GAJAH

NUMBER 29
2008

Journal of the Asian Elephant Specialist Group

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Number 29 (2008)

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.

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**This publication of Gajah was financed by the
Wildlife Reserves Singapore**

Editorial Note

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Cover: Giving a helping trunk in the Walawe Left Bank Development area, southern Sri Lanka
Photo by Prithiviraj Fernando

Layout and formatting by Dr. Jennifer Pastorini
Printed at Melios (Pvt) Ltd.

Editorial

Heidi S. Riddle (Member Editorial Board)

Communication. It is one word representing a simple concept: the exchange of thoughts, messages, opinions or information by speech, writing or behavior. Yet the value of communication is often overlooked, especially in species conservation.

As members of the IUCN Asian Elephant Specialist Group (AsESG) we are all aware of the many challenges facing Asian elephant conservation. The AsESG membership has varied expertise and experiences – from science to academia, administrators to laypersons. Through communication and open debate, the AsESG assists and supports Asian elephant conservation by providing advice and a consensus of professional opinions. These views can help governmental entities responsible for conservation to better plan and implement effective actions. However, to achieve the goals of the AsESG, the membership needs to be proactive and understand the importance of, and the need for, effective and timely communication. With no communication the AsESG would simply cease to exist.

As a step towards improving communication the AsESG has created several Task Forces, each one addressing specific conservation issues. These Task Forces allow smaller groups of members to focus communication on a specific topic, therefore providing the building blocks for broader group discussions. As AsESG members, each one of us has taken on the responsibility to actively communicate our views and experiences when questions arise – either during a Task Force discussion or with the entire AsESG. This communication frequently extends beyond the AsESG, further serving as a valuable means of networking, one of the important facets of responsible conservation.

If the AsESG is to be considered a leader in the field of Asian elephant management and conservation, then we should lead by example and actively communicate successes, even failures, to inspire ourselves and others to do what is best for Asian elephants. There are limitations to any elephant conservation work, so it is important to draw on each other's experiences to improve our

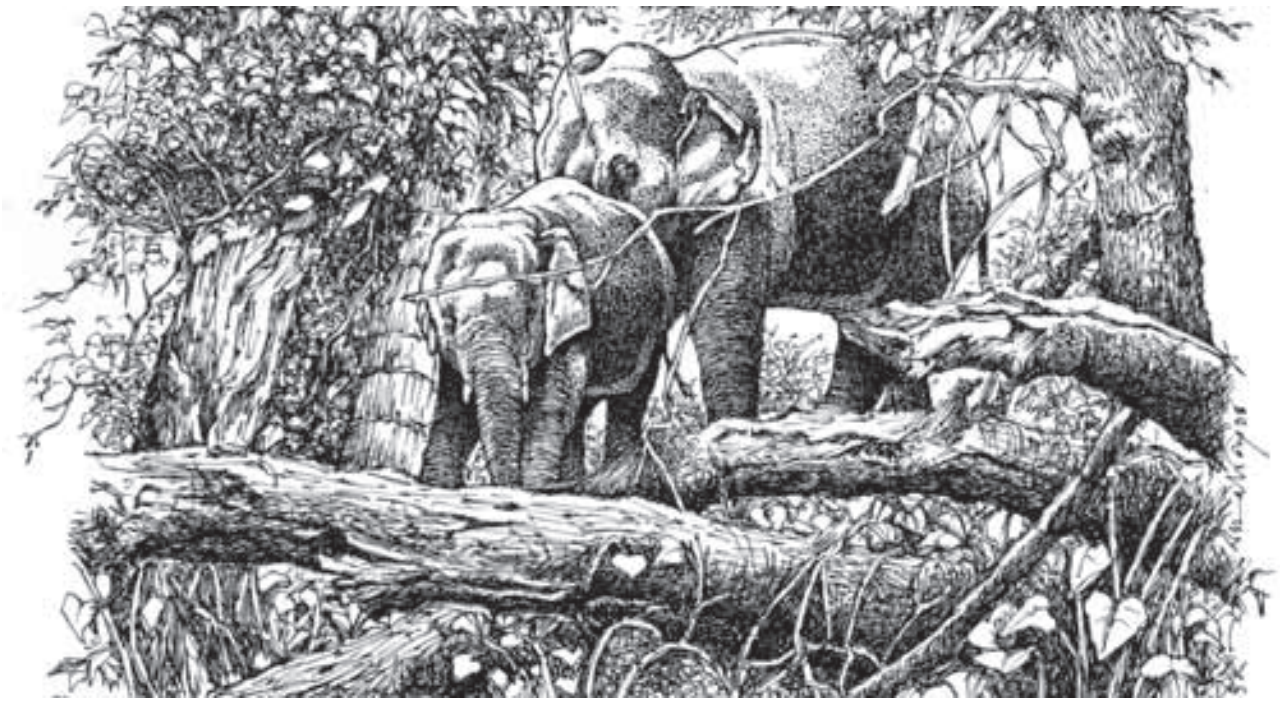
At the Seblat river near the Seblat elephant camp in Bengkulu province, Sumatra
Photo by Heidi Riddle

own efforts. We can achieve this through communication. The best way to be a responsible communicator is by offering a clear point of view and providing accountability. Successful communication at all levels is a priority when managing projects and staff; this is also true of communication between professional colleagues in other projects or groups. Often it is simply incomplete information or a lack of communication that cause conservation issues to stagnate.

Communication takes many forms: there are structured opportunities such as formal meetings, workshops, and action planning, and the AsESG membership should actively participate in these types of discussions. Additionally there are other communication mediums: the AsESG hosts a website and publishes this professional journal, Gajah. Gajah is a communication forum offering an open exchange of ideas and discussion about issues confronting elephant conservationists today. The journal presents a wide diversity of regional experiences and an array of topics. Gajah is not merely a compilation of news and articles about Asian elephants; it is also an important tool to communicate within the AsESG, and to help identify resources for projects and staff outside of the AsESG. However, the AsESG membership's active participation is always needed to better communicate timely information about upcoming meetings or workshops, summaries of discussions, or project activity reports.

Communication provides an opportunity for every one of us to participate in a meaningful way in Asian elephant conservation, even far beyond our specific project(s) or study area(s). With open communication, any project from any region can make a difference on a broad scale.

The goal of the IUCN Asian Elephant Specialist Group is to facilitate the sharing of ideas, experiences, and challenges regarding the many elephant conservation issues across the world. Gajah is an important communication tool provided by the AsESG. On behalf of the Editorial Board of Gajah I invite each and every one of you to actively participate by communicating your thoughts and achievements, as there is much knowledge to be gained from one another. If we can be effective communicators – within and outside of the AsESG - it will motivate us all to be better elephant conservationists.



Drawing by Arnab Roy

Notes from the Co-chairs IUCN/SSC Asian Elephant Specialist Group

Simon Hedges and Ajay Desai

As mentioned in the Note from the Co-chairs in the last issue of Gajah (back when the workshop was still in the planning stage), Ajay and I facilitated a Strategic Conservation Planning Workshop for Asian Elephants in Phnom Penh in Cambodia last month (20–24 October 2008). This strategic planning workshop was requested by range State delegates at the Range States' Meeting in Malaysia in 2006, and was similar – but not identical – to the Regional Strategic Planning Workshops for Central African Elephants and West African Elephants (which lead to regional strategies and national action plans for elephants in those parts of Africa).

In fact, last month's workshop took the form of two back-to-back Asian elephant conservation workshops. The first workshop focussed on a range-wide status review, attempting to map all Asian elephant populations and compile data about those populations (e.g. population size and trend, threats to the population). The second workshop aimed to take these "where to save the species" data and use them to draft an outline conservation strategy for Asian Elephants throughout their range (i.e. "how to save the species"). The two workshops were organized by the Wildlife Conservation Society (WCS) and WWF AREAS, with funding from WCS, the AsESG, the U.S. Fish & Wildlife Service, and WWF AREAS.

The process was designed to be fully participatory and conservationists from all 13 Asian elephant range States attended the workshop, as did other elephant conservationists from outside these States. Government representatives from 10 of the 13 range States participated in the workshops; there were to have been representatives from all 13 range States governments but some last minute problems including a border conflict between Thailand and Cambodia led to some people cancelling.

In the first workshop, the participants mapped and characterised known populations of Asian elephants, as well as areas that may sustain populations but where recent survey data are lacking. Participants also identified land which may act as linkages between known populations, and areas where the species might be restored in future. Preliminary maps were developed before the workshops, and then refined at the workshops.

In the second workshop, the focus was on strategic planning using the new IUCN/SSC Species Conservation Planning Task Force's recommended approach (the Task Force's guidelines were launched at the World Conservation Congress in Barcelona immediately before the elephant workshops). The participants used the Status Review of the first workshop to develop a draft outline conservation strategy for Asian Elephants, again within a participatory process. The draft strategy identified a vision, goals, and objectives together with appropriate actions aimed at mitigating and eliminating threats to elephants.

The intention is that this draft outline strategy be completed over the November 2008 to January 2009 period through a process of wider consultation, review, and revision than is possible is a workshop setting. We would therefore like to ask the AsESG's membership to participate in the review and revision process. Our hope is that this process will be of value to all those engaged with the conservation of this important and charismatic species, including national governments and local and international NGOs. Outputs from the process will include up-to-date distribution maps, a detailed status report, and a conservation strategy for Asian elephants. The workshop process will of course also feed into the IUCN Red List.

The final strategy will be relatively high-level, but will be devised in such a way that it can easily be used within a national conservation planning

process, and hence help promote and aid national implementation of range-wide and regional goals and objectives. Recent successful examples of this approach include the regional strategies and national action plans developed for cheetahs, African wild dogs, African elephants, and Asian wild cattle and buffaloes.

National workshops are a vital part of the process since most conservation action is planned and implemented at the national or local level. We hope, therefore, that the October 2008 range-wide workshops will be followed by a series of national workshops, with the support of the AsESG and conservation partners such as USFWS, WWF, WCS, FFI, AZA, IEF, Smithsonian, et al. and so promote on the ground conservation action for elephants across Asia.

In other news, and indeed helping to achieve one of the draft strategies objectives, the AsESG's Human–Elephant Conflict Task Force has begun the process of compiling a review of human–elephant conflict (HEC) mitigation measures in Asia. This review will then be discussed during a 2-day HEC Mitigation Workshop in Beijing immediately before the Society for Conservation Biology's Annual Meeting in July 2009. In holding the workshop, the IUCN/SSC AsESG's Human–Elephant Conflict Task Force will bring together a group of people (including but not restricted to the HECTF's members) with practical experience of HEC mitigation work in Asia to:

(a) Review the causes of HEC
- Identify processes/actions that can stop (minimize) the creation of new HEC situations.
- Identify and review processes/actions that can stop the escalation of existing HEC situations and possibly reverse some of the factors that contribute to HEC.

(b) Review and list the types of HEC situations (i.e. dispersal, pocketed populations, etc.) and mitigation measures in place
- Compile a list of mitigation methods used across Asia.
- Review and compile a summary of what has worked and what has not, where, and why (if known).
- Develop a document listing best management practices and keep that current on the IUCN/SSC AsESG's website as 'a living document'.

No such compilation of HEC mitigation measures exists for Asia and consequently such a review was requested by the Asian Elephant Range States' government representatives at the Range States' Meeting in Kuala Lumpur in 2006.

The lack of such a review is unfortunate because of (1) the severity of HEC in much of Asia and (2) because there are many ongoing efforts to address HEC in Asia but many of these efforts are replicating existing methods unknowingly due to the poor dissemination of information about what has worked and what has not.

By holding the 2-day HEC Mitigation Workshop in Beijing immediately before the Society for Conservation Biology's Annual Meeting in July 2009, we will be able to take advantage of the fact that many people knowledgeable about HEC will be attending the SCB meeting at their or their institutions' expense, which will reduce the cost of holding the HEC mitigation workshop.

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Tusker (India)
Photo by Chelliya Arivazhagan

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The Last Kraal in Sri Lanka

H. I. E. Katugaha

Kandy, Sri Lanka

Introduction

Elephants have been captured from the wild and tamed for mans use in many Asian countries including India, Thailand, Burma (now Myanmar), Nepal, Cambodia Laos, Vietnam and Sri Lanka. The initial captures have been recorded from over 2000 years ago. Some think that elephants may have been captured even before that. Many forms of capture have been used – noosing, in pits and the Keddah, Kraal and Mela Shikar method.

In the Kheddah or Kraal method a stockade is constructed. It is made of strong jungle timber. It was triangular in shape with a wide mouth and ending in a funnel or narrow passage. Inside were two timber enclosures. This is big enough to accommodate the elephants that are driven in as a group and then captured, tamed and trained. I will give in detail the last elephant kraal held in Sri Lanka later. The Portuguese first introduced the kraal method of capture.

The elephants are surrounded and driven into the first enclosure within the stockade were they were given a short respite during which time they were able to drink water made available within the enclosure. Then trained, decoy elephants, assisted by drivers, entered the stockade and drove the wild elephants into the second enclosure and thence into the funnel. As each captive arrived at this point cross-bars were pushed in behind him to imprison him. Then it was noosed, secured to two tame elephants, and led out.

The Dutch stockade followed the Portuguese pattern but was often a rounded triangle with a somewhat broader funnel. The stockade in this triangular form continued to be used till about 1800 when the inner enclosure was done away with leaving only one main enclosure and the funnel at the apex. In early British times , prior to 1833, the shape of the stockade underwent radical change and became a plain rectangle with a narrow entrance and no funnel; from the front angles two lines of fencing, well concealed, were continued forward and outward so as to contain and guide the elephants to the stockade's entrance.

In the Mela Shikar method men, on the backs of tame elephants, go into a wild herd with a noose at the end of a long pole. They choose the wild elephant to be captured and pursue it till they come close to it. Once close they hold the pole so that the noose is in front of the face of the elephant. Then they try to noose the elephant by putting the noose over the elephant's head and onto the neck. It has been argued that the Mela Shikar method is better in that only selected elephants are caught and there are no unnecessary deaths.

In Cambodia herds were driven into swamps and noosed with the help of specially trained hunting elephants. In the lakes of Cambodia harpoons were shot at their ears from boats. These drives were only possible with hundreds of people.

In the Peoples Democratic of Lao elephant capture was mainly in the provinces of Attopeu and Champassak. It was first practiced by a 'ethno-linguistic group, which is said to speak a Khemer –like language'. Capture here was by Mela Shikar. There are no captures now by this method.

In Myanmar (formerly Burma) elephant capture has been practiced for a long period. Olivier (1978) says "Before 1658 elephants were being exported to South India and to Gujarat in north-west India. After 1650 many of them went to Ceylon as well". The capture of elephants from the wild was to serve the numbers required for export. Burma had a Keddah Department which was disbanded only in 1912. Records show that 1,286 elephants were captured in Keddahs.

In India, Raman Sukumar says that it could be assumed that between 30,000 and 50,000 elephants have been captured or killed during the period 1868 and 1980. He goes on to say 'Entire herds were taken in the north but only solitary animals in the south, with the exception of the kheddah captures in the southern Mysore state'.

The first mention of Thailand trading in elephants is in the 13th century. Therefore the capture of wild elephants has been from before that time. Tachard (1688) recorded that in 1681, that 40,000 men were employed for various work in the conduct of a Kheddah. Capture by the Kheddah method was stopped in 1906. However elephant capture continued in that country using the Mela Shikar method.

In Sri Lanka during ancient times the capture or killing of any wild elephant was punishable by death. The king had the sole authority to capture ok kill elephants. His stables were supervised by the 'Gajanayaka Nilame' who was responsible for the capture and taming of wild elephants. Elephants were used for different purposes by the king - as draught animals; for ceremonial use, in warfare; kings staged elephant combats for their entertainment; kings used elephants to execute criminals and also used elephants as decoys in the capture of wild elephants.

The pit method of capture was found to cause injury to the captives and was given up, and noosing became the method of choice. Wild elephants were noosed in four ways. One by laying a noose along an elephant path, by using a trained female as a decoy and then noosing the elephant, with the use of intoxicants Cannabis was mixed into a ball made of Tamarind fruit. These balls were kept along a path used by elephants, which consume these balls and become intoxicated. After that the intoxicated animal was noosed and led away. Noosing of elephants on the run by Panikkans is where the leader selects an animal to be noosed and runs behind the herd and slips a noose on a hind leg of the selected animal and quickly fastens the loose end to a tree.

The elephants from Sri Lanka were famous, from ancient times, and had been exported mainly to neighbouring India. It was during the period of Portuguese occupation that the Stockade method of capture of elephants was introduced to Ceylon. By then it was the method of choice in South India. The Kraal (pronounced crawl.) consists of a stockade of varying dimensions to which a herd of elephants were driven. They are then noosed to trees that are within the stockade, and later taken out for taming and training. Robert Knox, the captive in the Kandyan Kingdom in the 17th century refers to the stockade as a Pound.

This method of capture was continued by the Dutch and later by the British. As the number of captures increased so did the number of elephants exported. Such Kraals were conducted in various parts of Sri Lanka, from the South, Labugama to Kurunegala and Sabaragamuwa.

One must remember that these Kraals were held when much of the country was still covered in jungle and there were a large number of wild elephants. It has been estimated that at the turn of the 19th centaury there were about 12,000 wild elephants. Loss of habitat, shooting for sport, and other deaths soon reduced the number of wild elephants and by the time Sri Lanka got independence in 1948, their numbers had reduced to around 3,000. So it was that the last elephant Kraal in Sri Lanka, was held at Panamure in 1950.

A short history of Kraals held at Panamure

In 1870 an elephant Kraal was organized by Iddamalgoda Basnayaka Nilame and Ekneligoda Dissawa at Labugama, for the entertainment of The Duke Of Edinburgh who was visiting Ceylon. .Maduwanwela Rate Mahathmaya and J.T. Ellawela went to witness this event. Some time later, in the 1880's Madwanwela RM. Encouraged by J.T. Ellawela went to Kolonna Korale in search of a suitable place to organize a kraal. The two of them selected the site at Panamure to have a Kraal including the main steam to which the elephants came. There was also a perennial spring to which elephants came; perhaps it contained some minerals that elephants craved for. The stockade was built surrounding the stream and the eternal spring. From then on

Figure 1. Map of the stockade as drawn by the late Sam Elapata Dissawa, giving the dimensions and situations of the camps.

Kraals were held at this site. Elephant Kraals were held at this site in 1896, 1898, 1902, 1907, 1912, 1914, 1918, 1922, 1924, 1929, 1944 and the last in 1950 (Elapata 1997).

The last elephant Kraal held at Panamure in 1950 was held on private land owned by Sir Francis Molamure. Figure 1 shows the map of the stockade. It is customary as in past Kraals that the organizers should invoke the blessings of the jungle deities before embarking on such a massive project.

The first operation is the building of the stockade. Large logs were used, all the trees cut were from Sir Francis's private land. The posts used in the 1944 Kraal were tested for their strength and those that were in good condition were used again. Tame elephants were used to keep the logs in place till they were tied. This elephant was 'Gunaya ', which was the only one that stood up to the young mating Bull that had to be destroyed. All the posts of the stockade were tested and the logs fastened while building the stockade . Every knot too was checked out. It must be noted that only every other vertical post was fixed to the ground. This ensures a certain amount of 'give' when a wild elephant charges the stockade. The upright posts were ten feet apart.

The knots that fasten the horizontal bars of the stockade were done (Fig. 2). A large number of men were involved in the operation. Over a hundred men were involved in building the stockade and several tame elephants were used to get the logs in place (Fig. 3).

During this time several temporary buildings came up. A post office was established and a Police station. Soon Kraal town came to be. Sir Francis visited the site periodically to supervise the stockade and see to the setting up of the camps for the other helpers in running the Kraal. These were mainly The Francis Molamure camp, Sam Elapata Camp, Willie Maduwanwela camp, Danny Muttetuwegama camp. One for the Governor General and for several others.

When every thing was ready and the wild elephants were located the main Kraal began. Before the actual driving of the elephants begins a ceremony is held to bless the Kraal and to ensure the successful completion of the capture. It is interesting to note that such ceremonies are observed in most Asian countries. Such ceremonies are held in India before a 'Mele Shikar.' and before the 'Kedah.' in South India. So too in countries like Burma and Indonesia. It stems from a belief that the 'Jungle Deities' must be prayed for, seeking the blessings from them for the successful completion of all such activities before the actual capture operations begin.

At Panamure too such a ceremony was held, a mock stockade was made and dancers and 'Kattandiyas' were called in to perform this ritual. Once the preliminaries are over the next step is to guide the wild elephants into this stockade.

Figure 2. Making knots to fasten the bars.

Figure 3. Tame elephant helping to build the stockade..

The drive

Now the selected herd has to be guided into the stockade. This is a huge undertaking. A large number of men, around six hundred of them were involved in this operation. A line of beaters is established to surround the herds and guide the wild elephants in the direction of the enclosure without causing a stampede.

No guns, fire crackers, tom toms (drums) or banging of tin cans was allowed during the Panamure Kraal of 1950. In most countries guns were fired in the air and fire crackers used to stampede the wild elephants towards the stockade. In such cases some elephants were lost during a stampede. But this was not done here.

Walalgoda Ralahamy was in charge. Sam Elapata was in the thick of proceedings. A stout stick was given to each man to tap on trees. Gentle talking too helped. These unnatural noises were enough to keep the wild elephants moving forward The wild herd was never allowed to stampede. Beaters on either side prevented them from going out. Beaters, divided into groups of three, were responsible for keeping fires burning during the nights to prevent elephants from breaking out during the night. Food was carried to the beaters. Strict vegetarian meals were provided during the drive. The beaters kept a ring of fires and kept singing 'Pel Kavi' to keep the wild elephants in check. Pel Kavi is a chan like singing which tell a story.

Slowly but surely the herd was brought close to the stockade gate. Finally the gate was opened and the herd driven in. After all the elephants were inside the gate was closed. This herd was made up of 16 elephants with a few loners hanging around. Two of the females were in oestrus. Unfortunately one strong young bull ran into the stockade with the herd.

The noosing

Expert noosers get help from tame elephants to get this dangerous job done (Fig. 4). One end of the rope is tied to the neck of the tame elephant. The nooser carries the other end of the rope, walking by the side of the tame one. The ropes used for this are strong and made of hide for the initial noosing. Two other tame elephants come in to help in keeping the wild ones in place.

In the meantime the young bull elephant that came in with the herd was mating with two of the females inside the stockade. Once noosing started there was no trouble and a few elephants were noosed. The noosing went on uneventfully with the noosers and tame elephants doing their job. Things were going on as expected till the matriarch was tied up.

When the matriarch was tied up, the young bull that was mating in the stockade became uncontrollable and began charging all the tame elephants that came in for noosing. He was mating in the stockade with the matriarch till she was tied to a tree. He was noosed but he snapped the ropes on two occasions. He broke free even

Figure 4. Noosers and their tame elephants at work.

from the 'Hira Gala'. A man was sent up a tree and a wire rope one inch thick was kept as a noose. Unfortunately as the young bull stepped on the noose the man pulled up the rope it did not get the whole foot only half of the foot. The noose was stuck between the nails. The wire was broken with one kick but the wire irritated the bull even more.

Many tame ones were sent in but they refused to confront the maddened bull. Then three tame elephants, including the 'Mapitigama Tusker, were sent in to confront the young bull. I will quote from Sam Elapata Jr. who witnessed this episode:

'The Mapitigama tusker when confronted by the bull turned his back in fear and was dug in his hind quarters by the wild bull using his tushes. He fled screaming. The other too fled in fear and only Gunaya owned by my father stood up to him. He could not match the strength of the wild one, which was bigger and stronger. On the head on clash Gunaya was pushed side ways on impact, then a hard thrust on the shoulder and Gunaya fell on impact. The wild bull then placed his right foot on Gunaya and began thrusting his tushes on the shoulder of the fallen elephant. Ratharahamy his keeper fell with the tame elephant and fled to safety It was then that Sir Francis came up with his 'charmed stick' and managed to chase the wild one away'.

The organizers considered the release of the bull but that was too dangerous, as the mating bull would never have left the area. He would have been a grave danger to the beaters and thousands of visitors that came to witness the event.

After considering all options at the time Sir Francis decided to have the bull shot. It was a sad moment. There was another problem. No firearms were allowed in Kraal Town. As Sir Francis was considering getting the police to do the shooting, fate intervened in his favour. In the form of Sam Kadirgama, Arthur Molamure and Shelton Ratwatte, who arrived at Panamure returning from a shoot. It was found that Sam Kadirgama had a powerful rifle that could do it. Sam Kadirgama shot the elephant as it was charging towards him. The hind legs of the elephant buckled at the impact of the bullet, which shows that it was indeed a superb shot that had penetrated the brain. Next his front legs gave way and he rolled over (Fig. 5). The young bull would not have known what hit him and probably was dead before he hit the ground.

Though the News Papers screamed, "Tusker shot while defending the herd" it was not a tusker nor was he the leader of the herd. He was just a strong male that had joined the herd because of his sexual desires. I must also state that the shooting of elephants was not banned at the time. They were shot in defence of crops and for 'sport', with a license of course.

There was much agitation about the 'unnecessary deaths' caused by these kraals and public opinion ran high. Finally Parliament decided and passed a law banning elephant Kraals. So this became the last Kraal to be held in this country.

A few incidents that occurred during the Kraal

An adult female charged Sam Elapata whilst he was in the stockade supervising the noosing. The position of her trunk, curled up and tucked away under the chin away from harm as this is the most sensitive part of in her anatomy. This is a sure sign that this is no mock charge. In a mock charge the trunk is swinging, ears spread out, tail up and the elephant will come screaming. Sam Elapata was able to quickly get behind an upright of the stockade and escape from harm.

On another occasion Sam was with the Governor

Figure 5. Bull shot at the last Kraal.

Figure 6. Baby accepting milk from a bottle.

General Lord Soul bury inside the stockade when an enraged female elephant charged them. Running back Sam Elapata pushed Lord Soulbury into a deep ditch and jumped in after him. The elephant reached the ditch, looked down at them and ran away. Elephants can never jump into ditches thanks to the structure of their knees. Lord Soulbury and Sam escaped from the elephant.

A mother straining at her bonds while the youngster stays by her side and the little baby has a nap on the sand. All three animals were captured without difficulty and it was heartening to see this little one accepting milk from a bottle from her captors the next morning (Fig. 6). Noosing was coming to an end and the captives were seen straining at their bonds. All adult elephants captured during the Kraal except for the two tiny babies had gunshot injuries.

The noosing was finally over and the next event was the public auction of the captive elephants. Elephant owners came from far and wide to purchase the wild ones. Prices vary from elephant to elephant. When one buys an elephant he must take the animal away as soon as possible, usually between five or six days.

All this hue and cry that was made on the death of one animal. The emotions expressed and the debates in Parliament about this unfortunate incident, finally led to the ban on Kraals, capture and killing of elephants. Considering the fast declining number of elephants in the wild this ban came at the correct time.

Panamure is but a memory now. Gone are the elephants, bear, leopards and all the other smaller animals that roamed free in these jungles. The jungle itself is no more. Panamure is a developing town today. Just one or perhaps two of the upright post of the stockade are left and preserved in this town as historical mementos. They still stand in mute testimony reminding us of the event that took place over fifty years ago.

Acknowledgements

My grateful thanks to: The late Sam Elapata Snr. for relating all those incidents to me over and over again. Mr. Jayantha Jayewardene for persuading me to write this down, editing and finally getting it in print. Sam Elapata Jnr. for kindly allowing me to get a set of his father's photographs from his album and for all the information about the Kraal. Also to Mr. Eddie Elapata for all the information about the Kraal. To my late brother Upali and to the late Mr. Willie Maduwanwela for all the information gathered by me during our conversations in Kandy some years ago.

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Constructing Age Structures of Asian Elephant Populations: A Comparison of Two Field Methods of Age Estimation

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Introduction

Construction of age structures of populations is central to studies of demography of large vertebrates (Caughley 1977). Unlike in the case of the African elephant (*Loxodonta africana*), there are few published age structures of wild Asian elephant (*Elephas maximus*) populations (Sukumar 1989, 2003). On the other hand, age/sex structures for several Asian elephant populations are available in reports, especially in governmental records pertaining to population censuses. Assessments of the dynamics of such populations based on the reported age structures are only as good as the field methods used for estimating the age of individuals.

It is generally accepted that the most accurate method of ageing ungulates is the degree of tooth eruption and wear. This method has been successfully applied to several African elephant populations that were culled in population-control measures several decades ago (e.g. Johnson & Buss 1965; Laws 1966, 1970; Krumrey & Buss 1968; Sikes 1971; Hanks 1972; Smuts 1977). Non-destructive methods have relied upon a comparison of field estimates of body measurements (typically height at withers or body length) or morphological characteristics with those of elephants of known age (Douglas-Hamilton 1972; Croze 1972, Laws *et al*. 1975; Hall-Martin & Ruther 1979; Jachman 1980). Such field techniques are most applicable to the endangered Asian elephant (Sukumar 1985, 1989), in which invasive procedures are not feasible or desirable. Shoulder height was found to be a very good parameter for describing linear growth in elephants (Laws 1966; Laws *et al* 1975), and Sukumar *et al.* (1988) used data on shoulder height from records of captive-born as well as captured Asian elephants to fit growth curves for male and female elephants in southern India based on von Bertalanffy equations.

Additional morphological characteristics that may be used for ageing include skull size, ear size, extent of upper fold of the ears, depigmentation of ears, temporal and buccal depression, and tusk thickness (for males). Thus, age may be estimated in the field either by photographing elephants for estimating shoulder height more precisely (Laws 1966; Douglas-Hamilton 1972; Croze 1972; Laws *et al* 1975, Hall-Martin & Ruther 1979; Jachmann 1980; Sukumar 1985) (henceforth referred to as the photography method), or by subjectively estimating age using a combination of visually-assessed height and the additional morphological characteristics mentioned above (Sukumar 1985) (henceforth referred to as the visual method).

The visual method is necessarily subjective but, if validated, would be very useful to apply in the large-scale elephant censuses, through the direct sighting method, that are carried out regularly in many elephant range countries. This paper thus compares the results obtained by the photography and visual methods with regard to age structure of the elephant population in Mudumalai Wildlife Sanctuary, southern India during 1999-2003.

Methods

The study was carried out in Mudumalai Wildlife Sanctuary, southern India, which is part of the world's largest wild Asian elephant population, the Nilgiri-Eastern Ghats population. Elephants classified by the photography and/or the visual methods were placed in four major age classes – Calf (0-1 yr), Juvenile (1-5 yr), Sub-adult (5-15 yr) and Adult (>15 yr) with further refinement into 11 sub-classes (age charts in Tables 1 & 2).

Table 1. Rule of thumb age/height criteria for elephants (based on Sukumar 1985, 1989).

Major age classes	Approx. height [feet]	Sub-classes [years]
Calf (0-1 yr)	3-4	
Juvenile (1-5 yrs)	4-6	1-2, 2-3, 3-5
Sub-adult (5-15 yrs)	5½-7 - female; 6-8 - male	5-10, 10-15
Adult (>15 yrs)	>7 female; >8 male	15-20, 20-30, 30-40, 40-50, >50

Individual male Asian elephants were identified by the characteristics of their tusks such as size, shape, broken ends, etc. Prominent adult female elephants of a herd were identified by a combination of ear characteristics (if present) such as cuts, holes and degree of folding, wounds or warts on the body, length of tail, presence or absence of hair at the end of the tail and general body structure (the traditional classification into the basic "*koomeriah*", "*dwasala*" and "*mriga*" types (see Choudhury 1976). Individual identification allowed us to avoid double counting of the same herds or adult males. We aged elephants using the following procedures.

a. Visual method

We used diagrams of elephant shoulder heights at different ages constructed from captive elephants of known ages (see Sukumar *et al.* 1988) as a field guide for elephants up to fifteen years old. Above the age of 15-20 years the annual increments in height are small (or the curve reaches an asymptote) and, thus, it is not possible to fix age visually from height alone. They were thus aged, with some degree of subjectivity, based on external morphological characteristics mentioned previously such as skull size, ear size, temporal depression, (degree of folding and de-pigmentation of ears, Table 3) and tusk thickness in males.

Table 2. Chart of age/height relationship based on the equations derived for captive elephants that have been suitably corrected for wild elephants (Sukumar 1985, 1989).

Age [years]	Height [cm]	
	Male	Female
0	90	89
1	121	119
2	139	135
3	155	149
4	169	161
5	180	170
6	190	177
7	198	183
8	205	188
9	212	193
10	217	197
11	222	200
12	225	203
13	228	206
14	231	209
15	235	213
20	250	228
25	262	234
30	268	238
40	272	240
Asymptotic	274	240

b. Photographic method

We used two variants of the photography method to estimate the shoulder heights of elephants.

i. Pole method (Foster 1966; Douglas-Hamilton 1972; Jachmann 1980), in which the lateral view of the elephant was photographed in an open area or while crossing the road where the fore foot and shoulder are clearly seen, and a second picture was taken after the elephant moved away of a calibrated vertical pole held by an assistant at the exact spot where the elephant had stood or crossed. This allowed an accurate measurement of shoulder height by a comparison of these two photographs that are at the same scale.

ii. Distance measurement method, in which we photographed elephants while they crossed a path or road, and, after they moved away, measured the distance (using a measuring tape) between the spot from where the photograph was taken and the spot where the elephants had crossed the path. This distance was typically in the range of 30-75 m. In case the elephants crossed at slightly different distances, the distance of the nearest elephant and that of the farthest elephant were measured. Intermediate values were allocated to the other elephants by visual judgment from the photographs. In actual practice the inter-elephant

Table 3. Ageing older female elephants based on external morphological characteristics (varies with individuals and needs to be quantified more precisely.; the ear folding may proceed behind the ear).

Age [years]	Degree of ear folding or curling	Depigmentation of ears
25-30	Ear fold begins. Is clearly visible (25% fold) by about age 30 years	Depigmentation begins with small reddish dots at corner of the ear pinna
30-40	Fold progresses from front to back of ear. Over 50% fold by age 40 years	Depigmentation is clearly visible by the age of 40 years
40-50	Fold complete between age 40 and 50 years but the fold in still curled	Depigmentation becomes very prominent by the age of 45-50
>50	The ear fold flattens completely beyond 50 years	Above 50 years clearly seen as reddish layer along the outer side of corner of the ear

distance did not exceed 5 m. Photographs were taken of each animal using an SLR camera with 200 mm-fixed focal length lens. The same instrument was used all through the study period. The height of each elephant in the photograph was measured from the sole of the forefoot to the top of the scapula (commonly termed as height at withers or shoulder height) using a scale calibrated at 0.5 mm interval. From the heights as measured on the image heights, factor of magnification, distance to the object, and the focal length of the camera lens used, shoulder heights were estimated.

We used the likelihood-ratio chi-squared statistic (G^2) (see Agresti 1996) to examine differences between the age structures arrived at by the different methods; the age structure from the photographic method was considered to be the expected category as this is the more objective method of age-estimation.

Results and discussion

A total of 653 elephants were classified by the photographic method and 777 elephants by the visual method. The frequency distributions of age and sex classes of elephants in Mudumalai Wildlife Sanctuary during 1999-2003 obtained from the two methods viz., visual method and photographic method are shown in Table 4. Adult females constituted the major age class of the population, as inferred from percentage of elephants in this age class by both photography and visual methods (41.7% and 39.6%, respectively), followed by sub-adult females (18.5% and 17.0% respectively) and juvenile females (12.6% and 13.8% respectively). Adult males constituted a very low percentage of the population, an inference derived from both the methods (2.5% and 1.7%, respectively). Sub-adult males constituted 7.0% and 5.5%, and juvenile males formed 10.3% and 11.3% of the elephant population in Mudumalai Wildlife Sanctuary as inferred from the photography and visual methods, respectively. However, calves could not be sexed, and equal percentage was allocated to both sexes. A comparison of data from the two methods revealed that the numbers of animals in the different age categories were independent of the type of method used for classification, both when data from both sexes were analysed together (G^2=16.27, df=21, p=0.75), as well as for females (G^2=6.432, df=10, p=0.78) and males (G^2=9.32, df=10, p=0.50) analysed separately.

Thus, the visual method seemed to perform adequately and can be used *in lieu* of the photographic method for obtaining demographic information during large-scale censuses when the

Table 4. Population and age structure (frequency in upper row, percentage in lower row) of elephants classified by photographic and visual methods in Mudumalai Wildlife Sanctuary during 1999-2003.

	Females				Males				Total
Age class	Calf	Juvenile	Sub-adult	Adult	Calf	Juvenile	Sub-adult	Adult	
Photo	25	82	121	272	24	67	46	16	653
	3.8%	12.6%	18.5%	41.7%	3.7%	10.3%	7.0%	2.5%	100%
Visual	44	107	132	308	44	86	43	13	777
	5.7%	13.8%	17.0%	39.6%	5.7%	11.1%	5.5%	1.7%	100%
Total	69	189	253	580	68	153	89	29	1430

Table 5. Forest department census data from Mudumalai for the year 2002.

	Female				Male				
	Calf	Juv.	Sub-adult	Adult	Calf	Juv.	Sub-adult	Adult	Total
Block count	23	8	59	160	24	9	22	22	327
Waterhole count	17	18	42	126	18	7	19	17	264
Total	40	26	101	286	42	16	41	39	591

photographic method is rarely logistically feasible. It must be acknowledged that the visual method suffers from some subjectivity and the extent of this is likely to depend on prior experience. Therefore, how well will this method work when employed by forest/wildlife department staff who may have limited experience or training in ageing elephants?

We compared data from the forest department census of Mudumalai Wildlife Sanctuary for the year 2002 (see Table 5) with our age-structure based on the photography method and found that they were significantly different from each other (photographic method versus forest department block counts G^2=71.12, df=7, p<0.001; photographic method versus forest department water-hole counts G^2=38.96, df=7, p<0.001; photographic method versus forest department total census G^2=81.86, df=7, p<0.001). When we tested the forest department census data with our age structure derived from our visual method we again found that they were significantly different from each other (visual method versus forest department block counts G^2= 82.78, df=7, p<0.001; visual method versus forest department water-hole counts G^2=46.63, df=7, p<0.001; visual method versus forest department total census G^2=99.20, df=7, p<0.001).

When the forest department census data are compared with our visual method data it is clear that the former underestimate the number of juvenile elephants of both sexes. It is most likely that elephant age/age class was being overestimated, a common problem even in the case of estimating the ages of captured elephants (Sukumar *et al*. 1988). Such overestimation is carried forward into the sub-adult and adult age classes of both sexes (see Table 6). In particular, the estimation of adult male to female ratios, an important parameter in demographic studies, is typically distorted in favour of males, giving a false impression of the prevailing ratios. While we have given the Mudumalai census data as an example of this bias, this is also true of most other census data derived for various forest divisions in the southern Indian states of Kerala, Karnataka and Tamilnadu we have examined.

We, therefore, suggest that field staff are given two training sessions, the first, well in advance of the census programme and, the second, just before the programme. The latter is being carried out across several forest divisions in southern India and may be extended to other divisions. In addition, if a trained researcher accompanies groups during the census and independently collects data, it would be useful in assessing the extent of error or bias in the dataset. We provide a guide for ageing elephants in a herd (Figs. 1 & 2). One possible reason for overestimating the ages of solitary males, in the absence of an adult female, is the lack of a reference to place the height of the male. Therefore, in the case of solitary males (or male groups), measuring forefoot circumference, which can be used to calculate height (see Sukumar *et al*. 1988), may also be used for age estimation. A pictorial field manual would also assist the staff in more accurate ageing of elephants in the field.

Acknowledgments

We thank the Ministry of Environment & Forests, Government of India, for funding this research, and Tamilnadu Forest Department for permissions to work at Mudumalai Wildlife

Table 6. Percentage of ages/sex structure comparison between visual method and Forest Department census (Mudumalai during 2002)

Age class	Visual method		Forest dept.	
	% Female	% Male	% Female	% Male
Calf	5.7	5.7	6.7	7.1
Juvenile	13.8	11.1	4.4	2.7
Sub-adult	17.0	5.5	17.1	6.9
Adult	39.6	1.7	48.4	6.6

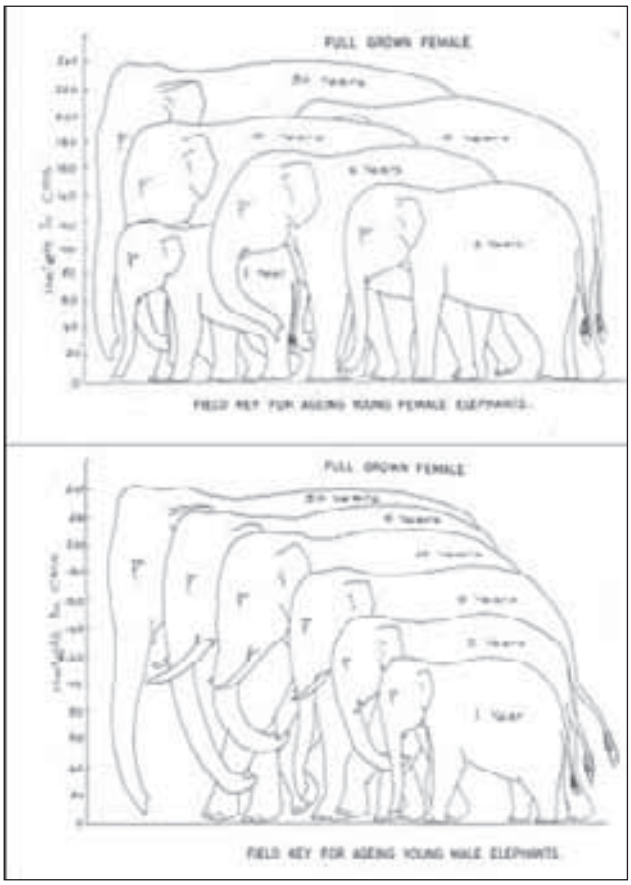

Figure 1. Diagrams of elephant shoulder heights at different ages constructed from captive elephants of known ages (source Sukumar *et al*.1988).

Sanctuary. We also thank Dr. Vidya T.N.C. and Dr. K. Thiyagesan for help with the analysis or comments, and Krishnan, B. Bomman, and Mohan for field assistance.

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Figure 2. Field guide for ageing Asian elephants in the field.

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A herd of Elephant at Kabani back water, Nagarahole National park
Photo by Chelliya Arivazhagan

Gajah 29 (2008) 17-23

Elephant Crop Raiding in a Disturbed Environment: The Effect of Landscape Clearing on Elephant Distribution and Crop Raiding Patterns in the North of Aceh, Indonesia

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Introduction

The Sumatran elephant (*Elephas maximus sumatranus)* still occurs over 44 subpopulations scattered across much of their historical range all over the island of Sumatra (Heurn 1929; Hedges *et al.* 2005). However, the persistence of many populations is threatened by habitat loss, poaching, and direct conflict with humans (Santiapillai & Jackson 1990; Leimgruber *et al*. 2003; Nyhus & Tilson 2004; Hedges *et al*. 2005). The Sumatran elephant is listed as Endangered in the 2004 IUCN Red List of Threatened Species (IUCN 2008), and is included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; UNEP-WCMC 2003).

Over the last decade, elephant conservation across the island of Sumatra has increasingly been coping with the occurrence of conflict between humans and wild ranging elephants (Nyhus *et al.* 2000; Rood 2006; Linkie *et al*. 2007). Continuous forest conversion for the purpose of plantation development, wood extraction and the opening of community gardens has virtually eliminated all lowland habitats (Leimgruber *et al*. 2003). Elephants have been forced to move to the forested slopes of mountain ranges where they frequently enter gardens and raid crops (Nyhus *et al.* 2000; Nyhus & Tilson 2004; Linkie *et al*. 2007). The current landscape configuration, in which small patches of degraded forests are interspersed with small-scale gardens and plantations, are believed to facilitate the occurrence of human-elephant conflict (Hoare 1999; Sitati *et al*. 2005; Rood 2006). As elephant habitat gets increasingly encroached by human settlers, the reduction of available habitat within the historically occupied elephant range has led to an increase of elephants raiding crops (Linkie *et al*. 2004; Sitati et al. 2005). In some cases, the total conversion of elephant habitat has left elephants residing in a landscape dominated by humans. This has eventually led to frequent encounters between humans and elephants with both human as well as elephant lethal casualties as a result (pers. obs.).

A number of studies have tried to focus on the processes underlying the occurrence of crop raiding (Sukumar 1990; Barnes 1996; Hoare 1999; Hoare 2000; Williams *et al.* 2001; Osborn & Parker 2003; Sitati *et al*. 2003; Zhang & Wang 2003; Fernando *et al*. 2005; Sitati *et al*. 2005; Venkataraman *et al*. 2005; Webber *et al*. 2007). Many of these studies have mentioned habitat destruction as an ultimate cause of the occurrence of crop raiding (CR). However, even though widely accepted (Hoare 1999; Sitati *et al*. 2003; Williams *et al*. 2001; Sitati *et al.* 2005), no work has been undertaken to quantify to which extent deforestation or forest configuration shapes the spatial pattern of CR. This paper describes the patterns of HEC occurring over the province of Aceh, North Sumatra, by means of forest configuration and topological descriptors. Elephant distribution data and CR patterns will be compared by means of landscape descriptors, forest cover data and forest clearing patterns. Consequently, elephant distribution patterns will be compared to the occurrence of human-elephant conflict to assess to which extent elephants are being displaced from their natural habitat.

The patterns of CR on a landscape scale will be compared with forest configuration and forest clearing patterns. The occurrence of CR is generally believed to emerge from habitat degradation and consequently, a decrease in resource availability. As the existing suitable habitat within elephants' home ranges gets increasingly fragmented by human encroachment, the encounters between humans and elephants are expected to increase. Therefore, an increase in CR is expected with increasing habitat fragmentation. Secondly, forest clearance over the past three decades, has often completely depleted all forest from the historic ranges of several elephant groups in Aceh. If elephants are constrained to their historic ranges being unable to move into forested areas, CR is expected to occur as a result of displacement and will therefore be frequent in areas that have been subjected to forest clearing in the past. However, if elephants are able to endure continuous habitat alteration by moving into alternative forested habitats, the occurrence of human-elephant conflict will not solely occur in recently cleared areas but is more likely to decrease with the total amount of forest cover available to elephants within their historic home range.

The effect of landscape topology will be used to assess the effect of landscape characteristics on elephants. Elephants are wide ranging animals that have been found to move over distances up to 52 km (Sukumar 1989). Elephant movements through the landscape will therefore be constrained by a number of parameters describing landscape characteristics such as elevation, slope, and elevation heterogeneity. Therefore, we hypothesize that the occurrence of human-elephant conflict will depend on landscape characteristics describing accessibility to elephants.

Methods

Study area

Data was collected within the forests of northern Aceh, ranging from 95°25'E-96°40'E and 05°30'N-04°08'N (Fig. 1). The geology of the area is dominantly sandstone or granite, but limestone formations are common along the west coast. The study area completely covers the nature reserve of Cagar Alam Jantho and the majority of the Leuser ecosystem, which still support large tracts of intact lowland and montane rainforest. The vegetation is dominated by dipterocarp rainforest interspersed with patches of pine forests, disturbed or secondary forests and *Imperata cylindrica* dominated grasslands. Most of the area has a protected status, but traces of prior logging concessions, which had been abandoned due to the armed conflict, can be found up to 20 km into the forest. Current logging activities are illegal but nevertheless rampant throughout the area. Moreover, between 1980 and 2000, 20% of the total forest cover got cleared, mainly for wood trade.

Elephant distribution dataset

During two field seasons ranging from April to August in the consecutive years of 2006 and 2007, data on elephant distribution was recorded across the north of Aceh. Data collection was conducted following a systematic stratified sampling design. This was achieved by stratifying the landscape according to 500 m elevation intervals and three landcover classes (forest, non-forest, plantation). Within each stratum, five random sites of 1 x 1

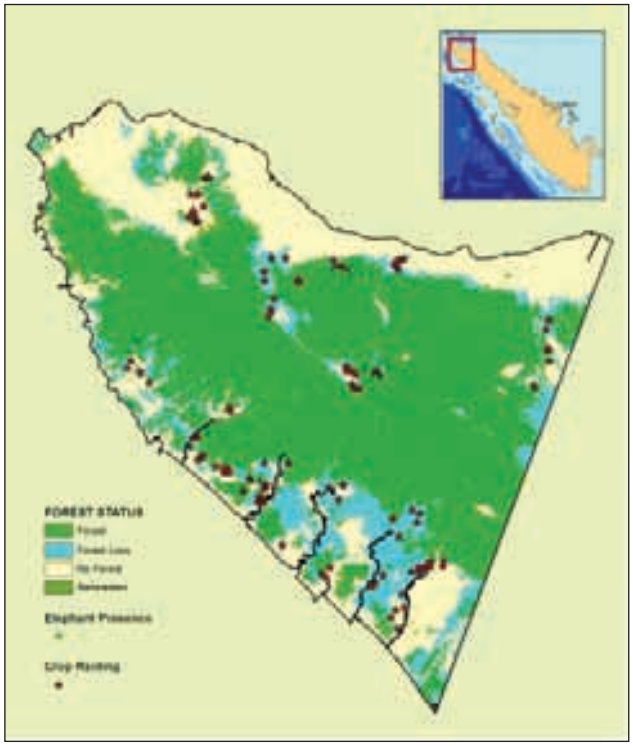

Figure 1. Deforestation across the north of Aceh.

km were selected and plotted on a map. Within each site one 250 x 200 m plot was set out and sampled by means of five 200 x 5 m wide strip transects. While walking transects, each elephant track (and other species tracks) encountered were recorded, along with the time, habitat type, elevation, slope and GPS position.

Crop raiding dataset

Between 1985 and 1997, 62 records of human-elephant conflict (HEC) were collected over the whole of Aceh, all of which originated from interview reports with local communities. From the years 2000 to 2006 another 316 incident records and interviews were conducted using different descriptors to assess causes of HEC. None of these reports, however, provide any constant estimation of HEC intensity. As most of the reports used for analysis were collected opportunistically, or when HEC escalated (reports from the Indonesian conservation agency, e.g. BKSDA). The available data, however, does provide a good representation on the occurrence patterns of HEC over time. For the purposes of this study, only the crop raiding records compiled between 2000 and 2007, resulting in a total dataset of 120 CR events, were used in the analysis.

Landscape descriptors

Distribution patterns of elephants and CR data were analyzed by means of five landscape descriptors produced using ArcGIS 9.3 (ESRI). Two topographical descriptors were used to assess the relative importance of elevation heterogeneity on the occurrence of elephants including: 1) elevation heterogeneity based on a 90 x 90 m digital elevation model (http://glcfapp.umiacs.umd.edu:8080/esdi/index.jpg). 2) landscape curvature was calculated. However, since this descriptor appeared to be highly correlated to the elevation heterogeneity index it was discarded from the analysis. Forest configuration descriptors included: 1) proportion of forest cover within a 2 km radius of the focal cell, 2) the proportion of forest logged between 1880-2000, within a 2 km distance of the focal cell, and 3) the number of forest patches larger than 1 ha within a 5 km radius of the focal cell, 4) distance to previously logged area. To enable comparisons between individual landscape descriptors, all landscape maps were standardized before analysis.

Data analysis

For this study, ecological niche factor analysis (ENFA) was used to calculate the relative contributions of a set of landscape descriptors to predict elephant distribution and CR-patterns (Hirzel & Arlettaz 2003). ENFA compares the distribution of presence observations in a multidimensional space of environmental variables to the environmental variance across the entire study area (Hirzel *et al*. 2002; Hirzel & Arlettaz 2003; Hirzel *et al.* 2006). The relative contribution of a certain predictor is calculated based on factors (similar to a PCA) that define: 1) how the species mean habitat characteristics differ from the mean available habitat present in the entire area (marginality), and 2) the overall variance of habitat characteristics to the species habitat variance (specialization). To enable comparisons between the elephant distribution data and the CR distribution data, the same set of landscape descriptors were used in the analysis of both data sets.

Subsequently, a discriminant analysis was preformed to investigate how each of the descriptors discriminates between the two datasets (Legendre 1998). Like the ENFA, this multivariate analysis works in the space defined by the descriptors but it uses the distributions of both datasets to calculate an index that maximizes the interspecific variance while minimizing the intraspecific variance. Therefore, the discriminant factor is the direction along which the two species differ the most, i.e. it is correlated with the variables on which they are most differently distributed. To analyze the amount of overlap in the occurrence of CR and elephant occurrence, both datasets were plotted against their relative discriminant scores and a one-tailed T-test was applied to test for significant differences between population means.

Statistical analysis were preformed using Biomapper 4.0 and Openstat statistical software which are freely available online.

Table 1. Results of the discriminant analysis.

Descriptor	ED* Marg. (71%)	89% Spec1 (18%)	CR* Marg. (83%)	94% Spec1 (11%)	DA 80% DA-Factor
Elev. heterog.	-0.062	0.473	-0.343	0.147	0.545
Dist. logged area	-0.783	0.437	-0.425	-0.883	0.509
Forest cover	0.359	0.566	-0.503	0.402	0.520
Fragmentation	0.461	0.148	0.251	-0.121	-0.367
Prop. logged	0.204	0.493	0.621	-0.149	-0.197

*ED = elephant distribution, CR = crop raiding

Results

Elephant distribution

The first factor of the ENFA analysis, which describes the distance between the average landscape conditions in which elephants were found present and the average conditions present in the entire study area, appeared to account for 89% of the variance present in the elephant distribution dataset (Table 1). The correlations between the first (marginality) factor and the landscape descriptors shows that elephant occurrences were most often found in, or close to areas which have been logged between 1980-2000 (marginality score = -0.783). Furthermore, elephants appeared to inhabit areas that still had intermediate levels of forest cover (marginality score = 0.359) and were moderately fragmented (marginality score = 0.461). The marginality score explained 71% of the total variation present in the dataset implicating that most of the species specialization is been accounted for by the species marginality (e.g. their deviation from the average conditions in the study area).

Crop raiding patterns

ENFA analysis of the CR pattern showed that the 5 landscape predictors used in this analysis accounted for 94% of the variation between CR events present in the dataset (Table 1). The marginality score (distance from the average conditions) shows that the occurrence of crop raiding occurs most frequently in or near areas, which have previously been logged (marginality score = -0.883). However CR appeared to be moderately correlated to current forest cover (marginality score = 0.402) indicating that CR is most likely to occur in areas, which are still partially forested. Nevertheless 74% of the CR events occurred within logged areas and 25% of the CR events took place in areas, which had no forest cover within a 2 km radius of the CR location.

Discriminant analysis

The results of the discriminant analysis are given in Table 1. Even though the discriminant analysis does not completely differentiate between the occurrence of CR and the presence of elephants (a reasonable amount of overlap exists between the two datasets, Fig. 2), the group means are significantly different (one tailed T-test: $t=9.9$, $p<0.0001$, Fig. 3). This indicates that the occurrence of CR and the occurrence of wild ranging elephants can be significantly separated based on the five landscape descriptors used for this analysis.

The distribution of elephant presences and CR events along the DA factor (Fig. 2, Table 1) reveals that a high proportion of forest cover and an increase in elevation heterogeneity correlate

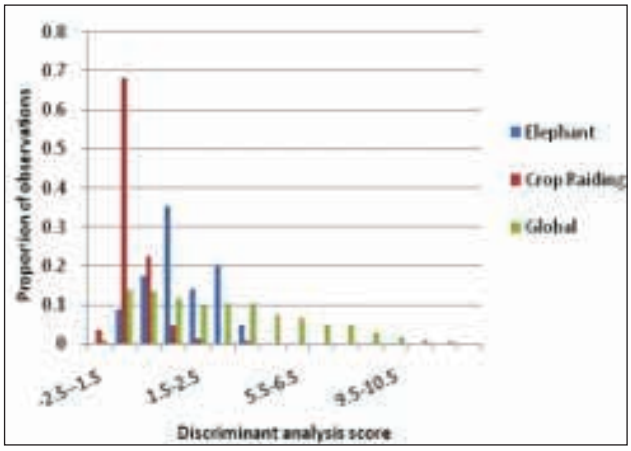

Figure 2. Distribution of elephant distribution records, CR events and the global distribution of all cells along the discriminant factor.

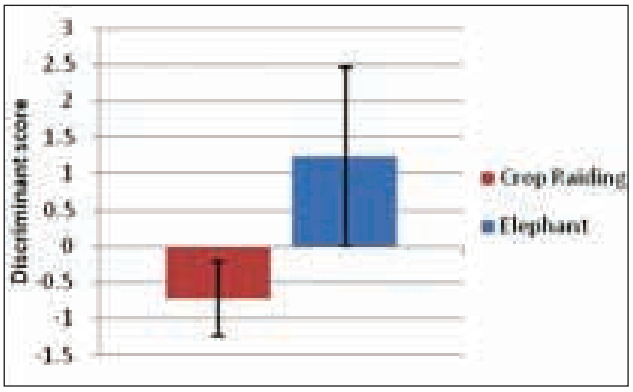

Figure 3. Average discriminant score for elephant presences and CR events. Error bars indicate standard deviations from the population mean. Population means are significantly different.

with elephant presence (Table 1, Fig. 2). On the other hand an increase in landscape fragmentation correlates with the occurrence of CR events. The single factor on which both groups cannot be separated is the proportion of forest logged between 1980-2000. This indicates that the observed overlap is concentrated within areas that had been logged over the last 30 years.

Conclusions

The results of the analysis presented in this study show that intermediate habitat fragmentation does not displace elephants from their natural ranges. The spatial matrix of secondary forest and agricultural areas near primary forest provide sufficient habitat for the elephants to prevail. As forested areas are partially opened for agricultural purposes, elephants will reside and utilize the subsequent regrowth as a resource of protein rich foliage. Furthermore, the remaining forested patches are still used and are likely to provide shelter for the elephants during the day.

However, as conversion of lowland habitat continues, elephants do not respond by moving to alternative areas, but are forced to reside in smaller patches of less suitable habitat. Therefore, the currently observed distribution of elephants across the landscape might not only be determined by the availability of resources, but is to a large extent shaped by historic ranges and movements. This will inevitably lead to the situation in which natural elephant habitat is totally converted and the remaining groups permanently reside in a matrix of secondary forest and agricultural landscape. In order to adapt to this new situation, elephants start exploiting the newly established resources (agriculture and secondary regrowth) to meet their dietary demands, with an increase in crop raiding as a result.

The results of the ENFA analysis demonstrate that the occurrence of crop raiding by elephants appears to be concentrated in logged areas on the forest border. This finding supports the scenario in which elephants are being displaced and persevere within the remaining forested areas. Surprisingly an increase in forest fragmentation does not explicitly lead to an increase of crop raiding. Seemingly, elephants, which inhabit highly fragmented, but still moderately forested areas, do not necessarily raid crops. Yet, as the remaining forest patches are being cleared for agricultural expansion, the incidence of crop raiding by elephants increases. Even if all forest within an elephant's range is completely cleared, they are likely to continue to dwell within their historic range and will not move into new areas.

Discriminant analysis of our data showed that the elephant distribution patterns and CR patterns clearly distinguish between forested habitats and opened forest. Also, elephants inhabit hilly terrain that is less suitable for agriculture, this leads to a low incidence of CR in moderately hilly terrain. The high overlap between the occurrence of elephants and CR in logged areas supports the fact that elephants more frequently occupy forested areas, and supports the idea that elephant populations are being displaced from their natural habitat. Consequently as forest borders are shifted to an extent that elephants are forced to move into highly rugged mountain terrain, elephants are forced to rely on agricultural areas to forage. In such cases, the scale and extent of crop raiding and encounters between humans and elephants are prone to increase to a critical extent.

Implications for conservation

The implication that elephant habitat use is limited by the total area of forested area within lowland areas of moderate elevational

variation (e.g. flat land to lowland hills) means that further clearance of these areas could lead to a total deterioration of available habitat and will ultimately lead to a rise in human elephant conflict and further population declines. As land use planning for conservation landscapes within and outside accomplished conservation areas is becoming a new standard in large mammal conservation practices, the effects of land use configuration, elephant behavior and human response are the most important issues to account for when dealing with elephant conservation (O'Connell-Rodwell *et al*. 2000; Leimgruber *et al*. 2003; Venkataraman *et al*. 2005).

Continuous forest clearance and habitat degradation will ultimately lead to an increased encounter rate between human residents and wild elephants, and consequently to intensification of human elephant conflict (Linkie *et al*. 2004; Linkie *et al*. 2007). Since the larger area of natural elephant ranges lie outside protected areas, appropriate conservation management and efficient land use will be of critical importance and essential to minimize conflict and to guarantee the prevalence of local elephant populations. Land use zoning and forest rehabilitation should therefore be used to segregate areas of human interest and elephant habitat. Buffer zones should maximize the distance between suitable elephant habitat and human populated areas by minimizing resource extraction by humans, and simultaneously offer carrying capacity for elephants displaced by rural development.

Acknowledgements

This work was conducted as a part of the FFI-Aceh Aceh Forest and Environment Program, funded by Multi Donor Fund. We would like to thank Indonesian Ministry of Forestry Directorate General of Forest Protection and Nature Conservation (PHKA) for providing permission to work in the area and the Indonesian Conservation institute (BKSDA) for sharing data. Our special gratitude goes out to our colleagues in the protected areas division of FFI-AFEP, who have greatly contributed to realize this manuscript. We would like to thank Iep and Torro for their support with collecting human elephant conflict data and the field staff for their tremendous effort to collect elephant distribution data under harsh field conditions.

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Serum Levels of Some Electrolytes of Captive Sri Lankan Elephants

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Introduction

Baseline data on serum levels of electrolytes of the Sri Lankan elephant (*Elephas maximus maximus*), a subspecies of the Asian elephant (*E. maximus*), is extremely scarce: restricted to two studies from one laboratory (Silva & Kuruwita 1993a, 1993b). On the other hand, several workers belonging to different laboratories have documented serum electrolyte levels of the African elephant (*Loxodonta africana*) (Bartles *et al*.1963; Dillman & Carr 1970; Brown & White 1979) and the Indian elephant (*E. maximus indicus*) (Simon 1961; Brown & White 1980; Sreekumar & Nirmalan 1989; Sarmah *et al*. 1999). Since the Sri Lankan elephant is endemic and critically endangered it is important to confirm the only data available on its mineral status of blood (Silva & Kuruwita 1993a, 1993b) by other workers and also to extend the investigations to other electrolytes as well. In addition, such data are extremely useful directly in proper diagnosis and treatment, captive breeding and general welfare, and indirectly in the longterm conservation and efficient management of our majestic animal. This study was undertaken with these aims in mind.

Methods

A total of 21-48 adults (9-20 males and 13-28 females), apparently healthy elephants, who participated in the Navam Perehera (a cultural pagent) in 1997 and 1998, were the subjects of this study.

Blood samples (5-10 ml) were collected (in standing position) from a vein or artery on the posterior side of either ear (using aseptic precautions) without sedation (between 7.00 h – 12.00 h) using butterfly needles (18 gauge) connected to a plastic 10 ml syringe. The entire bleeding process lasted 1.0-1.5 min.

Blood was allowed to clot at room temperature (28-31^{o}C) and the serum was separated within three hours of collection by centrifugation at 500 g for 20 min. The serum was stored at –70^{o}C until the mineral levels were determined. All the assays were carried out using standard commercially available test kits (Randox, Ireland).

The potassium level in the serum was determined by a precipitation technique. The potassium ions are reacted with sodium tetraphenylboron in a protein free alkaline medium to produce a turbid suspension of potassium tetraphenylboron. The amount of turbidity produced is proportional to the potassium concentration. Initially, a precipitating reagent (trichloro acetic acid, 500 µl) was added to the serum sample (50 µl) and the mixture was centrifuged at high speed for 5- 10 min. The clear supernatant was separated. Then the working reagent (1000 µl, prepared by mixing equal volumes of solutions of sodium tetraphenylboron and sodium hydroxide) was added to the supernatant (100 µl). The solutions were mixed to produce a homogeneous turbidity and allowed to stand for ~5 min at 25^{o}C. A standard solution of potassium ions was also treated in a similar manner. The absorbance of these solutions was measured at 578 nm using a Shimadsu double beam spectrophotometer (UV-21005, Schimadzu Corp., Kyoto, Japan), against a reagent blank. The potassium levels in the samples were calculated relative to the standard. The method is linear up to a potassium concentration of 10 mmol/l.

A colorimetric procedure was used in order to estimate the calcium level in the serum. Reaction principle: Calcium ions react with O-cresolphthalein complexone in an alkaline medium to produce a violet complex. The serum sample (25 µl) was mixed with the complexing reagent (0.5 ml) and buffer solution (0.5 ml, pH=10.7) provided in the test kit. The absorbance

Table 1. Serum potassium, calcium, magnesium and inorganic phosphorus levels of elephants.

Serum parameter		n	Mean ± SD	Range	Mode	Median	Variance
Potassium	Males	20	2.89 ± 0.89	1.28 – 5.05	2.54	2.73	0.80
	Females	28	2.95 ± 1.16	1.02 – 4.83	--	3.37	1.35
	Entire group	48	2.92 ± 1.05	1.02 – 5.05	2.54	2.86	1.10
Calcium	Males	10	2.37 ± 0.21	1.88 – 2.66	--	2.40	0.04
	Females	13	2.38 ± 0.27	2.06 – 2.80	2.39	2.39	0.07
	Entire group	23	2.38 ± 0.24	1.88 - 2.80	2.30	2.39	0.06
Magnesium	Males	14	0.90 ± 0.26	0.53 – 1.32	--	0.87	0.07
	Females	19	0.63 ± 0.23	0.27 – 0.99	--	0.60	0.05
	Entire group	33	0.75 ± 0.27	0.27 – 1.32	--	0.75	0.07
Phosphorus	Males	9	1.34 ± 0.29	0.97 – 1.64	1.55	1.55	0.09
	Females	12	1.27 ± 0.29	0.97 – 1.61	1.58	1.13	0.08
	Entire group	21	1.30 ± 0.29	0.97 – 1.64	1.03	1.13	0.08

of the sample was measured at 570 nm using a Shimadsu double beam spectrophotometer (UV-21005, Schimadzu Corp., Kyoto, Japan), against a reagent blank between 5-50 min. A similar procedure was followed with the standard calcium solution. The concentration of calcium (mmol/l) was calculated using the equation:

$$\text{Calcium concentration} = A_{sample}/A_{std} \times 2.5$$

The calcium concentration is linear up to a value of 3.75 mmol/l.

The magnesium levels were estimated using a colorimetric assay. The method involves the reaction of magnesium ions with the metallochrome dye calmagite in an alkaline medium. A chromophore which absorbs at 520 nm is formed (Calcium is excluded from the reaction by complexing with EGTA). Initially, a working reagent was prepared by mixing equal volumes of the dye reagent (contains calmagite and EGTA) and buffer solution (pH=12.5). Then, the serum sample (10 µl) was mixed with the working reagent (1.0 ml) and incubated at 25°C for 60 sec. A similar procedure was carried out on the standard solution. The absorbance of the two solutions was measured at 520 nm using a Shimadsu double beam spectrophotometer (UV-21005, Schimadzu Corp., Kyoto, Japan), against a reagent blank within 30 min. and the magnesium concentration was calculated:

$$\text{Magnesium concentration} = A_{sample}/A_{std} \times 1.0$$

This method is linear up to 2.67 mmol/l.

The inorganic phosphorus levels in the serum were determined colorimetrically. The inorganic phosphate is reacted with molybdic acid to form a phosphomolybdic acid complex, which is reduced by ammonium ion (II) sulphate to molybdenum blue, which is measured at 690 nm. Initially, a working reagent was prepared by mixing equal volumes of the molybdate reagent and the reductant. The serum sample (30 µl) was mixed with the working reagent (1.0 ml) and allowed to stand for 10 min at 25°C. The same procedure was carried out using the standard phosphorus solution. The concentration of inorganic phosphorus in the serum samples was determined relative to the standard. This method is linear to 8.0 mmol/l. Two pre-assayed quality control sera (Randox, Ireland) were used as positive controls to monitor accuracy. The results are represented as means ± SD. Statistical analyses were made using Mann-Whitney U-test. Significance was set at $P<0.05$.

Results

All the serum samples were slightly yellowish in colour. The results obtained are summarized in Table 1. Of the electrolytes monitored, irrespective of the gender, potassium had the highest concentration and magnesium the lowest. Further, there was no significant difference ($P>0.05$) in the levels of different electrolytes between males and females.

Discussion

There are nine physiologically important electrolytes in mammalian blood serum (Carola *et al*. 1990). Of these, this study monitored the levels of four electrolytes (K^+, Ca^{2+}, Mg^{2+} and

inorganic phosphorus) in the blood of adult captive Sri Lankan elephant. What is more is that this is the first study to determine the serum magnesium level of the Sri Lankan elephant. Blood samples were collected from 21-48 apparently healthy captive animals, which is a sizable number to provide meaningful data: the present number of captive elephants in Sri Lanka is reported to be 186 (Kurt & Mar 2003). Further, the electrolyte profiles were determined using procedures, which are widely used and claimed to be reliable and sensitive. Because of these facts the data obtained can be considered as representative and regarded as reference baseline data for captive adult Sri Lankan elephants.

The results show that serum calcium, potassium and inorganic phosphorus levels are in agreement to what has been previously reported for domesticated (Silva & Kuruwita 1993b) and free-ranging (Silva & Kuruwita 1993a) adult Sri Lankan elephants, thus confirming their data. Since this is the first study to report the serum magnesium level of Sri Lankan elephants comparison cannot be made with other Sri Lankan workers.

Calcium and inorganic phosphorus levels reported in this study are also comparable to what has been reported for Indian (Simon 1961; Brown & White 1980; Sreekumar & Nirmalan 1989; Sarmah *et al.* 1999) and African (Bartles *et al.* 1963; Dillman & Carr 1970; Brown & White 1979) elephants. Interestingly, the serum potassium level of Indian elephants (by 40%) (Simon 1961; Brown & White 1980; Sreekumar & Nirmalan 1989; Sarmah *et al.*, 1999) and African elephants (by 47-51%) (Bartles *et al*. 1963; Dillman & Carr 1970; Brown & White 1979) were markedly higher than in the Sri Lankan elephant. There could be several reasons for this discrepancy. Differences in the composition of the diet may be one possibility: Sri Lankan captive elephants are given a fairly fixed menu consisting of three main items, namely, kitul (*Caryota urenus*), logs, coconut (*Cocus nucifera*) fronds and jak (*Artocarpus nucifera*) branches and leaves (Godagama *et al*. 1999). Species and subspecies difference may be another possibility: striking differences are reported with some physiological parameters in the Sri Lankan elephant with the other subspecies of the Asian elephant (Ratnasooriya *et al*. 1992, 1995, 1999; Lincoln & Ratnasooriya 1996). Alternatively, the low serum potassium level in the Sri Lankan elephant may result from low resorption and/or high secretion of K^+ in the uriniferous tubules of the kidney as kidneys excrete 80-90% of serum potassium (Carola *et al*. 1990). Decrease in serum potassium level occurs in diarrhoea, vomiting, diabetic acidosis and chronic kidney diseases (Carola *et al*. 1990). But, such events cannot account for the low serum potassium levels of healthy Sri Lankan elephant.

In this study, gender differences between serum electrolytes determined was not evident as previously reported (Ratnasooriya *et al*. 2006) for lipid profile of Sri Lankan elephants. However, gender differences in serum glucose (Ratnasooriya *et al*. 1999) and cholesterol (Ratnasooriya *et al*. 1995) are reported in the Sri Lankan elephants.

In conclusion, this study, reports for the first time, the serum magnesium level of Sri Lankan captive adult elephants. It also confirms the previously reported serum levels of potassium, calcium and inorganic phosphorus of Sri Lankan elephants.

Acknowledgements

This study was supported by a grant from National Science Foundation of Sri Lanka (RG/95/C/06). Thanks are also due to Dr. D. S. Kodikara for collecting the blood samples.

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Elephant herd at Buttuwa plain, Yala National Park, Sri Lanka
Photo by Prithiviraj Fernando

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Conservation Values of Asian Elephants: People's Appreciation

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Introduction

The Asian elephant *Elephas maximus* has been considered as one of the most reminiscent cultural symbols of the people of Asia and it also stands for the need to safeguard sufficient natural forest areas; however the survival of the species has been in danger due to a number of conservation issues (AERCC 1998). Asian elephants are confined to 13 Asian range countries, of which, India holds over 50% of the global population – approximately 24,000–28,000 distributed across 18 states of the country (Menon 2003; Sukumar 2003). Northeast India holds around 30% of the country's total elephant population (Bist 2002b). Within this north-eastern countryside, the state of Assam is known as the key conservation region of Asian elephants (Stracy 1963; Gee 1964; Santiapillai & Jackson 1990; Choudhury 1991,1997; Bist 2002b) with an elephant population of about 5200 as assessed in the year 2005 (Talukdar *et al.* 2006).

The recognition that the Asian elephant is an endangered species and needs special protection, came after the inclusion of this species in Appendix I of CITES in 1975 and formation of the Asian Elephant Specialist Group of the IUCN in 1976. Consequently, the elephant is upgraded to schedule-I of the Indian Wildlife Protection Act, 1972 (Bist 2002a).

The survival of elephants is also very crucial from the ecological point of view as elephants play an important role in maintaining the balance in our delicate ecosystem. For that reason, the need of the hour is to prepare some long term strategies for conservation of the elephant and its habitat. To prepare and implement any such efforts, it is necessary to find out people's attitude towards those strategies. It is also necessary to understand the economic value attached to the conservation of elephants, as one of the key causes for elephant habitat decline is the failure to account adequately for their environmental and ecological non-use values. Although more attention has been given on economic issues involved in the conservation of African elephants, *Loxodonta africana*, the Asian elephant has received little consideration (Bandara & Tisdell 2004). Keeping this in mind, we initiated an economic valuation study in Golaghat District of Assam from January to July 2007 to see how people appreciate different economic values related to elephant conservation. This is a preliminary attempt to understand the feasibility of valuation study with regards to wildlife in general, and elephants in particular, in this region.

Methods

We selected Golaghat district (Fig. 1) as our study site. The latitudinal and longitudinal extension of the district ranges from 25°45'N to 26°30'N and 93°45'E to 94°05'E. The forests in Golaghat district are represented by seven Reserve Forests: Diphu, Rengma, Doyang, Nambor North, Nambor South, Upper Doigrung and Lower Doigrung. The forested landscape is represented by Eastern wet evergreen and semi evergreen forest (Champion & Seth 1968). The landscape plays a vital role in the migration of elephants from Kaziranga National Park to the hills of Nagaland through Karbi Anglong (pers. obs.). In the recent past, the establishment of Numaligarh refinery in Telgaram area, the widening of National Highways and growing tea estates has lead to fragmentation of elephant habitats and destruction of their natural corridors (Talukdar *et al.* 2006). This is responsible to a great extent for the increasing human elephant conflict situations in the district. On the other

hand, the people of Golaghat district respect elephants and pray to them as Lord Ganesha. The elephants still occupy a special position in the hearts of the people. In such a diametrically opposed situation, we were very much interested to study people's attitude about elephants and how they appreciate different economic values related to elephant conservation. Therefore, we selected the district as our study area.

We used focus group discussions and household survey methods to collect primary data that were mostly used in the study. However, to provide the respondents with the background information, several published and unpublished literatures on elephants were used. A sample of 240 households was surveyed using the multi stage sampling procedure. In the first stage, the villages affected by human elephant conflict were divided into four forest zones, and eight villages from those created zones were randomly selected for surveys taking two villages from each zone. A sample of 120 persons was selected for survey using proportional allocation method. In the next step, eight urban wards were randomly selected from the eight development blocks taking one ward from each development block. A sample of 120 persons was selected using proportional allocation method (Kothari 2003).

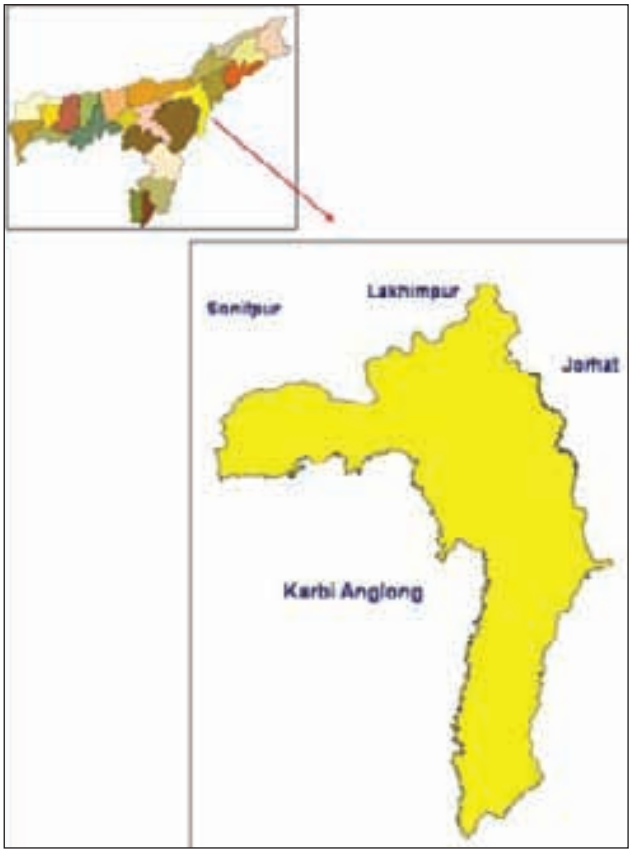

Figure 1. Map of Golaghat District, Assam.

An interview schedule was used to gather the information. The interview was face-to-face. Following Bann (1999), we used a set of valuation questions to determine whether people recognised different use and non use values related to elephant conservation. Before the actual interview, the respondents were provided with the background information regarding the current status of elephants and conservation, and the issues related to conservation of elephants that need to be addressed. The study began with focus group discussions. The primary stakeholders were involved in a consultative process and the issues were discussed in such group discussions. After having an idea of people's perception of elephants, micro level data was collected through household surveys.

Results and discussion

To have an idea of the respondents' attitude towards different values associated with the conservation of elephants, their mindset was explored. Respondents were presented with a series of six valuation statements and asked whether they agreed or disagreed with each statement. The six statements were used to see how people recognize the non consumptive, direct, option, bequest, existence and indirect use value of elephant conservation. The findings of the attitudinal statements are shown in Figure 2.

Overall, the respondents strongly recognized different values related to conservation of Asian elephants in Golaghat district ($^{2}_{5}$= 275.07, P<0.01). The first valuation statement was intended to gauge respondents' attitude towards conserving elephants in the wild to promote tourism industry and other recreations in Golaghat district. 95% of the respondents appreciated the statement. This is the recognition of non consumptive use value of elephants and its conservation. The second statement aimed to draw out how people appreciate direct use value of elephants. 53.3% of respondents agreed with the direct use of elephants. The rest of the respondents

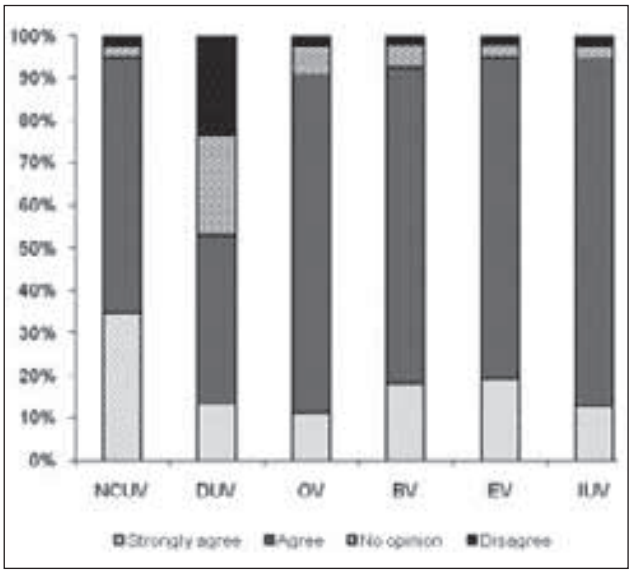

Figure 2. People's opinion on different values (NCUV=Non Consumptive Use Value, DUV=Direct Use Value, OV=Option Value, BV=Bequest Value, EV=Existence Value, IUV=Indirect Use Value).

(46.7%) were against the view that the elephants should be conserved to be used purely for domestic purposes Therefore, the direct use value of elephants was not a determining factor for the respondents being willing to conserve elephants. The third statement was to assess the appreciation of the option value concept among respondents. 90.8% of the respondents either strongly agreed or agreed with the statement affirming the option value of wild elephants in Golaghat District. Again, 92.5% of the respondents agreed to the statement meant to draw out bequest value motive of elephant conservation: i.e. respondents believe that elephants in the wild are of value because of the benefit they could provide to future generations.

The fifth statement asked respondents if they felt one had a duty to conserve elephant habitats from thoughtless developmental activities regardless of the cost. The question sought to reveal whether the respondents felt that 'elephant habitats' were of intrinsic value and we therefore have a duty to protect those. 95% of the respondents recognized the existence value of elephants in Golaghat District. Moreover, 94.6% of the respondents agreed to the statement meant to draw out indirect use value suggesting a high appreciation of the indirect use value of the elephants (Fig. 3).

Conclusion

The people of Golaghat district were found to be well aware of the issues related to the conservation of elephants in the wild. They recognised different values attached to elephants and its conservation. Since people appreciate different values related to elephant conservation, there are sufficient reasons to infer that they may be willing to contribute part of their incomes to implement some concerted approach to conserve elephants. Therefore, a micro level study to estimate the willingness of the community people to pay for conserving elephants could be suggested. The study was in fact an experimental attempt to determine how people recognise different concepts of economic value related to elephant conservation. We found that they very well appreciated different use and non-use values related to elephant conservation. Therefore, according to the community revealed preference pattern, a concerted approach to the sustainable management of elephants and their habitats should be implemented in the district and thus it carries some encouraging messages to conservation loving people in general.

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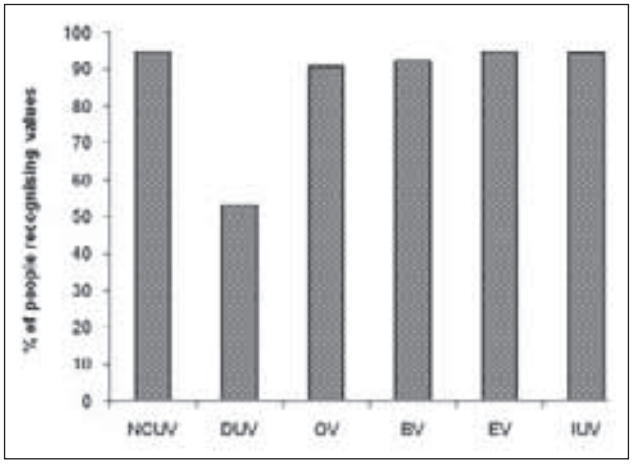

Figure 3. People's opinion on different values.

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Elephant herd roaming in the tea, Assam, India
Photo by WWF India

Gajah 29 (2008) 32-34

Unusual Behaviour of Asian Elephants in the Rajaji National Park, North-West India

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Introduction

The behaviour of wild animals is a subject of great interest leading to understanding the nature of various species, which may be helpful in their management and conservation. The behaviour of Asian elephants (*Elephas maximus*) particularly domesticated elephants in circuses and zoos provide recreation to many people. However, the behaviour of wild Asian elephants is difficult to observe and study. Although several studies on the behaviour of African elephants (*Loxodonta africana*) have been conducted, few studies have been carried out on the behaviour of wild Asian elephants. Here we present some notes on unusual behaviours of wild Asian elephants observed during a long-term study on the behavioural biology of Asian elephants in sub tropical moist deciduous forests of India.

The observations were made in the Rajaji National Park (RNP), in the Shivalik foothills (lesser Himalayan zone), which is one of the world's most spectacular landscapes, encompassing tall grasslands and Sal forests (Fig. 1). The vegetation of the area is 'sub tropical moist deciduous' forest with extensive stands of *Shorea robusta* (Sal), *Mallotus phillipinensis* (Rohini), *Acacia catechu* (Khair), *Adina cordifolia* (Haldu), *Terminalia bellirica* (Bahera), *Ficus bengalensis* (Bar), *Dalbergia sissoo* (Shisham). Rajaji National Park [$29^0$15' to $30^0$31' North Latitude, $77^0$52' to $78^0$22' East Longitude] is spread over an area of 820 km^2 in and around the Shivalik foothills, which lie in the lesser Himalayas and the upper Gangetic plains. Spread across Hardwar, Dehradun and Pauri districts of Uttarakhand state, RNP has been designated as a reserved area for the "Project Elephant" by the Ministry of Environment and Forests, Government of India.

Acrobatic behaviour

On 30th April 2007 when we were inside the forest we came across a group of elephants consisting of several adult females, sub-adults and juveniles and one adult male elephant. The adult male was following the group at a few meters distance. The adult male elephant saw us and started running towards us up to a few meters then suddenly stopped. The elephant then touched the ground with its trunk and bent forwards. Next it raised one of its hind legs in the air followed by the other hind leg and then the right front leg. At one point three legs of the elephant were in the air and the elephant was standing on its trunk and

Figure 1. Elephants during the sunset in the Rajaji National Park.

Figure 2. Acrobatic behaviour of an adult male.

left front leg (Fig. 2). He held this position for about one minute. Then he came to its normal position, went back and rejoined the group.

Climbing and sliding behaviour

During the course of study we frequently observed elephants moving over steep hills, through very narrow passages and across steep slopes in situations even difficult for a human to traverse. At one spot in Mundal forest beat (Chilla forest range) we found footprints and feeding signs of elephants in a very narrow passage at a height of about 30 feet. We could see that there was a climber - *Bauhinia vahlii* (maljhan) at that spot, a favourite food item of elephants. The elephant had probably mounted up to that height just to feed on this fodder species.

Soundless movement in forest

During the autumn a heavy bed of fallen leaves can be seen all around the area in RNP. The sound of the fallen litter was always noted while we walked through such areas with dry leaves. Even the movement of smaller wild animals makes enough noise, which is a good indicator of their movement through forest areas. However, it was observed that when elephants walked through these areas there was no sound at all. It is amazing that such an animal with a huge body and heavy legs does not make any sound while walking through these areas. Many human casualties, mainly with woodcutters and grass-cutters, have occurred in this region. This is probably due to the victims not hearing any sound of movement of elephants before they are getting too close

Variations in feeding behaviour

Haplophragma adenophylla (kut sagaun) and *Tectona grandis* (sagaun, Fig. 3) are important fodder species for elephants, from December to June. However, elephants have been feeding extensively on these species only since the last 5-6 years and before 2002 elephants were not observed to feed on these species. Only the bark is utilized by the elephants and they may spend even a whole day feeding on it. Consequently, elephant induced damage to these species is quite extensive. These species were planted in a few forest pockets some 20 years ago.

In Shyampur (Hardwar forest division) and Chilla forest range some elephants consume *Eucalyptus* spp. especially during dry months. Elephants started to feed on this species only after August 2007. They consume the soft bark of this species. Only four identified adult bull elephants were observed to feed on it and no groups were seen utilizing eucalyptus species as their food.

Long-term bull association

Generally it is thought that bull elephants prefer to live a solitary life after attaining an age of about 16 years. Male elephants were observed to join groups during breeding periods and they were observed near groups for short durations.

Figure 3. Cow and calf feeding on teak bark.

During the last three years, we have continuously observed six individually identified adult bull elephants living together and moving inside and outside the protected area. In 2007, four of them were separated from each other for a short period during summer (March - June). Otherwise they were seen moving, playing and resting together and had a very close association round the year. An adult bull elephant (about 50 year old) was always observed to lead the group.

Unexpected close encounters with people

We used to observe movement of elephants across the Singhal bridge on Hardwar – Bijnor National Highway. On the evening of 8th July 2006 we were waiting for the elephants to cross the bridge and saw a mentally deranged person who was totally naked coming towards the bridge. At the same time a single tusked bull elephant (commonly called 'Ganesh') came out close to the person. The elephant was scared of the person and ran away from him and re-entered the forest. After five minutes, the elephant came towards the bridge and attacked a vehicle creating a hole in the back of the vehicle with its tusk. However the elephant did not cause any major harm to the vehicle or to its occupants.

On the evening of July 8th, 2007, we were waiting at the Singhal bridge. A handicapped person in a hand driven handicap cycle rickshaw reached the bridge crossing the irrigation canal road. At the same time we saw two adult bull elephants emerging out from the forest and come slowly towards the national highway. The handicapped person was just 10 feet away from the elephants. The elephant, which was in the front, saw the handicapped person and was not at all disturbed. The handicapped person also was not scared of the elephants near him and crossed the bridge followed by the elephants coming to no harm.

Acknowledgements

We thank the Science and Engineering Research Council, Department of Science and Technology, Government of India for providing financial support and thanks are due to Dr. R. C. Srivastava, Scientist 'G' & Advisor and Dr. Jagdish Chander, Scientist 'F', DST, for their cooperation and valuable suggestions. Dr. U. Dhar, Director and Dr. R. K. Maikhuri, Scientist Incharge (Garhwal Unit), G. B. Pant Institute of Himalayan Environment and Development, Kosi – Katarmal, Almora are acknowledged for providing facilities, encouragement and suggestions. We are highly thankful to Prof. B. D. Joshi, Department of Environmental Sciences, Gurukul Kangri University, Hardwar and Dr. S. P. Sinha, Sr. Scientist, Wildlife Institute of India, Dehradun for their suggestions regarding to field investigation. Shri Srikant Chandola, Additional Principal Chief Conservator of Forests (Wildlife), Government of Uttarakhand and Shri G. S. Pande, Director of the Rajaji National Park are acknowledged for giving the permission to carry out the research work in the said area. Thanks are to various concerned forest officials and staff for providing help during the field investigation.

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A herd of elephants at Luni river, Rajaji National Park, India.
Photo by Ritesh Joshi

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Drug Immobilisation – Yesterday, Today and Tomorrow

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Introduction

Drug immobilisation (DI) of captive elephants is more often required in range countries than in the western world. Even if such a situation arises, it will be often in zoos and rarely in circuses. In the zoos, the immobilising team gets a controlled environment and the darting is relatively easy. In range countries DI is required mostly in two situations. One situation is in forests where there are logging operations. Even though logging is stopped officially in the forests, it still happens in many plantations of coffee, tea and cardamom as well as illegally. Darting in a forest environment is very difficult since the elephant, often a bull in musth, can easily charge you and your escape to safety is very difficult. Climbing a tree, which is big and elephant proof is difficult; otherwise the animal can knock you down. If you go round a bush, the animal will wait for you on the opposite side. This has actually happened and resulted in the death of a senior forest officer. If you run it can easily overtake you. Occasionally there may be a person mounted on the elephant who can be a mahout or a layman as in the case of festivals, or a hired help who are known as elephant mounts. This is again an additional risk.

In a DI, there are three components, the dart gun, the syringe and the drug. My first darting was a bull in musth, which weighed 5250 kg, pride of the owner and pet of the local public. The drug available was a nicotine alkaloid having a low margin of safety. Now I don't dare to use nicotine although I have used it in 25 bulls with a couple of mortalities, mostly due to indirect reasons. Then I tried gallamine (Flaxedil®), which could be reversed by neostigmine. But a great amount of effort was required to get the commercial preparation to the concentration required for use in elephants. Later newer chemicals, with a greater margin of safety that could be used intra-muscularly route, were developed. They were xylazine and acetylpromazine (ACP), which are powerful sedatives. Etorphine which is commonly known as M99 or its combination with ACP (Immobilon LA®) was out of reach because of its narcotic nature and hence the difficulty to obtain.

Finally I managed to get information that a combination of xylazine (Rompun®) and ACP is ideal for captive elephants. Getting Rompun® was a big task and I managed to get it through the Rotary Club of Thrissur and ACP (high potency, 20 mg/ml) was imported directly from the manufacturer, Boots Pure Drug Company, UK.

On many occasions the elephants had to be immobilised in the hot sun and ACP was found to cause photosensitisation on the dorsum. Although the fact that phenothiazines often cause photosensitisation, the ACP reaction was extensive and the practice had to be abandoned. Then I tried xylazine with ketamine. Ketamine also showed photosensitivity in the hot sun. This I learned from the clinical condition and from literature surveys. The use of xylazine alone has the disadvantage of disturbance during inductions, which can prolong the induction period or even nullify the effect. Xylazine can be combined with midazolam, a short acting benzodiazepine compound for synergistic effect. Other drugs for captive elephants are azaperone, medetomidine and ditomidine. For wild animals etorphine with ACP (Immobilon LA®) is the preferred one. Carfentanyl, which is more powerful than etorphine is also available. But these being narcotic and since most of the countries are signatories to the Singles Convention, which controls narcotic sales and distribution, they are difficult to obtain and there are strict rules and regulations for its stocking and use. But personal use convinced me that Immobilon LA® is an excellent drug for wild elephants.

Captive elephants

Tips of captive elephant immobilisation:

1. Control the crowd. They create more problems than the elephant itself.
2. Carry strong polypropylene ropes (preferred over nylon ropes) 2 cm in diameter and 20 m long, preferably with an iron ring at one end to noose.
3. After darting (Fig. 1) the drug effect starts by 8-10 min. noticed by the relaxation of penis but peak effect will require 45 min. in an undisturbed situation.
4. Test for the level of immobilisation is done by touching the back with a long pole (usually bamboo). If sedation is not enough wait and if necessary give additional dose after one hour, depending upon the degree of sedation.
5. Snoring may be noticed which does not indicate the depth of anaesthesia. Snoring is due to relaxation of vocal cords and the animal can be explosively aroused if disturbed.
6. Noose the hind and forelimbs in alternate fashion.
7. Pull each rope of the forelimbs alternatively to the tethering site, which is to be selected in advance (Fig. 2).
8. 10-15 persons are required to pull each rope. Animal may aimlessly swing the trunk and it may frighten the volunteers who pull the ropes.
9. Ropes on the hind limbs held by persons act as a break. This rope may be tied to a tree if available whenever necessary. But the knots are to be made to release easily.
10. Animal which under sedation may be mounted also if transported too long distances and also if the ground is uneven. After tethering, remove the syringe holding vertically, to avoid bending of needle.
11. Treat the punctured wound caused by the penetration of the dart syringe by injecting any broad spectrum antiseptic to the site. Or an intra -mammary infusion, which is having a nozzle may come in handy. This to avoid the development of an abscess at the darting site subsequently.
12. Treat the punctured wound by injecting antiseptic solutions or an intra-mammary infusion may come in handy. This is to avoid development of abscess at the injection site.
13. Open the syringe at the tailpiece to avoid popping of plunger.
14. Clean the needle assembly. Needles have to be cleaned. Those, which will have blood clots use a stylet. Sterilise the syringe assembly; 75% alcohol can be used.
15. Keep the syringe charge the 0.22 blank dry. The easy way to do this in the tropics, is keeping it in a metal plate in the hot sun or use a silica gel which will change the colour, in the presence of moisture.
16. Never put any left over drug or opened distilled water ampoules in the kit. This may dampen the charges.
17. Pass the empty assembled dart through the barrel and ensure its easy passage. Slight bulge can hinder easy passage. It will be difficult to change the syringe after filling it with drug.
18. If the syringe meets resistance after filling, then it can be due to over tightening, usually the tail piece. Hence unscrew the tail assembly a little to enable easy passage.
19. Don't leave any vacant space in the dart. Fill it with water for injection.
20. Air in the dart can wobble the syringe.
21. Short syringe with long needle is likely to tumble forward before reaching the target, hence avoid such short syringe.
22. Ensure the syringe charge is selected properly and inserted into the syringe in the correct direction.
23. Warm up the charge rubbing between the palms to ensure proper explosion.
24. Clean the syringe dart and the syringe

Figure 1. Always use a 'cover' while darting.

Figure 2. Coax to the tethering site.

projector (gun) as early as possible - "look after your weapon before you look after yourself."

25. A mobile phone may come in handy for ease of communication.
26. Spray water over the face and body of the immobilised animal to wake it up from sedation. Retraction of penis is an indication of recovery, but do not chill the animal. This is important if darting is done during the heat of the day. Chilling can cause impaction especially if the stomach is full.
27. Lying down and sleeping for a long period after darting and tethering, is also not advisable. Keep the animal standing and relax and let it sleep till it is fully recovered. Elephants can stand and sleep.
28. Animal will not feed and drink till fully recovered. Xylazine alone or its combination is the preferred drug since the animal can be coaxed to obey the commands.
29. Always give a dose only for standing sedation for ease of translocation.
30. Carry additional ropes if extra restraint is necessary (limbs, tail or even trunk).

Wild elephants

For wild elephant immobilisation, often it is possible to plan ahead and elaborate preparations are required:

1. A project leader who will supervise the entire operation.
2. Trackers and labourers to carry water cans.
3. Ropes for tying legs, tail, trunk etc.
4. Drug of choice is etorphine with acepromazine (Immobilon LA®).
5. Always carry human antidote. Most of the team members must be aware, where the antidote is kept. If human antidote (Narcan®) is not available use Revivon® as an emergency measure.
6. Have enough number of walik-talkies with the team. Cell phones may not have coverage in forest.
7. Carry machete, axe, sticks etc.
8. Have minor surgical tools and dressing materials.
9. Most of the animals where there is HEC may have bullet wounds. A metal detector will help to locate bullets buried in the tissues.
10. A heavy dose of long acting antibiotic.
11. Carry enough ropes and gears to shift the animal to lateral recumbency in case it falls on sternal recumbency.
12. If radio-collaring is the purpose of DI, check the length of the collar belt and do some rehearsal before the actual collaring. This will help to complete the process quickly. Remove the electronic lock sufficiently in advance not to forget the same in the last minute haste.
13. If animals are transported check the vehicle for appropriate scaffolding, tethering facility, floor strength etc.
14. Set the timepieces (wristwatches) of all team members to avoid confusion about the darting time, induction time, revival time etc.
15. Once the animal is down, herd mates will hang around. Hence carry guns to scare them away. These are in addition to the heavy rifles that are to be carried for safety of the darting team. Guns will make more noise than rifles, which will help to scare and keep the herd mates at bay. Koomkies can also be used for this purpose.
16. If a cow with a calf is immobilised the calf also may need a mild dose, so that the mother can be handled. A mere physical control may not be sufficient
17. Carry a strong solution of potassium permanganate to clean, if Immobilon LA® is spilled. Use gloves and specs while handling the drug.
18. Burn or bury all contaminated disposable tools (e.g. syringes) and other accessories.

19. Carry absorbent cotton and paper tissue to clean surfaces quickly in case of spillage.
20. Animal may be darted either from elephant back or on foot, depending upon the terrain and skill of the marksman.
21. Carry as many magnetic compasses as possible, preferably GPS so that the team will not lose their way in the forest and help them to come out of the forest.
22. Keep the team members in touch as frequently as possible without making much noise.
23. Study direction of wind before approaching the animal.
24. Retreat all team members before giving antidote (Fig. 3).
25. Supplementary drugs other than antidotes, e.g. stimulants, vaccines, toxoids, antibiotics, supplemental drugs are to be carried in a separate back-pack.
26. All the team members especially if they are new should be appraised about the whole sequence and their assigned duties. If possible show a video to the team.
27. Biometry and physiological parameters are to be recorded or for convenience dictating machine (Dictaphone®) may be used.
28. Also record ambient temperature, relative humidity.
29. Never attempt darting in the evening or near a waterhole.
30. If DI is a planned sufficiently in advance prefer dry season and nights with moonlight so that the party can return from the forest even if it is late due to various reasons.
31. Have a good marksman if required.
32. If a depredator elephant is the target, make sure that the right animal is identified and captured.

Discussion

When I started on 22nd April 1979, I had only nicotine that has a narrow margin of safety and also without any antidote. Then came muscle relaxants, which were reversible but with poor margin of safety and which requires immediate reversal and frequent relapses. Opiates, e.g. etorphine heralded a new era with quick and predictable reversing agents. But the problem was its narcotic nature and difficulty in obtaining it as well as extreme precaution to be taken due to toxicity. Then xylazine (Rompun®) and Ketamine were another milestones that initially lacked antidotes but later development of antidotes were a boon for the veterinarians. The future of immobilising animals would be 'No-Drug Immobilisation' for elephants. It is not a utopian wish since it has already been achieved in deer farming to avoid drug residues, and to a large extent in cattle. This uses very high DCV equipment with two electrodes. This has to be distinguished from Taeser®, equipment used for self-defence in countries like US. This usually operates on battery and mortality is not possible since the battery get totally discharged even before accidental death, which is a safety point. In electronic immobilisation the muscles are locked and can be released gradually using a sliding switch. In captive elephants even a long pole can be used and once the muscles are locked, chains or other tethering tools can be put. Since captive elephants are used to tethering routinely unnecessary struggling and injury arising out of it is unlikely.

Figure 3. When reversing stand at a safe place.

I feel envy about those who can use it on captive elephants, probably not in a very distant future.

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Gajaha 29 (2008) 39-40

Some Remarks on the Success of Artificial Insemination in Elephants

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Introduction

In North America reproductive technologies such as artificial insemination (A.I.) have become high priorities for increasing reproductive success in captive elephants (e.g. Kiso *et al.* 2007). However, the results achieved so far are rather sobering as shown by a few data. Between 1st Jan. 1999 and 31st Jan. 2008 205 captive elephants (124 Asian, and 81 African elephants) have been born in western facilities that partake in the European Endangered Species Programmes (EEP) and the North American Species Survival Plan Program (SSP). According to the data bank of the EEG 184 neonates of both species were delivered following natural mating and 21 following A.I. (Kurt & Endres 2008) The sex ratio of neonates subsequent to natural mating was 87 males, 92 females, and 5 of unknown sex. Following A.I. the sex ratio read 17 males and 4 females. The rate of stillbirths after A.I. was 33.3% and hence three times as high as after natural mating (for details see Table 1).

In the countries of origin first A.I. experiments were carried out in the 1990th in Myanmar (Mar, pers. com.) And since then 2 captive bulls have been born after A.I., one on March 7th 2007 in Lampang (Thailand) and one on April 30th 2003 in Qinling Wildlife Park (Xi'an, China) that died on December 26th 2005. Out of all 23 (18 males, 5 females) African and Asian elephants born world wide following A.I. so far to date, 13 still lived in May 2008, 12 males and 1 female.

According to the database of the EEG there are presently at least 3 Asian elephants pregnant due to A.I. in the international zoo world (1 each in Europe, North America and Australia) and 2 African ones in North America. A third female had a miscarriage in August 2008 about 7 months after A.I. However, the number of females used for A.I. experiments seems to be at least 3 times higher than the number of females getting pregnant and sometimes experiments with a particular female are repeatedly carried out over periods of at least 7 years. These actions increasingly attract the interest of welfare NGOs, which often rightfully criticise the brutal training methods used to make to make the animals

Table 1. Number of births from 1.1.1999 - 31.1.2008 after natural mating (N.M.) and artificial insemination (A.I.) in Europe and Israel (EEP) and USA and Canada (SSP).

		Loxodonta africana			*Elephas maximus*			Total
		EEP	SSP	total	EEP	SSP	total	
Number of births	N.M.	49	15	64	77	43	120	184
	A.I.	3	14	17	2	2	4	21
	Total	52	29	81	79	45	124	205
Sex ratio after N.M.	Males	23	5	28	43	16	59	87
	Females	25	9	34	33	25	58	92
	Not known	1	1	2	1	2	3	5
Sex ratio after AI	Males	3	10	13	2	2	4	17
	Females	0	4	4	0	0	0	4
Stillbirths after N.M.	N	2	1	3	8	9	17	20
	%*	4.1	6.7	4.7	10.4	20.1	14.2	10.9
Stillbirths after A.I.	N	-	6	6	1	-	1	7
	%*	-	42.9	35.3	50.0	-	25.0	33.3

*Stillbirths as percentage of the value of all births in the relevant category.

amenable for the A.I. procedures.

Although we agree that studies concerned with A.I. have added considerably to the knowledge of reproduction biology in elephants the EEG maintains a critical view, since neither an extremely high neonate mortality nor an extremely male biased sex ratio can be favourable for preservation of the species in captivity. If an increasing reproduction rate is wanted in Asian countries of origin, attention should be concentrated on a number of more successful breeding centres without A.I. as e.g. the Pinnawela Elephant Orphanage in Sri Lanka or the Royal Elephant Kraal at Ayutthaya in Thailand.

The Pinnawela herd grew from about 30 animals in 1983 to about 70 in 2003 from orphans found in the wild but also through captive propagation. Within this period 12 females gave births to 22 offspring (12 males 10 females). The neonate mortality reads 4.5% (Kurt & Garai 2007) At the Ayutthaya Kraal harbouring presently 75 elephants (22 males and 53 females), 37 neonates were registered between February 2000 and January 2008 (19 males, 18 females). They were born by 25 females and fathered by 7 bulls of the Kraal and 4 bulls from other owners (Unknown 2008). The neonate mortality was 13.5%, i.e. similar to the respective value from western facilities following natural mating and far below of the neonate mortality known from offspring born after A.I.

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Young bull mating at Periyar Tiger Reserve, Thekkady, India
Photo by Chelliya Arivazhagan

Gajah 29 (2008) 41-44

Participatory Development in Nepal: Challenges and Opportunities for Conservation in Managing Human Elephant Conflict

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Introduction

Human Elephant Conflict (HEC) is increasing with the continuous conversion of elephant habitat for human use, subsequently creating conflict between rural farmers and elephants, and becoming a major conservation concern across Africa and Asia (Sukumar 1989; Osborn & Parker 2002). Addressing the issue of HEC is imperative as this continuing conflict not only jeopardizes the survival of elephant populations, but also contributes to the loss of human life whilst undermining collective conservation efforts within local communities (IUCN; Nelson *et al.* 2003; Chong & Norwana 2005).

In the past HEC has been addressed on a technical level, investigating tangible mitigation methods available. However it is not possible to address the problem of HEC effectively without information about what it is elephants are damaging, and where and when these damage incidents occur (IUCN). Data on HEC distribution, frequency and severity needs to be gathered through deliberate and standardized field research as incidents occur in order to understand the causes and scale of the problem (IUCN; Desai 2002; Nelson *et al.* 2003; Chong & Norwana, 2005), so a broad picture of the key explanatory factors will allow for the development and implementation of effective, site-specific solutions, mitigation and management plans (IUCN).

At the same time key ideas in participatory development of including those living in poverty within their own development have been registered as a key factor in the success of development projects. This success acknowledges the need to include those who are most affected by HEC to become involved with the solution (Nelson *et al.* 2003). Recent literature also reflects this in an increase of grassroots rhetoric, heralding HEC as more of a developmental issue.

This paper is based on information gathered as part of a six month field expedition in Nepal, from August 2006 to February 2007 and operating under the WWF that investigated HEC between Bardia National Park in Nepal and Katarniyaghat Wildlife Reserve in India. It supports the notion that there is a demand for greater enumeration of HEC incidents, and offers suggestions for marrying enumeration and local participation in development projects. It supports Osborn and Parker (2003) suggestions that an integrated community-based, low-tech approach will be the most sustainable solution to conflict.

Participatory development

With habitat loss and environmental degradation being the underlying causes of HEC (Desai 2002 as cited in Chong & Norwana 2005) and both often facilitating [the need for] protected area strategies the 'Yellowstone model' has been adopted in many areas, however has not met with great success in many developing countries (Gurung 1995; Schelhas 2001); and in some circumstances can be attributed to having accelerated the impact of some Human Wildlife Conflict (HWC).

In response to the challenges associated with the Yellowstone model's 'fence and fines' approach to nature conservation, participatory approaches such as Integrated Conservation and Development Programs (ICDPs) have been applied into many protected area strategies (Gurung 2006; IIED 1994). The reorientation of Nepal's conservation endeavours to encourage a more participative approach, and the success of the KMTNC's (King Mahendra Trust for Nature Conservation)

Annapurna Conservation Area Project (KMTNC/ ACAP), influenced national conservation policies and paved the way for community initiatives in Nepal (Gurung 2006), reflecting the paradigm shift away from 'top down' approaches to more so called 'bottom up' approaches. This move towards ICDPs acknowledges that people need to be engaged within the development process if conservation strategies are to be sustainable in the long term (Parker 2004).

Despite this reorientation, some past strategies remain unchanged in Nepal's Terai and patterns of rural development have fuelled the expansion of the agricultural frontier. In doing so, islands of suitable habitat arise amongst a sea of agriculture, putting humans in direct conflict with wild animals and uncultivated landscapes (Sanderson 2004). As a result, subsistence farmers bear the cost associated with maintaining wild elephant populations, (Osborn & Parker 2003) making HEC a crucial issue for Nepal (WWF).

Enumeration of Human Elephant Conflict

The IUCN's present data collection and analysis protocol for HEC situations in Africa propose using a combination of sampling methods, in order to obtain primary data. This involves the reporting of HEC incidences to trained enumerators who visit the site of the incident, and interview the affected person(s) as soon as possible after the incident. The enumerator makes their own assessment of the incident by completing an Elephant Damage Report Form, as well as asking the complainant to provide them with retrospective details about the incident (IUCN). This information is then analysed allowing sites to be compared.

Figure 1. Elephant proof trench digging.

These protocols have been initiated in some regions on the African continent but not yet in Nepal, and it is felt that a more stable political situation is required before such a protocol could be implemented (A. Christy Williams, pers. comm.).

Discussion

With the need for greater enumeration of HEC incidents in Nepal, and simultaneously a call for more local participation in development projects, and the inclusion of those who are most affected by HEC (Nelson *et al.* 2003) this paper draws on Osborn and Parker (2003) suggestions for a new approach to Problem Animal Control (PAC) that focuses on what communities are able and willing to do for themselves by having them take responsibility for problems such as crop pests. Whilst these suggestions are being applied (still) to tangible mitigation methods, they could be applied to locals in the collection of primary data on HEC incidents.

By doing away with the need for trained enumerators, and instead providing a User Community (UC), Community Forest User Group (CFUG), or Village Development Community (VDC) with the means of recording incidents of HEC - such as with standardised spreadsheets like the Elephant Damage Report Forms - it would become possible to unite both participation and conflict enumeration by having farmers participate towards the enumeration of HEC. Such a method would be subject to the inherent biases not present with impartial enumerators, but could however provide valuable information on the frequency and distribution of incidents, with relatively minimal input.

Data collection could see completed spreadsheets being delivered to a single centralised office, or a series of satellite offices. Alternatively the adoption of 'technological leapfrogging' may be used by having individuals trained in inputting data onto palmtop computers with information being transmitted by wireless connection to

a central computer, addressing the logistical challenge of remote locations.

Including local people in the collection of primary data could encourage willingness for locals to get involved in long-term processes like land use planning and economic development, also suggested by Nelson *et al.* 2003. By encouraging farmers to take greater responsibility for the problems of HEC, we would see a move towards decentralisation, with HEC as an issue of Community-Based Natural Resources Management (CBNRM) or Common Pool Resources (CPR) through initiating ecotourism.

Decentralisation and participatory development have emerged as an important instrument of environmental and development policy in the last two decades. Where common pool resources (CPR) and community based natural resources are concerned, the goal of decentralization policies has often been to increase participation of rural households in decision making and benefits related to environmental resources (Agrawal & Gupta 2005), something that needs be done in addressing HEC.

However, factors that help explain local participation in decentralised schemes need to be examined. Many rural communities, especially in Nepal's Terai and more generally in South East Asia, are highly differentiated and stratified (Agrawal & Gupta 2005). In such circumstances, the question of differential participation becomes especially important because the benefits of decentralisation policies are seen to improve with greater participation. Presumably, those households that participate more in efforts to devolve control over resources are also the ones that gain greater benefits from resources. Conversely, non-participating households benefit less from decentralisation because they are unable to exercise their voice (Agrawal & Gupta 2005). In CBNRM schemes for tackling HEC this could see mitigation measures being taken away from lower caste communities and applied where conflict is perhaps less severe.

Policies that aim to empower communities and alter the status quo vis-à-vis power structure within the community are likely to meet resistance from local elite's, as they resist any form of structural change. Where approaches reinforce or build upon local networks of power and authority, less resistance from the elite is likely (Parker 2004). It is important that research and ICDP facilitators recognise local level conflict and power inequities.

Conclusion

Limited time and money is often spent on technologies aimed at tackling the challenges of HEC, with little research going into trying to map where and when incidences occur. By acknowledging the need for local involvement (Figs. 1 & 2) in moving towards alleviating HEC - with focus on what communities are able and willing to do for themselves – ideas of shifting the responsibility for crop protection to farmers and self reliant participatory development and conflict alleviation – that isn't completely reliant on outside funding – is at least theoretically, an approach that is more sound than any single technical solution (Osborn & Parker 2003).

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Figure 2. Elephant proof trench in Laksmipur.

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Way Kambas elephant camp, Lampung province, Sumatra
Photo by Wahdi Azmi

Gajah 29 (2008) 45-51

The U.S. Fish and Wildlife Service Asian Elephant Conservation Fund - The First Ten Years of Support

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Introduction

In both Asia and Africa, conservation strategies focus on native species such as elephants. Although modern day elephants are not indigenous to the Americas, the United States government has been a strong supporter of elephant conservation initiatives through federal legislation authorizing the African Elephant Conservation Act in 1988 and the Asian Elephant Conservation Act in 1997. Both of these Acts enabled the establishment of funding to provide financial assistance to in-situ conservation and are managed by a federal agency, the U.S. Fish and Wildlife Service (FWS) under the Department of Interior.

The Asian Elephant Conservation Fund (AsECF) has supported a variety of projects in all Asian elephant range states over the past ten years via a competitive grants' program. This support has been in the form of financial assistance awarded to applicants who submit funding proposals. A committee from the U.S. Fish and Wildlife Service evaluates these projects. All proposals submitted to the AsECF have matching funds.

During the past ten years, the AsECF has supported about 20 projects annually at an average funding amount of US$ 47,000.00 per project. This has provided a total amount of funding assistance of US$ 9,500,000.00 generating matched funds for these projects in the amount of US$ 12,500,000.00. Project activities have covered a wide range of topics important to Asian elephant conservation, including applied research, surveys and monitoring, management plan development, protection of at-risk populations, efforts to combat illegal trade, transfrontier elephant conservation, law enforcement, capacity development, community outreach, conservation education, protected area management, habitat conservation and management, and human-elephant conflict reduction.

As conservation needs evolve over time, the AsECF suggests that stronger collaborations and alliances between governmental agencies and various groups supporting conservation be explored, along with prioritizing issues from a landscape perspective and addressing conflicts with wildlife more effectively. In this article we explore some of these potential innovative approaches to tackle the increasing challenges faced by wild Asian elephants (and other wildlife) and the habitats that they rely on in a rapidly changing human landscape.

History of the Asian Elephant Conservation Act

The Asian Elephant Conservation Act resulted from the efforts of a former United States Congressman, Mr. Andy Ireland, who was seeking to support elephant conservation in a meaningful way by facilitating a private/public partnership. Mr. Ireland, at the time Senior Vice President of Feld Entertainment, parent company of the Ringling Bros. and Barnum & Bailey circus and the Center for Elephant Conservation, had been a former Representative in Congress from the State of Florida for almost 20 years. In 1997, discussions with FWS personnel pointed to a need for an Asian Elephant Conservation Act modelled after the previously approved African Elephant Conservation Act (1988) and Rhinoceros and Tiger Conservation Act (1994). With the support of Feld Entertainment, Mr. Ireland then spearheaded the effort to obtain legislation that would become the Asian Elephant Conservation Act. Mr. Ireland enlisted his former colleagues in Congress, the Honourable Jim Saxton, a Representative in Congress from

the State of New Jersey, and the Honourable Neil Abercrombie, a Representative from the State of Hawaii, who agreed to sponsor the legislation. They built support within the local U. S. conservation community by bringing together the American Zoo & Aquarium Association and the World Wildlife Fund, and, along with Feld Entertainment, formed a small coalition of private partners. This helped provide means for U.S. based organizations to aid Asian elephant conservation by supporting federal legislation encouraging such partnerships.

The legislation to create the Asian Elephant Conservation Act, H.R. 1787, sponsored by Mr. Saxton and Mr. Abercrombie, along with fifteen other co-sponsors, was introduced into the United States House of Representatives on 4. June 1997.

The legislation proposed "to assist in the conservation of Asian elephants by supporting and providing financial resources for the conservation programs of nations within the range of Asian elephants and projects of persons with demonstrated expertise in the conservation of Asian elephants." On 31. July 1997, a public hearing was held on H.R. 1787. The hearing was held before the House Subcommittee on Fisheries Conservation, Wildlife and Oceans, Committee on Resources, in Washington DC.

The hearing was attended by the main sponsors of H.R. 1787: Mr. Neil Abercrombie and Mr. Jim Saxton, as well as several committee members: the Honourable Sam Farr, a Representative in Congress from the State of California, the Honourable George Miller, a Representative in Congress from the State of California, and the Honourable Don Young, a Representative in Congress from the State of Alaska.

In his opening statement, Mr. Saxton made the following comments: "… The fundamental purposes of this legislation are twofold: one, to create an Asian Elephant Conservation Fund, and, two, to authorize the Congress to appropriate up to US$ 5 million per year to this fund to finance various conservation projects for each of the next five fiscal years. This legislation is modelled after the highly successful African Elephant Conservation Act of 1988 and the Rhinoceros and Tiger Conservation Act of 1994. The new authorization would be separate from those funds appropriated for African elephants, rhinos, and tigers. Under the terms of H.R. 1787, the Secretary of Interior would carefully evaluate the merits of each proposed conservation project, select those that best enhance the future of the Asian elephant, and give priority to those projects whose sponsors demonstrate the ability to match some portion of the Federal funds. In addition, the bill stipulates that the Secretary may accept donations to assist Asian elephants and shall spend no more than 3 percent of the amount appropriated to administer the fund. Unless immediate steps are taken to conserve this magnificent animal, it will surely continue to disappear from much, if not most, of its traditional habitat. We cannot allow the Asian elephant, which has such a direct impact on so many other species, to become extinct. The goal of H.R. 1787 is to stop the decline and hopefully rebuild the population stocks of this irreplaceable species by financing with a small amount of Federal money a limited number of conservation projects…"

The hearing also received statements from several experts including: Marshall P. Jones, Assistant Director for International Affairs, FWS, accompanied by David Ferguson, Chief, Branch of Middle East, South Asia, and South African International Affairs, FWS; Dr. Eric Dinerstein, Chief Scientist and Director, Conservation Science Program, World Wildlife Fund; Andy Ireland, Senior Vice President, Feld Entertainment, Inc.; Dr. Terry Maple, President/ CEO, Zoo Atlanta and President-elect, American Zoo & Aquarium Association (AZA); Dr. Mary Pearl, Executive Director, Wildlife Preservation Trust International; Dr. Michael Stüwe, Research Associate, Conservation and Research Center, Smithsonian Institute; and Dr. Raman Sukumar, Chairman, IUCN/SSC Asian Elephant Specialist Group. Furthermore, Dr. A.J.T. Johnsingh, and A. Christy Williams, Wildlife Institute of India, supplied additional material to the Committee.

The bill, H.R. 1787, was unanimously approved by the committee, and it was then sent to the

United States House of Representatives for consideration by all 435 members. The House passed H.R. 1787 on 21. Oct.; the United States Senate later approved it on 8. Nov. without a hearing. Finally, President Clinton signed H.R. 1787 into law on 19. Nov. 1997.

The Asian Elephant Conservation Act gave the United States Congress permission to create an Asian Elephant Conservation Fund managed by the FWS. The Act allows funds to be spent to specifically support Asian elephant conservation in range states, and the budget is re-approved on a yearly basis.

On 13. March 2007, the House Natural Resources Committee, Subcommittee on Fisheries, Wildlife and Oceans, held a legislative hearing on H.R. 465, the Asian Elephant Conservation Reauthorization Act of 2007, to reauthorize the Asian Elephant Conservation Act of 1997. During this hearing witnesses included: Mr. Kenneth Stansell, Acting Deputy Director, U.S. Fish and Wildlife Service; Dr. Michael Fay, Wildlife Conservation Society and National Geographic Society; Dr. Sybille Klenzendorf, Director, Species Conservation, World Wildlife Fund; Mr. John Berry, Director, Smithsonian's National Zoological Park; and Mr. Josh Ginsberg, Vice President and Chief of Conservation Operations, Wildlife Conservation Society. H.R. 465 was approved and continues to support Asian elephant conservation projects today.

A decade of Asian elephant conservation support

The Asian Elephant Conservation Act is designed to support the conservation of Asian elephants by providing financial resources to programs in range countries of Asian elephants, and to projects of persons or organizations with expertise in Asian elephant conservation. A proposal review committee, consisting of members from the FWS primarily, reviews project proposals submitted to the AsECF, evaluating them using a scoring system as well as in-depth discussions about each proposal, and the assistance provided by the AsECF is leveraged by a matching support of both public and private funds.

Since funds became available in 1999 and through 2007, the AsECF has assisted over 20 projects per year at an average amount of US$ 47,000.00 per project. The total amount of financial assistance provided by the Asian Elephant Conservation Fund through 2007 was US$ 9,500,000.00 and these funds generated matching support for the projects in the amount of US$ 12,500,000.00. These programs have been implemented in all thirteen Asian elephant range states, and cover a wide variety of work supporting the conservation of Asian elephants. Project activities supported by the Fund include applied research, surveys and monitoring, management plan development, protection of at-risk populations, efforts to combat illegal trade, transfrontier elephant conservation, law enforcement, capacity development, community outreach, conservation education, protected area management, habitat conservation and management, and human-elephant conflict reduction. Some project examples include: identifying corridors, poaching and the trade in ivory, protection and strengthening law enforcement by supporting anti-poaching camps, vehicles, and personnel field gear, use of captive elephants for conservation, publication of legal digest on wildlife laws and of "Gajah," various meetings and workshops (such as the Asian Elephant Range States meeting), innovative education programs, the Monitoring of Illegal Killing of Elephants (MIKE) program, and emergency relief post tsunami in 2005.

In the first few years of the AsECF, program areas with the most supported projects were: survey and monitoring (24%), conflict resolution (23%) and habitat management (16%). Between 2004 and 2007 20% of projects primarily focused on applied research, 18% on human-elephant conflict mitigation efforts, and 11% on capacity building. In the 2008 funding cycle, close to 40% of the projects supported had a human-elephant conflict mitigation component.

The number of proposals received by the Fund each year averaged around 30 until 2007. During the 2008 funding cycle more than 80 proposals were received by the AsECF. With rapidly increasing loss of habitats there has been escalating human-elephant conflict and this

has been reflected in the proposals received by the Fund. Additionally, there has also been an interest in looking at diseases affecting elephant populations, such as *Mycobacterium tuberculosis* and elephant endotheliotropic herpes virus. Over the years, great advances have been made in surveying techniques and technologies with many of these supported by the Fund. Much has also been invested to improve law enforcement training and implementation, as well as increased local capacity. Despite this, it appears that in many range areas wild Asian elephants continue to walk a very tight rope and may be losing ground. Clearly, greater collaboration between Governments and non-governmental groups is essential if we hope to maintain healthy wild elephant populations and healthy habitats. These same habitats also serve as the watersheds and lungs that help maintain healthy human populations.

Suggested direction for future Asian elephant conservation support

As conservation needs change with time, it is vitally important to evaluate what has been done and what needs to be done to address environmental issues important to elephant conservation and habitat protection such as climate change and the need for forest restoration work, as well as linking this work with the establishment of corridors. In an era of accelerating global climate change, burgeoning human populations, rapidly dwindling wild habitats, and greatly increasing competition for natural resources, it is urgently important to work together on conservation issues ensuring the long-term viability of healthy landscapes to support healthy populations of humans and wildlife, including wild elephants. The very habitats that support wildlife are also increasingly important for their ecosystem services, including such vital essential elements as fresh water sources, flood control, ground water recharge, topsoil regeneration, global climate moderation, and disease minimization.

The time for habitat restoration has clearly been recognized by many, and projects that include such a construct along with human health, ecosystem health, human family planning, environmental education, are all ideas that beg further consideration. A paradigm shift is necessary to offer solutions to the problems. Clearly, such an approach to wildlife conservation requires coalitions that include wildlife biologists, social scientists, health-care professionals, creative educators, micro-credit financiers; essentially a truly interdisciplinary approach is needed to understand and address the complexity of the problems. Many lessons can be learned from work being done to support the conservation of species other than Asian elephants, including some of the projects that are being supported by other Multinational Species Funds within the FWS. Education and community awareness projects should be creative, train the trainers and teachers, and be prepared to update their resource materials, learning lessons from other areas, including other range countries and beyond. The AsECF is in no position to solve human poverty alleviation problems, but applicants who form capable coalitions that can tackle both wildlife (particularly Asian elephants) and human needs could apply to the AsECF for start-up/bridging funds and leverage other sources of funding that support human needs such the World Bank or Global Environmental Facility (GEF).

The concept of "sustainable development" may require serious re-evaluation; it may be well past the time when any development can be considered, sustainable or otherwise. A better approach would be to think in terms of "sustainable management" of natural resources. With accelerating global climate change and worldwide recognition of the need for restoration and conservation of natural forests for the purposes of carbon sequestration, protection of ecosystem services, and natural disaster mitigation, there is now further possibility of expanding ideas on habitat protection. It is important for conservationists to look at ways to make communities benefit from forest protection and restoration, such as by providing carbon credits directly to the communities involved in habitat protection and restoration efforts. Some carbon credit funds could also go to support protected area management efforts, continued training for protected area managers, or similar immediate benefits. Such efforts would help provide greater habitat security for elephants and

other wildlife. Clearly these efforts would also benefit from coalitions, such as a partnership between ecologists, educators, human and veterinary health-care professionals, business management specialists, social scientists, micro-credit experts, to name just a few. Whenever and wherever a project is developed, "sustainability" should always be given serious consideration. Sustainability is not solely limited to sources of funding, but also includes important aspects such as the long-term viability of efforts continuing beyond the life of the specific project, the importance of the area with respect to elephant populations, biodiversity, and ecosystem health. Applicants could explore the use of the AsECF to leverage these other non-traditional sources of funds for potentially non-traditional approaches to wildlife and habitat conservation efforts.

The AsECF strongly encourages groups to work together, and there is more effective information sharing so efforts are not duplicated. It is also important credit be given where it is due, and credit be shared among partners so partners do not feel alienated – everyone's contribution to conservation is important. Many conservation groups prefer to stake out their own areas of work (such as a territory), but this has not always been very helpful to the natural resources they wish to conserve. Networking helps conservation in many ways: for example, it is important to know the reasons for successes or failures of mitigation measures in various regions, and make current data widely available to most effectively prioritize issues such as wildlife corridors or habitat restoration. Just as Asian elephant populations share habitats and resources with other wildlife and human populations, it is time for conservationists to better share information and resources, and to formulate multidisciplinary approaches to tackle the modern day issues of Asian elephant conservation.

Conclusion

The Asian Elephant Conservation Fund has supported many noteworthy projects during the last decade and will continue to do so. As problems faced by wild Asian elephants and their habitats continue to further escalate, projects should be designed considering important issues such as: accelerating climate change, increased need in connectivity of habitats including transboundary corridors and connectivity between protected areas, urgency for habitat restoration, as well as important coalitions that can approach and tackle problems from a multidisciplinary perspective and knowledge base. The AsECF will continue to encourage such collaborations and projects that have greater prospect and hope for sustainability, for wild Asian elephants and their habitats, and for the peaceful co-existence with humans living near them.

Supplemental information regarding grants under Asian Elephant Conservation Fund

The Asian Elephant Conservation Fund

Administered by the U.S. Fish and Wildlife Service, Department of the Interior and authorized by the Asian Elephant Conservation Act, United States Public Law 105- 96, 111 Stat. 2150, 16 U.S.C. 4261-4266.

Objectives

To provide financial assistance to support the effective long-term conservation of Asian elephants. This program provides support for projects that focus on one or more of the following areas: applied research, including surveys and monitoring; enhanced compliance with treaties and laws that prohibit the take or trade of Asian elephants or regulate the use and management of their habitat; conservation education and community outreach; development and execution of conservation management plans; enhanced protection of at-risk populations; habitat conservation and management, including protected area and reserve management; local capacity building; reduction in human-elephant conflicts; transfrontier conservation; and wildlife inspection, law enforcement, and forensics skills.

Assistance

Through a competitive grants' program.

Uses and restrictions

Project work should occur within the range of the Asian elephant, or, if work is to be conducted outside of the range, the proposal should show a clear relevance to Asian elephant conservation. Applied research projects should address specific management needs and actions. Funds provided under this program will not be used for: the purchase of firearms or ammunitions; buying of intelligence information or paying informants: gathering information by persons who conceal their true identity; law enforcement operations that prompt suspects to carry out illegal activities so they may be arrested (entrapment); or any activity that would circumvent sanctions, laws or regulations of either the U.S. or the country in which the activity would occur. This program is administered in compliance with the Federal Grants and Cooperative Agreement Act of 1977, as amended. These funds may not be used towards training U.S. Federal Government personnel.

Applicant eligibility

Applications may be submitted by any Asian government agency responsible for Asian elephant conservation and protection, and by any other organization or individual with demonstrated experience in Asian elephant conservation. Non-governmental applicants should include a recent letter of support from the appropriate local, regional, or national governmental wildlife or conservation authority, and these endorsement letters should make specific reference to the project by its title, as submitted on the proposal.

Application procedure

Proposals must be submitted in English. Documentation must demonstrate the participation and/or endorsement of the local government(s). Projects with matching funds (cash) or in-kind support (salaries, equipment, etc.) equal to or exceeding the amount requested from the FWS are preferred. The Notice of Funding Availability and Application Instructions are located on this program's website. Hard copies are available upon request from the Division of International Conservation, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, Room 100, Arlington, Virginia 22203, USA. A proposal will not be considered complete if all required elements are not submitted as instructed.

Projects are reviewed and competitively selected for funding based on established criteria contained in the Asian Elephant Conservation Act (16 USC 4261 4266). Review criteria can be found in the application information at the website.

Deadline

This program has two annual deadlines. The first deadline is November 1 each year. The second deadline is April 1 each year.

Decisions on funding of projects are made within 180 days after receipt of the project proposal.

Matching requirements

To the extent possible, grant funds are matched by nonfederal funds (i.e., non-U.S. Government funds). In determining whether to approve project proposals, preference is given to projects for which matching funds are available.

Length of assistance

Funding is for one year or less. Projects that require more than one year of funding will be required to compete on an annual basis through submission of additional proposals. Awarded funds must be spent during the performance period that is approved for each Assistance Award, and in accordance with program financial and performance reporting procedures.

Reports

Each grant recipient is required to submit regular progress and accounting reports. A final report that evaluates the success of meeting goals is required within 90 days of the project's completion. Complete reporting requirements can be found at this program's web page.

Range of financial assistance

Variable amounts. Due to the limited funding available and the desire to support diverse projects, preference will be given to proposals requesting $ 50,000 or less. Higher amounts may be requested with appropriate justification.

Related programs

15.619, Rhinoceros and Tiger Conserv. Fund
15.620, African Elephant Conservation Fund
15.629, Great Apes Conservation Fund
15.645, Marine Turtle Conservation Fund.

Funded projects

Annual summaries of the projects funded under this program can be found at the website. Hard copies of this information are available upon request from the Division of International Conservation.

Proposal selection criteria

Proposals will be reviewed on the basis of criteria developed from the Asian Elephant Conservation Act (16 U.S.C. 4261-4266). Due to the limited funding available and the desire to support diverse projects, preference will be given to proposals requesting $ 50,000 or less.

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15.621 Asian Elephant Conservation Fund (2008) *The Catalog of Federal Domestic Assistance.* http://www.cfda.gov/pls/portal30/CATALOG.PROGRAM_TEXT_RPT.SHOW?p_arg_names=prog_nbr&p_arg_values=15.621

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Charging elephant, North-west India.
Photo by Ritesh Joshi

Gajah 29 (2008) 52-53

First Workshop for Mahouts and Paramedics about Elephant Medical Management Conducted in Sumatra

Christopher Stremme[1], Nazaruddin[2] and Heidi S. Riddle[3]

[1]*Veterinary Society for Sumatran Wildlife Conservation*
[2]*FOKMAS and Way Kambas National Park*
[3]*International Elephant Foundation*

About 300 Sumatran elephants (*Elephas maximus sumatranus*) are housed in elephant training centres throughout Sumatra, and about another 250 are housed in zoos, safari parks, logging companies and conservation NGOs throughout Indonesia. A lack of veterinary care in many of these facilities is due to insufficient funds, equipment and laboratory facilities.

In facilities where veterinarians are available, the quality of medical management depends very much on the support and cooperation of mahouts, paramedics and camp managers. In facilities were no veterinarians are available, or only visit occasionally, almost all medical management and procedures are performed by the mahouts and paramedics themselves. Therefore, to improve health management of captive Sumatran elephants it is very important to build knowledge amongst mahouts, paramedics and camp managers about the needs and uses of various medical procedures, and how to perform them.

To address this issue, the Sumatran Mahout Association (Forum Komunikasi Mahout Sumatra/FOKMAS) together with the Way Kambas National Park, conducted a workshop for mahouts and paramedics to increase knowledge about general medical management needs and basic techniques of laboratory diagnostics for elephant medical management.

The first workshop for mahouts and paramedics was conducted from 23. - 26. June 2008, at the Way Kambas Elephant Training Centre in southern Sumatra. This workshop was enabled by technical and financial support from the Veterinary Society for Sumatran Wildlife Conservation (Vesswic), International Elephant Foundation (IEF), and elephant family (ef).

The workshop was attended by 44 participants representing all elephant training centres in Sumatra, as well as zoos, safari parks and NGOs from Sumatra, Java and Bali.

The opening speech was given by the Director of the Directorate of Biodiversity and Species Conservation of the Agency for Forest Protection and Nature Conservation (KKH/ PHKA). Presentations about the general role and importance of paramedics and mahouts for elephant health management were given by speakers from the Indonesian Veterinary Association (PDHI).

A qualified wildlife veterinary technician from the Indianapolis Zoo (USA) was invited by IEF to assist with the workshop. The veterinary technician conducted lectures and practical demonstrations about storing, shipping, processing and evaluating blood, faeces and urine samples, as well as handling, storing, and maintaining a stock of medical equipment, drugs, and supplies. A written manual about all these issues was prepared for distribution to the participants.

Veterinarians from the Vesswic Elephant Health Care Program conducted lectures about basic elephant anatomy and physiology; major diseases in elephants and how they relate to laboratory findings; techniques for collecting blood, faeces and urine samples; and basic treatment schemes and techniques including calculating drug dosages. Vesswic staff also led practical demonstrations about collecting samples of

blood, faeces, and urine from elephants, as well as drug administration.

The workshop resulted in increased knowledge and understanding amongst participating mahouts and paramedics of general elephant health care needs, treatment regimes, and laboratory diagnostics. The workshop also increased awareness about the need for improved elephant medical care amongst responsible Indonesian government authorities such as the Agency for Forest Protection and Nature Conservation (PHKA), Directorate for Biodiversity and Species Conservation (KKH) and the Indonesian Veterinary Association (PDHI).

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Gajah 29 (2008) 54-56

An International Workshop on the Conservation of the Bornean Elephant in Sabah: What Were the Outcomes?

Laurentius N. Ambu[1], Marc Ancrenaz[2] and Benoît Goossens[3,4]

[1]*Sabah Wildlife Department, Kota Kinabalu, Sabah, Malaysia*
[2]*Kinabatangan Orang-utan Conservation Project, Sandakan, Sabah, Malaysia*
[3]*Danau Girang Field Centre, Lower Kinabatangan Wildlife Sanctuary, Sabah Wildlife Department, Kota Kinabalu, Sabah, Malaysia*
[4]*Cardiff School of Biosciences, Cardiff University, Cardiff, UK*

An International Workshop on the Conservation of the Bornean Elephant was held in Kota Kinabalu, Sabah, 21. - 23. May 2008, at the Shangri La's Rasa Ria Resort. The workshop was hosted by the Sabah State Government and co-organised by the Sabah Wildlife Department, Cardiff University, the NGO HUTAN, Universiti Malaysia Sabah and WWF-Malaysia. Funding was provided by the Darwin Initiative for the Survival of Species (UK), the US Fish and Wildlife Service Asian Elephant Conservation Fund (USA), Borneo Conservation Trust (Sabah) and the Rasa Ria Resort itself. Around 150 participants from around the globe attended the workshop, including elephant experts from India, Indonesia, Malaysia, Thailand, Gabon in central Africa, UK and USA.

The Bornean elephant, the eastern-most population of the Asian elephant, is evolutionarily distinct and is a high priority for conservation (Fig. 1). The aims of the workshop were to present the results of the works carried out in the State during the last eight years and to discuss the results with all stakeholders involved in the conservation and the management of elephants in Sabah. The objectives were (1) to provide a forum for presenting and discussing the results of on-going studies about the Bornean elephant ecology, its distribution, movement and habitat use, the population genetics, and human-elephant conflicts; (2) to provide sound management recommendations for securing elephants long-term survival in Sabah; and (3) to produce a resolution endorsed by all workshop participants and to be tabled before the Sabah State Government in a near future.

The Workshop was opened by the Assistant Minister of Tourism, Culture and Environment, Bolkiah Haji Ismail and closed by the Minister of Tourism, Culture and Environment, Datuk Masidi Manjun, to whom the resolution was presented.

The participants of the workshop recommended a series of conservation measures to enable the future viability of Bornean elephants in Sabah. Issues such as human-elephant conflict, elephant management, habitat management, research and education, fundraising and tourism were discussed and priority actions were set.

First, the conference identified four major elephant areas and urged their declaration as "managed elephant ranges" (MERs): Lower Kinabatangan, Tabin, Deramakot-Sebuku, and Ulu Kalumpang. These four elephant ranges should ideally be maintained under natural forest management and all necessary measures to re-establish connectivity within and between these ranges need to be investigated.

Second, other major recommendations included: (1) the establishment of a Borneo Elephant Conservation Alliance (BECA) to encourage collaboration and communication between all stakeholders involved in elephant management in Sabah. This alliance will help coordinate fundraising, conservation, research, education and information sharing; (2) the urgent need to produce basic biological information on the Bornean elephant to better understand the dynamics and the ecology of this species in Sabah; (3) a better understanding of elephant habitat requirements and land-use interactions;

(4) decide for and implement a moratorium on new oil palm development within 500 m on both sides of the Kinabatangan river and include all state lands covered with forest and adjacent to the Lower Kinabatangan Wildlife Sanctuary (LKWS) into the LKWS; (5) more attention to be given to the problem of elephant crop raiding and conflict mitigation; and (6) create a management committee for Responsible Elephant Tourism (RET), chaired by the State Ministry of Tourism, Culture and Environment.

Third, some additional recommendations were identified by the different working groups and were the following:

(a) Human-Elephant Conflict (HEC) Working Group recommendations: (1) to improve mitigation measures for HEC by exploring the efficacy of direct elephant management, electric fencing, clarifying land demarcation, increasing support from government and NGOs and defining policy; (2) to increase awareness of HEC by improved interaction with the wildlife authorities, facilitated if necessary by NGOs; (3) to unblock former elephant migration routes which have been constricted by land-use changes, by land purchasing or leasing from industry and communities; and (4) to establish a credible compensation scheme for crop raiding and injury following best practice from outside models if appropriate.

(b) Habitat Management Working Group recommendation: (1) Secure connectivity within and between the key MERs with specific protection for critical corridor habitats.

(c) Elephant Management Working Group recommendations: (1) to set goals for minimum viable population sizes for the elephant populations in Sabah; (2) to establish a decision making framework for establishing the non-viability of a population or its overabundance. Specific population and habitat viability analysis for the elephants of Sabah should be carried out when sufficient data become available; (3) a viable ex-situ management strategy for Bornean elephants should be established with international cooperation; and (4) elephants need specific protection measures to enable their conservation in situ. Such measures should use patrol units, intelligence networks, guard systems, penalties for illegal activity and potentially, after consultation, the upgrading of the elephant's status to Schedule 1.

Figure 1. A Bornean elephant in the forest of the Lower Kinabatangan Wildlife Sanctuary.

(d) Research Working Group recommendations: (1) to understand the ecology; habitat use and ecophysiological limitations of elephants in the major central forest population in Sabah to enable a predictive approach and landscape planning for reserve design and to understand what limits their present distribution on the island of Borneo; (2) to establish a research community network (within the auspices of BECA) to enable co-ordinated research activities, joint funding proposals and to enhance the local research infrastructure (physical and human) in Sabah; (3) to carry out research to understand the socio-economics of human-elephant interactions, including financial consequences of crop raiding,

an assessment of potential compensation measures and the economic and ecological effects of elephant based ecotourism.

(e) Education Working Group recommendations: (1) to use direct advocacy to educate and influence those involved in land-use decisions, via specialised education tools, direct interaction and early stage curriculum development; (2) to build educational capacity and improve general coordination using Sabah Environmental Education Network (SEEN) and by focusing on training teachers and honorary wildlife wardens; (3) to spread environmental education activity best practice from the Kinabatangan to other elephant range areas; and (4) to seek funding for educational materials (books, audio-visual), especially from industry.

(f) Fundraising Working Group recommendations: (1) enable sustainable and interactive funding by exploration and engagement in Payment for Ecosystem Services (PES) mechanisms, creation of a Sabah Elephant Conservation Trust Fund targeting tourists visiting elephant sites, by building funding partnerships with corporations/industry and through public fundraising campaigns; (2) identify organizations that support operational costs and salaries which are currently difficult to attain; and (3) improve fundraising capacity by providing necessary training and identifying and building on existing skills.

(g) Tourism Working Group recommendations: (1) of highest priority, and within the auspices of BECA, create a management committee (involving relevant government agencies, local communities, researchers, tour operators and NGOs) for Responsible Elephant Tourism (RET), chaired by the state Ministry of Tourism Culture and Environment; (2) produce guidelines, rules and regulations for RET using a standardized information package to be developed and disseminated to Tourism Players by the management committee; (3) to introduce a RET compulsory training program with certification, developed and implemented by the management committee under the approval of the state Ministry of Tourism Culture and Environment, including stringent health and safety and local infrastructure guidelines; (4) raise awareness, build capacity and encourage participation of local communities in RET including financial support and creation of economic opportunities; and (5) incorporate elephant and environmental issues in the guidelines and especially focus on measures to minimise behaviour changes in elephant populations as a result of tourism.

As stated by Datuk Masidi Manjun at the closing ceremony on May 23 “Time is running out fast and there are not many animals left in the wild. If we do not do something urgently I think we are going to lose these animals. This wildlife, as part of the State natural heritage, is the very reason why people come to Sabah. We need to protect wildlife and its natural habitat!”

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Figure 2. Workshop participants below the official banner.

Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

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

U. Bechert, J.M. Christensen, C. Nguyen, R. Neelkant & E. Bendas

Pharmacokinetics of orally administered phenylbutazone in African and Asian elephants (*Loxodonta africana* and *Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 188–200

Abstract. The pharmacokinetic parameters of phenylbutazone were determined in 18 elephants (*Loxodonta africana* and *Elephas maximus*) after single-dose oral administration of 2, 3, and 4 mg/kg phenylbutazone, as well as multiple-dose administrations with a 4-wk washout period between trials. After administration of 2 mg/kg phenylbutazone, mean serum concentrations peaked in approximately 7.5 hr at 4.3 ± 2.02 μg/ml and 9.7 hr at 7.1 ± 2.36 μg/ml for African and Asian elephants, respectively, while 3 mg/kg dosages resulted in peak serum concentrations of 7.2 ± 4.06 μg/ml in 8.4 hr and 12.1 ± 3.13 μg/ml in 14 hr. The harmonic mean half-life was long, ranging between 13 and 15 hr and 39 and 45 hr for African and Asian elephants, respectively. There was evidence of enterohepatic cycling of phenylbutazone in Asian elephants. Significant differences ($P < 0.0001$) in pharmacokinetic values occurred between African and Asian elephants for clearance (27.9 and 7.6 ml/hr/kg, respectively), terminal half-life (15.0 and 38.7 hr, respectively), and mean residence time (22.5 and 55.5 hr, respectively) using 2-mg/kg dosages as an example. This suggests that different treatment regimens for Asian and African elephants should be used. There were no apparent gender differences in these parameters for either elephant species. © 2008 American Association of Zoo Veterinarians.

L.A. Bates, P.C. Lee, N. Njiraini, J.H. Poole, K. Sayialel, S. Sayialel, C.J. Moss, R.W. Byrne

Do Elephants Show Empathy?

Journal of Consciousness Studies 15, #10-11 (2008) 204-225

Abstract. Elephants show a rich social organization and display a number of unusual traits. In this paper, we analyse reports collected over a thirty-five year period, describing behaviour that has the potential to reveal signs of empathic understanding. These include coalition formation, the offering of protection and comfort to others, retrieving and 'babysitting' calves, aiding individuals that would otherwise have difficulty in moving, and removing foreign objects attached to others. These records demonstrate that an elephant is capable of diagnosing animacy and goal directedness, and is able to understand the physical competence, emotional state and intentions of others, when they differ from its own. We argue that an empathic understanding of others is the simplest explanation of these abilities, and discuss reasons why elephants appear to show empathy more than other non-primate species. © 2008 Imprint Academic.

A. Campos-Arceiz, A.R. Larrinaga, U.R. Weerasinghe, S. Takatsuki, J. Pastorini, P. Leimgruber, P. Fernando & L. Santamaría

Behavior rather than diet mediates seasonal differences in seed dispersal by Asian elephants

Ecology 89 (2008) 2684–2691

Abstract. Digestive physiology and movement patterns of animal dispersers determine deposition patterns for endozoochorously dispersed seeds. We combined data from feeding trials, germination tests, and GPS telemetry of Asian elephants (*Elephas maximus*) to (1) describe the spatial scale at which Asian elephants disperse seeds; (2) assess whether seasonal differences in diet composition and ranging behavior translate into differences in seed shadows; and (3) evaluate whether scale and seasonal patterns vary between two ecologically distinct areas: Sri Lanka's dry monsoon forests and Myanmar's (Burma)

mixed-deciduous forests. The combination of seed retention times (mean 39.5 h, maximum 114 h) and elephant displacement rates (average 1988 m in 116 hours) resulted in 50% of seeds dispersed over 1.2 km (mean 1222–2105 m, maximum 5772 m). Shifts in diet composition did not affect gut retention time and germination of ingested seeds. Elephant displacements were slightly longer, with stronger seasonal variation in Myanmar. As a consequence, seed dispersal curves varied seasonally with longer distances during the dry season in Myanmar but not in Sri Lanka. Seasonal and geographic variation in seed dispersal curves was the result of variation in elephant movement patterns, rather than the effect of diet changes on the fate of ingested seeds. © 2008 Ecological Society of America.

R. Clubb, M. Rowcliffe, P. Lee, K.U. Mar, C. Moss, G.J. Mason

Compromised survivorship in zoo elephants

Science 322 (2008) 1649

Abstract. We analyzed data from over 4500 elephants to show that animals in European zoos have about half the median life span of conspecifics in protected populations in range countries. This discrepancy is clearest in Asian elephants; unlike African elephants in zoos, this species' infant mortality is very high (for example, twice that seen in Burmese timber camps), and its adult survivorship in zoos has not improved significantly in recent years. One risk factor for Asian zoo elephants is being moved between institutions, with early removal from the mother tending to have additional adverse effects. Another risk factor is being born into a zoo rather than being imported from the wild, with poor adult survivorship in zoo-born Asians apparently being conferred prenatally or in early infancy. We suggest stress and/or obesity as likely causes of zoo elephants' compromised survivorship. © 2008 Reprinted with permission from AAAS.

R. Hermes, J. Saragusty, W. Schaftenaar, F. Göritz, D.L. Schmitt & T.B. Hildebrandt

Obstetrics in elephants

Theriogenology 70 (2008) 131-144

Abstract. Obstetrics, one of the oldest fields in veterinary medicine, is well described and practiced in domestic and exotic animals. However, when providing care during elephant birth or dystocia, veterinary intervention options differ greatly from any domestic species, and are far more limited due to the dimensions and specific anatomy of the elephant reproductive tract. In addition, aging of captive elephant populations and advanced age of primiparous females make active birth management increasingly important. Intrauterine infection, uterine inertia and urogenital tract pathologies are emerging as major causes for dystocia, often leading to foetal and dam death. This paper reviews the current knowledge on elephant birth and the factors associated with dystocia. It then summarises recommendations for birth and dystocia management. As Caesarean section, the most common ultima ratio in domestic animal obstetrics, is lethal and therefore not an option in the elephant, non-invasive medical treatment, induction of the Fergusson reflex or the conscious decision to leave a retained foetus until it is expelled voluntarily, are key elements in elephant obstetrics. Surgical strategies such as episiotomy and foetotomy are sometimes inevitable in order to try to save the life of the dam, however, these interventions result in chronic post-surgical complications or even fatal outcome. Limited reliable data on serum calcium concentrations, and pharmacokinetics and effect of exogenous oestrogen, oxytocin, and prostaglandins during birth provide the scope of future research, necessary to advance scientific knowledge on obstetrics in elephants. © 2008 Reprinted with permission from Elsevier.

R. Ingomar Petersen & K.K.B. Dahl

How to keep elephants in a glass house - A new elephant house for the Copenhagen Zoo

Structural Engineering International 18 (2008) 227-229

Abstract. When the end-user is a herd of Asian elephants weighing up to 5500 kg each, extra care is needed in the design of the physical environment. Even more so when the requirement for natural daylight makes it necessary to provide the building with a glass roof. The new elephant house of the Copenhagen Zoo is intended to set a benchmark for all future housing of elephants in inner city zoos that come under the northern climate zone. The 3300 m^2 building with 5000

m^2 landscaped outdoor facilities will provide the zoo's herd of eight Asian elephants with the best in animal husbandry and welfare. For a structural engineer, the design of an elephant house is "back to first principles" in the determination of the loads and in making sure that adequate robustness is provided. Visitors to the new structure will also place a large demand on the strength of the building, as more than 1,2 million visitors will pass through the building each year. Among these will be parents with prams and school children, making it essential that the visitors' section of the building also must be able to resist considerable wear and tear. © 2008 International Association for Bridge and Structural Engineering.

R. Joshi & R. Singh

Asian elephant (*Elephas maximus*) and riparian wildlife corridors: A case study from lesser-Himalayan zone of Uttarakhand

The Journal of American Science 4 (2008) 63-75

Abstract. Developmental activities are increasingly recognized as the cause of habitat fragmentation and shrinking of wildlife corridors. This study assessed the status and importance of the Chilla – Motichur and Khara – Anjani riparian wildlife corridor in northern India. We review the potential involvement of developmental activities in the recent past, which has affected frequent movement of Asian elephant (*Elephas maximus*) within their home range. These corridors linking the Chilla forest with Motichur forest and Shyampur forest are subjected to severe anthropogenic pressures. Livestock grazing, fuel wood collection and movement of people are the major activities observed in both corridors. These anthropogenic activities have substantially affected the movement of elephant within their home range and have led to the loss of forests connectivity. The long-term effects will include genetic isolation, habitat fragmentation within the same forest and enhancement in the human-elephant conflict in adjoining areas. Genetic isolation of elephant populations may also increase the chances of replacement of inter-breeding to intra-breeding, and thereby reduce the population persistence even for wide ranging wildlife species. Additionally, minimization of all kinds of biotic pressures in the corridor areas and providing higher protection to riparian wildlife corridors are highly recommended. © 2008 The Journal of American Science.

L. Lin, L. Feng, W. Pan, X. Guo, J. Zhao, A. Luo & L. Zhang

Habitat selection and the change in distribution of Asian elephants in Mengyang Protected Area, Yunnan, China

Acta Theriologica 53 (2008) 365-374

Abstract. Elephants were confined to Mengyang Protected Area in China and their distribution range had reduced greatly compared to past records. A preliminary study of habitat selection by Asian elephants *Elephas maximus* Linnaeus, 1758 and their distribution was conducted in

Worshipping at the 'Temple of the Tooth' before the Kandy perahera, Sri Lanka (2008)
Photo by Jennifer Pastorini

Mengyang Protected Area and its surrounds using site visits and transect surveys from July 2003 to December 2006. Although no variable significantly influenced their habitat selection, elephants still showed preference for altitudes between 900 and 1200 m, gradients < 30°, and orientations to the south-east, south and south-west. Human activities, including habitat transformation and degradation, disturbance by large infrastructure and poaching were considered to be the main factors inducing elephant distribution changes. © 2008 Mammal Research Institute Polish Academy of Sciences.

A. Menargues, V. Urios & M. Mauri

Welfare assessment of captive Asian elephants (*Elephas maximus*) and Indian rhinoceros (*Rhinoceros unicornis*) using salivary cortisol measurement

Animal Welfare 17 (2008) 305-312

Abstract. The measurement of salivary cortisol allows non-invasive assessment of welfare in captive animals. We utilised this technique to test the effect of zoo opening on six Asian elephants and two Indian rhinoceros at the Terra Natura Zoological Park, Alicante, Spain, during pre-opening, opening and post-opening periods. Salivary cortisol concentrations were found to be significantly higher during the opening period than during pre- and post-opening periods for both species. This method could prove a useful tool in monitoring the success of decisions taken to improve the welfare of captive animals. © 2008 Universities Federation for Animal Welfare.

L. Ren, M. Butler, C. Miller, H. Paxton, D. Schwerda, M.S. Fischer & J.R. Hutchinson

The movements of limb segments and joints during locomotion in African and Asian elephants

The Journal of Experimental Biology 211 (2008) 2735-2751

Abstract. As the largest extant terrestrial animals, elephants do not trot or gallop but can move smoothly to faster speeds without markedly changing their kinematics, yet with a shift from vaulting to bouncing kinetics. To understand this unusual mechanism, we quantified the forelimb and hindlimb motions of eight Asian elephants (*Elephas maximus*) and seven African elephants (*Loxodonta africana*). We used 240 Hz motion analysis (tracking 10 joint markers) to measure the flexion/extension angles and angular velocities of the limb segments and joints for 288 strides across an eightfold range of speeds (0.6–4.9 m s–1) and a sevenfold range of body mass (521–3684 kg). We show that the columnar limb orientation that elephants supposedly exemplify is an oversimplification – few segments or joints are extremely vertical during weight support (especially at faster speeds), and joint flexion during the swing phase is considerable. The `inflexible' ankle is shown to have potentially spring-like motion, unlike the highly flexible wrist, which ironically is more static during support. Elephants use approximately 31–77% of their maximal joint ranges of motion during rapid locomotion, with this fraction increasing distally in the limbs, a trend observed in some other running animals. All angular velocities decrease with increasing size, whereas smaller elephant limbs are not markedly more flexed than adults. We find no major quantitative differences between African and Asian elephant locomotion but show that elephant limb motions are more similar to those of smaller animals, including humans and horses, than commonly recognized. Such similarities have been obscured by the reliance on the term `columnar' to differentiate elephant limb posture from that of other animals. Our database will be helpful for identifying elephants with unusual limb movements, facilitating early recognition of musculoskeletal pathology. © 2008 The Company of Biologists.

J. Siegal-Willott, R. Isaza, R. Johnson & M. Blaik

Distal limb radiography, ossification, and growth plate closure in the juvenile Asian elephant (*Elephas maximus*)

Journal of Zoo and Wildlife Medicine 39 (2008) 320–334

Abstract. Eleven juvenile Asian elephants (*Elephas maximus*) were evaluated radiographically to determine the relative times of growth plate closure and phalangeal ossification in the bones of the distal forelimb. Specifically, the first, second, and third phalanges of the third digit (D3) were evaluated, as well as the third phalanx of digits 1, 2, 4, and 5. All elephants

were healthy at the time of examination. A retrospective evaluation of radiographs from six of the 11 juvenile elephants was also completed to augment the data set. This study reports the methods used to obtain high-quality radiographs of the distal juvenile elephant limb, ossification characteristics of the phalanges, relative times of growth plate closure within the proximal phalanges of D3, and a method for age estimation based on radiographic findings. This study will help clinicians in conducting elephant foot radiography, in evaluating foot radiographs in juvenile elephants, in recognizing normal versus pathologic change, and in estimating juvenile elephant age based on radiographic ossification characteristics and growth plate closure times. Consistent use of the proposed foot radiograph technique is recommended to facilitate foot disease recognition and as part of the annual examination of captive Asian elephants. © 2008 American Association of Zoo Veterinarians.

C. Thitaram, N. Thongtip, C. Somgird, B. Colenbrander, D.C.J. van Boxtel, F. van Steenbeek & J.A. Lenstra

Evaluation and selection of microsatellite markers for an identification and parentage test of Asian elephants (*Elephas maximus*)

Conservation Genetics 9 (2008) 921-925

Abstract. Numbers of the Asian elephants (*Elephas maximus*) population are declining due to poaching, human-elephant conflicts, capture of wild calves for tourism and export and habitat destruction, which also may cause inbreeding in fragmented populations. In order to contribute to a reversal of this trend, we have developed an identification and parentage test by evaluation and selection of markers from 43 microsatellite loci that have been previously described for Asian or African elephants. Testing these markers on a panel of 169 Asian elephants comprising the 23 mother-offspring, 13 father-offspring and 13 parents-offspring pairs yielded 26 polymorphic markers. However, only 14 of these were found to be suitable for an analysis of molecular diversity, 12 of which will be implemented for an identification and parentage test to control the capture of wild calves in Thailand and neighboring countries. © 2008 With kind permission from Springer Science+Business Media.

If you need additional information on any of the articles in the above section, please feel free to contact me. If you are aware of a new publication on Asian elephants (in 2008 or 2009), let us know the reference and we will consider its inclusion in the next *Gajah*.

E-mail: jenny@aim.uzh.ch

Dressing up for the Kandy perahera, Sri Lanka (2008)
Photo by Jennifer Pastorini

News Briefs

Compiled by the Editor

1. Rehabilitation centres

New Delhi Press Trust of India
20 July 22 2008

The government has decided to set up six rehabilitation and recuperating centres for ailing and destitute pachyderms -- both domesticated and in the wild. The centres, to be set up for the first time in the country, will come up in Haryana, Orissa, Kerala and Karnataka. "These centres will start functioning by early next year. In Haryana, the forest department has entered into a Memorandum of Understanding with an wildlife NGO to establish one such rehabilitation centre," Project Elephant Director A N Prasad told PTI. These centres would be manned by trained forest department personnel and 'mahouts'.

The Government under its ambitious Project Elephant plan launched on the lines of the Project Tiger will help the state governments in setting up these centres as it will impart technical guidelines and manpower skills to respective states. "The Elephants that will be brought in these centres will include domesticated and destitute ones including those with various temple trusts in the country," Prasad said. There have been numerous cases when the giant Indian beauty has been left to fend for itself after it was rendered incapacitated from circuses and private owners.

2. Domesticated elephants poached for ivory, Sayaboury province Lao PDR (Laos)

Ingrid Suter, ElefantAsia
September 10, 2008

Alarming reports as Laos' endangered elephants are being poached for the illegal ivory trade. News of elephant poaching has been reported from Laos' north-west province Sayaboury. In two separate incidences a total of five elephants were found dead with bullets to their head and feet. Occurring in May and August of 2008 both cases are believed to be linked. All five of the dead elephants were male and had their tusks extracted from their heads by the poachers. Some of the elephants were found to have also had their tails removed. Three of the deceased elephants were privately owned and two were from wild populations. Alarmingly this is the first time domesticated elephants have been reported as being poached for the ivory trade in Laos. District and provincial authorities are taking the matter very seriously.

With less than 1000 wild and 560 domesticated elephants remaining in Laos, poaching is a very serious threat to the entire elephant population. The interrelationship between wild and domestic elephants is still very strong in Laos, with poaching directly affecting the survival of both populations.

ElefantAsia is a non-profit organisation based in the Lao PDR. Much of ElefantAsia's elephant veterinary work is undertaken in the province where the poaching occurred. "These deaths are alarming for both wild and domesticated elephants" says Mr Gilles Maurer, Cofounder of ElefantAsia. "With elephant populations rapidly declining, Laos cannot afford to lose its remaining elephant populations to ivory poachers. More needs to be done to protect wild elephants and promote breeding among the domesticated elephants".

Of particular concern is the fact that poachers are now targeting domesticated elephants and not just wild populations. "Elephants are valuable livestock and many families rely on the income gained from the work of a single elephant. Poaching of domesticated elephants is a huge loss for Lao communities as well as the Asian elephant population" says Mr Maurer. "With only two births occurring for every ten deaths, elephant populations must be given the chance to reproduce so they can be enjoyed by Lao communities for years to come".

ElefantAsia intend to reverse declining elephant numbers through their national breeding strategy. This strategy aims at giving mahouts incentives to breed their domesticated elephants, thereby increasing the number of elephants living in Laos. "Can you imagine Laos without elephants? Unfortunately this is the reality if more elephants are not born" said Mr Maurer. "Poaching is just one threat to the elephant population and we really need to encourage mahouts to breed their elephants for future generations to enjoy. Laos must become a safe haven for elephants rather than a nation where the last few remaining elephants are killed for their ivory. That would be a cultural tragedy". Authorities in Sayaboury and Paklay are investigating the elephant deaths and are anticipating an arrest of the poachers.

3. Indonesians threaten to poison elephants

Agence France Presse
August 5, 2008

Indonesian villagers threatened Tuesday to poison rare wild elephants that are destroying their palmoil plantations in search of food. "The residents are so angry and have said they will put poison around the plantation areas to kill the elephants unless officials take quick action," said Jambo Dalem village chief Teungku Baili. He said he had warned officials in Trumon Timur district of Sumatra's Aceh province, but nothing had been done to protect the plantations. A herd of eight elephants grazed through the villagers' plantations twice last week, apparently lured to the rows of palm fruit after their natural habitat was wiped out to make way for the lucrative crop. "I'm afraid that another attack on their plantations will push villagers to launch their plan" to poison the animals, the village chief told AFP by telephone. "People here eagerly planted palmoil as it brings more profits, but it's all been easily destroyed by elephants." The elephants have been destroying plantations since 2000 but the problem has become worse over the past two months, he said.

Conflicts between wild animals and humans have long been on the rise in Sumatra, where tropical jungles have been almost completely wiped out except on mountain slopes. Experts say palm oil plantations offer the pachyderms a more attractive source of food than can be found in the forest. The population of Sumatran elephants was estimated at between 2400 and 2800 last year, a decrease of 35 percent from 1992, according to the World Wide Fund for Nature.

4. Central farmers lose crops to elephants (Vietnam)

Thanh Nien News
August 4, 2008

Seven members of Y Ngo's family in the central province of Dak Lak depend on one hectare of farmland. But their farm is all but destroyed, damaged by severe drought and wild elephants. "The area they trample destroys 10 times more than what they eat and there is no way rice can survive being stepped on by elephants," said Ngo, a farmer in Ba Na Village of Ia J'loi Commune in the province's Ea Sup District.

For the past two weeks the 82 households of seven ethnic minority groups in Ba Na Village have been disturbed, usually at night, by wild elephants from a nearby forest that come and trample their farmland. The farmers can only make noise – from a safe distance – to try to shoo the elephants away. But this tactic stopped working after only a few days. "I want to save my rice so much but if I go any closer the elephants could kill me," Huu said.

Chu Van Binh, whose rice field is near Ngo's, said the elephants had crushed his watch-tower about 10 days ago. Luckily, no one was in the hut at the time. The elephants returned to his rice field two days ago, leaving footprints everywhere, he said. Le Van Huu, deputy head of Ba Na Village, said the wild elephants had destroyed more than five hectares of local rice fields. Ba Na fields cultivated by people from nearby villages had also attracted the interest of the elephants, Huu said. He said now the villagers had to build watch-towers every hundred meters along the border between their farmland and the forest.

Three to five people in each tower take turns to

watch for elephants, Huu said. The village had more than 10 hectares of corn that was almost ready for harvest. But all the farmers' hard work would amount to nothing if the elephants got past the fence, the village deputy head said. "Sometimes the elephants come every night and no one dares to sleep soundly." The farmers were all dead tired because they had to work all day in their fields but could not sleep at night, he said. Although the elephants are regular visitors, villagers still don't know how many there are because they can't see clearly from far away.

Meanwhile, Ia J'loi Commune administration does not seem to be making much of an effort to support the farmers. They are still looking for food relief for locals who lost 300 hectares of rice to a recent drought. "The provincial administration is far away and the commune is so poor it cannot help all the farmers in difficulties," a commune official said.

5. Killer elephant to be killed in Nepal

Bernama
September 29, 2008

Local administration in southeastern Nepal has directed the district forest office to kill a wild elephant that has killed 13 people and destroyed property of locals, China's Xinhua news agency reported Monday. According to forest officer Jeeban Kumar Thakur of the local administration of Lahan, Siraha district, some 130 km southeast of Nepali capital Kathmandu, issued the direction during a meeting held at the forest office on Sunday by using the authority under the Local Administration Act.

The administration asked the forest officials to try to chase the elephant at first and kill it if posed threat to public security. The elephant has killed 13 persons in Siraha and Saptari districts so far, destroyed 100 houses and damaged crops. A six-member team led by Dr. Thakur Prasad Gaire from Chitwan National Park, at the direction of Ministry for Forest and Soil Conservation, has already arrived in Siraha to kill the beast.

6. Rings made of elephant hair flood central highland souvenir shops (Vietnam)

Thu Huong, Vietnam News Agency
August 31, 2008

To ethnic minority groups living in the central highland province of Dac Lac, a ring made of hair taken from an elephant's tail is far more than an ordinary ornament. Because most people consider it to be an amulet that is expected to bring them luck in love, local couples often use elephant hair as a pawn in the game of love.

Although no one has ever been able to prove the reliability of such a rumor, rings plaited with elephant hairs are now appearing in many souvenir shops. But the consequences of such beliefs in the significance of the elephant rings are leaving a tale of cruelty – thieves are often the ones who cut off the tails of the massive beasts. The elephant's hair tail is worth VND200,000-300, 000 (US$12-18), depending on its length and a ring woven with elephant's hair costs around VND500,000 ($30). Any ring inlaid with white elephant hair can be sold at double the price because it is considered rare.

Love-birds find that the exotic flavour is another attraction of the unique ring. This new trend has fuelled tourists' quests for rings inlaid with elephant hair but at the same time has spawned a trade that involves gratuitous cruelty. Y K'Tuk, an elderly resident of Buon Don, the province's most famous tourism village, couldn't hide his anger while recalling how his elephant lost his tail. "They sneak in at night when my family are sleeping. After his tail was cut off, my elephant was in so much pain that he couldn't eat for days. I can't bear witness to his suffering."

Most local ethnic minority groups like Ede or M'nong have a tradition of imposing stiff punishment on people who steal elephant's tail hairs. The stolen hairs should be burnt as an apology made to the "elephant god". However, a blind rush for high profits has blighted people's eyes to the danger and suffering they are causing.

7. Elephant kicks heroin habit with China island rehab

Beijing
September 4, 2008

An elephant has kicked his heroin habit after a three-year stint on an island rehab in southern China, an official and state media said Thursday. The four-year-old Asian elephant, called Xiguang, has now being transported to a wildlife reserve in southwest China after being cured of his addiction with some clean living on Hainan island, Xinhua said.

Xiguang became hooked on the narcotic after animal smugglers captured him and other elephants by luring them with bananas laced with heroin in 2005, the official news agency said. "The four elephants are arriving here from Hainan tomorrow," wildlife park official Mr Xu, who refused to give his full name, told AFP on Thursday.

Police caught the smugglers in May 2005 on the border between China and Myanmar, and noticed that Xiguang was acting strangely, the Beijing News website reported. His eyes kept streaming, he made continuous trumpeting noises, and was finally diagnosed with withdrawal symptoms from the drug, the report said.

Xiguang was sent to a wild animal protection centre in Hainan, where rehabilitation experts and vets gave him injections of methadone -- five times the dose needed for a human being -- for a year, Xinhua said. After a year, he had started to recover, and the dose of medicine was progressively reduced. The animal is now being transported 1,500 kilometres (930 miles) across southern China to Kunming, the capital of Yunnan province.

The Asian elephant is an endangered species, with only 25,600 to 32,750 left in the wild, according to the World Wildlife Fund. The animals are victims of conflict with humans, as they destroy plantations and fields in their quest for food, leading to retaliatory killings. They also fall prey to poachers for their ivory, the fund says.

8. Wildlife keepers warn against elephants tendency to move sanctuary (Myanmar)

Xinhua
September 26, 2008

Wildlife keepers in Myanmar have warned against tendency of move of sanctuary of wild elephants from deep mountain range in western Rakhine state to agricultural field as elephant feed is running short there this year, the local Biweekly Eleven News reported Friday. Such wild elephants are being found shifting from the May Yu mountain range bordering Bangladesh to agricultural farms with crop plantations of local farmers and destroying the plantations for the sake of feed, the report said, calling on the farmers to take measures to prevent the crop plantations from being spoiled out of the wildlife's move. The report attributed the tendency of the elephants to the extinction of bamboo plantation in the Rakhine Yoma natural bamboo forest during this year which the elephants depend on for their feed.

Meanwhile, Myanmar has taken measures for elephant conservation by restricting the catching of such animal in the country's Bago Yoma mountain range in the central part where most of the elephants take sanctuary, other local report said. In order to prevent elephant from extinction in the country, the Myanmar forestry authorities allowed catching of the wild elephants in the mountain range's Hlegu area only once in three years, prescribing the ratio of the elephants caught to be handed over to the authorities, according to the report.

Similarly, in the wake of tiger extinction threat, Myanmar wildlife police and forest rangers have also planned to step up combating wildlife trade and crimes in the tiger reserve and special training programs have been introduced jointly by the Myanmar forest ministry and the Wildlife Conservation Society (WCS). With only 150 tigers reportedly remained alive in Myanmar's tiger reserve, tiger conservation is being undertaken in Hukaung Valley, the geographical condition of which creates a suitable place for survival of the tigers. The Hukuang Tiger Reserve

in Myanmar's northernmost Kachin state, which was established in 2004, covers an area of about 22, 000 km^2, and is claimed the largest of its kind in the world.

9. Burma takes measures for wildlife conservation

Xinhua (New China News Agency)
September 23, 2008

Myanmar [Burma] has taken measures for wildlife conservation by restricting the catching of elephant in the country's Bago Yoma mountain range where most of the animals take sanctuary, the local Weekly Eleven journal reported Tuesday. In order to prevent elephant from extinction in the country, the Myanmar forestry authorities allowed catching of the wild elephants in the mountain range's Hlegu area only once in three years, prescribing the ratio of the elephants caught to be handed over to the authorities.

Meanwhile, the authorities also called on the country's people to participate in the task for conservation of rare birds and wildlife to stabilize the ecosystem which faces collapse as in the world, singling out that there are only nine endangered species out of 144 in the world can be found in Myanmar. Golden deer, one of the nine species in existence in Myanmar, are being protected in Chatthin Sanctuary in northwestern Sagaing division, the authorities said, adding that "though three kinds of species of the golden deer are found in South East Asia, there are now only Myanmar golden deer left".

Noting that the population of tigers worldwide gradually declines with tiger species being available in 13 countries only, the authorities said Myanmar is cooperating with seven other Asian nations in an effort to establish a tiger protection corridor which extends as 5,000 miles (8,000 kilometres) for endangered ones. Disclosing that there are only 100 tigers left in Myanmar, the authorities said, in cooperation with the Wildlife Conservation Society (WCS), tiger conservation is being undertaken in Hukaung Valley, the geographical condition of which creates a suitable place for survival of the tigers.

The authorities stressed the need also to conserve the environment, saying that too much extraction of wildlife, plants and fish, establishment of plantation after clearing, the natural forests and pollution endanger the existence of biodiversity in the long run. The authorities also called for systematic control of indiscriminate cutting down of trees, hunting and trading of wildlife products. According to the authorities, only about 150 tigers remain alive in Myanmar's tiger reserve. The tiger data collection of the forestry ministry was jointly carried out with the cooperation of the New York-based Wildlife Conservation Society (WCS) since 1998 with the use of camera trap as well as modern scientific method.

The Hukuang Tiger Reserve in Myanmar's northernmost Kachin state, which was established in 2004, covers an area of about 22, 000 square kilometres, and is claimed the largest of its kind in the world. In the wake of tiger extinction threat, Myanmar wildlife police and forest rangers have planned to step up combating wildlife trade and crimes in the tiger reserve and special training programmes have been introduced jointly by the Myanmar forest ministry and the WCS. The authorities have called for creating a balance between the needs of local communities and the wildlife, which constitutes one of the major challenges for them. Tigers are also facing extinction all over the world due mainly to the international trade in body parts destined for the Asian traditional medicine market, wildlife biologists said.

Meanwhile, the Myanmar authorities have warned traditional medicine practitioners in the country to avoid using tiger bones in producing their medicinal products to help conserve endangered animal species. As tiger has been prescribed as "completely protected" under the Protection of Wildlife and Conservation of Natural Areas Law since 1994, the ministry urged the practitioners to keep away from such practice, otherwise such species would vanish in the country.

Myanmar was estimated to have over 3,000 Bengal and Indochina tigers by 1980, the second in Asia after India, according to experts.

Instructions for Contributors

Gajah welcomes articles on all aspects of Asian elephants, of interest to those involved in conservation, management and research on Asian elephants and the general public. Articles may include but are not limited to research findings, opinions, commentaries, anecdotal accounts and book reviews. Readers are encouraged to submit comments, opinions and criticisms of articles published in *Gajah*. Such correspondence should be a maximum of 300 words, and will be edited and published at the discretion of the editorial board.

Manuscripts with a maximum of 5000 words are accepted for the "full paper" section. These manuscripts may be sent to reviewers outside of the Editorial Board of *Gajah*. Such peer reviewed papers will be identified in the journal by means of a footer that reads "peer reviewed paper". Manuscripts with a maximum of 2000 words are accepted for the "short paper" section. These manuscripts are reviewed by the Editorial Board of *Gajah*. Such editor reviewed papers will be identified in the journal by means of a footer that reads "editor reviewed paper".

Tables and figures should be kept to a minimum. Each needs to be on a separate page at the end of the manuscript. Legends should be typed separately (not incorporated into the figure). Use of black and white figures is encouraged to facilitate reproduction. Refer to figures and tables in the text as (Fig. 2) and (Table 4). Include tables and line drawings in the MS WORD document you submit. Photographs, maps etc. should be submitted as extra files in JPEG or TIFF format.

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Sukumar (1989) demonstrated that...

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

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

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

Manuscripts should be submitted by e-mail to the editor <romalijj@eureka.lk>. If unable to do so, a hard copy can be sent to: Jayantha Jayewardene, 615/32 Rajagiriya Gardens, Nawala Road, Rajagiriya, Sri Lanka.

Deadline for submission of manuscripts for the next issue of Gajah is 30. April 2009.

NUMBER 29
2008

GAJAH

Journal of the Asian Elephant Specialist Group

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