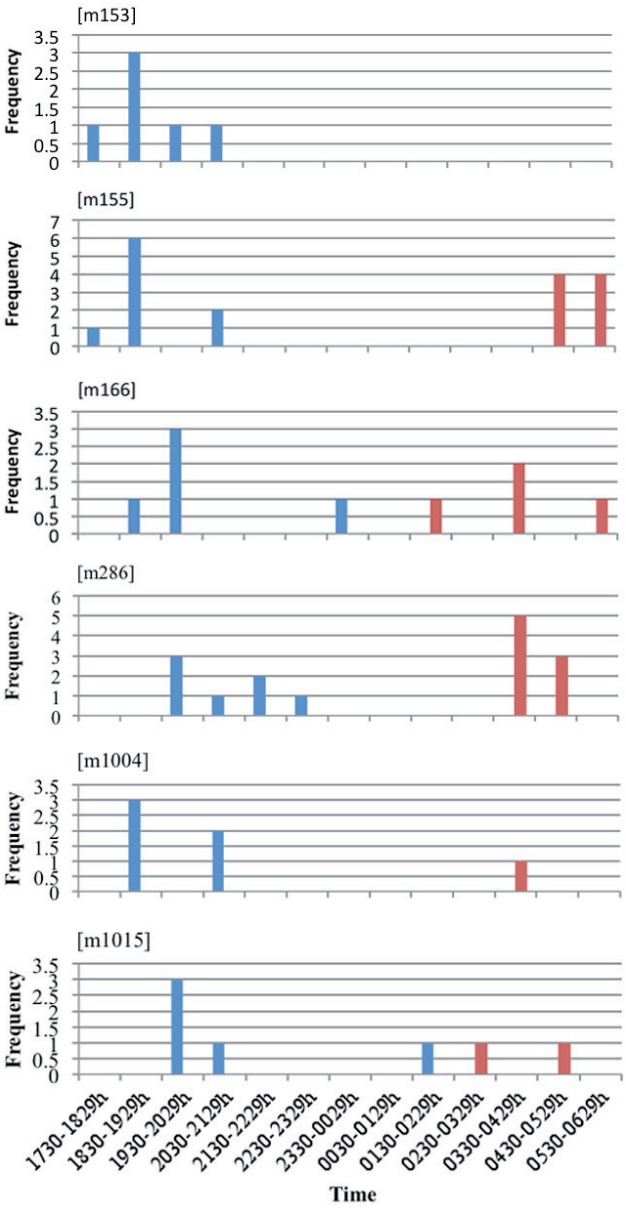


Figure 9. Times of individual elephants leaving (blue) and returning (red) to the park.

A similar pattern was observed in Hasanur in southern India, where raiding by single bulls was the most common but groups of up to four males came together for raiding (Sukumar 1989). Sukumar (1989) also recorded a higher grouping propensity during the night, with only 7% of bulls observed to be in groups during the day and 43% during the night. An observational study by McKay (1973) found 18%, 19% and 38% of males to form diurnal bull groups in Yala, Gal-Oya and Lahugala National Parks respectively in South-east Sri Lanka. Nettasinghe (1973) recorded a bull group of eight at Thamankaduwa area in north-central Sri Lanka. We found 30% of the males identified in our study to associate in bull groups. The group of nine observed by us is the largest bull group recorded in Sri Lanka to date. Therefore, our study found a comparatively high tendency for bull group formation, which is likely to be related to the raiding behaviour of the observed individuals.

We detected all three age-classes of males crossing the fence to and from the villages. Thus it is likely that the number of 'problem elephants' (Fernando 2011) in the area will increase in the future as more young elephants take up raiding.

Timing of leaving and returning to the park.

We found that elephants left the park at dusk and returned at dawn. In southern India males entered crop-lands between 19:00 h to 22:00 h and returned before sun rise (Sukumar 1989). A study in Laikipia plateau, Kenya, found elephants raided crops during the night and that they moved more rapidly when in human dominated areas (Graham *et al*. 2009). In North-western Sri Lanka, de Silva & de Silva (2007) found that feeding hours shifted to the late evening or night in areas with high habitat disturbance. The preference for entering human areas and presumably raiding crops during hours of darkness as observed by us and other studies, could be related to minimizing detection hence risk.

Methods of leaving and entering

Only a small proportion of males used the same point for exiting and returning to the park. We

found that the majority of males left the park through road openings but their return was not detected. This could be due to returning through another road opening or by breaking through the fence at a different site, or not returning but moving-on. As elephants sometimes broke the fence even when they could exit the park through an opening, and the fence was broken regularly along its length at multiple points, most elephants that exited the park could have returned by breaking the fence at another point. Our results suggest that the electric fence on the park boundary was ineffective in preventing males from exiting the park, hence it didn't stop the crop raiding.

Individual variation

Intra- and inter- individual variation was observed in times of exit and re-entry, hence amount of time spent outside. While the times of exit and re-entry by a particular individual varied between dates, some individuals appeared to favour particular time periods. Such variation could be due to different extents of crop raiding and risk taking by different males but could also be related to experiences on a particular night and crop guarding by villagers.

Individual males showed variation in the method of crossing the fence with M155 and M166 mostly using openings and the others showing an irregular pattern. Individual variation in methods of crossing the fence suggests that individuals varied in their ability and/or preference. As elephants have high memory capacity and can learn from each other (Savage *et al*. 1994; McComb *et al*. 2001; Byrne *et al*. 2009), such variation maybe related to past experiences and associations.

We found a high degree of preference for particular villages by specific individuals, with only one of 13 elephants observed at all three villages. As the three villages were within an area of about 5 km^2, our results suggest localization of crop raiding males at a fine geographic scale. While we do not have the information to determine cause, such localization could be related to variation in resource (crop) availability and degree of crop protection hence risk, together with home range boundaries, competition between individuals and variation in risk taking.

Conservation importance

Our study demonstrates that night vision camera traps can provide accurate individual identification of problem elephants and can provide information on the demography, number of raiders, patterns and timing of the movements of such elephants. Such data enables managing 'problem elephants' without negatively impacting non-raiding individuals.

The main management actions for HEC mitigation in Sri Lanka and across the range are translocation, elephant drives and constructing electric fences. In addition to the general failure of translocation in mitigating HEC (Fernando *et al*. 2012), our findings indicate that translocation is impractical in our study area, as a large number of males caused problems. Elephant drives would also be inappropriate and ineffective, as only males raided and they crossed the fence at will. Therefore, the most effective HEC mitigation measures for the area would be community based methods, centred on small 'exclosure' electric fences, rather than the extensive 'enclosure' fence on the park boundary.

Acknowledgements

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Research Article *Gajah 42 (2015) 15-21*

Human-Elephant Conflict around Manas National Park, India: Local People's Attitudes, Expectations and Perceptions

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Abstract. We conducted a study on local peoples' attitudes, expectations and perceptions of human-elephant conflict in fringe areas of Manas National Park. A questionnaire was administered to 563 residents in 24 villages during 2007-09. We found the respondents had positive attitudes towards elephants. Support for elephant conservation was significantly associated with gender, age and education of the respondents. We also found significant differences between actual and perceived frequency of conflict incidents, with respondents quoting far higher numbers of conflicts than what occurred.

Introduction

Religious and cultural ties between people and wild animals in India are of special significance where elephants are concerned. The Asian elephant (*Elephas maximus*) is inextricably linked to the country's mythology and history. Traditionally worshipped as Lord Ganesha, the elephant is also a symbol of fertility, wealth and abundance. This indirect presence of the animal in the daily lives of the general populace has saved the species from extinction (Nath & Sukumar 1998; Varma *et al*. 2008).

The close and ancient relationship between people and elephants provides hope for the long-term survival of Asian elephants in India (Sukumar 1989; Lahiri-Choudhury 1991; Daniel 1995). However, growing incidences of human-elephant conflict (HEC) are affecting the socio-economic status of villagers living in and around elephant habitats, leading to negative feelings towards elephants, thus hindering conservation efforts.

Most elephant habitats in India are surrounded by human habitations. Therefore success in conservation efforts depends on the local people, their perceptions, expectations and attitudes towards the issue. If these aspects are not taken into account, conservation goals would be difficult or costly to achieve. Unfortunately, as little or no emphasis has been given to understanding peoples' attitude towards HEC in planning or developing conservation and management strategies, this issue is becoming a major conservation concern (Varma *et al*. 2008).

While individual economic losses suffered from crop raiding can be relatively high, farmers in developing countries often have limited access to cash and are rarely compensated for their losses (Nyhus *et al*. 2005; Linkie *et al*. 2007; Warren *et al*. 2007). Inability to prevent crop raiding and the absence of compensation may lead to retaliatory killing of problem animals (Jackson & Wangchuk 2001; Nyhus *et al*. 2005).

The survival of Asian elephants is crucial from an ecological point of view as elephants play an important role in maintaining ecosystem balance. Therefore long-term strategies need to be developed for conservation of elephants and their habitats. To develop and implement such conservation strategies it is necessary to assess people's attitudes towards elephant conservation and HEC. Here, we describe the local peoples' attitudes, expectations and perceptions of HEC in the fringe areas of Manas National Park (MNP), Assam, India.

Materials and methods

Study area

MNP is a prime Asian elephant habitat within the Bhutan Biological Conservation Complex in the Eastern Himalaya Biodiversity Hotspot (CEPF 2005) and facilitates trans-boundary movements of elephants and other wildlife between India and Bhutan. MNP is located in Baksa and Chirang districts of Assam, India (26°35'-26°50'N, 90°45'-91°15'E) within the Chirang Ripu Elephant Reserve (2600 km^2) (Fig. 1). MNP spans both sides of the Manas River and is contiguous in the east and west with Reserve Forests. It is bounded in the north by Bhutan and in the south by a belt of thickly populated villages.

There are 61 recognized fringe villages within ~2 km distance from the park boundary which are followed by layers of additional villages further south. Increasing human population in fringe villages has led to encroachment, illegal hunting and tree-felling within MNP (Sarma *et al*. 2008). Many people residing in the fringe areas are dependent on MNP for their livelihoods, such as livestock grazing, thatch, fodder and fuel wood collection. The majority of the population in these villages belongs to the *Bodo* tribal community. The other communities are *Assamese*, *Bengali*, *Nepali* and a negligible number of *Adivasi* (Tea tribe).

Data collection

Simple random sampling was used for selecting households of respondents. Prior to the survey the questionnaire was tested with 50 people and ambiguities and misinterpretations were clarified (Kumssa & Bekele 2014). The survey was conducted in 24 randomly selected villages during 2007-09. We interviewed people one at a time to assure independence of data (Lammertink *et al*. 2003) and interviews lasted between 20 to 30 minutes. The questionnaire sought information on the demography, education and livelihood of respondents; their concerns on elephant conservation and MNP; and their attitudes, expectations and perceptions on HEC. Additionally, we conducted weekly field visits and recorded the number of HEC incidents that occurred in the 24 villages.

Results and discussion

Profile of respondents

A total of 563 individuals were interviewed of which 89.88% (n=506) were men. Since women were reluctant to face interviews their participation was less. Moreover, men were the general spokespersons in the community. This constraint in questionnaire-based sampling in the region is reflected in other studies as well (Barua *et al*. 2010; Das *et al*. 2011). People interviewed were between the ages of 18 to 58 with a median age of 39 years.

Majority of the people interviewed were tribals (94.14%, n=530) of the *Bodo* community. Due to their traditions and ethno-specific practices the *Bodo* tribe is heavily dependent on MNP for cattle grazing, collection of timber, firewood, thatch, wild vegetables and fruits, fishing and occasional hunting of wild animals for meat (although removal of any kind of forest produce from the park is not permitted). As they are the dominant tribe in the entire Manas landscape, their participation in conservation planning is very important.

Of the respondents 83.13% (n=468) were educated and the balance had no formal education or were illiterate. Among the educated, the level of education ranged from primary to the Graduate level. Education is an important factor in being

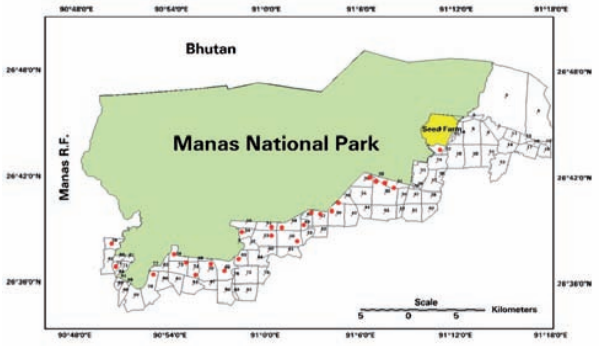


Figure 1. Map of study area (red dots indicate the sampled villages).

able to understand HEC, and conservation in general. The value people place on wild animals often depends heavily on their knowledge and so education is a major tool in conservation (Sutherland 2000; Mishra *et al*. 2003).

The prime agricultural crop cultivated in the region as stated by the respondents was paddy (summer paddy: 9.77%, autumn paddy: 19.54%, winter paddy: 70.69%). Majority of the local people were subsistence farmers (71.23%, n=401) without any alternative source of livelihood. Thus, the impact of elephant depredation is likely to be quite high. Lower income groups that generally do not get incentives from protected areas are more likely to resist rules and regulations, and continue to encroach upon wildlife habitat (Kumssa & Bekele 2014). This phenomenon was quite evident in MNP where 20.47 km^2 of the park has been encroached (Sarma *et al*. 2008). In MNP, initiatives should be immediately undertaken to stop further destruction of elephant habitat and to restore the already lost (encroached) forest areas through eviction followed by allowing regeneration of natural vegetation.

Attitudes towards elephants

The respondents had positive attitudes towards elephants, with 77.09% (n=434) saying that elephants should be conserved and that they have a right to be in MNP, 14.74% (n=83) of the people's response was neutral whereas 8.17% (n=46) said, elephants should not be conserved and they have no right to be in Manas (χ^2_2=913.55, P<0.001). When asked if they had benefitted from elephant presence, 91.83% (n=517) said no, 0.71% (n=4) said yes and 7.46% (n=42) of the people did not respond (χ^2_2=1040.92, P<0.001). Thus, even in the absence of any benefit from elephant presence the local people had a positive attitude towards elephants, which was perhaps influenced by the religious and cultural belief of the elephant as a God. Support for elephant conservation was significantly associated with gender (χ^2_2=9.14, P<0.025), age (χ^2_2=10.71, P<0.005) and education (χ^2_2=347.03, P<0.001) of the respondents. Female, older (≥39 years) and literate respondents were found to be more compassionate towards elephants (Table 1).

The association of a positive conservation attitude with literacy confirms the importance of education and awareness in conservation. Heinen (1993) and Kumssa and Bekele (2014) observed similar situations in their studies in Kosi Tappu Wildlife Reserve in Nepal and Abijata-Shalla Lakes National Park in Ethiopia respectively. Local people were also very conscious of the importance of forest resources in MNP and the benefits of living near the park. Of the respondents, 91.83% (n=517) said they liked living near the park and supported the existence of MNP. The benefits mentioned by the people included obtaining forest resources like thatch, firewood, medicinal herbs, and access to grazing land for their cattle, forest department jobs and tourism related services.

This positive attitude provides hope for elephant conservation in this region, which can be used to promote human elephant coexistence to ensure future survival of Asian elephant in the Manas landscape. However, on the other hand 8.17% (n=46) of the respondents were unhappy about the existence of the park, due to HEC or restrictions on forest resource use. Education, increasing awareness and compensation may help reduce the negative attitudes observed.

Table 1. Attitude of respondents towards Asian elephant.

Demographic variables		N	Positive (%)	Negative (%)	Neutral (%)	χ^2	df	P-value
Gender	Male	506	75.30	8.89	15.81	9.14	2	*P*<0.025
	Female	57	92.98	1.75	5.26			
Age	Young	269	76.95	11.52	11.52	10.71	2	*P*<0.005
	Old	294	77.21	5.10	17.69			
Education	Illiterate	95	7.37	35.79	56.84	347.03	2	*P*<0.001
	Literate	468	91.24	2.56	6.20			

HEC perception

When the respondents were asked about the level of HEC, 72.11% (n=406) perceived it as medium but that it was on the rise, 18.12% (n=102) as low and 9.77% (n=55) felt that the extent of HEC was high. Measures to reduce conflict at this early stage and initiation of long-term conservation strategies are of utmost necessity before the conflict becomes severe and unmanageable in the future. Such strategies may include creation of a buffer zone between MNP and villages through landuse planning, awareness programs for human-elephant coexistence, promotion of economically viable alternative crops to paddy and diversified livelihood opportunities. The perceptions and attitudes of people are influenced by their background experiences (Karimi 2009). Interestingly, all the people who perceived HEC as high had suffered elephant depredation in the last two years and had crop fields located next to MNP. Conversely, people who perceived HEC as low did not experience any elephant depredation so far. Thus, previous experience of HEC influenced people's perception on HEC. Particularly, when the damage exceeds a certain limit, people's perceptions may change and victims may develop negative attitudes that can lead to retaliatory killing. A study conducted by Karimi (2009) on African elephants in Tanzania also revealed that farmers' perceptions are shaped not only by background experiences, but by individuals' experiences with factors that have the most potential to cause damage.

The entire Manas landscape experienced a severe socio-political crisis (*Bodo* agitation) during the late 80's which devastated the infrastructure of the region, caused large scale destruction of the forest habitat, caused severe lapses in the management of the park and resulted in local extinction of several species, including the Indian rhinoceros (Nath *et al*. 2009; A.R. Rahmani pers. comm.). According to the respondents HEC was higher before the agitation then dropped during the peak agitation period. This could be due to decrease of unplanned agricultural activity by people and disturbance created by the rebel groups inside MNP, which they used as a major hideout during the agitation period. The respondents also stated that HEC has increased since the end of the agitation. However, to establish the fact of this statement historical information on HEC is required which is lacking.

Endangered wildlife sometimes takes more than its share of the blame (Nyhus *et al*. 2005). This fact was evident during our study too. We found that the median differences between the actual and perceived frequency of conflict incidents was significant ($T=69$, $P<0.05$, Wilcoxon's test for matched pairs) with respondents quoting far higher numbers of conflicts than what actually occurred in the villages (Table 2). This type of exaggeration is common and reported in many conflict sites where compensation policies exist. Sekhar (1998) therefore suggested that outside

Table 2. Actual frequency of HEC during the study period and median frequency of HEC perceived by the respondents.

No.	Village	Frequency of HEC	
		Actual	Perceived
1	Barengabari	188	300
2	Koroibari	170	200
3	Chourang (4 no.)	158	250
4	Bamunkhal	156	225
5	Pub Chengmari	132	190
6	New Betbari	120	140
7	Kahitama Gaon	105	125
8	Phulkumari	83	150
9	Lonthybari	72	90
10	Sutradhar Para	58	82
11	Oxiguri	51	100
12	Sadhupara	47	150
13	Ujan Bahbari	39	50
14	Milanpara	24	100
15	Borghagra	15	60
16	Chalchali	15	45
17	Ghilajhar	14	30
18	Aaohata	12	50
19	Moirajharpam	11	30
20	Moinamata (Pathar)	8	10
21	Chaolabari	7	5
22	Elengamari	7	12
23	Kachubil No. 2	7	3
24	Jengrengpara	6	5

verification of wildlife damage is essential because self-reporting results in overestimates of damage.

Causes of HEC perceived by local people

When asked about what could be the possible causes of HEC in the region, 38.01% (n=214) said forest destruction and shortage of food resources are the root causes of HEC. Other causes of HEC mentioned were human disturbance inside the park (14.56%, n=82), problem animals (13.14%, n=74), increased elephant population in the park (10.30%, n=58), after-effect of Bodo agitation (9.41%, n=53), Forest Department's inability to manage the elephants (5.86%, n=33), no idea (5.86%, n=33), close proximity of the village to the park (2.13%, n=12) and high palatability of cultivated crops (0.71%, n=4) (χ^2_9=4583.02, P<0.001). Of these, only close proximity of the villages to the park (Lahkar *et al*. 2007, 2009; Nath *et al*. 2009, 2013; Das *et al*. 2011) and high palatability of cultivated crops (Sukumar 1990) are likely to be true.

Existing HEC mitigation measures and their extent of use

HEC mitigation mostly consisted of methods used to drive away elephants, such as noise-making activities like shouting (17.23%, n=97), drum beating (1.60%, n=9), bursting of fire crackers (13.14%, n=74), use of flash lights (6.57%, n=37), pelting stones (14.74%, n=83), throwing burning firewood or other objects that are found within reach (4.97%, n=28) and use of spears (0.89%, n=5). Use of a combination of different methods was high (40.85%, n=230). The noise-making activities and throwing things are reactive and confrontational which increase the risk of injury and death to farmers from elephants as the aggression level increases on both sides (Fernando *et al*. 2007). Moreover, these methods tend to lose their effectiveness as elephants become habituated with increased exposure to them. With increasing habituation people may tend to use lethal methods (e.g. spears), which however should not be encouraged. In MNP, as the intensity of conflict is not severe, low cost mitigation measures such as trip wire alarm systems, use of flash lights, regulated use of fire crackers and strengthening of traditional crop guarding systems could still be effective.

Mitigation measures suggested by local people

When the villagers were asked if they had any ideas on how to make HEC mitigation more effective, 26.29%, (n=148) responded that they had no idea, 21.85% (n=123) suggested patrolling by Forest Department officials along the park boundary during the night so that they can be of immediate help at the time of conflict occurrence, 19.36% (n=109) construction of barriers like rubble walls or electric fences to prevent entry of elephants into the settlement area, 13.85% (n=78) crop guarding by farmers, 10.83% (n=61) capture and removal of habitual raiders and 2.31% (n=13) suggested lighting the park boundary as a HEC mitigation measure. Of the respondents, 5.51% (n=31) suggested culling of problem animals. When queried further, five of the respondents revealed that they had experienced property damage from elephants and had not received any compensation. Underlying reasons for the rest of the respondents who advocated culling were unsuccessful as they were drunk and showed aggressive behaviour at the time of data collection. Different suggestions have been put forwarded by the respondents on possible conflict mitigation measures. However in our view, education and awareness of the local people on how to live safely with elephants should be the foremost HEC mitigation initiative so that precautionary measures can be taken to avoid encounters with elephants. This strategy will minimize incidence of HEC to a large extent and ensure human-elephant coexistence.

Regarding who should be held accountable for HEC, most replied that the Forest Department was (58.08%, n=327). This view was perhaps influenced by the general notion of people that elephants are government (Forest Department) property. According to 25.22% (n=142) elephants were responsible for HEC as they came out of the forest instead of staying inside. Communities were responsible according to 6.04% (n=34) of the respondents and around 10.66% (n=60) had no idea who should be held accountable.

Compensation

When asked about the present compensation policies 88.63% (n=499) said they were not satisfied, 8.70% (n=49) said that they have no idea about the compensation scheme. Of the respondents 2.66% (n=15) were partially satisfied, because they had received in kind support from Forest Department in some way. The dissatisfaction with compensation was because the compensation process of the Forest Department was very slow and in most cases the victims did not get any compensation even after repeated follow ups and consequently stopped claiming for their losses. The absence of or faulty compensation systems may create antagonism towards elephants and may hinder the conservation efforts in MNP. Already there had been four cases unofficially reported in MNP during the period of study where the suspected problem elephants were shot dead by villagers in retaliation (Nath *et al*. 2013).

Compensation schemes can make people more tolerant to damages caused by elephants, but most are often inadequate, highly bureaucratic and open to problems such as fraudulent claims and corruption (Perera 2009). The existing compensation policy in MNP should be transparent, recompense process should be expeditious and victims should be compensated. However, a proper damage verification mechanism should be in place to avoid possible exaggeration errors. This will ensure local community's support in elephant conservation.

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Research Article *Gajah 42 (2015) 22-29*

Mitigating Human-Elephant Conflict near Shwe-U-Daung Wildlife Sanctuary, Myanmar

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Abstract. Human-elephant conflict (HEC) in Myanmar poses a serious threat to wild elephant conservation. We initiated a project to build the capacity of local communities for mitigating HEC around Shwe-U-Daung Wildlife Sanctuary. Our goal was to reduce the amount of conflict and to improve communities' ability to cope with elephant damage in a sustainable way. We achieved this by developing and implementing village action plans, improving communications related to HEC both within and among villages, and by enhancing and expanding the types of mitigation techniques used by the villagers.

Introduction

Myanmar is a key country for the conservation of Asian elephants (*Elephas maximus*) with the largest amount of remaining wild land in elephant ranges (Leimgruber *et al*. 2003), and a large elephant population. Population estimates for Myanmar vary from 4000-5300 (Sukumar 2006) to less than 2000 wild elephants (Leimgruber *et al*. 2011). As in other Asian elephant range countries, human-elephant conflict (HEC) in Myanmar poses a serious threat to wild elephant conservation. Community-based, farmer-level methods have been described as the best approach to mitigating HEC because interventions that are driven by government departments or non-governmental organizations are often not sustainable over the long-term given funding situations or their perceived lack of transparency to the communities (Osborn & Parker 2003). Community-based programs, on the other hand, can help increase the community's trust of management (O'Connell-Rodwell *et al*. 2000), which is an important aspect of conservation (Stern 2010), and support HEC mitigation. For example, communities in the Western Ghats of India preferred decentralized and participatory strategies and were willing to contribute labour to elephant conservation (Ninan & Sathyapalan 2005). Few studies have examined human-elephant interactions in Myanmar, and the capacity, training, and resources to help local communities mitigate human-elephant conflicts are extremely limited (Leimgruber *et al*. 2003). Here we describe a community-based project to build the capacity of local communities for mitigating HEC around Shwe-U-Daung Wildlife Sanctuary in Myanmar.

Methods

Study area

Established in 1941, Shwe-U-Daung Wildlife Sanctuary (SWS) (326 km^2) is located in Tha-beik-kyin and Moe-kok Townships in the Mandalay Division, and Moe-meik Township in northern Shan State (Fig. 1). SWS lies within Myanmar's principal agricultural region and people have farmed the area for centuries. In the 1990s, changes in human population and habitat led to increased HEC in SWS and the surrounding area, growing from 1–3 to 8–10 events per year (Aung 2007). Elephants that had primarily lived in SWS began to range outside the sanctuary and their numbers began to decline (Leimgruber *et al*. 2011). The area around SWS lost forest, particularly southwest of the sanctuary, primarily due to rapid human population growth 6.4%/year from 1996 to 2000 and 3.8%/year from 2001 to

2003 (Township State Peace and Development Council Annual Reports 1995-2003). Encouraged by businessmen, people moved into the area from across the Ayeywaddy River in Shwe-bo and Sagaing Districts for illegal gold-mining, charcoal, and bamboo extraction opportunities inside the sanctuary.

In 2008, SWS staff estimated that two groups of elephants, each with 20-30 individuals, lived in and around SWS, down from a total of 90-100 individuals in the early 2000s (pers. comm. warden of SWS). Part of the elephant population decline was due to the capture of elephants by the government's Myanmar Timber Enterprise (MTE) for use in the timber industry. In 2002 local authorities asked the Ministry of Forestry to increase the number of capture permits in the area for MTE and private catchers to help mitigate conflict and 63 elephants were captured from 2002 to 2005. Seven elephants died during capture, which has a high mortality rate in Myanmar (Aung 1997).

We worked with the warden of SWS to identify the primary locations of HEC around the sanctuary in October 2007, and identified 12 villages, to the southwest of SWS (Fig. 1). One village in the area was established more than 200 years ago and two others were established earlier in the 20th century. The other nine villages were established within the last 30 years. Two of the villages were initially established as temporary camps for bamboo extraction and were later registered as villages. Village populations ranged from less than 100 to more than 1000.

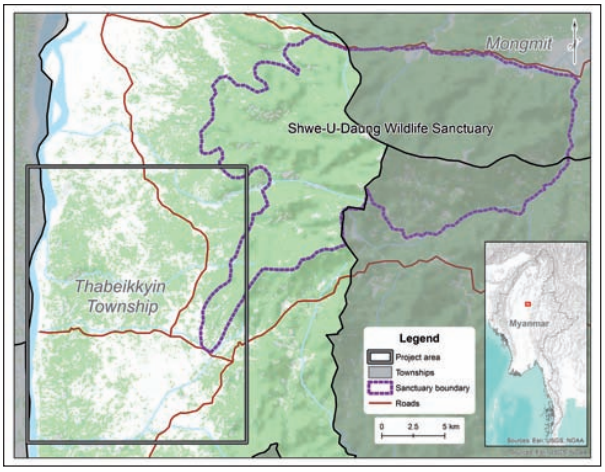


Figure 1. Location of study site.

Data collection and project activities

We conducted demographic and attitudinal surveys, as well as focus discussions in each of the 12 villages to assess people's attitudes toward elephants and to identify and describe HEC events in the area. We compiled historical HEC data through interviews with farmers and from SWS records from 2000 to 2006, and collected data on HEC events that occurred during the survey period. We obtained data on wild elephants from the Forest Department and SWS records. Following the period of information-gathering, a meeting was held with nine village chairmen whom the sanctuary warden and other officials had recommended for participation in the project. Five of these villages volunteered to participate in the HEC mitigation project.

In each of the participating villages, we held meetings to describe the project. Subsequently, 5-8 representatives from each village, with whom we had detailed discussions, helped create volunteer Elephant Protection Committees (EPC) within the context of the traditional formal system of village authority. EPCs consisted of the village chairman and two or more members of the community who were chosen based on their knowledge and close ties to the forest. We conducted a one-day workshop for the first five villages together in early 2008, during which EPC members were trained to maintain sighting records of wild elephants and to record elephant sightings by villagers. Resource mapping activities were conducted with the EPC members to understand which parts of the village and fields were most vulnerable to elephants. Members described the HEC mitigation methods currently used by their village and we shared with them mitigation methods collated from a review of literature.

Following the workshop, the EPCs of each village drafted action plans with the understanding that they would be primarily responsible for overseeing implementation of the activities in collaboration with village residents. Contents of each village's action plan included: 1) identifying priority sites around the village where elephants were most likely to enter from the sanctuary into

the villages and fields; 2) describing a system for people to use loudspeakers to call other villagers when elephants came into the village or croplands; 3) listing specific mitigation activities to be conducted; and 4) choosing which members would keep records for the community, including where elephants were seen. Everyone in the village was informed about reporting sightings of elephants or elephant signs to an EPC member. Two SWS staff was trained as project assistants. They learnt how to lead community meetings and work as facilitators, helped the communities write the action plans, and learned how to monitor HEC and maintain records and how to teach community members these skills. SWS staff made monthly visits to each village to facilitate and monitor implementation of the action plans over the next two years. In May 2008 three public meetings with one to three villages at each meeting were convened to discuss the success of action plans in mitigating elephant damage and to plan future actions. Participants analyzed the information in their record books, compared the results of the methods used to scare away elephants, and shared overall experiences.

At the end of the project in 2010, surveys were conducted in the five project villages with a random sample of community members (n=95) and EPC members (n=32 of 50). The community survey was designed to evaluate people's understanding of the project and their perceptions of its success or failure. The EPC member survey was conducted to measure their opinions about being leaders of the project.

Results

Attitudes toward elephants

The attitude survey conducted at the beginning of the project showed that, despite the conflicts with elephants, the majority of respondents liked elephants and believed they should be protected in Myanmar (Table 1). Two-thirds of respondents said they like elephants because they are valuable, while one-third said that they benefit the country. Two percent said they liked elephants because they are rare wild animals. In response to why elephants should be protected, the majority again said because it is a valuable animal, while a minority felt that they should be protected because their habitat has been encroached, because protecting them in the forest would help to keep them from entering human settlements and agricultural fields, and because they are rare wild animals.

For those who reported disliking the elephant, the main reason was due to crop damage, followed by having their movements inhibited by elephants, i.e. people were "not free" to go into the forest. Other reasons for disliking elephants were that

Table 1. Beliefs and knowledge about elephants (n = number of respondents who answered that question).

Question	%
Do you like elephants? (n=91)	
Like	71
Dislike	24
Do not know	5
Why do you like elephants? (n=78)	
Valuable	66
Benefit the country	32
Rare wild animal	2
Why do you dislike elephants? (n=26)	
Crop damage	24
Inhibit human movement	18
Kill humans	17
Eat paddy	15
Dangerous for humans	14
Destroy houses	12
Should elephants be protected in Myanmar? (n=91)	
Yes	77
No	10
No response	13
Why should they be protected? (n=85)	
Valuable animal	61
If they destroy cropland (i.e. "protected" understood as elephants being contained in the forest)	17
It is their habitat	12
Rare, wild animal	10
Why do elephants come to the villages? (n=77)	
They like to eat crops	66
They are following habitual trails	9
To eat rice, salt, paste stored in the house	6
To eat rare food	6
People moved into elephant habitat	5
Increased human population	4
Forest degradation	2
They move away from being caught by private & MTE	2

they were dangerous to humans and destroyed houses. When asked why elephants entered villages, the majority of respondents said it was because elephants like to eat crops (Table 1). Others suggested that elephants were following their habitual trails.

Conflict mitigation activities

Prior to this study, people were using mitigation methods such as physically guarding the crops, making noise, burning fires, lighting firecrackers, firing home-made firearms, and flashing lights at the elephants on a household basis, with no systematic or collaborative action among farmers. After the creation of the community-based plans for mitigating HEC, the villages used combinations of three different mitigation techniques (Table 2):

Sensory Disturbance

Light, sound, and smell were used in combination in all villages whenever villagers saw elephants entering the village or croplands. Individuals were posted as lookouts in priority sites and alerted villagers by using loudspeakers provided through the project. Each household would be responsible for different mitigation methods, such as lighting fires, shining flashlights, or beating drums. One farmer in Ohn-ta-gu shared two devices he had developed. One device was a small windmill made with plastic blades that would turn in the wind and hit tin cans to create noise and scare away elephants. The other device was a trigger alarm that consisted of a nylon thread strung around a crop field and attached to a stone inside a tin can that would alert the household when disturbed. Le-mile and Du-sit-chaung villages incorporated these methods into their plans. Villages burned rubber, cattle dung, and chillies to create a noxious smell, though this



Figure 2. Stringing CDs to keep elephants out.

was only useful if the wind was blowing toward the elephants. Burning rubber was a method from Thailand introduced by the second author, but during the project villagers stopped using this method because of the negative environmental effects. Villagers also experimented with another idea from Thailand: stringing CDs along the fence to reflect people's flashlights at night (Fig. 2). One village also tied flashlights to bamboo poles that faced the sanctuary. A mixture of chilli, pepper oil, tobacco, and grease was smeared on the string fences because it seemed to repel elephants.

Brush clearing

Villagers cut shrubs, tall grass, and small trees in unused land between the agricultural fields and SWS in a strip about 300-400 m wide. This was a new method conceived by us based on discussions with park staff and a community member who explained that elephants hid in the forest during the day and came to the fields at night. We hypothesized that elephants might hesitate to cross cleared areas and it would be easier to scare them back into the forest at night. During the first year, brush clearing was only used in Le-mile and Thabeikyn. Le-mile cleared every six

Table 2. Types of intervention used in the five villages and changes in HEC conflict in the first year of the project.

Village	Light, sound, and smell	Visual clearing	Unpalatable crops	Type of conflict eliminated	Type of conflict increased
Le-mile	√	√	√	All	None
Ohn-ta-gu	√			Human	None
Ka-be	√	√		Human	Crop and house damage
Du-sit-chaung	√			House, human	None
Kwe-mwe	√		√	House, human	Crop damage

months and Thabeikyn cleared annually. When the other villagers saw the success of the method they all implemented brush clearing during the second year.

Planting unpalatable crops

In Le-mile and Kwe-mwe, some farmers planted unpalatable crops such as sesame, ground nuts, agar wood, sandalwood, and chilli, as well as high-value trees. However, sugar cane was a very profitable crop and most farmers continued to plant sugarcane and were not that interested in alternative crops. Even so, in following years, sugar cane became less profitable and farmers stopped planting it, along with corn, which also had little value.

Additionally, at the warden's suggestion, signboards were posted at places along the main road where elephants were known to cross, to mitigate the problem of cars and motorbikes hitting elephants when they crossed the road.

Project evaluation

As mentioned above, in 2008, SWS staff had estimated that two groups of elephants, each with 20-30 individuals, lived in and around SWS. Both elephant groups roamed to the west and south of SWS in surrounding reserve forest and croplands but only one group periodically entered SWS. We found that conflicts decreased after the villages implemented the mitigation plans (Table 3). In the first year of the project in the five villages, no humans were killed, and three villages avoided any house damage. Le-Mile was the only village to implement all three types of activities and was successful in eliminating all three forms of conflict – human, house, and crop damage. In the second year of the project very little crop damage occurred in Le-Mile and Kyaukkwe. Only one house in Le-Mile and one small hut located beside cropland in Sinmwe village were destroyed by elephants. Most crop damage occurred in private company agricultural land rather than on village farmland. The combination of light, sound, and smell was very effective in driving the elephants away in all villages and brush clearing, particularly at Le-mile where they cleared every six months, was completely effective. After the first clearing, Le-mile had no elephants enter the village or

Table 3. Number of conflicts before (average per year from 2000-2006) and during the first year of the project in the original five villages.

Village	Conflict	Before	During
Le-mile (n=16)	Crop	8	0
	House	5	0
	Human	3	0
Ohn-ta-gu (n=16)	Crop	5	5
	House	1	1
	Human	4	0
Ka-be (n=13)	Crop	0	1
	House	1	4
	Human	2	0
Du-sit-chaung (n=9)	Crop	2	2
	House	2	0
	Human	1	0
Kwe-mwe (n=7)	Crop	1	3
	House	1	0
	Human	2	0

Table 4. Community evaluation survey (n=95) for villages in first phase of project.

Question	%
Are you aware of the program?	
Yes	100
Did you participate in its activities?	
Yes	84
No, but family members participate	12
No	4
Purposes or goal of this program?	
Correct answer	86
Not correct	8
Don't know	6
The name of committee set up in your village?	
Correct answer	76
Not correct	22
Don't know	2
Have you spoken with an EPC member?	
Yes	82
No	18
How many times?	
<5	20
50-10	40
10-20 times	22
Do you feel this program is successful or not?	
It can be in the future	19
Maybe, doing something is better than doing nothing	58
Success is difficult, it depends on long-term good leadership	17
Don't know	6

cropland. Although elephants were spotted coming close, villagers were able to drive them away and no damage occurred.

The evaluation by community members showed that the majority of people understood the goals of the project and also knew the name of the committee that was organizing the activities (Table 4). The majority of respondents reported speaking with committee members multiple times, indicating that the project was successful in including all members of the community and in providing them information about the project. When asked if the project was successful, the answers were tempered with a perspective that the project was in the beginning stages. While the vast majority felt that the project had the potential to be successful, they also pointed out that success depended on the long-term results and good leadership, while others said that doing something was better than nothing.

In the evaluation survey of the EPC members (Table 5), which was conducted with members from the original five villages, nearly all of them said that the project was helping to mitigate the HEC. All said they benefited from being members of the committee in terms of gaining knowledge and participating in their community. They also all felt that the process of creating the actions plans was useful because it gathered everyone's knowledge about the elephants, such as mapping their routes, gave them new ideas of mitigation activities, and helped the community to work together. They reported that they felt combined methods were the most successful, with one-quarter saying that unpalatable crop planting was the best method and one-fifth preferring brush clearing. Two-thirds of the EPC respondents said they supported the capture of elephants by the government and private companies in order to reduce the number of elephants. One-third said they did not support it because it causes the death of some elephants, which is not good for the country or for the people of Myanmar because it is a valuable species, and everyone should work together to conserve them.

Table 5. EPC evaluation survey (n=32) in first phase of project.

Question	%
Do you think that HEC has decreased since the action plans were implemented?	
Yes	96
Don't know	4
Do you enjoy participating in the meetings conducted by this program?	
Yes	100
Do you think the process to make the action plans was useful?	
Yes	100
Which methods do you prefer to protect the crops and households from elephant?	
Combined methods	56
Unpalatable crop planting	24
Visual clearing	20
Do you think the government should allow capturing of the elephants?	
Yes	68
No	32

Discussion

The primary objective of our project was to improve communities' ability to cope with elephant damage in a sustainable, community-based way that was not dependent on external resources. An underlying assumption of the project was that while the eradication of conflicts is not likely, reduction can be achieved (O'Connell-Rodwell *et al*. 2000; Osborn & Parker 2003). Like Graham and Ochieng (2008), our goal was to "demonstrate and evaluate community-based tools for HEC management, with the consent and participation of local community groups." This goal was accomplished by creating and implementing HEC action plans for each participating village, improving communications related to HEC both within and among villages, enhancing and expanding the types of mitigation techniques used by the villagers, and evaluating people's attitudes and perceptions of the changes in HEC events and HEC management to inform HEC planning in the future. Through this project, communities shared with each other the methods that they were already using to mitigate elephant damage, and new ones were also introduced, e.g. alert systems and brush clearing. Based on discussions of these methods within and among communities, communities wrote action plans for mitigating the HEC for the first time.

The project was successful in that there were fewer conflicts after the project began than before and there were no human injuries or deaths in any of the participating villages in the first year of the project. In Le-Mile, where brush clearing was used in addition to other mitigation activities, the project was most successful. Elephants are wary of crossing an open area to get to agricultural fields and the open area allowed farmers to easily see elephants, giving them time to mount an active defence. Other studies have also shown that wide buffers of vegetation not suitable for food or cover can decrease elephant movement in an area (for example, Nyhus & Tilson 2004). However, caution must be used when comparing the number of conflicts before and after the project. Before the project started, conflicts were self-reported by villages to park staff and not verified in any systematic manner. Another confounding factor is that ten elephants were captured by the MTE just as our project was beginning, and this may have significantly changed the elephants' behaviour. The villagers believe that this activity caused the elephant groups to splinter, resulting in elephants visiting the village singly or as mother-offspring groups instead of in groups of 7 or 8 as previously seen. This change in behaviour contributed to villagers being wary of pronouncing the project a success but thought it might be in the future.

Another indicator of the project's success is that four additional villages asked to join the project at the end of the first year. To address their request, we conducted a workshop for these additional four villages in the second year of the project, with participation from EPC members and government officials from SWS and the Forestry and Agricultural Departments.

Two key factors underlying the success of the project were that people were supportive of elephant conservation and we spent a great deal of time engaging with communities and relevant government officials before initiating the project. The support we found for elephant conservation in this project is not unusual. Just as the majority of people in this project site supported elephant conservation, the majority of respondents facing HEC in Sri Lanka, India, and Uganda, also valued elephants and supported their conservation (Hill 1998; Bandara & Tisdell 2003; Barua *et al*. 2010). The time spent conducting research prior to actively engaging the communities in mitigation activities gave insight into HEC challenges the communities faced and helped develop relationships with community members. The investment in understanding the communities' history, socio-economic status, resource use, and attitudes toward the sanctuary and the elephants was critical to developing constructive working relationships with the communities and the sanctuary staff.

One interesting limitation of the project was the uneven participation of women. Based on the success we had encouraging women's participation into other projects in Myanmar (Allendorf *et al*. 2012), we encouraged communities to include women on the EPCs. However, we found it was difficult for women to participate because of traditional beliefs about elephants. People believed that elephants are jealous of women because of their shorter gestation period, causing them to attack humans if women are nearby. One of the outcomes of this is that women were not members of EPCs although they did participate in the community workshops and meetings and in implementing the action plans.

In conclusion, by focusing on village resources and knowledge, supplemented with experiences from other countries, we built on the strengths and capacity that already existed in the communities, and helped residents find community-based solutions that are more sustainable over the long-term. However, while grassroots support and commitment from communities is vital to successful mitigation of HEC, community-based conservation may not succeed over the long-term without top-down support from government and its policies. Community-level mitigation, particularly in the case of wildlife conflict over large landscapes, should be considered in the context of national-level planning and sharing of information (Fernando *et al*. 2008). A broad-scale approach can take into account corridors and seasonal movements, while maximizing benefits from large-scale interventions, such as electric

fencing, corridor restoration, and planting of unpalatable crops. A landscape approach could also incorporate outreach to communities to help them understand the larger context of the contribution they are making to conservation.

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Impact of Mining on Elephants of Chhotanagpur Plateau, Central India

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Introduction

The Central Indian landscape sweeps across the Satpura Hills of the Vindhyachal mountain range to merge with the Eastern Ghats and is straddled by the Indo-Gangetic plains in the north and Mahanadi Basin in the south. The Chhotanagpur Plateau, spreads over 30,000 km^2 of this hilly to undulating landscape, covering 13 districts across three states: Odisha (erstwhile Orissa), Jharkhand, and parts of West Bengal (Fig. 1). Almost 9000 km^2 of the plateau are covered by forest. At least 25 different tribal communities and an amazing diversity of wildlife including Asian elephants (*Elephas maximus*) thrive in the area. Beginning from its terminal point at Kapilash Sanctuary in Dhenkanal District in Odisha, almost contiguous forest continues to the north across the state boundary into West Singbhum District and then to Dalma Wildlife Sanctuary in East Singbhum District of Jharkhand. This vast forest is an important elephant habitat. However, underneath the forest cover occurs a great wealth of minerals.

India is the third biggest exporter of iron ore, after Brazil and Australia with most Indian exports being to China. Against India's reserve of 25 billion tons of iron ore, China has 200 billion tons treated as 'strategic resource reserves'. China Iron and Steel Association, the most powerful steel lobby of the country has recommended: "Like oil reserves, China should also have iron ore reserves. Large amounts of ore can be bought when prices are relatively cheap to guard against a monopoly from global mining companies" (China News 2010).

Chhotanagapur plateau is the country's biggest repository of iron and chromite ore with 90% of the global reserve of chromite ore being found in Odisha. Out of the total national reserve of iron ore, more than 61% occurs under the forests of Chhotanagpur plateau, distributed within the state boundaries of Jharkhand and Odisha (Ministry of Mines 2010). Initially, to take care of "imperial needs" of the British colonists and subsequently to keep in step with globalisation initiatives by free India, the plateau was exposed to exploitation for almost a century and a half. Beginning from the mid-nineteenth century, resources from these forests have been exploited for industrial activities. However, the magnitude and methods significantly differed from the present.

The first iron ore mine in the country was set-up by Bengal Iron and Steel Company Limited in Chiria and Duia in Saranda, both in West Singbhum District of Jharkhand in 1902. One of these mines pursuing an out-dated 'hand mining' method, which is a highly sustainable practice now discarded by others in preference of mechanised mining that produces more with less 'unskilled' manpower, is still functional and has provided employment to local tribal inhabitants for more than a hundred years.

Beginning in 1991, India started to dismantle trade barriers that had been in place since independence in 1947, ushering in an era of liberalised trade and economic growth. Such neo-liberal initiatives allowed easy access to natural resources by exploitive industries even within sensitive habitats that are home to forest dwelling people and wild animals. Due to an unprecedented swell in demand, the Indian government altered the National Mineral Policy in 1993. This encouraged private investment in exploration and mining of several strategically important natural resources, including iron ore, reserved until then exclusively for the government

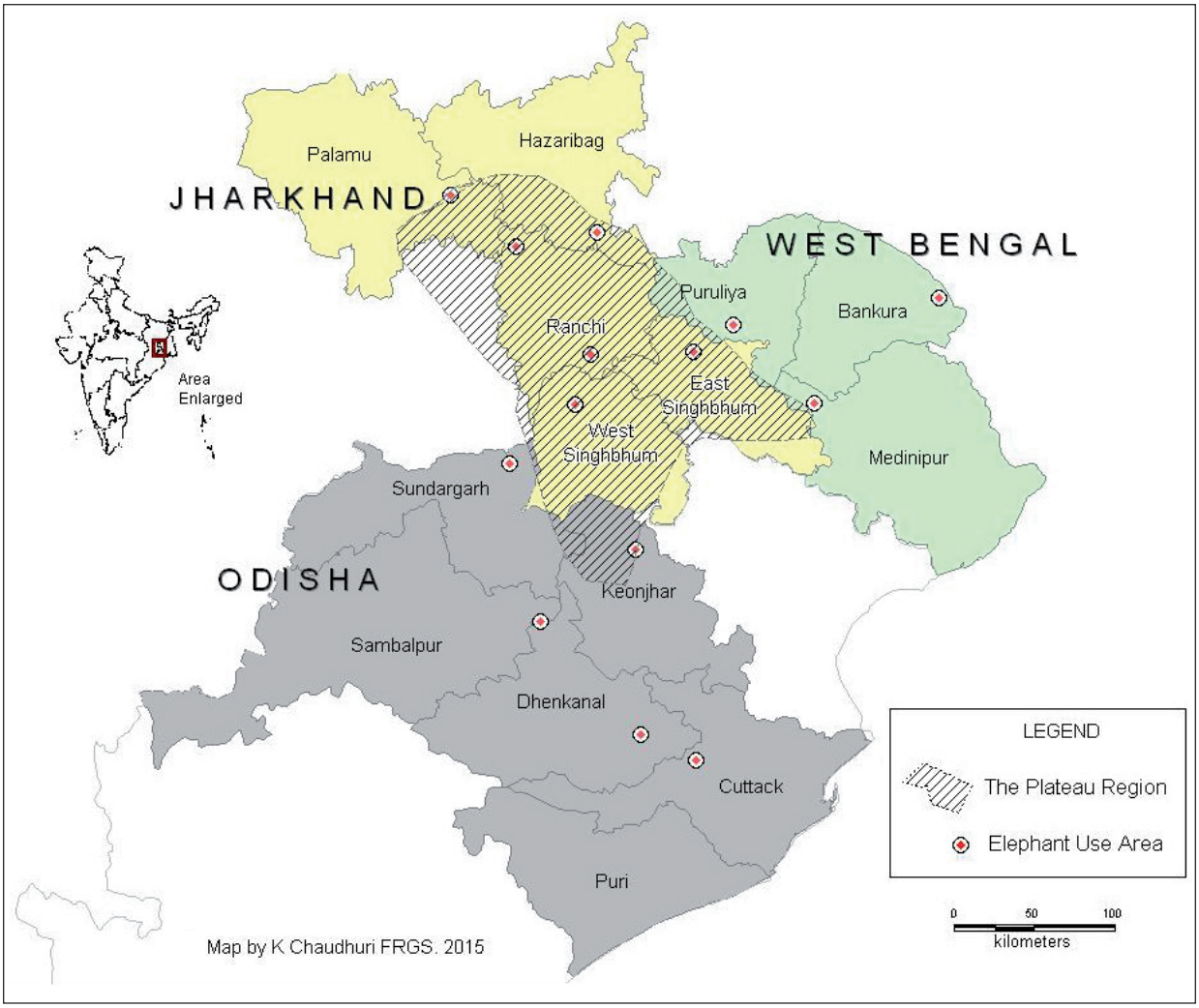


Figure 1. Map of the Chhotanagpur Plateau in the Odisha-Jharkhand elephant landscape.

sector and steel makers. In the present changed circumstances, the norms framed by the Indian Bureau of Mines (IBM), the regulating agency for mining operations, are observed more in the breach. The prospect of making enormous profits resulted in unsustainable growth and encouraged the proliferation of illegal mines. The margin of profit to be made by the traders was incredible. The cost of extraction and transportation to export points ranged between $ 6.25 - 8.12 per ton in 2007, against the prevailing selling price of around $ 100 per ton (in 2007 conversion rate). At the 56th meeting of the National Development Council in New Delhi, chaired by the Prime Minister, the Chief Minister of Odisha drew the attention of the council to the 'supernormal profits' being enjoyed by the mining companies operating in his state. He informed that the profits by mining operators exceeded even the annual budget of Odisha.

Impact of mining

In the last two decades 'strip mining' or open cast mines for iron ore has been initiated in Keonjhar District of Odisha and West Singbhum District of Jharkhand. Taking advantage of Section 2 of the Forest Conservation Act, vast stretches of Reserve Forests have been de-notified for non-forestry purposes like setting up industries and environmentally unsustainable opencast mines.

An example cited below indicates recent changes in land-use of two forest ranges of Odisha plateau; Joda and Keonjhar Sadar (Table 1). Since 1991, when unrestricted mining was permitted, mining activities extended over 1200 ha and the forest area decreased by 17,000 ha. It also shows the trend of decrease in agricultural land and increase in settlements that indicate settlement by outsiders in places vacated by original farmers.

Table 1. Changes in land use in two mining blocks of Odisha (Sadar and Joda Ranges) (World Bank 2006).

Land use	Area (ha)		Change in
	1989	2004	15 years
Settlements	4,288	5,287	+ 999
Agriculture	58,411	56,873	- 1,538
Forest	49,031	32,078	- 16,953
Wasteland	12,472	24,281	+11,809
Mining	2,402	3,585	+1,183

During the period 2001 to 2009 64,000 ha and 11,000 ha of prime elephant use areas were leased out for mining in the Keonjhar highlands of Odisha and Singbhum of Jharkhand, respectively (Fig. 2).

Thus, 75,000 ha of mostly woodlands were stripped of vegetation. An enormous quantity of water is required for washing of mined ore, which is procured by confining hill streams in reservoirs. In the dry season the entire flow is retained within the reservoirs to ensure uninterrupted supply for ore washing thus drying of downstream flows. Water that passes out from the washings remains heavily laden with sediment and becomes unfit for consumption and is released into spill channels. As a result of the mining, natural drainage patterns were altered and most perennial water bodies dried up and indigenous people were evicted. Additionally, activities peripheral to actual mining, like the operation of crushing plants, transportation of ore by road through vulnerable forest patches, and blasting day and night for recovery of mineral, generating deafening sounds exceeding >180 db at 150 meters, increased. During the peak demand period of 2006-2011, 18,000 ore-laden trucks passed through National Highway 215 that connects the mining belt in Joda Block with the seaport of Paradip, causing permanent closure of elephant transit (movement) paths through Sidhamath and Thakurani Reserve Forests in Odisha and the Singbhum Elephant Reserve in Jharkhand.

The beginning of intensive mining in Keonjhar, the heartland of mining activities, resulted in a dramatic twist in the human-elephant conflict that had taken a turn towards the worse previously. In the years between 2001 and 2006, the number of village houses damaged by elephants was 1739, while from 2006 to 2010, 511 houses were damaged, showing a dramatic decline. Similarly, trampling damage to crop areas by elephants reduced from 2845 to 1677 acres during the same period. Such reduction in conflicts was probably

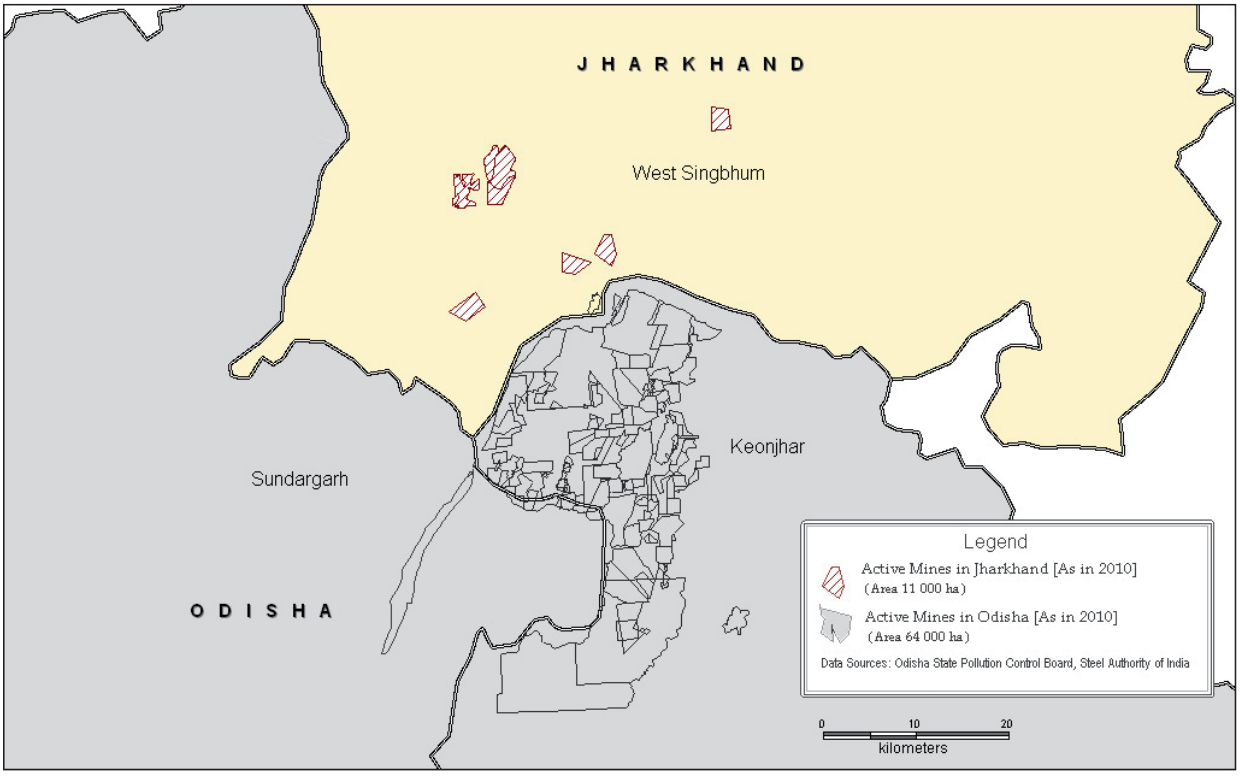


Figure 2. Locations of mining leases in Odisha and Jharkhand.

caused by a decline in the number of elephants in the forests where intensive mining activities were continuing (Source: Keonjhar Forest Division Records).

Interestingly, the decrease in elephant depredation in Keonjhar was closely followed by an increase in the neighbouring Dhenkanal District. In newly accessed locations by elephants, 67% of elephant deaths occurred in the 2005-2010 period, against 33% in the 2000-2005 period. Similarly, damage to crop areas increased from 1892 to 3802 acres in this period (Source: Dhenkanal Forest Division Records).

Mining leases in Odisha are grouped in close clusters where lease boundaries of neighbouring mines almost overlap each other. Such compactness does not leave space for elephant transit between the Keonjhar highlands and Singbhum in Jharkhand. Fortunately in Jharkhand the mines are spaced out over a very large geographical area, leaving vast stretches of closed canopy forests in between. Relatively fewer disturbances in the jungles of Singbhum are an encouraging experience. However, with a long list of pending mining applications with the Ministry of Environment, the scenario will surely worsen. New projects are in the pipeline in East Singbhum (Patka), Seraikella-Kharswan, West Singbhum (Karampada and Manoharpur). These proposed iron ore mines will eliminate more than 5000 ha of forestland and are being resisted by the local tribal communities, on occasions violently.

On the other side of the mining block, in Singbhum of Jharkhand, the virtual closure of elephant transit paths into Odisha and the denial of access to the Dalma Wildlife Sanctuary due to the recent completion of the Subarnorekha Multipurpose Canal in the north created at least one new elephant population with 24-40 individuals of mixed age and sex composition. This population has established a home range in the degraded forests of West and East Singbhum Districts (Chaudhuri 2011). Considering the recent rise in human-elephant conflict in densely populated Khunti and urban areas of Ranchi, the likelihood of this group's involvement cannot be ruled out.

Specifics defined by the Indian Bureau of Mines categorically state: "It (the Mine Closure and Completion Plan) must aim at leaving the area in such a way that rehabilitation does not become a burden to the society after mining operation is over." However, in utter disregard of stipulations, several mines remain as they were, well after the expiry of 'life' when a certain depth is reached, and cause the disruption of elephant transit paths. So even after 'closure', harmful impacts of such mines continue. Ironically, many abandoned pits of even 100 m depth are still retained by mine lessees as 'sites for future exploitation', hence they do not come under the purview of 'Mine Closure Plans'.

Signs of environmental violence born out of the compulsion to retain user rights of natural resources are already seen in most parts of India. It is time that sustainable mining practices are introduced, especially when almost all mining regions are scattered over forest tracts that sustain indigenous tribes and wildlife.

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Elephants in Corbett National Park (India)
Photo by A. Christy Williams

Human-Elephant Conflict: Improved Co-existence through Multiple Stakeholder Interaction in Kerala, India

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Introduction

Maintenance of biodiversity and conservation of wildlife is considered an essential component for the sustaniable development of a nation. While the benefits of conservation are enjoyed by all, villagers living near conservation areas often bear the associated costs (Gubby 2012). Poor tolerance towards wildlife conflict is observed in Kerala, where losses due to human-wildlife conflict is less than the national average (Sinu & Nagarajan 2015). Taking suitable action in conflict situations will enhance people's tolerance and facilitate wildlife conservation. This is particularly important for conflicts caused by elephants, which is least tolerated by people, as the damage per incident is much higher than with any other species (Naughton-Treves 1998). Human-wildlife conflict involves the interaction among several stakeholders with different perceptions and roles (Niraj *et al*. 2012), but their interactions and perceptions are not much discussed (Kanagavel *et al*. 2013).

Here, we discuss human-elephant conflict (HEC) in fringe areas of Moothedam Panchayath in Kerala, India, and evaluate the reaction of villagers and the response of authorities subsequent to a series of elephant conflict incidents in one area, and the way media communicated this issue.

Methods

Moothedam Panchayath lies between N11.29º E76.30º to N11.31º E76.34º and N11.35º E76.31º to N11.35º E76.35º. The forests in this area come under the administration of Nilambur South and North Forest Divisions, Kerala, and are part of the Western Ghats. There are six Wards (8, 9, 4, 3, 2, 1) adjoining forests in Moothedam Panchayath.

To assess all HEC incidents in this panchayath data collection was done on a monthly basis from June 2014 to May 2015 by visiting farms and households in forest fringe areas. Observational methods and secondary data collection were used (Easa & Sankar 2001). Compensation data of Nilambur South Forest Division during the year 2014-2015 was analyzed. Field data collection and analysis of newspaper articles were conducted related to the increased conflict.

Results and discussion

Intensity of HEC

A total of 134 incidents of crop damage, nine incidents of property damage and two human injuries were recorded, due to conflict with elephants. Of the total crop damages, 57% were caused by individual elephants and the rest by herds. People engaged in deterring elephants from their farms and human injuries occurred due to response of elephants to human aggression. Property damage included damage to private solar fences, pipelines, slabs of wells, water tanks and barbed wire fences. About 60% of damages occurred at immediate forest fringes not more than 50 m away from the forest boundary.

A total of 109 applications were sanctioned for ex-gratia payment for damage caused by elephants, of which 99 were for crop damages, one for injury and nine for property damages. A total of Rs. 1,134,931 (US$ 17,350) was sanctioned

with Rs. 1,042,580 (US$ 15,950) being for crop damage and Rs. 4000 (US$ 60) and Rs. 88,351 (US$ 1350) for injury and property damage respectively.

The least conflict happened in Ward 3 during the year of study. The Forest Department had provided several mitigation methods in Ward 3, including an elephant proof trench, solar electric fence and stone fence, each approximately one km in length (Figs. 1 & 2). The solar fence and elephant proof trench were not properly maintained possibly due to lack of manpower and funding.

Recent incidents

Unlike last year, recurrent incidents of elephant crop raiding and property damages were observed since June 2015 in Ward 3, associated with the fruiting of Jack trees. Discussion with villagers and forest authorities along with observation of footprints revealed that all the conflict incidents were caused by the same elephant, with one partially broken tusk. Property damage caused included damage to window glasses of households, water tanks and pipelines. The solar powered fence and stone fence were also damaged. Crop damage included damage to banana, tapioca, coconut and jack trees. The elephant moved out up to about 450 m from the forest boundary. The path traversed by the elephant outside the forest was about 1 km in length, mostly through human habitations.



Figure 1. Elephant proof trench in ward 3.



Figure 2. Stone fence damaged by an elephant.

The regular conflict incidents and their perception regarding the mild response from the authorities agitated the residents. As a result, people submitted a mass petition to the Panchayath office demanding quick action to end the conflict.

Conflict resolution

Proper handling of conflict issues is mandatory to generate a better attitude among residents towards Forest staff and thereby towards conservation. As a result of the public agitation, a meeting was organized to discuss the conflict issue at the Panchayath office. Multiple stakeholders involving villagers, politicians, the Divisional Forest Officer, the Forest Range Officer and media persons participated in the meeting.

The meeting demonstrated that people perceive wild animals as the property of Forest authorities, which illustrates their general negative attitude towards crop raiding wildlife. People considered that the authorities prioritized wild animals over humans when dealing with conflict. The suggestion by authorities to remove jackfruits near the forest fringes before ripening, was totally opposed by villagers. People demanded increase in ex-gratia amount, which they considered was too low compared to the losses. Villagers expressed their willingness to work together with conservation authorities for the participatory management of conflict. With regard to the present conflict situation, people considered the tusker causing conflict as problematic and requested the authorities to end the issue either

by translocating it or by placing an order to shoot it. People even demanded the permission to shoot elephants which were causing regular conflict.

Authorities explained that wildlife conservation is not for the Forest Department but for all. The various ecological and behavioural parameters associated with the conflict were discussed. The practical difficulty associated with the amendment of compensation amounts was also explained. Regarding the present situation, authorities assured that the damaged solar fence and stone fence will be repaired to prevent further conflict. The officials intimated to the villagers that the Forest Department is taking efforts to bring *Kunki* elephants to control the crop raiding elephant. Villagers were unwilling to accept the explanation regarding the ecology and behaviour of crop raiding elephants and demanded a quick solution that will prevent elephant conflict in the same day. Finally a decision was taken by authorities to appoint watchers along the forest boundary. Also a committee including Forest authorities, politicians and villagers was appointed, to ensure implementation of the mitigation methods and to monitor conflict incidents.

Media and conflict

We collected elephant mortality records for the period January to July 31, 2015 from the DFO office, Nilambur North and South Forest Divisions. A total of seven elephant deaths consisting of six males and one female were recorded. Though final autopsy reports are awaited, preliminary reports suggested that one of the deaths was due to poisoning (Fig. 3). It was a male elephant that died near human habitations near the Vazhikadavu elephant corridor in Gudallur-Nilambur Ghat road, Nilambur North Division (Sukumar & Easa 2006). Media reported the incident as retaliatory responses due to recurrent conflict in the area.

We analyzed the words used by journalists and the content of the stories published regarding con-flicts, in six regional newspapers (in local language) - Mathrubhumi, Malayala Manorama, Madhyamam, Desha-bhimani, Chandrika and Koumudhi. A negative tone was noted while mentioning elephants in five newspapers. Elephants were described as 'attacker', 'problematic', 'life threatening' etc. One of the newspapers had a headline as 'Finally forest authorities considered those lives destroyed by elephants', to describe the above mentioned meeting held at Moothedam Panchayath Office to discuss the conflict issue. Reports such as this, further add to the negative impression towards elephants. There was little discussion on underlying proximate causes while reporting conflict by media. Lack of scientific awareness about conservation issues among journalists, could be a reason for this bias (Barua 2010). Often, instead of addressing the multi dimensional aspects of conflict, mass media mainly talks about complex causality (Anderson *et al*. 2005). Mass media can play an important role in mitigating conflict by carefully addressing the issues in a more informative way as it has the capability to influence public opinion. Therefore, working closely with individual journalists and providing them scientific training is very important for addressing conservation issues (Barua 2010).

Keeping stakeholder's interests and maintaining a healthy working relationship with them



Figure 3. Elephant suspected to be killed by poisoning.

is essential to effectively address issues of biodiversity and conservation, especially for forests which are not under protected area status. Conservation issues can be addressed effectively by including the perceptions of key stakeholders (Kanagavel *et al*. 2013) particularly in the present context where conservation strategies such as "guard and gun", are replaced by 'participatory methods' (Mishra *et al*. 2009). The current complex socio-economic scenario of conservation (Sukumar 2004) adds value to participant interaction. Interaction among stakeholders makes them aware of each other's problems and limitations, changing the approach towards conflict and making its mitigation more realistic. Although large amounts are spent as ex-gratia payments to victims of conflict, this may not add much value in solving the problem. Management plans involving regular monitoring and assessment of conflict situations by a committee including Forest authorities, media persons and villagers will probably facilitate more interaction among them and possibly be a realistic step towards collaborative management of human-wildlife conflict in the study area.

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Training and Health of Captive Elephant Keepers in Sri Lanka

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The ancient Kings of Sri Lanka had elephants in their army to show their strength and to maintain status. It was customary for a prince to parade on a tusker in the city immediately before his marriage ceremony. At that time, elephants were used for logging, to pull carts, plough fields, execute criminals, in war, and in religious and state ceremonies (Jayawardena 2013). Usually elephants around 10 years of age were captured from the wild in kraals or by noosing and tamed. This knowledge has been documented in Ola leaf manuscripts (Jayawardena 2013). Thus Sri Lanka has had substantial experience in elephant husbandry practice, and the expertise to manage problems of managing wild-born elephants in captivity (Dangolla *et al*. 2002a).

In earlier times, the fathers and grandfathers of elephant keepers were also keepers and traditional knowledge of both elephant management and treatment was passed down from generation to generation. Most children of keepers did not attend school but sons would learn elephant keeping and agriculture while the daughters became housewives (Jayawardena *et al*. 2011a). This inheritance pattern was broken with the current generation because most children of former keepers did not take up elephant keeping (Weerasiri *et al*. 2004). With the socio-economic changes of modern times, elephant keepers started educating their children, and did not want them to become keepers (Jayawardena *et al*. 2011a).

The need for proper training with new techniques for both elephants and keepers has been highlighted previously (Jayawardene 2013). It has been accepted that there is a gradual decline in knowledge of both traditional elephant management and native elephant medicine. However, new elephant keepers often do not accept advice from the seniors who are masters of the trade. Perhaps, because they sometimes taught their apprentices using loud and abusive language (Jayawardena 2013). The new keepers appear to consider elephant keeping as just another profession (Jayawardena 2013). Several senior keepers have indicated that they left the profession after their elephant died due to this factor. Yet such retired keepers show their interest in elephants by meeting new keepers at festivals, by appearing when an elephant runs riot, by showing up when a keeper is injured by his own elephant, or when an elephant is seriously ill. This shows that the older generation of keepers loved their elephants and their profession and they still do.

In the recent past, new individuals have entered the elephant keeping profession either through interest or because there was no other occupation available for them (Jayawardena *et al*. 2011a). They have none or little traditional knowledge of elephant management or medicine and are relatively young. The majority of them believe that most elephant management issues can be settled using physical strength.

Until recently there had been no formal training for elephant keepers, both in private or state sectors, in Sri Lanka. This situation was identified in the year 2000, and the 'Captive Elephant Owners Association' was established. The association made attempts to educate keepers with the help of Indian veterinarians. However, this training was not well formulated and priorities were not identified. In addition, there was no recognition of the trainees subsequent to the training, which led to the failure of the training. In 2012, the state sector started training elephant keepers at Pinnawela Elephant Orphange. This training was organized through the Postgraduate Institute of

Science of the University of Peradeniya. The training was conducted separately for junior and senior keepers. In 2014, the National Zoological Gardens at Pinnawela Orphange successfully concluded another training program for novice prospective keepers. A group of 80 unemployed potential elephant keepers followed this program, which included five ladies. Up to this point, I have witnessed only one female keeper. She looked after a privately owned elephant but she too gave up the profession when she got married. Currently there is one female assistant keeper who helps her husband to look after the elephant.

Some of the medicines used by senior keepers in traditional elephant treatment have proven to be successful, for example remedies for wounds and sinuses (Perera *et al*. 2004). Though not scientifically tested, some medicines administered during mild colic also work.

The first clinical case of tuberculosis in a captive elephant in Sri Lanka was detected in the year 2001 (Dangolla *et al*. 2002b), and was suspected to have been contracted from the father of the keeper who was undergoing treatment for tuberculosis. Since then the awareness of TB in elephants and in elephant keepers in Sri Lanka has increased. Some calves in the Elephant Transit Home in Udawalawe have been suspected to be infected (Perera *et al*. 2011) and a few from Pinnawela Elephant Orphanage have been detected to be sero-reactive and are being treated.

The trunk wash test to obtain bacteria for culture is the recommended confirmatory test for elephant TB. Captive elephants in Sri Lanka do not allow anybody to manipulate their trunk, and they are difficult to train to suck saline into the trunk, raise the trunk, and expel the saline as is required to obtain a sample. Consequently, attempts to collect trunk wash samples from 60 captive elephants by me failed. An investigation on captive elephant keepers in Sri Lanka revealed a high possibility of keepers being sero-positive and warrants more attention (Dassanayaka *et al*. 2011). In general, keepers of privately owned elephants appear to neglect their health for unknown reasons (Dangolla *et al*. 2012).

In 2009, when privately owned elephants were brought to Kandy for the Esala Perehera, a mobile health clinic for keepers emphasizing respiratory health, was held. Approximately 10% of the keepers were Mantoux reactors and some had signs of latent TB (Jaywardena *et al*. 2012; Dassanayaka *et al*. 2011). Later, when such suspected keepers were advised to report to a chest clinic for further investigations they did not comply. This non-compliance by keepers can often be observed if they do not see the direct relevance and impact on their lives, especially monetarily. The situation among the same keepers with regard to liver and kidney functions were not very different (Jayawardena *et al*. 2011b). A number of them had liver and kidney problems according to serum enzyme tests and urinary analyses (Jayawardena *et al*. 2011b). One heavily diabetic keeper and a keeper with hematuria were diagnosed, but both were unaware of their condition (Jayawardena *et al*. 2011b). One elephant keeper with oral cancer died before the confirmatory histopathological report arrived (Jayawardena *et al*. 2014). Most keepers had missing teeth and one keeper did not have any teeth. The reasons for ill health among keepers include excessive liquor consumption, smoking and chewing beetle. The risk to life in their line of work may be a possible reason for these excesses.

The situation of the keepers at the Pinnawela Elephant Orphanage is slightly different, possibly because there is discipline among them due to the orphanage being a government institute. Relatively few of them smoke and consume alcohol frequently, and therefore the frequency of Chronic Obstructive Pulmonary Disease (COPD) is much less. However, it is noteworthy that the frequency of COPD and also Mantoux reactivity among them was much more compared to the general Sri Lankan population (Dassanayake *et al*. 2014). At a later time, when a batch of new people including five ladies was taken in for training to become elephant keepers, clinical results of their chest examinations were very similar to the general population.

Typically, when an elephant contracts an unknown or rare condition, their keepers try local remedies

before contacting an ayurvedic (traditional) doctor and when both these fail, a veterinarian is contacted. These days newly educated owners first contact veterinarians or both veterinarians and ayurvedic doctors simultaneously. Lack of priority referral of veterinarians is a disadvantage since modern western medicine and its approach can detect rare and new conditions effectively and early. This situation was obvious in Raja, the male elephant of Kegalle temple, who had an irritable bowel condition for more than 10 years, possibly as a result of the stress caused by a road traffic accident (Dangolla 2012).

Captive elephants will retain an important place in Sri Lanka into the future and elephant keepers will play a significant role. The observed decline in the elephant keeping profession warrants attention. Education programs by veterinarians and other experts must be introduced as part of elephant-keeper training, as at the Pinnawela Elephant Orphanage. Private individuals and institutions must hire only such trained keepers. For their continued professional development, new recruits must be kept under studentship of senior keepers until they find their own jobs. Social acceptance of elephant keepers must be improved if this profession is to be developed further and if captive elephants are to be given better care.

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Elephant Behaviour in the Night According to Sage Palakapya

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Introduction

Since ancient times, elephants have played a prominent role in the life of humans and have been venerated in India. Elephants have fascinated humans for millennia and a vast literature related to their characteristics, diseases and their treatment were developed in eastern cultures. Elephantology developed into a branch of science related to governance in ancient India and many early works on statecraft devote chapters to it. Indian poets have described the behaviour of elephants in many of their works. Maharshi Pālakāpya's treatise titled the 'Hastyāyurveda' is an elaborate text in the form of a discourse dealing extensively with elephant diseases and their remedies (Sharma 1894a). It runs to about 20,000 or more verses.

Most texts attribute the initiation of elephantology to the Sage Pālakāpya (Harbola 2003). Apart from him, among the other ancient authorities referred to are Vīrasena, Bṛhaspati, Nīlakaṇṭha, Vyāsa, Nārada, Rājaputra and Vaiśampāyana. Several such treatises have been briefly discussed in recent publications (Bhattacharya & Gondekar 1924; Cheeran 2013; Sheshadri, 2014).

Here I present gleanings from the 'Hastyāyurveda' text, about night time elephant behaviour and certain pacificatory rituals and remedies for disturbances caused in the night.

Night time behaviour of elephants

Although daytime behaviour of elephants is elaborately described by ancient texts, nocturnal behaviour is less discussed. Elephants venture out from the forests to raid crops at night, all over the world. Nocturnal movements of elephants in some African countries have been reported to be associated with the phase of the moon. (Barnes 2013). The behaviour of Asian elephants at night is referred to by sage Pālakāpya in his treatise. The 'Hastyāyurveda' [Kṣudra Roga Sthāna - section on Minor diseases, Chap. 43] mentions that as the age of an elephant increases it experiences more Vāta, Kapha and Pitta disorders (Sharma 1894b). As a remedial measure it must be given a suitable place, grape juice, barley, milk and gruel. The sleeping place must be made soft and its movement there must be made easy.

The Ṛtucaryādhyāya section [Chap. XV] of the text while describing the nursing of elephants during six seasons, states that during autumn, elephants must be made to sleep in a cool place under moon rays at night (Sharma 1894c). During the rainy season, it advocates that stables of elephants must be smoked with suitable incense to reduce pests at night. Night sleep for the rainy and cold seasons is for about 8 Nālikas (a Nālika is equivalent to about 60 minutes). The Akṣi Rogādhyāya of the first section [Chap. 18] mentions that sleeplessness in the night causes eye diseases like Nāyamprekṣi in elephants (Sharma 1894d) leading to headache, blurring vision and pain in the eyes. The text then describes an elaborate herbal mixture that is ground into a paste in milk, curd and butter followed by sprinkling over the eyes periodically as well as anointing the eyes as a collyrium (Añjana).

The Rātrikṣiptādhyāya [Chap. 47] states that insanity in elephants is caused by sleeping in wrong places. If an elephant being disturbed at night travels everywhere and hits its tusks against trees or walls, then its eyes get swollen and it suffers from diseases (Sharma 1894e). Likewise an elephant sleeping in cremation grounds or in the middle of four crossroads, or places that are not mind-pleasing and un-prescribed by

ancient scriptures, passes out urine aggravated by doṡas and suffers insanity. The text states that an elephant also suffers from insanity when being awake or when asleep while resting at the bottom of Chaityas (or shrines), when it tries to capture its reflection in waters sensing it as an opponent, if constantly being goaded by a staff or Aṅkuśa (sharp tool used in handling elephants), by seeing fiery substances or on being hurt by another elephant.

Conditions of an elephant afflicted by insanity

Sage Pālakāpya deals extensively with the condition of elephants deprived of sleep due to insanity. He states that such elephants give up all food, their strength is lost and they keep awake at night and sleep in the morning. Saliva oozes from their mouths, the eyes turn red and they always vomit. The skin and other body parts begin to smell. The elephants swoon and sometimes open their eyes in the night.

Medication of disease

The 'Hastyāyurveda' mentions the medical treatment of such insanity diseases of elephants as a list of herbs to be mixed with clarified butter and medicated oils and administered as mentioned in the text. Some of these herbs are used in collyriums that are anointed over eyes and to make incense sticks that are waved around in twilight periods.

Sacrificial pacificatory ceremonies for elephants

The text advocates the performance of Rākṣoghna (a sacrifice performed at night to appease spirits that trouble an elephant), secret food eating (Guptabhojana) and performing '*Bali'* (offerings to spirits) as stated in the text. Charmed talismans are to be tied by medical practitioners on elephant's head, tusks and other parts. One must anoint the elephant's forehead with sandalwood, while waving incense; flowers, gems, beads, fruits should be offered together with milk, honey, clarified butter, curd and wine as *Bali* to the spirits all around the dwelling place of the elephant. Sacred water filled pots (Kalaśas) that are charmed by Vedic hymns seeking protection for the elephant from various deities, heavenly beings like Devas, Yakṣas Navagrahas, ṛṣis, Forest deities, Asterisms, Herbs, Mountains, Rākṣasas, Sarpas (serpents), Piśachas and Dānavas are to be taken in circumambulation around the elephant (Sharma 1894f). One must thus perform the Rākṣoghna and offer sacrificial cakes and feast to the elephants [Gaja Śānti].

Performances of such rites at night around the dwelling place of an elephant suffering from insanity and other diseases remove the evil effects caused by spirits. Sage Pālakāpya also adds that elephants are to be anointed with warm mustard oil or massaged with oil mixed with urine of an ass, chameleon (Godha) or sheep (Basta). A mixture of hairs of elephant, monkey, sheep and cow along with clarified butter is to be burnt and used as incense for waving around it [Chap. 47]. The medicines to be administered to the elephants suffering from insanity during night are also to be charmed by hymns and given to it seeking an early cure for the diseases. Sacred ashes of the sacrifice performed at the dwelling place to appease the various spirits are to be smeared all over its body so that it gets a sound sleep in the night. An oil lamp should be lighted in the dwelling place to remove 'evil eye' disorders.

The text mentions that if elephants become too tired or stay awake in the night, the Vyāna Vāyu (one of the five vital airs in the body) enter the feet regions and cause inflammation leading to twisting of nails or a change of their colour along with boils. This is called Yavagaṇḍaśira disease and is to be treated carefully and immediately [Chap. 41] (Sharma 1894g).

Other instances of night behaviour of elephants

Sage Pālakāpya's text describes several other observations of night behaviour that are spread all over the text. Elephants may suffer from blood disorders, eye and foot diseases, urinary disorders and diseases due to aggravation of Pitta, Vāta and Kapha. They may be possessed by spirits. They may suffer from pregnant conditions, or due to harsh swampy and marshy areas of the

forests during rainy season, also get afflicted by pests, wild animals and serpents; or stricken by fear of falling into pits or seeing lightning strikes accompanied by rain; or suffer from loss of herd or group and family separation at night time. The Uttarasthāna [Snehapānavidhikathanam, Chap 2] states that such elephants must be administered oil in correct measures (Sharma 1894h).

If the oil is old, it affects the genitals, causes thirst and swooning. The elephant may also suffer from indigestion of oil during the night. The text prescribes that they must be made to sleep over cow-dung smeared ground and given a mouthful of soft tender green grass and barley to remove diseases due to Vāta. At several places, the text highlights that sleeping in unprescribed places that are not mind-pleasing to it, is the cause for several diseases.

Conclusions

The descriptions of Sage Pālakāpya's text are so exquisite that they inform us about the night time behaviour of elephants not found in other texts. Nocturnal behaviour varies from crop raiding to travels, suffering diseases, pregnancy, being attacked by other wild animals, succumbing to seasonal variations and so on. The text is clear in specifying these conditions and suitable remedies for the disturbances such as medication, pacifying the spirits, talismans, administering suitable diet in correct measures and maintaining a clean sleeping place. Study of these aspects by those keeping elephants, may allow identifying, examining and treating elephants in a timely manner, allowing easing of the pains that elephants may undergo from night disturbances.

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Building Relationships between Asian Mahouts

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The 7th Indonesian Mahout Workshop hosted by FOKMAS (Indonesian Mahout Communication Forum) was held from February 24-27, 2015, at the Minas government elephant training centre (PLG) located in the province of Riau in Sumatra, Indonesia. Seventy participants attended the workshop and represented most of the Sumatran government elephant camps, Conservation Response Units (CRUs), and other elephant patrol units in Sumatra, as well as several zoos and safari parks from Sumatra, Java, and Bali. The majority of participants were mahouts, but some camp managers and veterinarians from private facilities also attended.

The Indonesian Mahout Workshops were initiated in 2006 at the Seblat government elephant conservation centre in Bengkulu province (Sumatra) to provide an opportunity for mahouts to share information, strengthen their professionalism, and influence elephant conservation in Indonesia more effectively.

Several NGOs, including the International Elephant Foundation, Asian Elephant Support, and the Elephant Managers Association, provided workshop support to assist this professional training opportunity for mahouts. General issues discussed during the workshop included problems mahouts encounter in their elephant work and habitat conservation efforts, finding solutions to improve the care and management of Indonesia's wild and captive elephants, and means to create an information network with colleagues throughout Asia. FOKMAS and the Mahout Workshops are supported by Indonesian government conservation agencies

The 7th Indonesian Mahout Workshop was officially opened by the Director of Indonesian Biodiversity Conservation (KKH), Ir. Bambang Dahono Aji, M.M., M.Si, along with the Head of Riau Provincial Conservation Agency (BKSDA), Ir. Kemal Amas, M.Sc, and the Head of Siak District, Drs. H. Syamsuar, M.Si.





Myanmar mahout demonstrating to Indonesian mahouts how to tie harness rope.

During the first two days of the workshop several presentations and an informal hands-on session were conducted by visiting colleagues from the Myanma Timber Enterprise (MTE). The group from Myanmar included two MTE elephant veterinarians, an MTE manager, and a senior mahout (Singaung) from an MTE timber camp. The Indonesian mahouts were very attentive to the presentations from their Myanmar counterparts, and good discussions resulted from the interactions. The participants from Myanmar were impressed with the level of interest from the Indonesian mahouts and expressed the intention to develop similar meeting and training opportunities for mahouts in Myanmar. Following the Mahout Workshop, the Myanmar group had the opportunity to visit other Sumatran elephant camps and learn more about the use of elephants in Sumatra for eco-tourism and in conflict mitigation.

In addition to presentations, training in field navigation using maps and GPS units was conducted during the Workshop by Conservation Officer Diding Ichsan. This training was divided into two parts: theoretical background and hands-on practice in locations within the Minas camp area. All mahouts were instructed about various skills to deal with wildlife monitoring and illegal activities such as data collection and recording, GPS instruction, human-wildlife conflict mitigation techniques, and community relations. Building capacity of the mahouts with skills for improved forest protection and wildlife conservation also promotes improved job performance of these individuals.

The final part of the Mahout Workshop included discussion among the participants about improving elephant facilities and management in Indonesia, and a wrap up of the field navigation and GPS sessions.

These Mahout Workshops and interactions with fellow mahouts from around Asia are very important for the mahout staff across Indonesia. Prior to this Workshop, in December 2014, two Sumatran staff who have been regular instructors at the Indonesian Mahout Workshops, travelled to Myanmar to train MTE mahouts in the use of GPS and field navigation. As MTE reduces the amount of logging now done by elephants, they are turning to conservation activities, such as patrolling protected areas, for these ex-logging elephants.

There is a need to continue these regional professional exchanges and training as this has resulted in positive outcomes. In Indonesia, the government has requested input from FOKMAS about mitigating elephant conflict. FOKMAS is currently in the planning stages for the next Mahout Workshop and will continue hosting mahout training modules so this level of staff can be more effective participants in elephant conservation initiatives in Indonesia - and across Asia.



Minas elephants bathing.

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Appreciation

Dr. Fred Kurt (18.2.1939 - 6.6.2015)

By Alex Rübel and René E. Honegger

Fred Kurt was born in the Swiss town of Langenthal, the son of a hairdresser. As a five year old his mother took him to the city where the Circus Knie gave its annual guest appearance. He was fascinated by the big gray giants, bigger and more impressive than the mother-made stuffed elephant. They radiated a peace and warmth, which never let him go.

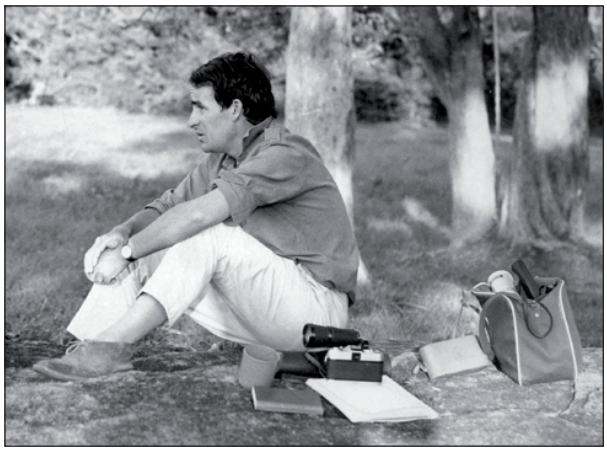
His mother had great understanding for his love for animals, and read to him from Brehm's animal life books. If he wanted to keep an animal himself, he gave it to his mother and was then able to care of it. So his room soon became a small zoo: fish, snakes, lizards and turtles moved in. He showed to his classmates how to dissect frogs. His curiosity of nature helped him early to a great knowledge of animals and soon he carried out his own research, in which he labelled toads and pursued their migration or surveyed fox burrows in the forest.

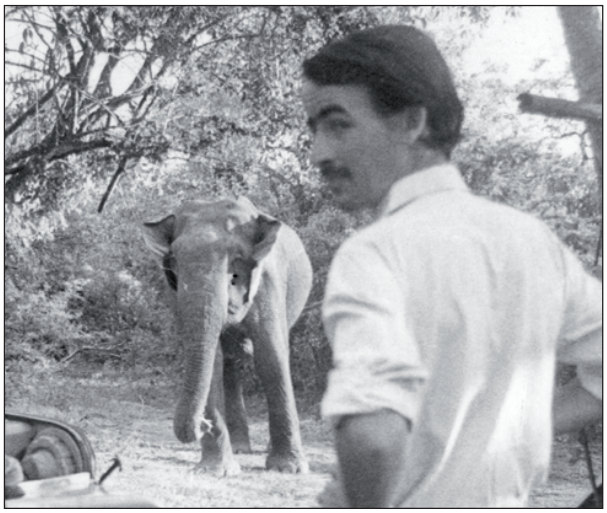
Part of the readings of this bright young lad was "Studies of the psychology and behaviour of animals in zoos and circuses" of zoo director Prof. Dr. Heini Hediger, who moved in these years from Basel to Zurich. His parents encouraged him to write to Hediger and he, impressed by the initiative of the young naturalist, helped the 17-year old to a summer job to study the dressage at Circus Knie, where he spent many nights at the elephant tent. This was followed in 1960 by his first publication on the sleep patterns of elephants "Le Sommeil des éléphants". It was not his last work in the circus. Along with Louis Knie in 1980 he wrote a book about the "Elephants and tigers at the circus".

During his studies in zoology at the University of Zurich, he got the opportunity to accompany Hans Kummer to Ethiopia for his study on Hamadryas baboons. He completed his doctoral thesis at the University of Zurich on the social behaviour of deer and due to his great knowledge became a member of the IUCN / SSC Specialist Group for deer. He wrote a number of books on the subject, in 1970 "Deer", 1977 "Wildlife of the cultural landscape" and 1991 "The deer in the cultural landscape - social behaviour and ecology of a fitter".

After graduation, the Smithsonian Institution in Washington charged him with a study on the social behaviour and the ecology of wild elephants in Sri Lanka. He lived there from 1967-1970 in the vicinity of his research site, the Ruhunu National Park. In 1970 he went on behalf of IUCN and WWF on a four-month study trip to North Sumatra. In his report on this gruelling mission he wrote: "We gave up living in tents and stayed in tabernacles. Each of us carried a weight of 10 to 16 kilograms. As food we brought only rice, tea and sugar in the jungle. This rather one-sided food we supplemented where possible with self-caught fish, tortoises, various flowers and leaves. Overall, we travelled 850 km, of which 250 km were in dug-outs the rest on foot."

Back at the University of Zurich as a lecturer, he repeatedly made excursions with the Zoological Institute and Zoological Museum or on behalf of the Smithsonian Institution, the WWF, IUCN,





UNEP, the World Bank and the Frankfurt Zoological Society, to Sri Lanka, India and Myanmar, to study elephants. From his circle of acquaintances he found interested tourists, which he led to the elephants who occasionally funded some of his research. In 1978 the IUCN / SSC Specialist Group for Asian elephants was launched, of which he was a founder. In addition, he planned reserves in Rwanda, Kashmir, Morocco and Austria.

In the eighties he increasingly dedicated himself to journalism and engaged further in elephant-studies and worked with the European Elephant Group, which publishes the serial publication "Elephants in zoo and circus", dealing in particular with the keeping of elephants in human hands. His conservation knowledge helped him to get a lectureship at the new Research Institute of Wildlife and Ecology in Vienna. In his 1982 book "Conservation-illusion and reality: On the ecology of threatened species and communities", he demanded that we move away from an emotional conservation attitude, away from pure species protection, towards greater knowledge of ecological relationships and to protect whole communities and habitats.

His main interest has always been the training of students in Sri Lanka, Switzerland and Vienna. His activities and publications have greatly contributed to increasing the knowledge about elephants and thus actively contributed to improving the keeping and conservation of elephants. Of course, he was there when Stephan Hering-Hagenbeck and Alan Roocroft founded in Hamburg the "First European Elephant Management School". He was looking for a better life for elephants in human hands. He condemned one-legged handstands of elephants in the circus as well as the brutal handling of elephants by some mahouts in Asia. Many improvements in housing conditions in Europe date back to his initiative. He was able to bring his experience comprehensively to both the elephant park in Cologne Zoo and the Kaeng Krachan Elephant Park in Zoo Zurich. Unfortunately, his idea, to carry back insights gained in Europe in working with elephants Asia and to train the local mahouts he sadly couldn't carry out anymore.

At the centre of his work are numerous publications. In addition to many journal articles, including for the magazine "Nature" by Horst Stern, are important books on elephants: 1986 "The elephant book - How Asia's last giants live", 1991 "The book of elephants", 2001 "Elephants in human hands - Research reports from Sri Lanka" and 2007 with Marion Garai "The Asian elephant in captivity - A field study".

In recent years, Fred Kurt worked hard on his latest book, which summarises his research and knowledge and which has been called best nature book in Germany: "Of Elephants and Men". The book appeared just in time for the opening of Kaeng Krachan Elephant Park in Zurich Zoo, which he helped shaping. Personally, he was a very valiant man, but he had the heart in the right place and a very good and strong humour. With the demise of Fred Kurt, we lose a great conservationist, one of the best elephant experts and a dedicated comrade and friend.



Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

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If you need additional information on any of the articles, please feel free to contact me. You can also let me know about new (2015) publications on Asian elephants.

M. Alamgir, S.A. Mukul & S.M. Turtona
Modelling spatial distribution of critically endangered Asian elephant and Hoolock gibbon in Bangladesh forest ecosystems under a changing climate
Applied Geography 60 (2015) 10-19
Abstract. The Asian elephant (*Elephas maximus*) and Hoolock gibbon (*Hoolock hoolock*) are two globally endangered wildlife species limited to only tropical Asian forests. In Bangladesh both species are critically endangered and distributed mainly in the northeast and southeast hilly regions bordering neighboring India and Myanmar. Using existing distribution data, land-use/land cover, elevation and bio-climatic variables, we modeled the likely distribution of Asian elephant and Hoolock gibbon in Bangladesh for 2050 and 2070. We used the IPCC's Representative Concentration Pathways (RCPs) e RCP6.0 and RCP8.5 and Maximum Entropy algorithm for our modelling. Our study indicated that the Asian elephant will be more resilient to climate change compared with the Hoolock gibbon. Habitat loss for the Asian elephant is also expected to remain constant (i.e. 38%) throughout the period, whilst Hoolock gibbon habitat will be more sensitive to climatic variations, with the species predicted to be extirpated from the country by 2070. Being highly exposed to climate change with ever increasing land use pressures, we believe our study in Bangladesh can be used to enhance our understanding of future vulnerabilities of wildlife in a rapidly changing climate. A trans-boundary conservation program with greater attention to the species that are less resilient to climate change is also essential. © 2015 Reprinted with permission from Elsevier.

M. Benadusi
Elephants never forget: Capturing nature at the border of Ruhuna National Park (Yala), Sri Lanka
Capitalism Nature Socialism 26 (2014) 77-96
Abstract. Yala National Park, in south-eastern Sri Lanka, is a complex of adjoining natural reserves covering a large forested area partly open to tourists. The park is surrounded by a wide swath of shrub jungle that serves as a buffer zone separating the protected lands from the nearest rural villages. There have long been disputes over access to natural resources in this region, but they became more heated after 2009 when the state finally emerged victorious from a long civil war with Tamil separatist rebels, established in the north-eastern territories. With the conflict resolved, the government was able to repackage the country as a new Asian destination for international tourism. © 2014 The Center for Political Ecology.

L. Bennett, S. Dunham, L. Yon, S. Chapman, M. Kenaghan, L. Purdie & R. Tarlinton
Longitudinal study of Asian elephants, *Elephas maximus*, indicates intermittent shedding of elephant endotheliotropic herpesvirus 1 during pregnancy
Veterinary Record Open 2 (2015) e000088
Abstract. Introduction: EEHV-1 is a viral infection of elephants that has been associated with a fatal haemorrhagic syndrome in Asian elephants. Previous studies have suggested that pregnant animals may shed more virus than non-pregnant animals. Methods: This study examined whether pregnancy affected the frequency or magnitude of shedding of elephant

endotheliotropic herpesvirus 1 (EEHV1) using Taq man real-time PCR on trunk washes from four female elephants from a UK collection over three time periods between 2011 and 2014. These periods included pregnancies in two animals (period 1 and period 3). Behavioural observations made by keepers were also assessed. Results: During period 1 there was a high degree of social hierarchical instability which led to a hierarchy change, and was associated with aggressive behaviour. Also during period 1 EEHV-1 shedding was of a higher magnitude and frequency than in the latter two time periods. Conclusions: These results suggest that there is no clear relationship between shedding and pregnancy, and that behavioural stressors may be related to an increase in EEHV-1 shedding.

K. Chelliah & R. Sukumar

Interplay of male traits, male mating strategies and female mate choice in the Asian elephant, *Elephas maximus*

Behaviour 152 (2015) 1113-1144

Abstract. Elaborate male traits with no apparent adaptive value may have evolved through female mate discrimination. Tusks are an elaborate male-only trait in the Asian elephant that could potentially influence female mate choice. We examined the effect of male body size, tusk possession and musth status on female mate choice in an Asian elephant population. Large/musth males received positive responses from oestrous females towards courtship significantly more often than did small/non-musth males. Young, tusked non-musth males attempted courtship significantly more often than their tuskless peers, and received more positive responses (though statistically insignificant) than did tuskless males. A positive response did not necessarily translate into mating because of mate-guarding by a dominant male. Female elephants appear to choose mates based primarily on traits such as musth that signal direct fertility benefits through increased sperm received than for traits such as tusks that may signal only indirect fitness benefits. © 2015 Koninklijke Brill NV, Leiden.

S. Dasgupta & A.K. Ghosh

Elephant–railway conflict in a biodiversity hotspot: Determinants and perceptions of the conflict in northern West Bengal, India

Human Dimensions of Wildlife 20 (2015) 81-94

Abstract. We quantified elephant–train casualties along the 163 km (101 mi) Siliguri-Alipurduar railway line in northern West Bengal, India and assessed stakeholder perceptions about this conflict. We found that casualties have increased post-conversion of this railway line from meter to broad gauge, and are highest during monsoons and winters. Higher casualty risk was associated with closer distances to nearest curve and higher forest cover. Elephants frequently visit near this railway line, and 83% of households living in close proximity to this line sighted elephants during 2012. Most train operators (87%) said that elephant–train collisions had increased, and cited speed, low visibility, and lack of warning systems as main reasons. Among household respondents, reasons for accidents included an increase in both train numbers and speed. Our suggestions for mitigating the conflict include installation of sensor-systems that can warn train drivers about approaching animals, and shifting trains to the alternate existing railway line. © 2015 Taylor & Francis Group, LLC.

P. Davidar, C. Rosset, P.C. Mammen, J.P. Puyravaud, R. Srivastava & B. Wright

Mortality records (1979–2011) shed light on threats to Asian elephants *Elephas maximus* Linnaeus, 1758 (Mammalia: Proboscidea: Elephantidae) in Nilgiris, southern India

Journal of Threatened Taxa 7 (2015) 7436-7442

Abstract. We compiled records of 291 elephant deaths over a 33-year period (1979–2011) from the Mudumalai Tiger Reserve and the reserved forests of Nilgiri North and South divisions of southern India from the databases of the Tamil Nadu Forest Department, the Wildlife Protection Society of India and the Nilgiri Wildlife and Environment Association. We tested the null hypothesis that the causes of elephant deaths would not differ with time, by gender and with level of protection. We classified records by gender and age: adults (≥15 years), sub adults (5–15 years), juveniles (>1–<5) and calves (≤ 1). We organised records over 3-decade periods. The database consisted of 209 adults (≥15 years), 27 sub adults (5–15 years), 33 juveniles (>1–<5) and 22 calves (≤ 1). MTR had the maximum records

(148) followed by NND (138) and NSD (4). The median age of death was 20 years for adult males and 30 years for adult females. Mean survival time for adult males was 22.45 years, and 31.84 for females. Poaching was responsible for the majority of deaths (40%), particularly of male elephants (82%), and unknown causes (31%) for the majority of female deaths (66%). Human-caused deaths, which included poaching and some accidents, averaged 72% between 1979 and 2000 and decreased to 22% during 2001–2011. Deaths due to unknown causes and diseases increased from 28% in 1979-1989 to 69% in 2001–2011. Relative to estimated population size, deaths attributed to poaching was higher in NND (47%) than in MTR (34%). The causes of death differed by region. In conclusion, the elephant population in the Nilgiris is at risk and needs stringent protection; the mortality database should be systematised; forensic capabilities upgraded, and detection of carcasses improved. © 2015 The Authors.

M.N. Elliza, M.N. Shukor, N. Othman & B.M. Md-Zain

Haplotype distribution among endangered Asian elephants (*Elephas maximus*) in Peninsular Malaysia

Malaysian Applied Biology 44 (2015) 129-135

Abstract. Asian elephants are classified as an endangered species on the IUCN red list, warranting more research and conservation efforts to protect them. A study of the distribution of haplotypes among Asian elephants in Peninsular Malaysia was performed using a partial DNA sequencing of a D-loop region. In this study, 10 haplotypes (Hap01–Hap10) were detected in Peninsular Malaysian populations with a high haplotype diversity (H) of 83%. Hap01 was shared by Kelantan (n = 1), Johor (n = 2), Pahang (n = 2), and Perak (n = 2). The other shared haplotype was Hap06, which was evident in the Pahang (n = 1) and Johor (n = 1) samples. DnaSP analysis demonstrated that low genetic diversity (π) was observed in Peninsular Malaysian elephants (0.55%). Conversely, the gene flow was high (Nm = 9.65 migrants per generation). In a test of population subdivision, all pairwise comparisons for Peninsular Malaysia were low (0.00 to 0.13) except for Kelantan–Pahang (0.57). Our results demonstrated that the genetic diversity was low within the different populations of Peninsular Malaysia. The level of genetic differentiation was also low, but the gene flow was high regardless of the geographic distance of the Asian elephant populations in Peninsular Malaysia.

M. English, G. Gillespie, B. Goossens, S. Ismail, M. Ancrenaz & W. Linklater

Recursion to food plants by free-ranging Bornean elephant

PeerJ 3 (2015) e1030

Abstract. Plant recovery rates after herbivory are thought to be a key factor driving recursion by herbivores to sites and plants to optimise resource-use but have not been investigated as an explanation for recursion in large herbivores. We investigated the relationship between plant recovery and recursion by elephants (*Elephas maximus borneensis*) in the Lower Kinabatangan Wildlife Sanctuary, Sabah. We identified 182 recently eaten food plants, from 30 species, along 14 × 50 m transects and measured their recovery growth each month over nine months or until they were re-browsed by elephants. The monthly growth in leaf and branch or shoot length for each plant was used to calculate the time required (months) for each species to recover to its pre-eaten length. Elephant returned to all but two transects with 10 eaten plants, a further 26 plants died leaving 146 plants that could be re-eaten. Recursion occurred to 58% of all plants and 12 of the 30 species. Seventy-seven percent of the re-eaten plants were grasses. Recovery times to all plants varied from two to twenty months depending on the species. Recursion to all grasses coincided with plant recovery whereas recursion to most browsed plants occurred four to twelve months before they had recovered to their previous length. The small sample size of many browsed plants that received recursion and uneven plant species distribution across transects limits our ability to generalise for most browsed species but a prominent pattern in plant-scale recursion did emerge. Plant recovery time was a good predictor of time to recursion but varied as a function of growth form (grass, ginger, palm, liana and woody) and differences between sites. Time to plant recursion coincided with

plant recovery time for the elephant's preferred food, grasses, and perhaps also gingers, but not the other browsed species. Elephants are bulk feeders so it is likely that they time their returns to bulk feed on these grass species when quantities have recovered sufficiently to meet their intake requirements. The implications for habitat and elephant management are discussed. © 2015 The Authors.

A.F. Humphreys, J. Tan, R.S. Peng, S.M. Benton, X. Qin, K.C. Worley, R.L. Mikulski, D.-C. Chow, T.G. Palzkill & P.D. Ling

Generation and characterization of antibodies against Asian elephant (*Elephas maximus*) IgG, IgM, and IgA

PLoS ONE 10 (2015) e0116318

Abstract. Asian elephant (*Elephas maximus*) immunity is poorly characterized and understood. This gap in knowledge is particularly concerning as Asian elephants are an endangered species threatened by a newly discovered herpesvirus known as elephant endotheliotropic herpesvirus (EEHV), which is the leading cause of death for captive Asian elephants born after 1980 in North America. While reliable diagnostic assays have been developed to detect EEHV DNA, serological assays to evaluate elephant anti-EEHV antibody responses are lacking and will be needed for surveillance and epidemiological studies and also for evaluating potential treatments or vaccines against lethal EEHV infection. Previous studies have shown that Asian elephants produce IgG in serum, but they failed to detect IgM and IgA, further hampering development of informative serological assays for this species. To begin to address this issue, we determined the constant region genomic sequence of Asian elephant IgM and obtained some limited protein sequence information for putative serum IgA. The information was used to generate or identify specific commercial antisera reactive against IgM and IgA isotypes. In addition, we generated a monoclonal antibody against Asian elephant IgG. These three reagents were used to demonstrate that all three immunoglobulin isotypes are found in Asian elephant serum and milk and to detect antibody responses following tetanus toxoid booster vaccination or antibodies against a putative EEHV structural protein. The results indicate that these new reagents will be useful for developing sensitive and specific assays to detect and characterize elephant antibody responses for any pathogen or vaccine, including EEHV. © 2015 The Authors.

B. Jasmine, D. Ghose & S.K. Das

An attitude assessment of human-elephant conflict in a critical wildlife corridor within the Terai Arc Landscape, India

Journal of Threatened Taxa 7 (2015) 6843-6852

Abstract. This study entails an attitude assessment of the local people living at Mankanthpur Village, one of the bottlenecks in the Bailparao-Kotabagh corridor, Terai West Forest Division, on the issue of elephant conservation, human-(wildlife) elephant conflict, and the measures to mitigate it. Data was collected through a questionnaire survey and several group discussions among the villagers. The frequency of crop raids and group size of elephants were calculated. Sixty-two crop raids took place during the study period (February– April 2010), and a mean sighting of 1.08 elephants per day was recorded. Data from the survey reflects that about 3.53 ha of crop land was damaged by the elephants during the survey period. The people residing on the fringes of the park and in the villages along the Bailparao-Kotabagh Corridor were surveyed about the conflict impact. Survey results indicate that the most effective management measures used were a combination of loud noise and scaring away elephants using fire. Local peoples' views regarding the current status of elephant raids and conservation were also documented. Peoples' reaction to compensation schemes was studied; 89% of the respondents feel an effective approach to compensation is a way to reduce sufferings due to conflict with wildlife. Attempts to reduce the conflict by forming local elephant control teams and enclosing the affected village with a tall cemented wall are under trial. The underlying assumption in this study is that if damage severely affects the livelihood of local communities, getting their active support, which is essential for conservation, will be difficult. © 2015 The Authors.

D. Jathanna, K.U. Karanth, N.S. Kumar, V.R. Goswami, D. Vasudev & K.K. Karanth

Reliable monitoring of elephant populations in the forests of India: Analytical and practical considerations

Biological Conservation 187 (2015) 212-220

Abstract. Reliable estimation of elephant population abundance and density assumes great importance in the context of massive threats from illegal hunting and habitat loss. However, available estimates of elephant populations, particularly in Asia, are often unreliable and misleading. We evaluate sources of bias and imprecision in commonly used estimation approaches, and demonstrate that if correctly applied, line transect sampling based on visual detections of elephant clusters can address these issues. We compare our own early transect surveys on foot that relied on purposive line placement, to subsequent surveys in 2011, which employed rigorous survey designs. Estimated elephant density D(95%CI(D)) in our study sites in India, ranged between 0.25(0.12–0.53) and 3.29(1.74–6.21) elephants/km2 in the earlier surveys and between 0.32(0.14–0.75) and 2.24(1.41–3.56) elephants/km2 in the 2011 survey. Although coefficients of variation of estimated detection probability (p) and cluster size (E(S)) were higher at low sample sizes, they dropped to <15% with n > 40 detections. Variance of encounter rate (n/l) was the largest contributor to the variance of density estimates. We recommend that rigorous line transect surveys must ensure: random transect placement with systematic and sufficient spatial replication to ensure adequate spatial coverage; coverage of sufficiently large areas in a short duration to ensure population closure; and investment of adequate effort to ensure reasonable number of detections. Field and analytical protocols presented here can enable reliable estimation of density and abundance of other wildlife species that can be visually detected in forests. They can lead to improved animal monitoring programs that are central to rigorously evaluating the effectiveness of widely employed, expensive conservation interventions meant to counter massive anthropogenic threats facing elephants and other large, diurnal species.
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D. Jathanna, K.U. Karanth, N.S. Kumar, K.K. Karanth & V.R. Goswami

Patterns and determinants of habitat occupancy by the Asian elephant in the Western Ghats of Karnataka, India

PLoS ONE 10 (2015) e0133233

Abstract. Understanding species distribution patterns has direct ramifications for the conservation of endangered species, such as the Asian elephant *Elephas maximus*. However, reliable assessment of elephant distribution is handicapped by factors such as the large spatial scales of field studies, survey expertise required, the paucity of analytical approaches that explicitly account for confounding observation processes such as imperfect and variable detectability, unequal sampling probability and spatial dependence among animal detections. We addressed these problems by carrying out 'detection—non-detection' surveys of elephant signs across a c. 38,000-km^2 landscape in the Western Ghats of Karnataka, India. We analyzed the resulting sign encounter data using a recently developed modeling approach that explicitly addresses variable detectability across space and spatially dependent non-closure of occupancy, across sampling replicates. We estimated overall occupancy, a parameter useful to monitoring elephant populations, and examined key ecological and anthropogenic drivers of elephant presence. Our results showed elephants occupied 13,483 km^2 (SE = 847 km^2) corresponding to 64% of the available 21,167 km^2 of elephant habitat in the study landscape, a useful baseline to monitor future changes. Replicate-level detection probability ranged between 0.56 and 0.88, and ignoring it would have underestimated elephant distribution by 2116 km^2 or 16%. We found that anthropogenic factors predominated over natural habitat attributes in determining elephant occupancy, underscoring the conservation need to regulate them. Human disturbances affected elephant habitat occupancy as well as site-level detectability. Rainfall is not an important limiting factor in this relatively humid bioclimate. Finally, we discuss cost-effective monitoring of Asian elephant populations and the specific spatial scales at which different population parameters can be estimated. We emphasize the need to model the observation and sampling processes that often

obscure the ecological process of interest, in this case relationship between elephants to their habitat. © 2015 The Authors.

Ritesh Joshi

Impact of Gujjar Rehabilitation Programme on the group size of Asian elephants (*Elephas maximus*) in Rajaji National Park, North-West India

Biodiversitas 16 (2015) 188-195

Abstract. A comparative study has been done to assess the impact of the Gujjar Rehabilitation Programme on the group's size of Asian elephants (*Elephas maximus*) in Rajaji National Park, north-west India. Field surveys were carried out before the Gujjar's rehabilitation during 1999-2001 and after the Gujjar's rehabilitation during 2006-2008 in Chilla and Haridwar forest ranges of the park. A total of 833 groups of elephants were sighted, varying from 2-5 (mean value±SD=28.5±24.7) to 21-25 animals (mean value±SD=8.2±4.6). The number of groups sighted in Haridwar forest after the Gujjars' rehabilitation were significantly low in summer and winter as compared before the Gujjars' rehabilitation. However, the number of groups sighted in Chilla forest before and after the Gujjars' rehabilitation in both the seasons was found to be same. Results indicated that elephant's group's size and movement was shrinking/ reducing in Haridwar forest, however, in Chilla forest it was found to be slightly expanding/ increasing. The impact of Gujjar Rehabilitation Programme has not brought any drastic change in restoring the larger population of elephants and in increasing their group's size, however, this has increased the frequent movement and activities of elephants within their home range. Restoration of large fragmented forest stretches/corridors for elephant's migration and habitat management are of paramount importance in providing elephants a wider way to move across entire landscape in large herds. As increase in human population in the nearby areas and developmental activities, with increase in vehicle traffic pressure on national highways and railway track existing across the park were found to be creating negative impacts on the overall movement of large groups of the elephants. © 2015 Nusantara Bioscience.

C.P. Kilgallon, R.S. Larsen, A. Wong & C. Yellowley

Analysis of a collagen II degradation protein C2C and a collagen II formation protein CP II in serum of Asian elephants (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 46 (2015) 146-149

Abstract. Osteoarthritis is a major cause of chronic lameness in Asian elephants (*Elephas maximus*) in captivity worldwide. Radiology and other imaging technologies are of limited use in the early diagnosis of this condition in elephants. Collagen II is a major component of articular cartilage. The degradation and formation of collagen II can be monitored by the measurement of specific biomarkers in biologic fluids such as serum. It is possible that these biomarkers could also prove useful in identifying disease in elephants. In this study two commercially available immunoassays which measure a marker of collagen II degradation (C2C) and a marker of collagen II formation (CPII) were evaluated in Asian elephants. The ability of the assays to detect and measure C2C and CPII in the serum of Asian elephants was confirmed. Median serum concentration of C2C was 148 ng/L in nonlame elephants (n = 33) and 91.2 ng/L in lame elephants (n = 7). The difference was statistically significant (P 1⁄4 0.0002). Median serum concentration of CPII was 519.3 ng/L in nonlame elephants and 318.7 ng/L in lame elephants. The difference was also statistically significant (P = 0.039). Whereas CPII concentrations in lame elephants mirrored findings from human and animal osteoarthritis studies, C2C concentrations did not. Further studies which evaluate these and other similar biomarkers are necessary to elucidate their usefulness in the diagnosis of osteoarthritis in proboscidae. © 2015 American Association of Zoo Veterinarians.

C.L. Lynsdale, D.J. Franco dos Santos, A.D. Hayward, K.U. Mar, W. Htut, H. Htoo Aung, A. Thura Soe & V. Lummaa

A standardised faecal collection protocol for intestinal helminth egg counts in Asian elephants, *Elephas maximus*

International Journal for Parasitology: Parasites and Wildlife 4 (2015) 307-315

Abstract. The quantitative assessment of parasite infection is necessary to measure, manage and reduce infection risk in both wild and captive animal populations. Traditional faecal flotation methods which aim to quantify parasite burden, such as the McMaster egg counting technique, are widely used in veterinary medicine, agricultural management and wildlife parasitology. Although many modifications to the McMaster method exist, few account for systematic variation in parasite egg output which may lead to inaccurate estimations of infection intensity through faecal egg counts (FEC). To adapt the McMaster method for use in sampling Asian elephants (*Elephas maximus*), we tested a number of possible sources of error regarding faecal sampling, focussing on helminth eggs and using a population of over 120 semi-captive elephants distributed across northern Myanmar. These included time of day of defecation, effects of storage in 10% formalin and 10% formol saline and variation in egg distribution between and within faecal boluses. We found no significant difference in the distribution of helminth eggs within faecal matter or for different defecation times, however, storage in formol saline and formalin significantly decreased egg recovery. This is the first study to analyse several collection and storage aspects of a widely-used traditional parasitology method for helminth parasites of E. maximus using known host individuals. We suggest that for the modified McMaster technique, a minimum of one fresh sample per elephant collected from any freshly produced bolus in the total faecal matter and at any point within a 7.5 h time period (7.30 am-2.55 pm) will consistently represent parasite load. This study defines a protocol which may be used to test pre-analytic factors and effectively determine infection load in species which produce large quantities of vegetative faeces, such as non-ruminant megaherbivores. © 2015 The Authors.

M.D. Madhusudan, N. Sharma, R. Raghunath, N. Baskaran, C.M. Bipin, S. Gubbi, A.J.T. Johnsingh, J. Kulkarni, H.N. Kumara, Prachi Mehta, R. Pillay & R. Sukumar

Distribution, relative abundance, and conservation status of Asian elephants in Karnataka, southern India

Biological Conservation 187 (2015) 34-40

Abstract. Karnataka state in southern India supports a globally significant—and the country's largest—population of the Asian elephant *Elephas maximus*. A reliable map of Asian elephant distribution and measures of spatial variation in their abundance, both vital needs for conservation and management action, are unavailable not only in Karnataka, but across its global range. Here, we use various data gathered between 2000 and 2015 to map the distribution of elephants in Karnataka at the scale of the smallest forest management unit, the 'beat', while also presenting data on elephant dung density for a subset of 'elephant beats.' Elephants occurred in 972 out of 2855 forest beats of Karnataka. Sixty percent of these 972 beats—and 55% of the forest habitat—lay outside notified protected areas (PAs), and included lands designated for agricultural production and human dwelling. While median elephant dung density inside protected areas was nearly thrice as much as outside, elephants routinely occurred in or used habitats outside PAs where human density, land fraction under cultivation, and the interface between human-dominated areas and forests were greater. Based on our data, it is clear that India's framework for elephant conservation—which legally protects the species wherever it occurs, but protects only some of its habitats—while being appropriate in furthering their conservation within PAs, seriously falters in situations where elephants reside in and/or seasonally use areas outside PAs. Attempts to further elephant conservation in production and dwelling areas have extracted high costs in human, elephant, material and monetary terms in Karnataka. In such settings, conservation planning exercises are necessary to determine where the needs of elephants—or humans—must take priority over the other, and to achieve that in a manner that is based not only on reliable scientific data but also on a process of public reasoning. © 2015 Reprinted with permission from Elsevier.

S.K. Mikota, K. Gairhe, K. Giri, K. Hamilton, M. Miller, S. Paudel, K. Lyashchenko, R.S. Larsen, J.B. Payeur, W.R. Waters, R. Greenwald, G. Dumonceaux, B. Vincent & G.E. Kaufman

Tuberculosis surveillance of elephants (*Elephas maximus*) in Nepal at the captive-wild interface

European Journal of Wildlife Research 61 (2015) 221-229

Abstract. A comprehensive elephant tuberculosis (TB) survey using culture and four serological screening tests was conducted in Nepal in response to concern raised by wildlife officials that TB could threaten wild populations of elephants, rhinos, and other susceptible species. Captive elephants come into close contact with wild animals during conservation and tourism activities inside Nepal's national parks. Private and government-owned male and female captive Asian elephants (*Elephas maximus*) were included in the study. The mean reported age was 38 years (range 5–60 years). A total of 289 samples from 120 elephants were collected for mycobacterial culture. Culture samples were processed at the National Tuberculosis Centre (NTC) in Nepal and the National Veterinary Services Laboratories (NVSL) in Ames, IA. Acid-fast organisms were observed in 11 and 21 samples processed at NTC and NVSL, respectively, and nontuberculous mycobacteria (NTMs) were isolated from six elephants. There were no isolations of *Mycobacterium tuberculosis* or *Mycobacterium bovis*. Blood samples were also collected from 115 of the elephants for serological testing using the Chembio ElephantTB STAT-PAK®, the Chembio MultiAntigen Print Immunoassay test, a multi-antigen ELISA, and an immunoblot assay. Culture and serological results were variable and required careful interpretation to develop criteria to assess TB risk. Elephants were assigned to one of four disease risk groups (high, moderate, low, and undetermined), and management recommendations for each group were made to government authorities. Serological results were prioritized in developing recommendations because of culture limitations and inconclusive culture results. This strategy was based on evidence for the early predictive value of serological tests and the urgent need expressed by wildlife authorities in Nepal to protect their captive elephants, mitigate TB at the captive-wild interface, and safeguard tourism. © 2015 With kind permission from Springer Science+Business Media.

D. Miller, B. Jackson, H.S. Riddle, C. Stremme, D. Schmitt & T. Miller

Elephant (*Elephas maximus*) health and management in Asia: Variations in veterinary perspectives

Veterinary Medicine International 2015 (2015) e614690

Abstract. There is a need to identify strategic investments in Asian elephant (*Elephas maximus*) health that will yield maximal benefits for overall elephant health and conservation. As an exploratory first step, a survey was administered to veterinarians from Asian elephant range countries at a workshop and via email to help prioritize health-related concerns that will mostly benefit elephants. Responses were received from 45 veterinarians from eight countries that had a range of experience with captive and wild elephants. The occurrence of medical conditions and responses to treatment varied among responses. However, injuries, parasitism, and gastrointestinal disease were reported as the most common syndromes responsible for elephant morbidity, whereas injury and infectious disease not due to parasitism were the most commonly reported sources of elephant mortality. Substandard nutrition, water quality and quantity deficiencies, and inadequate or absent shelter were among the factors listed as barriers to optimal elephant health. While this survey's results do not support definitive conclusions, they can be used to identify where and how subsequent investigations should be directed. Rigorous assessment of the relative costs and benefits of available options is required to ensure that investments in individual and population health yield the maximal benefits for elephants. © 2015 The Authors.

F.M. Molenaar, S.A. La Rocca, M. Khatri, J. Lopez, F. Steinbach & A. Dastjerdi

Exposure of Asian elephants and other exotic ungulates to Schmallenberg virus

PLoS ONE 10 (2015) e0135532

Abstract. Schmallenberg virus (SBV) is an

emerging Orthobunyavirus, first described in 2011 in cattle in Germany and subsequently spread throughout Europe, affecting mainly ruminant livestock through the induction of foetal malformations. To gain a better understanding of the spectrum of susceptible species and to assess the value of current SBV serological assays, screening of serum samples from exotic artiodactyls and perissodactyls collected at the Living Collections from the Zoological Society of London (Whipsnade and London Zoos) and Chester Zoo was carried out. There was compelling evidence of SBV infection in both zoological collections. The competitive ELISA has proved to be applicable for the detection of SBV in exotic Bovidae, Cervidae, Suidae, Giraffidae and most notably in endangered Asian elephants (*Elephas maximus*), but unreliable for the screening of Camelidae, for which the plaque reduction neutralisation test was considered the assay of choice. © 2015 The Authors.

H.S. Mumby, K.U. Mar, C. Thitaram, A. Courtiol, P. Towiboon, Z. Min-Oo, Y. Htut-Aung, J.L. Brown & V. Lummaa

Stress and body condition are associated with climate and demography in Asian elephants

Conservation Physiology 3 (2015) cov030

Abstract. Establishing links between ecological variation, physiological markers of stress and demography is crucial for understanding how and why changes in environmental conditions affect population dynamics, and may also play a key role for conservation efforts of endangered species. However, detailed longitudinal studies of long-lived species are rarely available. We test how two markers of stress and body condition vary through the year and are associated with climatic conditions and large-scale mortality and fertility variation in the world's largest semi-captive population of Asian elephants employed in the timber industry in Myanmar. Glucocorticoid metabolites (used as a proxy for stress levels in 75 elephants) and body weight (used as a proxy for condition in 116 elephants) were monitored monthly across a typical monsoon cycle and compared with birth and death patterns of the entire elephant population over half a century (n = 2350). Our results show seasonal variation in both markers of stress and condition. In addition, this variation is correlated with population-level demographic variables. Weight is inversely correlated with population mortality rates 1 month later, and glucocorticoid metabolites are negatively associated with birth rates. Weight shows a highly positive correlation with rainfall 1 month earlier. Determining the factors associated with demography may be key to species conservation by providing information about the correlates of mortality and fertility patterns. The unsustainability of the studied captive population has meant that wild elephants have been captured and tamed for work. By elucidating the correlates of demography in captive elephants, our results offer management solutions that could reduce the pressure on the wild elephant population in Myanmar. © 2015 The Authors.

N.K. Nath, S.K. Dutta, J.P. Das & B.P. Lahkar

A quantification of damage and assessment of economic loss due to crop raiding by Asian elephant *Elephas maximus* (Mammalia: Proboscidea: Elephantidae): A case study of Manas National Park, Assam, India

Journal of Threatened Taxa 7 (2015) 6853-6863

Abstract. A study was carried out in Manas National Park, Assam in northeastern India between 2007 and 2009 to understand the magnitude of human-elephant conflict through a quantification of damage and assessment of economic loss. A cluster of six villages adjacent to the Park was selected for this study. Five major agricultural crops were grown during the study period of which three were raided by elephants: winter paddy, autumn paddy and pulses. Paddy was the principle crop central to the farmers' subsistence. Winter paddy was the most cultivated crop and autumn paddy was the least cultivated. The incidence rate of crop raiding was highest for autumn paddy and lowest for pulses. Overall economic loss due to crop raiding was negligible, however at the individual farmer level, it was quite high. The study revealed that human-elephant conflict is not so severe, indicating ample opportunity for human-elephant coexistence in the region. Crop fields adjacent to the Park were particularly vulnerable to crop raiding which necessitates creation of a buffer zone. The frequency of raiding and the extent

of damage was found to be significantly less in crop fields which were guarded by farmers. This was due to traditional crop guarding practices being followed in the region, the strengthening of which could effectively reduce annual crop loss and thus human-elephant conflict could be minimized to a large extent. © 2015 The Authors.

K.A. Phair, M. Sutherland-Smith, G.W. Pye, A.P. Pessier & T.L. Clippinger

Esophageal dissection and hematoma associated with obstruction in an Indian elephant (*Elephas maximus indicus*)

Journal of Zoo and Wildlife Medicine 45 (2014) 423-427

Abstract. A 42-year-old female Indian elephant (*Elephas maximus indicus*) developed a sudden onset of excessive salivation and dysphagia. Esophageal obstruction was suspected; possibly related to palm frond ingestion. Esophageal endoscopy revealed a mat of plant material in the distal esophagus. An initial attempt at relieving the obstruction was unsuccessful, but subsequent use of custom-made instruments along with insufflation and hydropulsion enabled partial removal of the material. Postimmobilization care included aggressive intravenous and rectal fluids, anti-inflammatory and antibiotic administration, and fasting. Despite treatment, the dysphagia persisted and the elephant was euthanized due to lack of improvement and grave prognosis. Postmortem examination revealed remaining plant material in the esophagus, complicated by an esophageal dissection, mural hematoma, and secondary bacterial infection. Iatrogenic trauma may have contributed to the extent of esophageal injury. Although treatment was ultimately unsuccessful, the supportive care employed could potentially aid recovery in cases of less severe esophageal trauma. © 2014 American Association of Zoo Veterinarians.

C.M. Proctor & J.L. Brown

A preliminary analysis of the influence of handling method on adrenal activity in zoo African and Asian elephants

J. of Zoo and Aquarium Research 3 (2015) 1-5

Abstract. As a first step towards investigating the effect of management choice – free contact (FC) or protected contact (PC) – on zoo elephant well-being, this study evaluated serum cortisol concentrations in weekly samples collected over a 2-year period from 112 female elephants (58 African, 54 Asian) managed in either FC (n=58) or PC (n=54) management systems at 48 facilities. Results showed there were no differences in overall or baseline mean concentrations of serum cortisol between the two management systems. A GLM analysis exploring the response of individual baseline cortisol concentration to management (FC vs PC), facility, species, and the interaction of management and facility revealed that the only parameter with significant explanatory power was the facility where the elephants were housed. Thus, it may be more important to evaluate specific facility effects on adrenal activity, such as enclosure conditions, enrichment opportunities, or social interactions, rather than handling technique. Although many zoos are moving to a PC management approach, particularly within the American Zoo and Aquarium Association, from a welfare standpoint there is probably not a one-size-fits-all management strategy that is ideal. Rather, it may be necessary to consider individual elephant coping styles and social needs on a case by case basis before deciding whether FC or PC is most appropriate for management, especially when considering how to address welfare concerns. © 2015 The Authors.

A.L. Roca, Y. Ishida, A.L. Brandt, N.R. Benjamin, K. Zhao, & N.J. Georgiadis

Elephant natural history: A genomic perspective

Annual Review of Animal Biosciences 3 (2015) 139-167

We review DNA-based studies of elephants and recently extinct pro- boscideans. The evidence indicates that little or no nuclear gene flow occurs between African savanna elephants (*Loxodonta africana*) and African forest elephants (*Loxodonta cyclotis*), establishing that they comprise separate species. In all elephant species, males disperse, whereas females remain with their natal social group, leading to discordance in the phylogeography of nuclear and mitochondrial DNA patterns. Improvements in ancient DNA methods have permit- ted sequences to be generated from an increasing number of pro-

boscidean fossils and have definitively established that the Asian elephant (*Elephas maximus*) is the closest living relative of the extinct woolly mammoth (*Mammuthus primigenius*). DNA-based methods have been developed to determine the geographic provenance of confiscated ivory in an effort to aid the conservation of elephants. © 2015 Reproduced with permission from Annual Reviews.

R.K. Runting, E. Meijaard, N.K. Abram, J.A. Wells, D.L.A. Gaveau, M. Ancrenaz, H.P. Posssingham, S.A. Wich, F. Ardiansyah, M.T. Gumal, L.N. Ambu & K.A. Wilson

Alternative futures for Borneo show the value of integrating economic and conservation targets across borders

Nature Communications 6 (2015) e6819

Abstract. Balancing economic development with international commitments to protect biodiversity is a global challenge. Achieving this balance requires an understanding of the possible consequences of alternative future scenarios for a range of stakeholders. We employ an integrated economic and environmental planning approach to evaluate four alternative futures for the mega-diverse island of Borneo. We show what could be achieved if the three national jurisdictions of Borneo coordinate efforts to achieve their public policy targets and allow a partial reallocation of planned land uses. We reveal the potential for Borneo to simultaneously retain B50% of its land as forests, protect adequate habitat for the Bornean orangutan (*Pongo pygmaeus*) and Bornean elephant (*Elephas maximus borneensis*), and achieve an opportunity cost saving of over US$43 billion. Such coordination would depend on enhanced information sharing and reforms to land-use planning, which could be supported by the increasingly international nature of economies and conservation efforts. © 2015 Macmillan Publishers Limited.

A.F. Saripan & A. Reungsang

Simultaneous saccharification and fermentation of cellulose for bio-hydrogen production by anaerobic mixed cultures in elephant dung

International Journal of Hydrogen Energy 39 (2014) 9028-9035

Abstract. The objective of this study was to optimize the culture conditions for simultaneous saccharification and fermentation (SSF) of cellulose for bio-hydrogen production by anaerobic mixed cultures in elephant dung under thermophilic temperature. Carboxymethyl cellulose (CMC) was used as the model substrate. The investigated parameters included initial pH, temperature and substrate concentration. The experimental results showed that maximum hydrogen yield (HY) and hydrogen production rate (HPR) of 7.22 ± 0.62 mmol H_2/g CMC_{added} and 73.4 ± 3.8 mL H_2/L h, respectively, were achieved at an initial pH of 7.0, temperature of 55ºC and CMC concentration of 0.25 g/L. The optimum conditions were then used to produce hydrogen from the cellulose fraction of sugarcane bagasse (SCB) at a concentration of 0.40 g/L (equivalent to 0.25 g/L cellulose) in which an HY of 7.10 ± 3.22 mmol H_2/g $cellulose_{added}$. The pre-dominant hydrogen producers analyzed by polymerase chain reaction-denaturing gel gradient electrophoresis (PCR-DGGE) were *Thermoanaerobacterium thermosaccharolyticum* and *Clostridium* sp. The lower HY obtained when the cellulose fraction of SCB was used as the substrate might be due to the presence of lignin in the SCB as well as the presence of *Lactobacillus parabuchneri* and *Lactobacillus rhamnosus* in the hydrogen fermentation broth. © 2014 Hydrogen Energy Publications, reprinted with permission from Elsevier.

N. Sekar, C.-L. Lee & R. Sukumar

In the elephant's seed shadow: The prospects of domestic bovids as replacement dispersers of three tropical Asian trees

Ecology 96 (2015) 2093-2105

Abstract. As populations of the world's largest animal species decline, it is unclear how ecosystems will react to their local extirpation. Due to the unique ecological characteristics of megaherbivores such as elephants, seed dispersal is one ecosystem process that may be affected as populations of large animals are decimated. In typically disturbed South Asian ecosystems, domestic bovids (cattle, *Bos primigenius*, and buffalo, *Bubalus bubalis*) may often be the species most available to replace Asian elephants (*Elephas maximus*) as endozoochorous dispersers of large-fruited mammal-dispersed species.

We use feeding trials, germination trials, and movement data from the tropical moist forests of Buxa Tiger Reserve (India) to examine whether domestic bovids are viable replacements for elephants in the dispersal of three large-fruited species: *Dillenia indica*, *Artocarpus chaplasha*, and *Careya arborea*. We find that (1) once consumed, seeds are between 2.5 (*C. arborea*) and 26.5 (*D. indica*) times more likely to pass undigested into elephant dung than domestic bovid dung; and (2) seeds from elephant dung germinated as well as or better than seeds taken from bovid dung for all plant species, with D. indica seeds from elephant dung 1.5 times more likely to germinate. Furthermore, since wild elephants have less constrained movements than even free-roaming domestic bovids, we calculate that maximum dispersal by elephants is between 9.5 and 11.2 times farther than that of domestic bovids, with about 20% of elephant-dispersed seeds being moved farther than the maximum distance seeds are moved by bovids. Our findings suggest that, while bovids are able to disperse substantial numbers of seeds over moderate distances for two of the three study species, domestic bovids will be unable to routinely emulate the reliable, long-distance dispersal of seeds executed by elephants in this tropical moist forest. Thus while domestic bovids can attenuate the effects of losing elephants as dispersers, they may not be able to prevent the decline of various mammal-dispersed fruiting species in the face of overhunting, habitat fragmentation, and climate change.

R. Venu, T. Thoiba Singh, R. Veeraharin, D. Rajesh & C. Srilatha

First report of *Cobboldia elephantis* (Cobbold, 1866) larvae in a free ranging wild elephant from Andhra Pradesh, India

Journal of Parasitic Diseases 39 (2015) 168-170

Abstract. Larvae of *Cobboldia elephantis* have been reported from the stomach of a free ranging wild elephant (*Elephas maximus*) while conducting post mortem examination at Palamner forest range, Chittoor district of Andhra Pradesh state, India. This is the first report of *C. elephantis* in free ranging wild elephant in Andhra Pradesh state, India. © 2013 Indian Society for Parasitology, with kind permission from Springer Science+Business Media.

P.G. Vimalraj & M. G. Jayathangaraj

Endoparasitic infections in free-ranging Asiatic elephants of Mudumalai and Anamalai Wildlife Sanctuary

Journal of Parasitic Diseases 39 (2015) 474-476

Abstract. Free-ranging Asiatic elephants dung samples from various forest divisions of Mudumalai Wildlife Sanctuary (MWLS) and Anamalai Wildlife Sanctuary (AWLS) were examined for identification of endoparasitic infection. The dung samples revealed 100% endoparasitic infection, with a high prevalence of Strongyles (64%) in MWLS and Anoplocephala sp. (46%) in AWLS. Similarly, from the same samples egg per gram of feces was done to ascertain the individual parasitic load. The present research paper communicates the high parasitic prevalence of free-ranging Asian elephants in dry seasons of (February–June 2010) MWLS and AWLS. © 2013 Indian Society of Parasitology, with kind permission from Springer Science+Business Media.

L. Vogelnest, F. Hulst, P. Thompson, K.P. Lyashchenko & K.A. Vinette Herrin

Diagnosis and management of tuberculosis (*Mycobacterium tuberculosis*) in an Asian elephant (*Elephas maximus*) with a newborn calf

J. of Zoo and Wildlife Medicine 46 (2015) 77-85

Abstract. In 2006, five Asian elephants (*Elephas maximus*) were imported to Taronga Zoo, Australia, from Thailand. Pre-import and initial postarrival tuberculosis screening was performed by trunk wash (TW) culture and was negative for *Mycobacterium tuberculosis*. In April 2009, the ElephantTB STAT-PAK® (SP) assay was used to test the elephants. A 15.5-yr-old pregnant cow was reactive. TW frequency for this cow was increased from annually to quarterly. TW cultures remained negative on all other elephants. In February 2010, the Dual Path Platform® (DPP) VetTB assay was used for the first time, and the SP-reactive cow also reacted on the DPP. A SP was run concurrently and was reactive. All other elephants were nonreactive on both assays. Treatment was not initiated due to

concern about the effect of antituberculous drugs on the fetus. Quarterly TW cultures continued. The cow gave birth on 2 November 2010. A routine TW on 24 November 2010 was culture positive for M. tuberculosis. Although previous shedding could not be ruled out, reactivation of latent infection or exacerbation of subclinical disease due to parturition was suspected. Treatment with isoniazid, pyrazinamide, rifampicin, and ethambutol commenced. A 12-mo treatment course was completed within a 15-mo period. The isolate was susceptible to these drugs and genotyped as a Beijing strain. Stored serum samples from 2004 and 2006 were tested retrospectively and were reactive on SP and DPP. TW, SP, and DPP screening frequency increased to monthly for the positive cow on commencement of treatment in January 2011. Monthly serum biochemistry indicated drug-induced hepatitis. Therapeutic drug monitoring was conducted to ensure therapeutic levels were achieved. The infant calf was reactive on DPP, but TW culture negative, and was not treated. Serial DPP results for the cow and calf during and after treatment indicated that the antibody levels were declining, suggesting a favorable response to therapy in the dam, and that the origin of the antibodies in the calf were maternal, rather than a response to infection. © 2015 American Association of Zoo Veterinarians.

L. Zhang , L. Dong, L. Lin, L. Feng, F. Yan, L. Wang , X. Guo & A. Luo

Asian elephants in China: Estimating population size and evaluating habitat suitability

PLoS ONE 10 (2015) e0124834

Abstract. We monitored the last remaining Asian elephant populations in China over the past decade. Using DNA tools and repeat genotyping, we estimated the population sizes from 654 dung samples collected from various areas. Combined with morphological individual identifications from over 6,300 elephant photographs taken in the wild, we estimated that the total Asian elephant population size in China is between 221 and 245. Population genetic structure and diversity were examined using a 556-bp fragment of mitochondrial DNA, and 24 unique haplotypes were detected from DNA analysis of 178 individuals. A phylogenetic analysis revealed two highly divergent clades of Asian elephants, α and β, present in Chinese populations. Four populations (Mengla, Shangyong, Mengyang, and Pu'Er) carried mtDNA from the α clade, and only one population (Nangunhe) carried mtDNA belonging to the β clade. Moreover, high genetic divergence was observed between the Nangunhe population and the other four populations; however, genetic diversity among the five populations was low, possibly due to limited gene flow because of habitat fragmentation. The expansion of rubber plantations, crop cultivation, and villages along rivers and roads had caused extensive degradation of natural forest in these areas. This had resulted in the loss and fragmentation of elephant habitats and had formed artificial barriers that inhibited elephant migration. Using Geographic Information System, Global Positioning System, and Remote Sensing technology, we found that the area occupied by rubber plantations, tea farms, and urban settlements had dramatically increased over the past 40 years, resulting in the loss and fragmentation of elephant habitats and forming artificial barriers that inhibit elephant migration. The restoration of ecological corridors to facilitate gene exchange among isolated elephant populations and the establishment of cross-boundary protected areas between China and Laos to secure their natural habitats are critical for the survival of Asian elephants in this region. © 2015 The Authors.



Herd in Yala National Park (Sri Lanka)

News Briefs

Compiled by Jayantha Jayewardene

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1. Dong Nai tries to curb elephant disturbances (Vietnam)

Vietnam.net - 4.1.2014

The Ministry of Planning and Investment (MPI) has given the go-ahead to a project on supervising elephants in Dong Nai province, which aims to prevent elephant-human conflict and improve the natural landscapes of the Dong Nai Natural and Cultural Reserve. There are 11 elephants living in the forests belonging to the Dong Nai Natural and Cultural Reserve. Ten years ago, the group of elephants was believed to total 20 members. Meanwhile, locals all said that they have not tried to kill the elephants, because elephants are sacred animals.

According to the Vinh Cuu district People's Committee, local residents have to prepare every night to drive elephants away if they come to residential quarters. "In 2013 and the first nine months of 2014 alone, the elephants came 300 times, damaging 100 hectares of sugar cane, 60 hectares of cassava, 50 hectares of cashew and mango," a local official said. Local residents began asking for help to protect themselves from the elephants some years ago. The project began soon after it got approval.

The most important component is the installment of an electronic barrier to prevent elephants from entering residential quarters. This includes 20 kilometers of fixed fence and 10 kilometers of roving fence to be located in the forest area in two communes of Ma Da and Phu Ly of Vinh Cuu district. The barrier would operate with solar energy or electricity from the 220 V national grid. It would be designed in a way to just frighten animals, but not kill them.

2. Wild elephants of Khao Chamao still rile their neighbors (Thailand)

The Sunday Nation - 1.2.2015

The longstanding problem of wild elephants from Khao Chamao mountain ridge in Rayong roaming into residential areas or eating fruit in local plantations has continued despite various measures to try to stop this. The dredging of large deep canals to keep them from crossing to villages and farmland only works in part of the year. When the canals are full of rain-soaked clay the lanimals are able to cross. Many areas damaged by the elephants need to be declared disaster zones, and lengthy efforts and interviews with villagers have only upset them, he said, as people were angry about damage to their crops and property.

Building salt licks for elephants had been a little helpful but had not ended the problem, while growing banana trees for the elephants had also not resolved the problem, as thousands of banana trees were consumed in little more more than a week, Lamphun said. Awiruj Sapphaso, who has an 18-rai plantation where fruit is regularly eaten by the wild animals, said the planting of banana trees and building of salt licks could not save plantations from being ravaged by elephants from the wild.

A herd of 30 elephants entered his plantations on Tuesday and fed on various fruit grown on his property. They also broke water tubes to drink from them, as it is currently a drought period in the wild. Many fruit growers in the area have turned to cassava and rush to harvest crops - so the elephants don't dig up and eat up all cassava, while any fruit, either still on trees or harvested and stored for delivery, is moved promptly.

There are around 80 elephants in Khao Chamao national park, which connects to the Khao Chamao mountain ridge, where there are 280 to 300 elephants. Some herds return to the wild after entering residential areas or feeding on fruit, while many others stay overnight or a couple of days, before roaming to other areas and returning. The mountain ridge, which connects with five tambon in Khao Chamao district in Rayong, covers a vast area in four other provinces where around 23,000 residents - mostly farmers and fruit growers - live.

3. Tusker falls prey to wild cat attack at Valppara (India)

Express News Service - 25.2.2015

A 9-year-old elephant is suspected to have fallen prey to a marauding tiger near the tea estate in Valppara, bordering Kerala and Tamil Nadu. It is suspected that the pachyderm was attacked either by a streak of tigers or a marauding wild cat in the tea estate near Valppara when the elephant was grazing there. Earlier, tigers had hunted down two elephants, including a calf, in two separate incidents in the forests of the state a couple of years

The post-mortem report of the elephant had also reported that the animal died of fatal injuries suffered in the attack. The forest officials suspect that the jumbo might have been sick due to some other diseases, making it vulnerable to the attack by other predators.

4. Myanmar captures 9th rare white elephant in western Ayeyarwaddy

The China Post - 2.3.2015

Myanmar says it has found a rare, white elephant in the jungles of the western Ayeyarwaddy region. Forestry official Tun Tun Oo says the 7-year-old female was captured by his department on Friday, six weeks after it was initially spotted in a reserve in Pathein township.

White elephants, actually albinos, have for centuries been revered in Myanmar, Thailand, Laos and other Asian nations. Often pinkish in color, with fair eyelashes and toenails, the animals were normally kept and pampered by monarchs as a symbol of royal power and prosperity — and many people still believe they bring good luck to the country.

Myanmar has eight white elephants in captivity, most from the Ayeyarwaddy region. Five are now in the zoo in the capital, Naypyitaw, and three in Yangon. The capture of wild elephants for domestic use has become a threat to wild populations. India, Vietnam, and Myanmar have banned capture in order to conserve their wild herds, but in Myanmar elephants are still caught each year for the timber industry or the illegal wildlife trade, the WWF says.

5. Wild tusker returns to Nepal after trampling six to death (Nepal/India)

Press Trust of India - 5.3.2015

The wild elephant, which trampled six persons to death and seriously injured four others in Sitamarhi and Madhubani districts of Bihar over the last two days, returned to its natural habitat in Nepal during the wee hours today. Additional Chief Wildlife Warden said, “We successfully managed to send the wild tusker back to Nepal. It crossed the Royal Canal at the international border near Jainagar in Madhubani district at around 2.30 AM. We verified this with its footprints.”



Elephant bull spraying sand over his body
Photo by Ritesh Joshi

The elephant had strayed from its herd based at Parsa Wildlife Sanctuary in the neighbouring country during the ongoing mating season, after perhaps losing in a fight with some other tusker and entered Sitamarhi district on Tuesday last. It trampled four persons to death in Sitamarhi and entered Madhubani district yesterday, where it crushed two others.

Chaudhary said the wild tusker would have peacefully returned to its habitat, had the villagers not disturbed it by creating noise and chasing it.

6. Another wild baby elephant dies in Vietnam forest

Thanh Nien News - 26.3.2015

Locals in the Central Highlands province of Dak Lak on Tuesday discovered the dead body of a baby elephant in a forest near their farms. The animal, weighing 100 kilograms, was found dead with a large loss of skin and damaged toes.

Initial investigation has shown that the baby elephant must have died while moving with its herd and being stomped on to death by other bigger members. Locals said they had witnessed a herd of around 30 elephants flocking out from the forest, searching for food in recent days.

7. Thailand issues world's first elephant ID cards

New Strait Times - 26.3.2015

Thailand has issued the world's first elephant identity cards, Thai News Agency (TNA) reported. The cards were presented to four elephant operators in Muang Hua Hin Municipality in Prachuap Khiri Khan province in the upper south at a ceremony presided by governor Weera Sriwatanatrakul late last month. The operators are Elephant Village, Hutsadin Elephant Foundation, Hua Hin Safari and Hua Hin Hills Vineyard.

Listed in the ID cards are details such as an elephant's name and age, photos, bodily marks, place of living, owner's name, ID and microchip numbers. The cards were issued in compliance with a new regulation implemented by the Interior Ministry and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to curb illegal ivory trade.

Prachuap Khiri Khan assistant governor Pongpan Wichiansamut said the move is hoped to prevent wild elephants from being kept and raised illegally.

8. In a first, an ambulance for jumbos (India)

Times of India - 21.3.2015

An ambulance, specially designed to ferry or rescue ailing elephants, is expected to hit the city streets shortly. The vehicle, which can transport jumbos weighing upwards of 5,000kg, is similar to a normal ambulance. It is equipped with a medicinal kit, emergency tools and syringe storage units. Besides, a veterinarian can also conduct minor operations on an elephant in emergency situations.

Sanjeev Jain, who designed the ambulance, said, "The vehicle was customized on a specific demand made by Wildlife SOS and is one of its kind in the country at present. It is 15 feet long, 8 feet wide and 11.5 feet in height, with two air-conditioned cabins for veterinary and his assistant." Coordinator of Wildlife SOS Baiju Raj said, "The ambulance is good enough to ferry elephants who are either being exploited by circus owners or have been suffering from a prolonged illness in jungles."

The ambulance, which was built in collaboration with a vehicle design company, cost Rs 50 lakh. The chassis of the vehicle is made of steel instead of customary aluminium or iron.

9. Electric fences kill more tuskers in Tamil Nadu than poachers (India)

NewsHub - 23.3.2015

Electric fences are wreaking havoc in the Nilgiri Biosphere Reserve, killing four tuskers in the last six months. Erected illegally on private estates,

agricultural farms and resorts, these fences are being seen as the biggest threat to elephants in the Reserve that is home to almost 25% of the total Asian elephant population in the country.

All these fences had been drawing electricity illegally from connections meant for houses or sheds and in most cases, the officials concerned were aware they had been erected without permission. Owners of these estates have not been booked for the deaths. Equally responsible for the fences coming up are foresters, guards and watchers who patrol the forests, say naturalists.

In January 2012, in response to a petition, Madras high court directed the secretary of the state environment and forests department to remove illegally erected fences, solar and electric, in the elephant corridor in Nilgiris. Subsequently, an appeal was preferred against this order in Supreme Court, which dismissed it. Despite the high court order, farm owners and others continue to put up fences in the elephant corridor, say conservationists. Wildlife authorities said a case of an elephant being killed by an electric fence is always treated as a case of poaching. As the animal is categorized under Schedule I of the Wildlife Protection Act, the offender is imprisoned for a minimum of three years. In most cases, however, the owner of the resort, farm or estate who erected the fence goes scot free and only the caretaker is punished. Those punished get bail and come out of prison in a short time, admitted a forest officer who said this was a serious issue that had to be addressed by the authorities conceded.

10. Enumeration of elephants in ATR using new method (India)

Express News Service - 23.4.2015

An indirect enumeration of the elephant population in the Anamalai Tiger Reserve (ATR) will be conducted through the 'synchronised dung-decay rate' method from May 1. The results will enable the Forest Department to find why elephants are coming out of the forests. It will also help them assess whether people have encroached on elephant corridors, sources said.

Staff in all six forest ranges in the ATR will be involved in the enumeration. On day one, foresters, guards and anti-poaching watchers will mark fresh (under 24 hours old) elephant dung in the forests. They will also take the GPS reading of the spots where dung has been marked and also take photographs. Fresh dung samples will also be taken from 15 places across the six ranges the first day itself. The reserve has been divided into 15 sections to facilitate the process.

The process will be done seven times over 140 days to check whether the dung has disappeared or is intact. The Forest Department will get a clear picture of the elephant distribution in the reserve from the process. "We are counting the number of elephants through the 'synchronised dung-decay rate method'. This is the first time that we are doing it exclusively for elephants," said ATR Field Director V T Kandhasamy.

11. Vietnamese elephant injured by poacher's snare recovers after treatment

Thanh Nien News - 4.5.2015

A young elephant rescued from a poacher's trap in the Central Highlands is currently in better condition after being treated for severe wounds. Dak Lak Province's Elephant Conservation Center said the male, around three years old, was found by residents in the Yok Don National Park in February with trunk and leg wounds. The elephant was then brought to the center for medical treatment.

On April 18, Khajohnpat Boonprasert, an elephant veterinarian at Thailand's National Elephant Institute, and two Thai mahouts arrived at the center to help treat the elephant as requested. They anesthetized the elephant, cleaned the wounds and dressed them. After one week of treatment, the elephant got better. As his wounds start to heal, he walks more easily than before.

Home to one of the largest elephant herds, Dak Lak Province's forests used to be inhabited by more than 550 wild elephants in 1980. However, the number has significantly shrunk to five herds

with a total of 60-65 individuals. Some 20 wild elephants have died since 2009. Meanwhile, the number of domestic elephants in the province has also reduced from 502 individuals in 1980 to only 43.

12. Females have the last say in mating among elephants (India)

Express News Service - 9.5.2015

Female elephants control their mates and the manner of mating, reveals a study by post-doctoral fellow Karpagam Chelliah and Prof Raman Sukumar of the Centre for Ecological Sciences in IISc. The duo, who studied the mating preferences of elephants, have tried to find the importance of tusks, body size and musth in mating rituals. The data collection was carried out at Kaziranga National Park in Assam.

Mating preferences depend on several factors. "Some male traits may convey some information about male health and/or genetic quality to the female," explains Dr Chelliah. "The oestrous cycle of a female elephant is approximately 16 weeks, which means that if her egg is not fertilised within a day or two of ovulation, she would have to wait another 16 weeks for an opportunity to produce an offspring. So, paying attention to the current fertility condition of the males could be important in increasing the lifetime reproductive success of a female."



Wild elephant in Blang Raweu Aceh
Photo by Mahdi Ismail

The Asian elephant has elaborate mating rituals, one of which is the female walking in front of the male elephants to allure them. Males also compete with each other to copulate with an oestrous female, as well as 'guard' one or more females from other males. Research also showed that females are able to move away irrespective of the weight or height of the mounting male and found that this did not change even if the mounting male was in musth or had tusks. Besides, the duration of mounting is also controlled by the females.

13. Elephant sightings in Pu'er could be a sign for optimism (China)

GoKunming - 4.6.2015

Often when elephants make news in Yunnan it is for all the wrong reasons. However, snapshots taken this week in Pu'er show an apparently healthy herd of pachyderms meandering their way harmlessly through a coffee and tea plantation before disappearing again into the surrounding forest. The sighting took place outside of Manzhongtian, a small village midway between Pu'er City and Yunnan's border with Laos. Nineteen Asian elephants reportedly skirted a fence, walked through an open gate and then milled around with a herd of cattle for an hour.

Plantation owner Bai Yingfu told reporters it is the third time they've visited", adding a similar occurrences took place last summer and again in early 2015. Each time, the elephants ate a bit of corn or bananas and bathed in a pond on Bai's land, never causing any trouble other than slightly spooking his cattle. This is a marked change from typical news accounts concerning elephants in southern Yunnan, which often involve poaching for ivory or maulings.

On the surface, Bai's may sound like a simple feel-good story, but the farmer believes there is a deeper underlying meaning. "That the elephants come back means the environment here is still very good," he said, citing his plantation and those in the surrounding area adopting the organic and sustainable farming methods often required by coffee buyers such as Yunnan's Ai Ni Group.

14. Wild elephants found chomping on garbage (India)

Times of India - 7.6.2015

Garbage heaps are now making a presence in the country's forests too. The reserve forest near Bhakra range, 10 km from Haldwani city, has a large garbage heap bang in the middle of an important elephant corridor. On occasion, one catches sight of a majestic tusker making a meal of the mess. Forest department officials, asked if the garbage - which includes medical waste - might endanger the lives of wild elephants, said the "situation is being monitored".

A forest officer of the Terai Central and East divisions said, "Patrolling has been heightened in the area. CCTV cameras will soon be installed to keep vigil on such spots. Violation of wildlife laws and damaging flora and fauna will not be tolerated." The garbage heap lies in the elephant corridor between Fatehpur to Gadgadia. The district forest officer said the movement of elephants is not quite seasonal, though there is much movement in summer months when the animals head about in search of water too, among other things.

The use of a reserve forest area as a garbage site violates four pivotal laws: Forest Conservation Act 1980, Environment Protection Act, 1986, Public Liability Act, 1991 and Biological Diversity Act, 2002.

15. Wild elephant attack kills villager in SW China

Global Post - 22.6.2015

A villager was killed and his wife injured by wild Asian elephants while working in farmlands in southwest China's Yunnan Province, said local authorities on Monday. Villagers found Zhao Si dead and his wife Ming Ba injured in their own croplands Sunday morning in Menghai County, Xishuangbanna Dai Autonomous Prefecture. The scene was chaotic with footprints of the wild animals.

The attack happened on Saturday. Ming Ba was buried in a collapsed shed in the croplands, which saved her from further attacks by the elephants. She was sent to a hospital for treatment. The county forestry bureau has strengthened monitoring of the wild Asian elephants nearby.

There have been several attacks in Xishuangbanna, which is home to 250 to 300 wild elephants, in recent years. In 2012 and 2013, two women died in such attacks in the area.

16. Inside an elephant capture (India)

Peepli - June 2015

The escalating conflict between man and elephant in Hassan left the authorities with no option but to order the capture. A dozen or so tame elephants were sent to Hassan to assist in the process, and once they reached the venue, it began. Sharpshooters armed with tranquillisers set out into the forest on foot to track the elephants. At first, they focused on the males — and when one was found, they brought it down with tranquillisers.

Forest officials and their helpers roped up the stunned elephant. The tame elephants then assisted, forced, and coaxed the captive to where the flat-bed lorries waited — a long, tedious procedure during which the wild elephant occasionally collapsed from the stress and the effort of resistance and had to be revived. Once at the loading zone, the tame elephants acting in concert with the commands from the mahout head-butted the wild elephant from in front, forcing it backwards into the lorry.

17. Success: Two rehabilitated elephant calves return to the wild in India

One Green Planet (IFAW post) - 2.7.2015

Two months in an elephant's lifespan is a relatively short amount of time. But when two rehabilitated juvenile females, Tora and Rani, were monitored traveling with wild elephants for a period of more than 60 days, we celebrated it as an extremely important milestone: We are

witnessing what could likely become the first-ever successful reintegration of rehabilitated calves into the wild herds in Assam. We are eternal optimists. It is our optimism and never-say-die attitude that bore fruit after eight years of hard work trying to re-wild rescued elephants through a protocol of rescue, rehabilitation, release and reintegration.

The story goes back to February 2007 with the IFAW-WTI Elephant Rehabilitation Project in collaboration with the Assam Forest Department. In eight years that followed, this project has translocated 19 rescued elephant calves for rehabilitation to Manas Tiger Reserve in Assam. Nine elephant calves are currently monitored through radio-telemetry for periods varying from nine months to 38 months in the release habitat. The complexity of the process of rehabilitation of a rescued elephant calf is well-documented with an overall success rate of rehabilitation at 47.3 percent. Assimilation and integration of hand-raised young calves, deprived of normal social life during infancy, is critical for these animals to learn the long-term survival and successful reproductive skills from the society of wild elephants.

Both Rani and Tora were about two months old when they were rescued, albeit two years apart. They were translocated and released together, when Rani was two years and eight months old and Tora was four and a half years old. When the eldest elephant Jakhala, who was released with these tow, refused to associate with them, these two calves managed to find acceptance in the wild herd that they are now part of.

18. Spotting the elephant not in the room (India)

Science Blog - 10.7.2015

An automated thermal detection system that can discern wild elephants from background and other animals in infrared images, could save lives in parts of the world where the animals roam free and often enter villages and other human habitations. Siva Mangai and colleagues at Karunya University, in Coimbatore, Tamil Nadu, explain how encounters between humans and elephants are a critical safety issue in the Western Ghats.

"The movement of wild elephants crossing the forest borders and the preventive measures taken causes damage to the lives of both people and elephants," the team explains. They suggest that automated processing of infrared images from cameras placed at strategic locations might provide an early-warning system and reduce such encounters to the mutual benefit of both elephants and people.

However, object recognition remains a challenging task. The team has now developed a clustering-based image segmentation approach for accurate elephant recognition in infrared images. Segmentation is a process of grouping a set of objects into segments of similar characteristics.

19. Ikarra Vasu, the elusive elephant killer (India)

The Hindu - 12.7.2015

Ikarra Vasu, the elusive poacher wanted for the wild elephant killings in Vazhachal, went by the name Varattupara Veerappan. Wildlife enforcers said that his uncanny hunting skills had earned him the sobriquet. Vasu lived on the fringes of lush tropical evergreen forests that teemed with game.

Very much like his namesake, he took to hunting at an early age. Soon, he graduated to big game. He spent hours in their smithies on the Kerala-Karnataka border fashioning 'Damascus barreled' muzzle loaders designed to withstand potent gunpowder charges that could propel 12 mm steel slugs with lethal accuracy. Investigators said that Vasu and his gang had been operating in Munnar, Vazhachal and Parambikulam forests with impunity for the past several years.

However, he never came under the radar of wildlife enforcers. His operations came to light when a gang member, Kunjumon, defected and turned informant. Kunjumon stated that the

elephant poachers routinely camped on a rock formation adjacent to a stream near Vilangumpara deep inside Vazhachal forests. According to Kunjumon, the gang hunted at least 20 wild elephants for their tusks since November last.

Wildlife enforcers have launched a manhunt for Vasu. Several of his collaborators are already in custody. The raids to retrieve the tusks of the elephants is still on.

20. The last generation of working elephants (Cambodia)

Phnom Pehn Post - 18.7.2015

Consensus has long ruled against the capture of wild elephants. Now that the existing domestic population is in old age, owners are left wondering what comes next. Standing in front of a traditional thatched roof Bunong house, 41-year-old elephant owner Han Samoeun watched as two tourists were led back into his village, Putang, atop his brother's pachyderm.

Like most of the domestic elephants in this hamlet, an elephant tourism hotspot in Mondulkiri's Sen Monorom district, Samoeun's female elephant Noeng Pajal, aged 56, is in her twilight years. Almost all are aged over 50, and with an elephant life expectancy of about 65 years, the population is starting to dwindle.



Elephants near Veppankulam (Sri Lanka)
Photo by Sampath Ekanayaka

The Forest Administration does not allow villagers to catch elephants. From building Angkor Wat to farming in Cambodia's most remote corners, elephants have for centuries played a central role in Cambodian society, nowhere more so than the ethnic Bunong communities in the country's east. However, trapping and taming wild elephants has been outlawed since the 1990s, and importing them from other countries is illegal.

Cambodia only has somewhere between 400 and 600 elephants remaining in the wild, with habitat loss and poaching continuing to threaten their numbers. But for the Bunong, who have kept elephants for centuries, the inability to recruit new animals to supplement their ageing herd means confronting not only a significant loss of income, but also a future without the creature at the heart of their animist religion.

21. When humans and elephants collide (China)

ECNS - 24.7.2015

The war between humans and elephants rages in southwest China's Yunnan Province. This year alone, three people have been killed by wild elephants there, and three elephants are known to have been killed by either pesticides or gunshot.

A villager named as Wang from Xishuangbanna Dai Autonomous Prefecture, was detained by police on Sunday for killing a pregnant wild elephant. The villager opened fire with a homemade gun on a group of wild elephants that had invaded his land. A female elephant weighing more than 3 tonnes was later found dead in Wang's fishpond with a bullet in her head. The cow was carrying a 99-kilogram male calf and was almost ready to give birth.

On June 26, two immature bull elephants were found dead with blood oozing from their mouth, trunk and anus. Police found pesticides in the stomachs of both and have not ruled out the possibility that they were poisoned by farmers. As many as 16 wild elephants were seen in the area at the end of November and various incidents have since been reported.