GAJAH



GAJAH

JOURNAL OF THE ASIAN ELEPHANT SPECIALIST GROUP

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Number 17, January 1997

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ELEPHANT CAPTURE IN MEGHALAYA, NORTH EAST INDIA - THE PAST AND THE FUTURE

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INTRODUCTION

The fragementation and degradation of elephant habitats in India has led to rising levels of elephant - human conflict. Factors beyond the control of wildlife managers, e.g. high human population growth rates, have made the task of finding solutions to the conflict impossible. Under such a scenario it is desirable to reduce the number of elephants or keep the population size more or less constant for specific problem elephant populations. Capturing of elephants from populations involved in high rates of conflict for domestication has been suggested before as a strategy to achieve the above objective. This has to be done in a manner which does not endanger the viability of the population. Sukumar (1993) suggests that a population of about 100 to 300 elephants would have a high probability (>99%) of survival for the next hundred years. Wildlife managers should try to maintain these minimum sizes even in problem elephant populations (*op. cit.*). This is so because options might emerge in the future to help solve the elephant - human conflict.

The west Garo hills district in the north- east Indian state of Meghalaya is a place with high rates of elephants - human conflict (Williams & Johnsingh, 1996). A small population of about 160 elephants is spread over an area of 1000km^2 (Williams & Johnsingh, 1996). Much of this area is under shifting cultivation (*jhum*). As *jhum* settlements are interspersed with forest areas, elephants encounter crop fields, which have little or no protection, and raid them as the crops provide an easy source of highly nutritious food (Sukumar, 1991). The prospect of finding a solution to the conflict in this region is directly related to finding an alternative to the practice of *jhum*.

The human population in Meghalaya, has increased by 32% between 1981 and 1991 (Anon, 1992). This kind of high population growth rates will further reduce the already short *jhum* cycles thus further degrading the habitats and increasing patchiness in the area. Studies suggest that a *jhum* cycle of at least 10 years is considered necessary for *jhum* to be viable economically and energetically (Ramakrishan, 1992). It was found that more that eighty percent of the villages surveyed in west Garo hills had a *jhum* cycle less than 10 years (Williams & Johnsingh, 1996). The results of that study suggested that current level of *jhuming* in West Garo hills is unviable. However the chance of finding an alternative to *jhum* seems to be bleak in this region. Hence it is in the wildife manager's interest to reduce or atleast prevent the elephant-human conflict from increasing. One of the ways this could be done is to reduce or keep stable the current elephant numbers by capturing. Requests to reduce problem elephant populations by capture have already come from the various state Governments (Anon, 1994;1995).

A number of studies have been carried out, using mathematical models and computer simulations, to explore the effect of increased mortality in the various age - sex categories on the elephant population growth rates (Sukumar, 1991; Hanks, 1981, Hanks & Mclntosh, 1973). However since reducing elephant populations has been a sensitive subject in India, no one has looked at the effects of removal of elephants, by capturing, on a population.

In this paper,we present details about the age-sex structure of elephants captured during the 1980 *mela-shikar* operation in Meghalaya and discuss the implications of allowing the practice to resume in the west Garo hills to combat elephant - human conflict using a modelling approach.

METHODS

Elephant capture, using the traditional *mela-shikar* method was carried out in this elephant range till 1982. Information on estimated age, shoulder height, sex of the elephants and place of capture were got from the Meghalaya Forest Department records. The ages of these elephants were estimated from shoulder heights as given by Sukumar, Joshi & Krishnamoorthy (1988).

The west Garo hills elephant range lies approximately between 90°0'E and 90°25'E and25°25'N and 25°55'N. Further details about the area and elephants can be found in Williams & Johnsingh (1996). To explore the effects of capturing elephants of various age - sex categories, the program **VORTEX** (Lacy, 1993; Lacy, Hughes & Kreeger, 1995) was used. The following parameters were used; The birth probability was taken as 0.20/ adult female/ year. The annual age - specific mortality rates were as follows (see Sukumar, 1993 for more details);Female elephants; 10% (age 0-1 year), 4% (age 1-5 years), 2% (age 5-15 years)and 1.5% (5-15 year). Male elephants: 15% (0-1 year), 8%(5-15 years), 6% (>15 years).

The deterministic growth rate (r) of the population as calculated from life table analysis of the female segment using the above parameters was 0.02. This means that the population was growing at the rate of about 2% a year. Then the adult female mortality constant was held at 1.5% and the mortality rate for all other age - sex classes was dobled. This gave a deterministic growth rate (r) of 0.007, i.e. the population is growing at the rate of 0.7%. Environmental stochasticity is built into the model which samples from binomial probability distributions, where the standard deviation (SD) specifies the yearly fluctuations. SD in birth probability was taken to be 25% of the mean and SD in annual mortality rates for the various age-sex classes were taken as 20% of the mean. We also modelled a catastrophe such as a disease epidemic with 0.5% chance of occurrence and which would reduce the survival to 90% of its' orginal value. The Meghalaya Forest Department census figure of 166 elephants for this area (Anon ,1994) was used as the starting population. The carrying capacity was set at 400 elephants which was more than twice the population's starting size. It has also been assumed that in the case of sufficient animals not being available, in some of the years in the harvested age-sex classes, animals from other age-sex classes will not be captured.

The following scenarios were modelled;

1. Capturing 10 juveniles or sub-adult elephants (6 females: 4 males) every alternate year for ten years,
2. Capturing 10 adult females every alternate year for ten years and,
3. Capturing 10 adult elephants (6 females: 4 males) every alternate year for ten years.

For all the scenarios modelled it was specified that the capture should take place every alternate year as it would provide sufficient time for training and disposal of captured elephants. We have modelled captures only for ten years with the hope options to manage them otherwise would be available in ten year's time. All the population projections were for 100 years and were run 1000 times.

RESULTS AND DISCUSSION

We got complete records for 23 elephants which were captured during the year 1980; Five of the captures were in south Garo hills and 18 captures were from Mylliem and Khyriem Syiemship in the Khasi hills. The age-sex structure of the captured animals can be seen in Fig. 1. There seems to be a clear preference for elephants in the younger age classes. This may be due to the fact that younger animals are easy to capture and domesticate.

The male: female ratio of the captured animals is 1:1.3. However, the tusker: makhna (tuskless males) ratio is 1:1.5. Makhnas when young, are difficult to distinguish from females in the field and one suspects that young makhnas were misidentified as females and captured. If this is true then there seems to be a preference for female elephants. Adult male elephants go into *musth* for about two to three months every year. They are usually tied up during this period as they become uncontrollable and this represents a substantial loss of working days for the owners. This is not the case with female elephants and that may be one of the reasons for preferring female elephants, if such a preference exists.

The results of the various scenarios modelled under different deterministic growth rates can be seen in Tables 1&2. It can be seen for a population which is growing at around 2% annually, capturing only juvenile and sub- adult elephantss or capturing adult elephants (6 females: 4 males) produce identical results. The 10th year population is about 85% of the population size at year 1. However if only adult females are captured, the 10 th year population size is only about 75% of the population size at year 1.

When the growth rates fall to little over half a percent due to increased mortality in the various age-sex classes, with the exeeption of adult females, the three scenarios produce vastly different results (Table 2). The 10th year population sizes under scenarios 2 and 3, when deterministic $r = 0.007$, are about 65% and 58% of the population size at year 1. However, capturing juvenile and sub - adult elephants produces identical population sizes at year 10 under different population growth rates (Tables 1 & 2).

TABLE 1. Results of the scenarios when deterministic r = 0.02

Scenario	r	SD (r)	Population size				P(S) at Year 100
			Year 10		Year 100		
			N	SD (N)	N	SD (N)	
1	0.022	0.031	146	12.79	397	6.97	1
2	0.02	0.032	127	12.73	396	7.47	1
3	0.022	0.031	144	14.47	396	7.15	1

r-Stochastic r, P(S) - probability of survival

TABLE 2. Results of the scenarios when deterministic r = 0.007

Scenario (stochastic)	r	SD (r)	Population size				P(S) at Year 100
			Year 10		Year 100		
			N	SD (N)	N	SD (N)	
1	0.007	0.043	145	15.55	256	65.13	1
2	0.005	0.046	108	13.19	192	60.47	0.99
3	0.004	0.048	97	11.85	199	63.88	0.98

r-Stochastic r, P(S) - probability of survival

The results of the modelling exercise point to the various options available to the wildlife manger. If the objective is to keep population numbers stable, the best option would be to capture juvenile and sub-adult animals. Therefore capture by traditional *mela shikar* would be the ideal method, especially in hilly terrain like the west Garo hills. This may not necessarily reduce elephant - human conflict , but would prevent the conflict from increasing. However, if the objective is to reduce the current intensity of conflict by reducing the elephant population, capturing of young adult females would probably be the best option. The west Garo hills population under all the scenarios, excepting scenario 3 in Table 2, has greater than 99% chance of surviving to 100 years. The results did not differ significantly from that of scenario 1, when we modelled a preference for female juvenile and sub-adult elephants (2 male: 8 females).

As mentioned earlier, the west Garo hills is place with high density of humans (109 person /km^2) in the important elephant areas and the human population is currently growing at around 3% a year (Anon, 1993). The practice of *jhumming* is degrading the habitat further and the ability of the area to support elephants is probably reducing drastically. Under such a scenario, if the elephant population in west Garo hills is allowed to grow, the elephant - human conflict can only increase. This will have disastrous consequences for elephants in this region. Our modelling suggests if the annual adult female mortality increases suddenly beyond 6% from1.5% (when determinstic r=0.02) and 2.5% from 1.5% (when deterministic r$\geq$ 0.005), the population would start declining. If people start shooting at elephant groups which raid crops, it is likely that adult female mortality would go up. Adult females with young ones are more likely to feel threatened and they may charge when attempts to chase them from crop fields are made.

Elephant capture programmes can also be turned into a public relations exercise, where the forest department is shown as taking a sincere effort to solve the elephant human-conflict. Therefore for elephant populations threatened by high rates of elephant human-conflict, the capture programmes may actually result in buying much needed time. This time is required in case options to manage these elephants and to solve the conflict arise in the near future and also because every elephant population deserves such a chance. We conclude by emphasizing that this is only a preliminary modelling exercise and that any decision to implement elephant capture programmes must involve much more detailed analysis of actual field data of the population involved.

ACKNOWLEDGEMENTS

The ideas for this paper evolved during a status survey of elephants in Garo hills in Meghalaya. This project was carried out by the Wildlife Institute of India (WII) for the Meghalaya Forest Department and was funded by PROJECT ELEPHANT. We would like to thank Shri. S.K. Mukherjee, Director, WII and Shri, Vinod Rishi, Director, PROJECT ELEPHANT for the support extended to successfully complete the project. I would like to place on record our sincere thanks to Shri. Balwinder Singh, the Principal Chief Conservator of Forests and Shri. S.B. Singh, Chief Conservator of Forests (Wildlife), Shri. Tony Marak, Conservator (Wildlife) of the Meghalaya Forest Department fot the support given during the survey. We

appreciate the help given in field by Mr. S. M. Sahay, Divisional Forest Officer (Wildlife), South Garo Hills Division, Mr. J. Dutta, former Divisinal Forest Officer (Wildlife) and Mr. P.R. Marak, Divisional Forest Officer (Wildife) of the East and West Garo Hills Division. We thank the other Officers and Staff of the Meghalaya Forest Department without whose help this survey would not have been possible. T.R.K. Yoganand is thanked for his comments on an earlier version of the manuscript.

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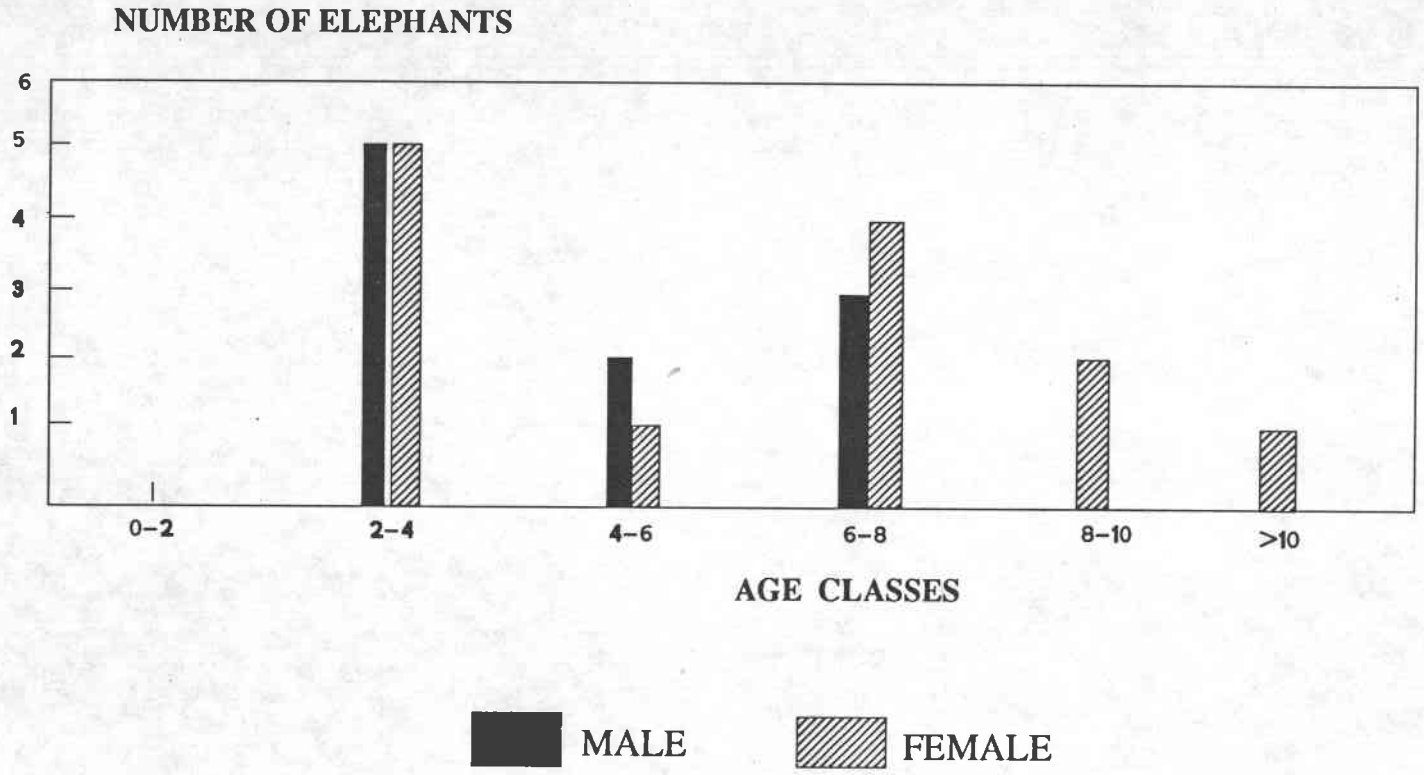


Fig. 1. Age - sex structure of captured elephants

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UTILIZATION OF ELEPHANTS IN TIMBER HARVESTING IN MYANMAR

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INTRODUCTION

The Union of Myanmar, with a total area of 676,577 km² is situated in South-east Asia within9° 35' and 28° 25 ' N latitudes and 92° 10' E and 101° degree 10' E longitudes. Approximately 75% of the country lies within the tropics, and having an altitudinal range from sea level to snow capped peak about 6000 m, the country has wide range of temperature and rainfall, which consequently contribute towards a wide variety of environmental conditions and diversified types of forest. Among different types of forest existing in the country, the mixed - deciduous forests of Mynmar are the best home for teak (*Tectona grandis*) in the world. Therefore, the forest management system in Mynmar is based on it's natural teak forests, and is called the Myanma Selection Felling System.

The forests management system in Myanmar, which is principally a selection - cum - improvement system has the primary objective of timber production for local consumption and export of valuable woods, especially teak. Myanma Selection Felling System is the only feasible system to manage the multi-species complex forests of Myanmar where only a few species are extracted out of nearly a thousand tree species growing in the forest. Myanma Selection Felling System was also known as the Brandis Selection System, because Dr. Dietrich Brandis, who started the scientific forest management in 1856 formulated the yield regulation of teak trees and adopted the system. Teak and other durable hardwood were harvested and utilized by the Myanmars prior to the colonial era. No doubt those timbers were extracted by using elephant power. In fact elephants had been employed by ancient Myanmar kings for war and construction purposes. Wars between rival kingdoms were impossible without combat elephants. Construction of palaces with huge teak pillars would not have been accomplished without elephant power.

Ralph Fitch probably the first Englishman to have visited Myanmar, arrived at the kingdom of Bago in 1586. He arrived on board a Portuguese vessel in search of Myanmar teakwood. He made an account on the five thousand elephants owned by the Nanda king of Bago including four white elephants. King Alaungphaya of Konbaung Dynasty issued a royal decree claiming state monopoly over teakwood in 1752. Historical documents of timber trade were mentioned during the Konbaung Dynasty in 1808 A. D., whereby teak became most popular in western communities. A senior member of the Bombay Burma Corporation visited Myanmar during the reign of the last Konbaung King, Thee Baw and was able to obtain a lease of certain forest areas to extract teak. As a result many forests previously inaccessible were opened up and elephants were bought up on a large scale. Some were bought mostly from Thailand and a few

also from India. But the majority were obtained by capturing wild elephants and breaking them in by methods mostly employed by Bamars, Kayins and Shans. Urged by the lust and greed for usage of teakwood for ship building, the British fought three wars against Myanmar in the years 1824, 1852 and 1885, finally annexing Myanmar. After annexation of the country in 1886 and up to 1942, a large majority of teak forests of Myanmar was worked under renewable long term leases by five major European firms. Annually over 684,000 cu^3 of timber were extracted by these firms using only animal power, i.e. elephant and water buffalo. Buffalo power can be used only on flat terrain for short hauling distances and smaller logs. Average annual extraction volume of timber by elephants after second world war years stood at 540,000 cu^3. Elephant logging in Myanmar has been indispensable and elephants have been valued as wheeled skidders, front end loaders and crawler tractors combined of present day equipment. The advantage of elephant logging is that the elephant itself is one of the biological components of the ecosystem.

Elephants

The word "elephant" is derived from the ancient Greek word *Elephas*, which means ivory. Millions of years ago there were 352 species of elephant. At present only two main species have survived the ravages of time and climatic changes that had taken place on the earth. These are African species known as *Loxodonta africana*, and the Asiatic species known as *Elephas maximus*. These two main species are vastly different in many aspects, the most prominent points of difference in the two main species are the shape and size of the ears, the formation of the spinal ridge, and the marked disparity in their average height and weight.

The Asiatic elephants have sub-species named after the country in which they are found. For example, *Elephas maximus maximus* stands for the sub-species found in Sri-Lanka. *Elephas maximus bengalensis* for those in Bengal and *Elephas maximus indicus* for those in India; *Elephas maximus birmanicus* for those in Myanmar ; *Elephas maximus sumatranus* for those found in Sumatra and *Elephas maximus hirsutus* for those in Malaysia.

Even within the country in Myanmar the elephants differ in size, temperament and value from the point of timber extraction. In temperament those of the Tanintharyi area are uncertain in disposition and more difficult to break in, but once trained they are considered superior as timber elephants to those of Rakkhine Yomas. Those in Rakkhine Yomas are found to be larger, taller, more leggy, with small head and thin skin, while those in Tanintharyi area are somewhat smaller, shorter but with larger head and thicker, rougher skin. Elephant is not impressive as a weight carrier when its size is considered. An elephant of average size (about 4 tons) can carry 270 kg on its back while a big freight camel can bear 230 kg. But ten men can carry 270 kg on their backs. On the other hand, elephant is a powerful hauler. It can easily skid a 3.5 cu^3 log. In teak forests of Myanmar, which are too jangled and mountainous for mechanical transport, the elephant has the edge over the tractor. In fact, the structure and strength of an elephant is not for carriage but for haulage.

Timber Extraction

Sustainable management of forests in Myanmar dates back to 1856, with the extraction of timber under the Myanma Selection Felling System. This system prescribes a felling cycle of 30 years in a felling series. Production of forest resource is assured by the Forest Working Plans. Teak girdlings and hardwood selection (S.F) marking over prescribed girth limits are carried out in conformity with working plans and Annual Allowable Cut (AAC) that have been set under systematic forest inventories. The Myanma Timber Enterprise of the Ministry of Forestry is responsible for harvesting of teak and hardwood from the forest all over the country. Planned targets are drawn within AAC. Field operations for extraction in the forest are planned according to the girdling and S.F. marking and field exploration reports.

There are three stages in the timber extraction method of Myanmar, namely:-

- The first stage of extraction which involves felling of trees and dragging timber logs away from the stump of the felled tree up to the measuring point where logs are measured for royalty payment and settlement of dragging charges,

- The second stage of extraction in which logs from the measuring points are transported to the river rafting depots, railing sidings and transit log-yards by floating along jungle creeks or by trucking along fine weather forest roads,

- The third stage which pertains to transportation of logs from main river depots, railing sidings and log yards by meand of rafting, railing and trucking.

Elephants are mainly used in the first stage of extraction. They are also used in the second stage of extration where stream floating is applied to transporting logs from measuring points to main river depots. The work of elephants in the first stage is termed *"stumping"* and that in the second stage is termed *"Yelaiking"*, a Myanmar word for an operation in which elephants are employed to help float a maximum number of teak logs out of a stream or creek.

Trees are felled according to the regulations set by the Forest Department (F.D.) Griddled teak trees or selection marked other hardwood trees are felled by the Myanma Timber Enterprise (M.T.E.). The trees felled are inspected by an officer in charge of the felling compartment and are marked with the officer's hammer deciding at which point of the felled tree is to be cross-cut. When the tree is cross-cu into logs, the officer again checks the area to see whether the logs are completely cut, and only then the relevant payment is done. It is then the stumping begins Stumping is carried out based on the information gathered in the exploration report of the compartment concerned. Generally the following methods of extraction are used for stumping in Myanmar:-

(a) Animal logging using elephants and water buffaloes.
(b) Mechanical logging
(c) Elephant cum mechanical logging.
(d) Cable logging

Factors determining selection of method of stumping are size of operation area, timber species, availability of floating streams, climatic conditions, silvicultural conditions or forest management, topography and the extraction cost. Elephant power is the most suitable means of extraction for Myanma Selection Felling System, in which individual mature trees are selected for extraction. Seasonal extraction operations begin in June, but have to be sure that the debris in the forest are cleared away by the first shower of rain. Felling orders are issued by the exraction range officers in June and felling started. The timber working elephants enter the forest around mid-June where there is enough water to drink and fodder to eat. About 1700 elephants are employed by the M.T.E. in timber extraction works in Myanmar. In addition, there are about 1200 elephants owned by the private contractors engaged in timber extraction works in the country. Elephant working parties are organized into groups of six or seven elephants. Each group is called a *"Waing"*or a camp. Each elephant has its rider , or *"Oozie"*. There is one head rider called *"Sin-Gaung"* in a *waing* who manages the camp. There are also helper riders called *"Pejeiks"* who assist the oozies in dragging works. The pejeiks are employed only in dragging season. Off the season they are either employed as fire watchers or as stream-bed sweepers during summer months. Working elephants are classified into grades according to their dragging power. The first class elephant is the one which can drag a 3.5 meter cube log at a time. The second class elephant can drag 2.5 to 3.5 meter cube. The third class can drag 2 meter cube, and the fourth class elephants are those which can drag less than 2 meter cube and of poor intelligence. The average extraction capacity of one elephant for one season is 270 meter cube of teak or 360 meter cube of other heartwood.

During working season, generally from June to February or March, the *pejeiks* have to clear and straighten the elephant dragging path in the evening while the elephants are resting. The elephants do not work consecutively. They work three days and rest for two days generally. The drag paths are chosen by the *"Sin-Oke"* who is in charge of fifty elephants riders. Obstructions along the drag path such as boulders, tree stumps have to be removed. Sharp bands in the creeks have to be widened for smooth passage. Traverse paths have to be cut along the contour of steep mountains where necessary. Even at the time of dragging, the drag paths have to be cleared for smooth movement of logs. The elephant men must taper one end of each log so that the log will not be stuck to the rock or small obstruction while dragging. They also have to check and repair the split drag hole. Normally logs are at first dragged away by stronger first class elephants from the stumps to the side of wider paths which can be used as transit. From the transit, logs can be dragged by second or third class elephants to the measuring points.

In some areas, streams may float well in their upper reaches but lower down, may flow over waterfalls or be blocked by boulders. A drag path has to be made round these obstructions if the

rocks are not economical to be blasted or else, logs have to be dragged uphill by using wire ropes and pulleys, and taken down a path back to the stream below the obstructions. If there is no way round the rocks or waterfalls, blasting several years ahead of the extraction is necessary. Lips have to be blasted off waterfalls in order to avoid a "jam" at the top. Logs have to be launched in very small batches so that they do not go over a fall together and smashed each other at the bottom. In some cases logs can be sent over falls at the end of the rains one at a time, and made fall upon a cushion of bamboo six feet deep at the base of the fall. Then they are cleared by elephants working under close supervision.

Timber from flat area and easy terrains can be extracted by a pair of buffaloes. A pair can drag a log about 2 meter cube and use the annual capacity of dragging by a pair of buffaloes is about 90 meter cube. Water buffaloes are more useful and effective in arranging logs in the yards or depots. Myanmar started using mechanical power for extraction in 1955. By experience, 100% mechanical logging is not feasible in Myanmar. Elephant cum mechanical logging is more effective and economical. The systematic use of cable logging technique was first introduced into Myanmar in 1979, with the inauguration of a technical co-operation project between Japan and Myanmar. The technique, modern and elaborate however, is not applicable entirely for Myanmar Selection System. The best result was obtained by the combination of cable logging and elephant logging.

There are three main methods of extraction in Myanmar, namely normal extraction mechanical extraction and elephants cum mechanical extraction. Normal extraction method is the cheapest method used by all European firm in pre-war days to extract dry teak. In pre-war days most of the teak forests were in inaccessible areas without roads. There were natural streams which flow in to main rivers. Fortunately all the rivers in Myanmar flow north to south down to the capital of Yangon which is the main port for export of timber. In normal extraction, the main object is to float the dry teak logs along the floatable streams of each compartment into main rivers from where the logs are rafted down to Yangon.

Elephants are used for *"stumping", aunging"* and *"yeleiking"* in normal extraction. *Stumping* and *yeleiking* have been defined earlier, but will repeat in another version for normal extraction. The term *"stumping"* is the dragging of logs from tree stump to the bank of floatable streams where logs are measured. *"Aunging"* is an operation of pushing down the measured logs by the elephants in rainy season when the streams are full of water. *Yeleiking* is performed in cold season. In this operation, logs which are left in and near the streams are dragged into stream-bed and placed orderly along the streams by the elephants, to be ready for easy floating in the next rainy season.

Normal extraction needs no special roads for elephants, and it is the cheapest and environmentally friendly operation. Felling is done in rainy and cold seasons by local timber - jacks who own simple felling implements such as cross-cut saws and axes. Normal extraction by free floating system depends upon the rain. All the logs cannot be floated down in one rainy season. The logs that were left behind along or near the floating streams have to be rearranged

There are three methods used in capturing wild elephants. They are *Kheddah* method, *Mela-shikar* method and *immobilization technique*. To capture wild elephants, schedules have to be made and a license for the capturing plots have to be obtained from the Forest Department. In *Kheddah* method a herd of wild elephants is driven into a stockade made of standing trees. The shape of the stockade is like a huge capital Y with two very long arms forming a wide funnel and the short leg of the Y into a narrow stocked or enclosure. *Mela-shikar* method involves capturing of wild elephant with the aid of height trained captive elephants called *Kunchees*. *Kunchees* must be tuskless . The head hunter on a Kunchee pays out the with a noose skilfully and the captive races away the Kunchee follows. When the young captive becomes tired, it is dragged by force with assistance of three Kunchees into training camp and trained. Immobilization technique is the method directly carried out by MTE staff with a team of 20 persons, well trained kunchee elephants and immobilizer guns. A hunter with immobilizer gun, a guide, a member with protection gun and some materials necessary for the party are carried on the first *Kunchee*. When a wild herd is found the most suitable young elephant is chosen and shot with immobilizer gun, after which the unconscious captive is fastened to the *Kunchee* with ropes and antidote is given. After recovering it is dragged to the camp and an put in the training cradle.

Since 1983, immobilization technique has been the only method used for capture of wild elephants in Myanmar. The captured elephants must be taught what should be know basically within four months after capture . They are trained to be able to understand opening and locking of fetters or hobbles, separation from others, up and down movements, i.e. lifting fore legs and sitting on four limbs. It is important for a capturing party to be able to catch with firm courage and perseverance, to train captives in short time with least harm and to cure the wounds and diseases within a short period.

The number of wild elephants to be captured annually is determined by the Forest Department and the capturing is done solely by skilled personnel of MTE trained specially for elephant capture. The annual allowable capture of elephants was set around 100 but the Forest Department limited the number to 40 after 1993.

The Forest Department calculates the number of elephants to be captured based on the workable age of wild elephant population. If the wild elephant population is high the animals tend to destroy cultivation because of scarcity of fodder in the forest. Therefore they should be tamed and trained to check the overpopulation in the wild and to make good use for timber extraction, as they are best suited for the work and the system of forest management in Myanmar.

According to 1980-1993 statistics, the total number of MTE timber elephants is quite stable at 2,900 but mortality rate among the calves under five years is higher than for other age groups. The current birth rate of captive elephants is not adequate to replenish the present

populace of timber elephants. On the other hand, the captive breeding programmes become one

of the alternatives for capture. Experience endorses the fact that the elephants born under captivity are more intelligent, less aggressive, easier to train, tractable and are of more reliable temperament than those captured from the wild.

To get better achievement in elephant breeding by natural mating, further investigations should be necessary to identify the best proven sires and to indicate which cow elephants are cycling. The Ministry of Forestry encourages research to improve breeding of elephants under captivity so that the captive population would be in a self-sustaining condition in the near future. The ultimate goal of these researches is to develop artificial insemination, the practical method to breed elephants in Myanmar.

The aims of the research programmes:

To identify which cow is in heat and when she ovulates by tracing the progesterone hormone profile of Myanmar cow elephants.

To improve the fecundity of cow elephants through captive breeding programmes and to develop artificial insemination as a practical means to replenish the number of timber elephants under captivity,

To study semen characteristics of bull elephants for the development of semen freezing technology,

To initiate database of registered books of Myanmar timber elephants.

The collaborating institutions for these research programmes are Metro Washington Park Zoo and National Zoological Park , Smithsonian Institution (USA). Support has been given by the International Foundation of Science of Sweden, to assist the Myanmar researchers.

Training

Both elephants born in captivity and those captured have to be trained to understand and obey human words of command and to be able to work accordingly. Training is given step by step such as training the calves, training for baggage purposes and training for timber extraction works such as stumping, *dragging*, a*unging* and *yeleiking*.

About 70 - 100 heads of captive born elephants at the age of 4 years are trained annually. Before the training begins the training site must be selected, skilled labour must be organized and medicine must be collected and prepared. Training is done by three methods, namely *crush method* (two walls), *half crush method* (one wall) and *cradle method*. The main aim for the calf training is for the calf to be able to understand and obey the common commands and to get close

relationship between man and elephant. Training procedure includes putting on fetters, releasing fetters, riding on head and back, walking with fetters, sitting on the knees and better relation

between man and elephants. The training is based upon the technique of reward and punishment. The training lasts about 21-30 days. Trained calves are continued to be trained gradually for baggage purpose up to 18 years of age. The trained caves under 12 years (between 4 and 12 years) have to be trained just to be familiar with saddle, and the maximum weight of baggage should not be more than 30 kg. Baggage trained calves of age between 12 and 15 years should be loaded not more than 70 kg in plain areas, 45 kg in hilly areas and 30 kg in steeper and difficult areas. Between 16 and 18 years age the maximum load should be 100 kg for plain area, 80 kg for hilly areas and 55 kg for steeper areas. Baggage elephants should not travel more that 22 km per day in cold season and 16 km in steep areas.

When baggage elephants reach the age of 15 years and if they are healthy and strong, they can be sent to working elephant camp as apprentices. In the first year, at the age of 15-16, they are trained to drag 1 meter cube log on plain area, work 2 days and rest 5 days; and on rest days they must be put on with dragging gear and let them observe other elephants on work. In the second year, between the age 16 and 17, they should be trained to drag 1 meter cube log and be taught the work of a*unging*. Working 3 days and resting 4 days is enough at this stage of training. In the third year, at the age of 17 and 18, they are trained to drag 1.5 meter cube log, work days and rest 3 days and taught *aunging* and a*unging* in tendem.

Elephant training is the principal work to obtain the full elephant power for extraction operations. But as in other forms of training which never really ends it is only through the slow and strenuous process of experience that it will eventually understand all the intricacies of timber extraction and the danger to which it is always exposed. The well trained elephant can be clasified as a very good working elephant.

CARE AND MANAGEMENT

As elephants are essential work force for timber industry in Myanmar, they need to be cared and managed well. Elephants owned by the Myanmar Timber Enterprise whether they are Calves at Heel, Trained calves or Full Grown adults, are being taken good care for their health by personnel of MTE.

Captive elephants, or tamed elephants of Myanma Timber Enterprise are classified according to age as Calves At Heel (CAH), Trained Calves (TC) and Full Grown (FG) elephants. Calves At Heel elephants are the the baby elephants from birth to 4 years of age. Trained calves are sub-divided into light transport baggage elephants of 5 - 15 years old and baggage *cum* light extraction apprentice elephants of 15 - 18 years of age. Full Grown elephants are the ones over 18 years. Full grown working elephants may be classified into the sub-groups. 18 to 24 years old elephants have to do light extraction work. 24 - 30 years old can be employed on hill forest but they are not fully developed. 30-38 years is the prime age for working elephants, at which they are in fine shape, healthy and strong. 38-46 years old elephants are definitely slower on hill, but almost as strong as in their prime. By 46-53 years they decline fairly in strength. 53-60 years old are only suitable for very light work, after which they are given retirement at the age of 60 years.

Working elephants are also graded according to their working capacity and age. The first class elephants are those between 30 and 45 years old, and can drag more that 3.5 meter cube per turn; the second class elephants are those which can drag 2-3.5 meter cube log at a time, and those in the age limit between 25-30 years and 45-50; those between 30-45 years old and cannot drag more than 2 meter cube log are also in the second class; elephants between 18-25 years age class and over 50 years old that can drag up to meter cube log are classified as the third class elephants: 25-50 years old elephants which cannot drag 2 meter cube log are also classified as third class up to 2 meter cube log classified as the third class elephants ; 25-50 years old elephants which cannot drag 2 meter cube log are also classified as third class animals; Poor and disabled elephants of any age and elephants over 50 years of age are in the fourth class; job training elephants in 15-18 years of age and elephants between 5-15 years of age which are only used as baggage carriers are fifth class elephants; and the sixth class elephants are baby elephants called Calves At Heel under 5 years old.

As mentioned earlier, elephant camps are organized with six or seven elephants in one camp with their riders called *oozies*, headed by a head rider *(Sin-gaung)* for each camp. There are timber working elephant camps as well as baggage elephant camps. In addition there are also elephant sick camps and summer time elephant rest camps.

Working elephants camp consists of about 6 elephants, usually with two males (one tusker and one tuskless) and four females. All elephants in the working camp should be over 18 years and under 50 years of age, but occasionally one or two 16 - 18 years old on job training elephants can be added in. The camp should be within easy distance of work in the forest. Camp site should be well drained but reasonably level. Food and water must be adequate for both staff and elephant during the work season. A fairly large area should be cleared of all vegetation to allow the site to dry out and to reduce the incidence of mosquitoes. A proper latrine should be built. The harness rack called the *Yay-dan* should be built between the camp and the elephant bathing pool. There should be a small roof over the rack to protect from rain. The elephant staff consists of a headman *(sin-gaung)*, one assistant head-man *(Gaung -gwe)*, one rider *(oozie)* for each elephants in the camp, three permanent helpers *(pejeiks)*, who are youngsters apprenticing the work prior to becoming the rider and two temporary *pejeiks* for the working season.

Working elephants have the duties of *stumping* and *dragging* of felled logs to the measuring point, and *yeleiking* and *aunging* of teak-logs in the side- stream. Working standard per head of elephant per year is 140 meter cube of teak or 220 meter cube of other hardwood. The *oozie* must go out and catch his elephant early in the morning every day. While he traces his elephant he should note if it has fed well the night before; if the bowel is normal and if the sleeping bed is normal. Anything unusual must be reported immediately to the *Sin-gaung* on return to the camp. Back at the camp, the elephant must be bathed, harnessed and shown to the *Sin-gaung*. The *Sin-gaung* should supervise the harnessing and set off to work ahead of the elephants, to supervise the *pejeiks* . On arrival at the work site , the harness should be inspected again to see that all are in correct position. In all timber extraction operations, everything must be done to help the

elephant by well made drag paths, intelligent use of rollers, use of blocks and tackles for uphill hauls, using two or more elephants in tandem to drag large logs along narrow paths, using two or four elephants in double tandem to drag logs along wide paths, and to use *gindeiks,* the wheeled carriers for long haulage over flat country.

Working months for clephants are from 15 th June to 20 th February with a rest of there weeks at the end of October, depending upon the temperature and locality. The usual practice of working days is 5 days work and 2 days rest in a week. When the elephants come back from the hot-weather rest camps they should not be put into full work straight away. For the first week they should work 4 hours a day, and then 6 hours per day in the second week, and in the third week and thereafter they should be assigned to full duty but not exeeding 8 hours per days in cool weather and 5 hours per day in hot weather. However **Sin-gaung** should break off work when elephants are tired. The amount of work an elephant can do in a day depends on such things as its general health and strength condition, the size of timber, the state of drag path, the nature of terrain, quality and quantity of fodder available in the vicinity and the season of the year. If the animal is out of exercise, the worklord should be gradually raised. No elephant should work beyond 10 am in the morning session and earlier than 3 pm in the afternoon session during hot weather months. Baggage elephant camps are situated at the timber extraction base camps. The duty of baggage elephants is to transport the forest utensils and belongings of officers in charge between base camp and the working camps.

Baggage elephant team consists of 6 (or-2) elephants, (ie. neither more than 6 nor less than 4 elephants in a team). Usually baggage elephant should be 5 - 15 years old, but occasionally, disabled elephants which cnnot be used in dragging work are included. The staff consists of one assistant head-man *(Gaung-gwe),* 6 (or - 2) riders *(oozies)* and one or two *pejeiks.* Baggage elephants should not travel more than 22 km per day in flat paths and not more than 16 km per day in moutainous and muddy paths. They should not go on more than 3 severe marches without any rest. The two most common cases of unfit baggage elephants are general debility and back-sores due to over loading.

As soon as an elephant shows any sign of being out of sorts it should be off work and placed under observation. Treatment depending on the symptoms shown should be adopted and, if the appetite is wanting, various things may be given to tempt him, such as wild plantain trees, bamboo shoots, cut *kaing (Saccharum spp.)* sugar cane, etc., depending on what is available. If and when inspite of careful handing in camp the elephant fails to respond to ordinary treatment it should be placed in a sick camp under the care of most competent man availlable. The sick camp should be in the middle of good grazing ground and accessible from all other camps. This moving to rest camp applies more particulary to animals that are becoming debilitated and injured.

In cases of servere injuries to the legs, severe debility and segregation during the outbreak of contagious diseases, it is necessary to hand feed the animal and usually two men to each

elephant will be required to keep the animal sufficiently supplied with fodder. Unless the sick animal is very close to the creek, it is better to carry drinking water to it. A close watch should be kept on the state of the bowels and urine. Nowadays veterinarian doctorrs and vet assistants specially trained for elephant care undertake the well being of timber working elephants of MTE. All elephants, after the working season which ends on 15th February, have to be moved to the summerrest camps where they are given rest period throughout the hot season until the end of May. All elephant staff have to go together with the elephants to the rest camps except one or two *pejeiks* who will pass the message from base camp to rest camps.

The site of rest camp should be the place where good running water for drinking and bathing, ample supply of fodder, sufficient shade are available. The rest camp should be in an isolated area to reduce the hazard of contagious diseases but should be accessible for the authorities and veterinarians for inspection. While in the rest camp all *oozies* must prepare new elephant gear for the next season's work. Elephant gear includes saddle, padding breast and girth straps, etc.

For the minimum period of 14 days after arrival at the rest camp, the elephants should be interfered with as little as possible, but when recovered from their initial fatigue, it is usual to brand those animals which require it, and to inoculate all animals against *anthrax*. These operations are carried out at this time of the year to save time during the working season. Calves under 8 years of age and pregnant animals should not be inoculated against *anthrax*, and youngsters between ages of 8 and 14 years are given only a half dose.

When elephants go into rest camp, they often lose condition at first because of being too tired to assimilate their new fodder. Within a fortnight however, they start to pick up and a ten day course of arsenic and strychnine tonic will materially help to restore thin and weary animals to health. Where fodder is sufficiently plentiful, it is a good plan to combine two or more herds in one camp to faciclitate the granting of leave to the staff.

Reproduction of captive elephants should be the most important phenomenon for the elephant staff and should be most taken care of by them. Sign of oestrus cycle of cow elephant, which is of 16 week interval, is hardly noticeable to human observers, but bull elephants are more observant. They use olfaction and vomeronasal organs to detect oestrus in cows. They will show enhanced interest in cows prior to ovulation and this can be observed by human beings.

Elephant staff have the duty to watch the incidence of season or heat in cow elephants. When the elephant staff see mating they must report to their immediate superior officers. And the officer must record the incidence in the book. The registration number of cow and bull, time and date of mating and name of the staff who has seen mating should be recorded. Elephants are pregnant are for 630 - 660 days (ie. 21 - 22 months). The signs of pregnancy are dull movement and swelling of breasts after one year, when seme milk-like secretion can be squeezed out from the teats. Pregnant cows should be given light duties. They should not be used in *aunging* and lifting of logs. Complete rest and leave from work must be given three months before and after

birth. Food supplements such as paddy, rice, sugar-cane, corn, etc, should be fed and vitamins and minerals such as Vitamin A, B Complex, Iron compound should be fed or injected to the pregnant cow.

An important duty of elephant staff in the care of elephants is bathing them. Elephants must be bathed in a clean large pool about two feet deep with a good volume of runing water. The purpose of bathing elephants is to clean the body surface before harnesssing and to correct body temperature. Proper bathing removes the eggs of gad-flies on the skin surface, and scrubbing with herbs stimulate the skin tissue to become dark and healthy. When bathing an elephant, it must be made to lie down on a side and then on the other and its whole body should be splashed freely with water, and all mud and dirt washed off. The rider and another man if available should then briskly massage and scrub every part of the animal with fibrous piece of the stem of a climber such as *donwe (Entada scandens)* or *su-yit (Acacia spp.)*. The elephant will thoroughly appreciate the treatment. special attention must be paid to the inside of the ears, lips, roots of tusks, between thighs and roots of the tail where parasites are most likely to be found. On work days elephants should be scrubbed with the aforementioned climbers for ten minutes before being harnessed and on rest days it should be aimed at scrubbing them in the morning and evening for twenty minutes each time. *Donwe* is the climber most commonly used, but *suyit* is perhaps even better, as it acts as a fly-repellant without injuring the skin. *Su-yit* is poisonous so should only be used where there is a good volume of runing water. In some areas, just before harnessing, a bit of a water extract of *su-yit* is spirinkied on the elephants to keep away biting flies.

ELEPHANT GEAR

Timber Elephants in Myanmar are still using, most satisfatorily, the harness designed for them from the time of Myanmar kings. Both in material and design, the harness has hardly gone through any appreciable alteration over the years, and although some slight modifications were made before the second World War by some British firms operating here, the essential points in the construction of the dragging gear remain practically the name. The harness consists mainly of *tha-yay* or padding; *endone* or saddle; *wun-baik-kye* or a girth or belly band; *geke-se-kye* or rope sling; *lebat* or breast band; and a pair of *swe-kyo* or dragging chains. Materiais required for the harness are all available in the forest and are usually collected in themonths of April and May. When the working elephants are at the camps. This is also the time when elephant staff carry out jobs such as replacing old, worn-out gear with new ones.

The material for *tha-yay* or padding comes from the fibrous bark of *bambwe (Careya arborea)* or *nabe* trees. Because of its astringent properties which help to cool and sooth the skin of the elephant, the bark of *bamwe* is preferable. It is important that the bark is well beaten with heavy stick, so that the *tha-yay* produced is soft and pliable. The pad or *tha-yay* should be of sufficient thickness to distribute the pressure of the load, but if too much is used the girth cannot be braced up sufficiently tight and the saddle tends to shift on the back. The number of pieces of beaten bark required varies, as it is not of a standard thickness, but 12- 15 ply giving a total thickness of six to seven inches is correct. A stiff bamboo mat placed below the top sheet of *tha-*

yay materially helps to distribute the pressure of load. The area of back covered by padding, or *tha-yay*, should not be unnecessarily large. Five feet across the back and two feet from front to rear is all that should be covered when an elephant is harnessed for dragging. Great care must be taken to keep *tha-yay* dry and free from grit and dirt.

Ondones or saddles are made out of light wood, measuring roughly 40- 45 cm in lengh, 10- 15 cm in width, and about 20 cm in height. A pair of *ondones*, joined together by two pieces of rope or plaited cane, rests on either side of the spinal ridge, across which the layers of *tha-yay* have already been evenly distributed. *Goke-se-keo* or rope-sling for the dragging chains should always be made of *shaw (Sterculia spp.)* fibers. The sling is doubled and the *tha-yay*, with the loops falling on either side of the elephant should be in line with the chest , or slightly above it. The ends of the lebat or breast band are then passed throught the loops. Goke-se-kyo thus lifts the lebat up and keeps it in place. What is most important however is that it can be easily cut away with a knife by the rider, in case a log, while being dragged over a slippery incline and gets out of control. The moment the goke-se kye is suddenly out, the lebat and the drag-chains drop to the ground. This saves the animal from being pulled down the steep slope by the falling log which it is dragging.

Wun-bike-kyo or girth, is a stout band made of plaited cane or woven shaw about 5 - 6.5 cm in breadth. It goes round end of the *ondones* which are thus pressed down in place during the hours of work. The *lebat* or breast-band is also made of thick strands of shaw which measure 18 - 23 cm wide and1.8 -2.1 m long. It is finished off at each end with firmly plaited loop to which the drag- chains are held on by means of hooks. In some extraction agencies the *lebat* is encased in leather softened with pig fat.

Swe-kye or drag- chains are generally of 12 mm or 16mm shortlink chains. A pair ofchains consist of a long chain of 4 - 6 m in length, with a hook at one end to fasten on to loop of the *lebat.* with an oval ring at the other end to pass through the drag hole of the log; and a shorter chain of 3 - 4 m length with a hook at each end, one to fasten the *lebat* and other to join with the oval ring of the longer chain. Other elephant gears such *as htoo* or fetters, *choon* or goad or driving hook, *Kah* or large baskets of cane or cradle-like wooden structure, and wooden or iron bell with wooden clappers are also used for each elephant.

CONCLUSION

The economical and environmental advantages of using the trained elephants in forestry operations are numerous. A fully trained elephant is an investment for a life time. It costs about U$$ 6.000- 10,000 to purchase a timber elephant of 20 years of age in Thailand, and about kyats 6000,000 - 1,000,000 in Myanmar. Such an elephant has a working life of 30 years. Compare this with the cost of a crawler tractor which cost more than U$$ 140,000 a unit and having working life of 6-10 years. Elephants do not need expensive spare parts, and the cost of maintaining them is far cheaper than that of heavy machinery.

The use of trained elephants in extraction of timber greatly reduces the environmental damage caused by heavy machinery and thus prevents excessive soil erosion and soil compaction. The establishment of logging roads for heavy machines not only destroys much of the forest but more seriously provides the access to many wild settlers and poachers to the interior of the forests. Elephant excreta provides rich organic nutrient sources for a wide variety of plants, soil bacteria and various other detritivores, which in turn make these resources available for plant use. The trained elephants can ascend steep hills, can work throughout the year except about three months during very hot wether, Unlike machinery which cannot be satisfactorily used in long rainy season in Myanmar. Bull elephants have a **musth** phenomenon, during which they tend to be aggressive, and are not put into work; female elephants can work throughout the year except their last trimester of gestation period.

The staple food of elephants throughout the country consists of various kinds of grass and bamboo, which are found in the undergrowth of forests. Elephants, while feeding in the forest will thin out this undergrowth in such a way to enhance germination and growth of many forest tree seeds. Aware of the fact that reckless cutting, shifting cultivation and clear cutting method of extraction are causes of deforestation in Myanmar, the management by Selection Felling System employs elephant logging a must which decidedly bebefits the system. The conventional practice of forest management of Myanmar is the most suited and practicable sustem under the widening concept of environmental awareness. In fact, forest ecosytems in Myanmar will never deteriorate so long as the present day method of elephant logging exists, and Myanmar is the only country in the world to use elephants wisely and rationally in timber extraction



GAJAH 17:23-35

STATUS OF ELEPHANTS IN NGHE AN AND HA TINH PROVINCES, VIETNAM

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INTRODUCTION

A field survey team survey team comprising scientists from World Wide Fund for Nature (WWF), Forest Inventory & Planning Institute (FIPI) and the Institute of Ecology & Biological Resources (IEBR) initiated a national review of the conservation status of wild elephant populations, between December 1992 and March 1993. In addition to gathering field data in selected locations, the team compiled through interviews, discussions with provincial and federal authorities and literature search, an overview of the present status of elephant distrubution, population estimates and human-elephant conflict in Vietnam (Dawson *et. al.* 1993). The conclusions from this national overview drew specific recommendations, two of which were the objectives of the study being reported here, namely, to carry out more thorough elephant densities surveys and population estimates in protected areas which were considered to hold viable elephant populations; and to assess quality of habitat between Vu Quang and Khe Thoi Nature Reserves in the north-central provinces of Nghe An and Ha Tinh with a view to establishing an elephant corridor.

In May 1992 a scientific mission, comprising members from WWF and the Ministry of Forestry (MOF) surveyed Vu Quang Nature Reserve and during the course of their field work discovered a species of large mammal new to science, which was subsequently described and named *Pseudoryx nghetinhensis* (Dung *et al.* 1993) Further surveys by scientists from FIPI found that the geographic range of this new bovid extended into the adjacent province of Nghe An Detailed surveys were recommended to ascertain distribution and density data in the two protected areas of Vu Quang and Phu Mat (formerly known as Khe Thoi) found in the provinces of Ha Tinh and Nghe An, respectively. Furthemore, basic studies of the species' ecology and behaiour were required to assist in planning a long-term strategy for its conservation.

With a view to carrying out the recommendations of both these previous projects in the two provinces of Nghe An and Ha Tinh, and as time suitable for field work in this region is limited by the rains it was decided (after discussions with the country representative and project administrator) to combine the work for both species, but for administrative reasons were kept

separate with different contracts and terms of reference. For the same reasons the results of the survey as it applies to elephants and other large mammals excluding *Pseudoryx nghetinhensis* is reported here. Field work was carried out between November 1993 - December 1994.

OBJECTIVES

1. Complete surveys of forest areas along the Lao border region in Nghe An and Ha Tinh provinces with a view to extending the protected areas system and maintaining corridors for the migration of elephants and other large mammals.

2 Conduct surveys of elephants and large mammals in the region and analyze results and present status report.

3. Make notes of signs of the Vu Quang ox *(Pseudoryx nghetinhensis)* and identify possible sites for follow-up long-term monitoring and field studies.

4. Prepare consultancy report for WWF and MOF on the findings.

METHODS

The surveys were carried out in the provinces of Nghe An and Ha Tinh in north-central Vietnam. In Nghe province several forest reserves were visited, while in Ha Tinh the field survey concentrated on Vu Quang Nature Reserve. In Nghe An intensive field work was carried out from December 1993 to January 1994, and again in October-November 1994. In this period several forest reserves were visited to ascertain the distribution of elephants and other large mammals. Habitat quality around the reserve was evaluated with a view to recommending establishment of forest corridors to link fragmented elephant populations. These included the forest near the communes Thien Phong, Thong Thu and Hanh Dich in Quy Phuong district. Parts of the proposed nature reserve Phu Mat were surveyed to assess distribution of elephants and the sao -la and included the forests of Khe Thoi in Tuong Duong district, Pu Noong in Con Cuong district and Cao Veu in Anh Son district. Reported incidents of human-elephant conflict were investigated in this province including areas in Quy Chau and Quy Hop districts, and Cao Veu in Anh Son district.

The surveys in Vu Quang Reserve were done in three parts. A reconnaissance survey for elephants and sao-la was carried out in November 1993. Based on the results of the reconnaissance more detailed census of elephants was carried out in January and March 1994. Detailed surveys for the sao-la and other large mammals were done between March and May 1994, and again from September to November 1994. These surveys included several visits to Kim Quang and Long Cao villages as well as visits to Huong Khe and Huong Forest Enterprise. Several weeks were spent surveying the uninhabited forests in the northern part of the nature reserve towards the border of Laos. Several locations were visited and assessed for suitability to erect a research

camp during January 1994. A temporary camp was set up at the site selected for the erection of the research camp and this was the base for the last phase of field work in Vu Quang (March-November 1994).

Elephant density and distribution

In order to obtain information on the presence of elephants, their past and present distribution in an area, two methods were used. First interviews of local hunters and other villagers were conducted to obtain subjective information on elephant distribution. To ascertain elephant distribution in the field reconnaissance surveys were carried out on foot using existing paths and roads, as well as cutting paths along random compass bearings. All walks were done at steady pace of approximately 2 km per hour. Signs of all large mammals were noted, in addition to paying particular attention to signs of elephants such as tracks, dung and feeding. Measurements were made of the circumference of the forefoot to estimate shoulder height of individuals and to infer from these their age. When signs of elephants were found, records were also made on the habitat and its condition. All signs of human activity encountered were recorded and particular attention was paid to this aspect in nature reserves.

In Vu Quang a detailed study was carried out to estimate the density of elephants using the indirect sampling technique described by Dawson & Dekker (1992). The method uses line transect sampling (Burnham *et al.* 1990) to estimate dung density, while data from the literature was used for two other parameters required to estimate elephant density, namely rate of dung decay and rate of dung deposition by elephants per day. Elephant densities are calculated using the program ELEPHANT (Dekker & Dawson 1992).

Human-elephant conflicts

To be able to assess the level and cause of human-elephant conflicts, a previously prepared questionnaire was used in interviews with the local people. Attempts were made to talk to the people who were directly involved. The actual location of conflict and the forests in it was surveyed to determine the quality of habitat and cause of conflict. Economic loss due to this conflict was assessed.

RESULTS

Elephant density and distribution

Nghe An Province

The total elephant population in the province of Nghe An is the highest found in northern Vietnam. However, as elsewhere in the country this provincial population is highly fragmented. Three distinct elephant populations have been identified. They are: the Quy Phuong population found in the forests of Thong Thu and Hanh Dich; the Phu Mat population found in the forests

of Khe Thoi and Cao Veu; and the Pu Huong population found in the forests that straddle the districts of Quy Hop and Quy Chau in the central region of the province. In addition elephants are found seasonally in the northern parts of Quy Chau district on the border to Thanh Hoa province. The distances between these populations are great (though not in terms of distances elephants can move) and the areas in between are not forested and have high human population densities. The possibilility of protected elephant corridors to link these populations, therefore, are non-existent.

Quy Phuong elephant population

The habitat available for the *Quy Phuong population* is small being between 50-70 km^2. This area is legally protected against logging and managed as a forest reserve by provincial authorities as it is the watershed for two major rivers. The habitat in this area is rich and diverse. Vegetation comprises mainly of primary evergreen and semi-evergreen forests, and mixed bamboo forests. Water is not scarce and the tall canopy provides adequate shade making this area highly suitable for elephants. The topography is undulating in the area which has an altitudinal range between 1000- 1200 m asl. This small patch of excellent habitat has a high biodiversity value. Floral diversity includes two endangered species of dipterocarp and 12 other tree species that are listed as threatened.

Based on elephant dung encountered in ratio to distance walked, measurements and distribution of tracks,the population is estimated to comprise between 15-20 individuals. While this density (0.3-0.4) appears to be quite high compared to other parts of Vietnam, compared to other parts of the Asian elephant's range this is a moderate estimate. The habitat available to the *Quy Phuong population* on the Vietnamese side is very small, but these forests are contiguous with Laos in the west, where they are quite extensive as seen by satellite images. So the *Quy Phuong population* is expected to be much greater, since on the Laotion side the topography is less steep and habitat extensive. The reason for the high quality of habitat in this area is obviously due to the logging ban imposed by the provincial authorities to protect this important watershed. However, some signs of illegal logging were recorded were recorded especially in the more accessible areas to the south near Hanh Dich commune. On the Thong Thu side, the protected forest is relatively inaccessible due to its steep ascent from 600 m, which is possibly the main (and only) deterrent against illegal logging!

The immediate vicinity of this patch of protected forest is inhabited by people belonging primarily to the Tai ethnic group. Shifting cultivation is way of life to these inhabitants and all forests close to or relatively accessible to the villages have been cleared for planting "dry paddy" which is a staple for the community. This makes the Thung Thu-hanh Dich forest a small is land surrounded by human activity, with no habitat contiguity on the Vietnamese side of the border.

The difficult access acts as a deterrent to hunters, but the scale of hunting that does take place poses the most immediate threat to faunal diversity of this small forest reserve. As the area is on the border to Laos , patrolling soldiers constantly hunt mainly as subsistence while on duty.

During the survey several gun shots were heard from the Laotion side where it is reported that the H'mong hunt regularly. It is reported that four elephants were poached on the Loa side during 1993. This could not be substantiated and no remains of elephant were recorded during the survey on the Vietnamese side. Even if this is not true, hunting is a potential threat for elephants and other large mammals in the area as the human expands in its immediate surroundings. Forest reserves or protection forests are primarily designated to prohibit logging; hunting is not a banned activity in such areas.

Phu Mat elephant population

The *Phu Mat population* is found in the forests of Khe Thoi in Tuong Duong district of Nghe An province. These forests form the western extremity of the proposed Phu Mat Nature Reserve. The reserve covers an area of 92,000 ha of forest and is found in the south of the province where it shares its border with Laos. It is located across the three southern districts of the province namely Tuong Duong, Con Cuong and Anh Son.

This large nature reserve is highly undulating and ha s an altitudinal range between 700 to 1,840 m asl. The north Troung Son mountain range acts as the natural international boundary between the two countries. Its shape and geography ensures a climatic range where precipitation increases sharply towards the east with relatively drier areas in the west.

Primary forests are found in the highly mountainous areas and cover an area of approxi mately 88,000 ha. While potentially this entire area is available as habitat for the Phu Mat population topography is a limiting factor where steep, rocky valleys are a deterrent to movement of elephants to the east. However a small, separate population of elephants is found in the eastern extremity of the reserve in Anh Son district.

The elephant population in Khe Thoi is substantial, and is possibly the largest single population in northern Vietnam. Based on frequency of elephant dung, tracks and feeding signs seen in relation to the distance covered during the survey, it is estimated that the Phu Mat population in Khe Thoi is at a minimum, 50 individuals. Signs of dung on peaks as high as 1,652 m asl (Phu Xam Liem) indicate a movement of elephant between Vietnam and Laos and the strong possibility that these elephants are part of a larger herd.

Habitat available for elephants is excellent in this part of the nature reserve, comprising a mixture of secondary and primary evergreen and semi evergreen forest and mixed forests with extensive stands of bamboo at lower altitudes. Water and shade are plentiful , while the local terrain is gently undulating. The forests in the area are a fair distance from human habitation, and while some illegal logging is taking place in flatter, accessible areas, it is not considered a threat to elephants. What is a threat however, is the massive collection of bamboo which is floated down in great masses, possibly seriously depleting the food resource of elephants. Gold panning is destroying the waterways and while this is not a direct threat to elephants, this does mean an influx of people and with it the threat of hunting.

There have been no reports of elephants being killed by people in this area and as such no conflict between people and elephants. The elephant population in the easterm extremity of the Phu Mat Nature Reserve in Anh Son district was found to be using the area between the upper Yen (a small river) and the hills to its north-west whose highest peak is 1343 m. The topography in this area is gently undulating and habitat quality in terms of contiguity and availability of food and shelter is assessed to be low.

Based on tracks and other signs it is estimated that the relative density of elephants in this area is fairly high. However no measurements were possible to estimate absolute density. It is evident that there is a lot of movement of elephants between several patches of forest that are found here. Fragmented habitat is causing increasing conflict between people and elephants in this part of the reserve. Although no one has been killed, elephants have destroyed sugar cane and paddy crops, and destroyed huts and mud houses. No evidence was found to suggest that this elephant population's range was contiguous with that found in the Khe Thoi area. Extensive highly undulating terrain, and in flatter areas large human settlements are factors that may constrain the movement of this small group of elephants towards the west. No evidence of elephants was found in the mid-region of the Nature Reserve, i.e. in parts of Con Cuong district it is reported that elephants were last seen here well over 20 years earlier.

Pu Huong elephant population

Habitat available for the Pu Huong population is highly fragmented and small. The forest area that is proposed to be made into a nature reserve is a forest enterprise with a small portion of protected forests to conserve the watershed in the area. The area demarcated for protection is only a proposal and includes vast areas of human population. The majority of people living in the area belong to the Thai ethnic group who practice shifting cultivation. This together with logging activities has further fragmented the habitat of the Pu Hong population.

The fragmented habitat is causing increasing human/elephant conflict in the area. Several cases of crop depredation and one case of human fatality were reported in Nam Son commune in Quy Hop district. Interviews revealed that crop raiding has increased since during the last two years. While previously elephants were only seen in this part of the district seasonally, a small population was reported to be resident in a small patch of mixed bamboo forest approximately two kilometres from the main village of the commune. From our field investigation (size of fresh tracks, dung and direct sightings) it is estimated that the group of elephants residing in this forest patch numbers between 5-8 individuals including a very young calf. Two elephants were sighted by the survey team, one of which was a tusker.

Interviews of villagers who had encountered crop-raiding elephants the previous night about 1 kilometre from the forest patch revealed that they saw 7 individuals. Fortunately neither the hunt or the people in them were harmed, although the crop was destroyed extensively.

The incident of human fatality was a case of accident when an old woman guarding a rice field along with her husband heard elephants and ran out to chase them with a fire torch in her hand. Approximately 10-15 ha of hill rice were destroyed by this herd of elephants during the year 1993. No compensation was given either for the case of human fatality or crop depredation by the provincial authorities. More incidents of human - elephant conflict have been reported during the year 1994 and were investigated by us in the same district but different commune(Mon Son) where elephant presence was reported for the first time, an indication that this fragmented herd is moving around in search of suitable habitat Several human abodes have been desroyed by crop raiding elephants, and the lack of experience of the local peple in dealing with elephants will invariably lead to human deaths if proper precautions are not taken. This experience is very reminiscent of how the situation escalated in southern Vietnam where several people were killed by elephants.

It was estinated that a small herd of four elephants recently destroyed harvested crops, and in theprocess destroyed several houses, and killed one old woman just before the lunar new year of 1995. In retaliation the villagers have killed three elephants.

Ha Tinh province

There are primarily two areas that have elephants in this province. The forested areas in Huong Khe district and in the Ho Khe Go Nature Reserve, and a small population in the Vu Quang Nature Reserve. Interviews with provincial authorities in Ha Tinh revealed that there has been an in creasing number of incidents of conflict between people and elephant, especially in Huong Khe district adjacent to Vu Quang Nature Reserve. Reportedly 48 elephants have been hunted during the previous four years, seriously depleting the populating in the province.

Extensive interviews with hunters has revealed that elephants are still reguarly killed for ivory, meat and hide in the province. Hunting expeditions are conducted across provincial and international borders, deep into adjacent forests in Laos and even as far south as Cambodia. These hunters are primarily former soldiers who are very familiar with the lay of the land, and have heavy weapons. A number of them have reportedly got killed during their forays into neighbouring countries.

Vu Quang elephant population

Extensive reconnaissance surveys in Vu Quang during two periods o f field work revealed that only a small portion of the Reserve is occupied by elephants. Evidence of elephant presence in Vu Quang was found only in the Dan Thai area (north-eastern parts of the he reserve) in degraded, secondary mixed bamboo forests, encompassing about 80-1000 km^2. As part of the reconnaissance fresh tracks of elephants were followed. After two days of tracking part of a herd was sighted in thick forests very close to a village. A second sighting of elephants in a different location about 2 km away from the first site revealed a mother and young calf, indicating that

the population is breeding and possibly a second herd. Based on the reconnaissance a detailed systematic dung count census was designed for Vu Quand and was carried out in March 1994. Transects were laid out at 0.5 km intervals using a 1:50,000 topographic map. Roads and rivers on the north-south axis were used as the baseline and transects ran at right-angles to these.

A total of 26 transects of two kilometres each was traversed during which a total of 86 samples were seen and measured in an average strip width of 15 metres, indicating the degree of visibility in the forest.Dung distribution indicated that the seasonal range of elephants during and immediately prior to the census (i.e., period of at least two months prior to census- based on age of dung encountered) was limited to approximately 40 km^2 in the central and western portions of the annual range identified during the reconnalssance.

It was impossible to find the requisite sample size to conduct the dung decay rate experiment. Elephant presence was extremely hard to detect and when seen it was only glimpses as the vegetation was very dense, and the elephants were very wary of human presence. These factors did not enable us to follw them to estimate rate of dung deposition. Therefore estimates for these parameters were taken from the literature, from areas as closely representative of Vu Quang in terms of climate and habitat. Data analysis reveals that the mean density of elephants in Vu Quang is 0.38/ km2 (0.2 - 0.56/km^2), and by extrapolation this would give a population estimate of between 8-22 individuals with a mean of 15 elephants. There were no reports of elephants damaging crops or people hunting elephants in the Nature Reserve, although it is reported that people often encounter them close to their villages.

OTHER LARGE MAMMALS AND BIRDS

Large mammals

In all 37 mammal species were recorded either directly, or through indirect evidencesuch as tracks, dung/pellets, hunting trophies, carcasses and skins. Sighificant records of some large mammals are described below.

Nghe An Province

The forest reserve in Thung Tu & Hanh Dich in Que Phoung district comprises excellent habitat and has a high biodiversity value. Floral diversity includes two endangered species of dipterocarp and 12 other tree species that are listed as threatened.

During the survey the term came across live, remains or tracks and signs of 26 mammal species including globally threatened species such as *Selenarctos thibetanus, Cuon alpinus.* Signs of *Bos gaurus* were abundant, while *Hylobates leocogenys* were frequently heard and sighed on two occasions.

In Khe Thoi of Phu Mat Nature Reserve a troop of 12-15 individuals of Phayre's langur *(Presbytis phayrei)* were sighted and observed for more than 30 mins. The troop included serveral young individuals. In Con Cuong district, several skulls of *Megamuntiacus vuquangensis* were found during field work in October/ November 1994.

A new deer which was found by the FIPI survey team in Phu Mat, not described but named the Slow-running or Mr. Chinh's deer, has been confirmed as not being a new species. DNA tests have revealed that it is a sambar deer. The shape and size of antlers which were the characteristics that set this animal apart are apparently an aberration.

Vu Quang

Interviews with hunters and inspection of trophies in Kim Quang village in Vu Quang Nature Reserve revealed that there were two species of *Muntiacus* species found in the area, the second one being of a very large size with large antlers on short pedicels. Serveral skulls were collected and after comparative measurements and DNA examination it was described as a new species. Further analysis juistified the creation of a new genus. A description was published of the new animal which was named *Megamuntiacus vuguangensis*. Hunting data collected reveal that *Megamuntiacus vuquangensis* is as abundant as the smaller *Muntiacus muntjak* found in the area, but found in slightly higher altitudes. During the snaring season of 1993 / 94 we have records of 27 barking deer caught, of which 13 were *Megamuntiacus*. The only other area where two sympatric barking deer speciesare found is in Borneo.

Further surveys done in provinces south of Ha Tinh have shown that the geographic range of this new species extends beyond the Hai Van pass. During the same period of initial "discovery", and quite separately, a second scientific team in Laos found evidence of this species. Two animals were found in captivity in Laos and photographed.

At the end of the first phase of field work in 1994, a *Megamuntiacus vuquangensis* adult male was sighted by two of us during the day, and observed for about three minutes in the southem part of the Reserve. A significant population of gaur *(Bos gaurus)* was recorded in Vu Quang in its south-eastern areas on the border to Laos. Fresh signs of feeding, tracks and dung revealed at least 20 individuals in one area.

An unusual civet pelt seen in December 1993 in the army camp at Kim Quang was found to be that of Owston's civet *(Chrotogale owstoni)*, a globally threatened species. This is the first record of this species in Annam, and a significant range extension to the south.Gibbons *(Hylobates leucogenys)* were heard frequently in most parts of the core area of Vu Quang, and one sighting confirmed that the subspecies found in this area is *H. l .siki*. Interviews with hunters revealed that two tigers had been snared in the last year at Vu Quang. Pelts, bones and claws were all sold to the Chinese market.

Threatened birds

A total of 222 bird species were seen during the field work. Forty-two new species of birds have been added to the list for Vu Quang Nature Reserve. Significant sightings and records are reported below. In the Khe Thoi area of Phu Mat Nature Reserve five species of hombill were seen namely, Great hombill, Wreathed hombill, Oriental Pied hornbill, Brown hornbill and most significantly the Rufous - necked hornbill. A male and female of the last mentioned species were seen on the ridge - trail going up to Phu Xam Liem at approximately 750 m asl. This is a globally threatened species with a very restricted range and this record is a significant one.In Vu Quang the significant record additions were of three globally threatened or rare endemic species, namely Red-collared woodpecker *(Picus rabien)* , Short - tailed scimitar babbler *(Jabouilleia danjoui)* and Yellow-billed nuthatch (*Sitta solangiae*).

THREATS TO LARGE MAMMALS AND THEIR HABITAT

Several major threats have been identified that could affect elephant and other large mammal populations and their habitat in areas surveyed. Habitat and elephant population fragmentation in the central Nghe An and Ha Tinh provinces will contribute to the increase in human / elephant conflict, especially as these vulnerable elephant populations are found outside the protected area system.

The increasing number of incidents of human-elephant conflict occurring in the central districts of Quy Chau and Hop in Nghe An province. So far two people have been killed in different areas, and in retalition three elephants have been slaughterred. This level of conflict will make this already fragmented population very vulnerable to extinction.

Serious mining for gold in the Khe Thoi river causing disturbance and degradation in a very impotant area for elephants in North - central Vietnam. People who are involvedwith the mining are persons living outside the buffer zone of the nature reserve and belong to the majority ethnic community Kinh. In addition to indiscriminate mining, most of these people engage in hunting, with heavy weapons. Although no evidence was found of elephants hunting, other endangered species shot were regulary encountered, e.g. gibbons, red-shanked douc langurs. If elephants are encountered, they would not be spared.

Serious hunting and snaring by the local communities in Vu Quang of large mammals, if not controlled, will drastically reduce their densities very quickly. On average every family (there are 4000 of them in Vu Quang) sets 30 snares, and catch about three large mammals including sambar, wild boar, barking deer, serow, saola, tiger and leopard. A resident wildlife trader in Vu Quang provides the link between local people and the market for smaller mammals and those valuable for trade such as gibbons, Malayan and Asiatic black bears, different species of which are caught alive for trade to China. In addition, the collection of turtles, pangolins different species of snake, large birds such as hombills, was regularly encountered.

CONCLUSION

The survey method used to collect density information on elephants, the dung count indirect method, is now established and widely used in rainforest areas where direct signting elephants is extremely difficult for several reasons. The indirect method is useful in areas with low densities of elephants and can provide adequate data for analysis after relatively small sampling effort, when compared to the amount of sampling that would be required if elephants were to be sighted directly. However because two other parameters have to be estimated (dung decay and deposition rate), and both of them are critically affected by local climatic and micro-habitat conditions, these have to be repeated in each site. Again, both these parameters need relatively large sample sizes and in Vietnam it has yet to be done in any site. The major difficulty being elephants are found in such low densities that adequate samples cannot be located for monitoring. The best that can be done in this situation is to use published data from other locations that resemble, as closely as possible, the site wher a census is being undertaken. Although not entirely satisfactory, resutls from such an exerise are far more acceptable than population estimates based on local information which cannot be substantiated or ground truthed.

There is no doubt that the total population size of elephants in Nghe An province is the best remaining in northem Vietnam. Although this provincial population is fragmented the habitat available to two of them is more extensive because it stretches into neighbouring Laos, thereby making them viable units. However, these two cannot be linked by a corridor because of the dense human populations and lack of habitat that can be considered to make corridor. The discovery of the Phu Mat population in Khe Thoi is particulary encouraging for several reasons. Its estimated size is one of the largest found in Vietnam, and the quality of habitat available to it on the Vietnamese side as well as its contiguity in Laos would certainly make this one of the most viable populations in the long-term. Additionally, these elephants are found in an area that is already earmarked for protection and management under international funding. This together with the relative inaccessibility into the elephant areas would be make this population safe. Once active management of the protected area comes into force, intensive management of the species would ensurre that this elephant population survives into the next century.

The worrying factor of the elephant population in Nghe An is the one found in the central parts of the province. There has been amarked increase in the number of cases of human- elephant conflict throughout the year. The amount crops destroyed both in the fields and after harvest has risen exponentially. The situation is worsened because elephants are moving around at random and are seen in areas that they have not been sighted in before. There is a very real danger of more people getting killed simply because they are not aware of how to react to the presence of elephants in their area. Constant harassment of the elephants by people when they are sighted has made the elephants lose their fear of man and made them more aggressive.

The elephant population remaining in Ha Tinh is very small and fragmented, with possibly no hope for long-term survival. However, the elephants in Vu Quang will be protected under the management of the nature reserve and is an important compnent of the faunal diversity of the area. The positive sign is that this population is in breeding condition and there is hope that given

adequate protection and no elephants are killed this population will increase in number and widen its distribution. All the information collected in these surveys will be used when the Ministry of Forestry and WWF together put together a species survival plan for the elephant.

Population pressures in the form of hunting is minimal in the Phu Mat area of Nghe an province as the human density is relatively low in the nature reserve's buffer zone. While the people living in the buffer zone (ethnic minority communities) do go out hunting in areas close to their villages, a far greater number of individual animals are hunted by people who are entering the reserve from the districts. A vast amount of people were found harvesting bamboo and mining for gold and as an additional activity hunting. People living in the buffer zones, at least in some parts of Phu Mat, are carrying out illegal logging for timber trade, seriously depleting and degrading habitat quality. In Vu Quang, however, large mammal diversity and density is being seriously affected by the very great hunting pressure exerted by the people living in the buffer zone. A lot of the hunting is done for purposes of trade and ways to combat this must be a priority when management activities begin.

RECOMMENDATIONS

* Central and provincial authorities together with WWF should as, a priority discuss and consider pragmatic solutions to the escalating conflict between people and elephants in the central district of Nghe An province.

* In order to ensure the long-term survival of the Phu Mat elephant population, active species management measures must be considered by the relevant authorities and included in the management plan of the reserve.

* In conjunction with provincial authorities of elephant range state in Vietnam and the central Forest Protection Department, the Elephant Action Plan for Vietnam should be completed as quickly as possible and funds sought for implementing the Action Plan.

* An education and awareness campaign should be launched provincially on how to deal with human-elephant conflict. While solutions are being found, in the interim people affected should be adequately compensated, and law enforced when people are caught killing elephants.

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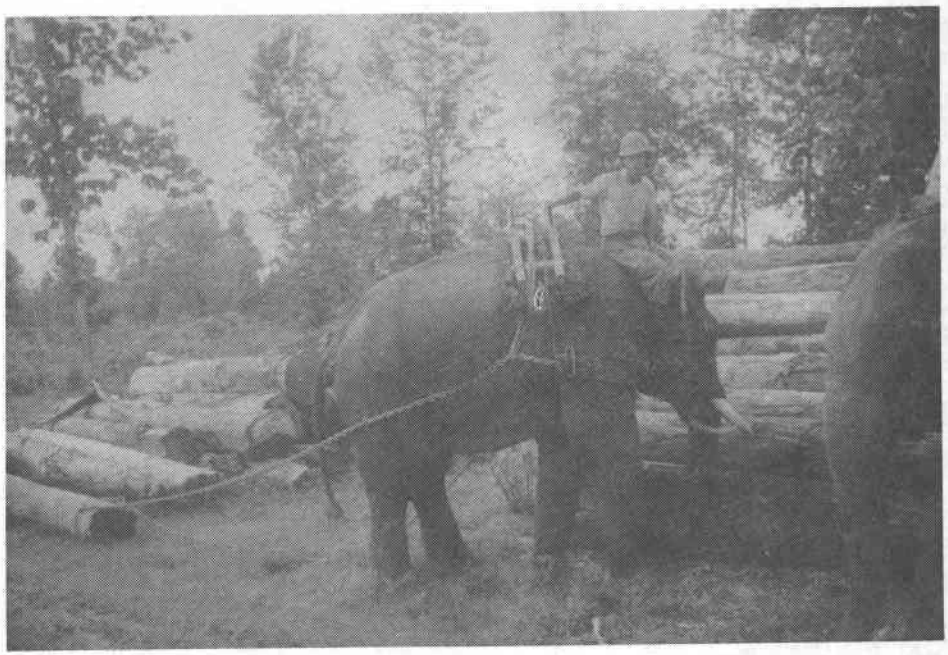
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GAJAH 17: 37-40

A CASE STUDY OF COLIC IN AN ASIAN ELEPHANT

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INTRODUCTION

Colic is defined as a name for severe paroxysmal gripping pain of the bowel or other parts. Though abdominal pain will occasionally arise from genito-urinary disturbances, most commonly colic is accepted as being of gastrointestinal in orgin. A case of colic is encountered in an Asian elephant and successful treatment is documented in this paper.

HISTORY AND EXAMINATION

The history relates to the six year old female elephant weighing 2.2 tons, belonging to a temple in Madras. The call was made for the veterinary intervention since that elephant was highly restless and found to be frequently lying down and getting up. The authorities were annoyed over this restlessness.

During the clinical examination, the elephant was observed in a standing posture. The elephant had a normal rectal temperature. The respiration and heart rates were found to be elevated. However the contour of the abdomen on examintion failed to reveal any abnormality. The oral cavities were apparently normal. Posture related examinations were carried out with the help of the mahout revealed difficulties to assume lateral recumbency position (mahout is the traditional name for the person who controls the captive elephants in South India). The history revealed that the elephant was offered bunch of banans and coconuts in *ad libitum* amounts before the day of occurrence of such abnormal status. Dung was passed freely and the consistency was similar to dung from any other healthty captive elephant. The faecal examination revealed no evidence of helminthic presence. The animal was administered with 90 ml Baralgon - the smooth muscle spasmolytic drug by intramuscular route and oral administration of magnesium sulphate and sodium chloride was carried out each at the rate of 500 gm daily for

3 days. Restriction of the feed was also advised. On the sixth day , the second call was made for the same elephant that exhibited anorexia again. This time the history revealed that the animal was now able to assume lateral recumbency position on command and restlessness was not noticed unlike the earlier time but the elephant failed to take food since morning. The clinical examination revealed the presence of swelling at the right thigh region - the site at which the antispasmodic injection was given earlier. Deep palpation of this site revealed grunting sound from the elephant. The haemogram revealed 34 percent PCV and 5. 01 million / Cmm RBC and 9000/ Cmm WBC. The biochemical examination revealed 3.7 mg percent BUN, 0.5 mg percent creatinine, 6.6 gm percent total protein, 3.3 gm percent albumin and 41.6 mg percent glucose. Icthammol glycerine was advised for external application together with hot and cold fomentations in an alternative manner. Oral administration of trimethoprim - sulphamethoxazole powder was carried out at a rate of 22 mg per kg body weight twice daily for 4 days. After 4 days of treatment, the appetite resumed to the usual level and the elephant became active, moving its tail and trunk freely.

DISCUSSION

The literatures related to the medical management of colic in captive Asian elephants are generally remote. Most of the times, the documentations are not efectively carried out with regard to the medical management of colic in Asian elephants. The digestive tract ailments, indigestion and diarrhoea in particular account for nearly half of the treatment recorded in 31 years in forest department veterinary records in Tamil Nadu (Krishnamurthy & Wemmer, 1995). The oral examination was carried out as a first step of the clinical examination in this elephant, and Mikota *et al.* (1994) too quoted that elephants may show anorexia and reactions of pain in teeth disorders. The reduced alertness and slowed movements of the trunk and legs as noticed in this case during the visit in this case during the first visit are reflective of the sick status of the elephants (Fowler, 1986).

A similarity may be adapted in the therapeutic approach of colic in horses and elephants because of the presence of simple stomach in them. Elevated respiratory and cardiac rates together with the marked resistance to assume the lateral recumbency position reflected the pain status in this elephant. History and the intermittently exhibited abnormal postures related this to the gastrict region in the elephant under inspection. Despite giving more amounts of bananas, astonishingly there was absence of change in the consistency of the dung or diarrhoea. The co-offering of the coconuts, the routine feedings and the impaired gastric motility might be the causes for suppressing the laxative efects of banana in this case. The oral adminstration of magnesium sulphate was preferred in this elephant in order to eliminate the possible food-borne unwanted metabolic products, in the gastric region.

Mikota *et al.* (1994) recommended usage of enemas using a garden hose together with the oral administration of mineral oil. Enemas were not administered in this case, since the animal defecated freely. Considering the specific nature of this elephant as

revealed by the mahout (this elephant prefers to take medicines mixed with preferred soild items than the liquid), the oral administration of mineral oil for laxative purpose was not selected and inspite of that, magnesium sulphate was chosen because this salt could be kept concealed with *"Po ngal"* (the term used for the cooked rice with jaggery in South India) for which this elephant always had a liking. Oral drug administration always assumes an important aspect in hefty wild animals like elephants and in this case both magnesium sulphate and sodium chloride were mixed with *Pongal* and was given in an unexpected way during the serial offering of small amounts of *Pongal.*

The marked resistance to assume lateral recumbency on command by Mahout revealed the existence of pain in the gastric region. Such posture related abnormalities in elephants were mostly associated with clinical conditions. George *et al.* (1990) encountered a case of elephant which had more desire for standing, revealed osteo-arthritis. Pushkaran (1987) stated that gastro-intestinal helminthiasis is a common problem in captive Asian elephants. However faecal examination did not reveal the evidence of any parasitic problem in this case.

Since there is no systematic pharmacokinetic studies with drugs like Baralgan in Asian captive elephants, the empirical dose rate was used in this elephant which helped the recovery as noticed by the resumption of "usual ability" of the elephant to assume freely the lateral recunbency after receiving command fron the Mahout. Though drugs like *Flunixin* have been recommended at a rate of 1 mg per kg body weght during the medical management of colic (Fowler, 1993). This drug is not avalable in Tamil Nadu. The occurrence of anorexia after few days of the earlier treatment might be due to the pain from the swelling at site of infection. The reason for the swelling was analysed to find out whether the drug has caused irritative action in the intra muscular area or is there any other cause. At least the needle used earlier was found to be having inadequate length for use in elephants. The needle for elephant as quoted in Technical Report No. 2 of Wildlife Institute of India should have the length of 51-63mm. Since the needle used was found to be of shorter length, there was a probability of the spasmolytic drug for being deposited near the skin in the fatty area and this might have caused the tissue irritation.

The relatively long time taken lor the swelling to get reduced might be correlated with the finding reported in an Asian elephant by George *et al.* (1989) that healing of skin related wounds generally takes more time than in other animals. Thus, the anorexia reported later may well be correlated with pain at the swelling. The elephant was administraterd with co-trimoxazole drug and many authors have quoted the synergistic effect of the sulfonomides in animals. The absence of rise in PCV and BUN ruled out the occurrence of dehydration in this elephant. The treatment approach coincided with the recommendations of treatment modalities in elephants as suggested by Mikota *et al.* (1994). The resumption of trunk, tail and legs together with resumption of normal appetite and absence of resistance to assume recumbency on command by mahout - all

indicated the successful response of the elephant to the therapeutic approach programmed. Though the practical experience gained may be little in each elephants, the documentation needs to be carried out on captive or free - ranging Asian elephant inorder to understand the still - to be detailed clinical information related to the elephants. Likewise, till the wildlife veterinarians make use of MedArks or any other related treatment modules for elephants, every fact needs to be reported with regard to these elephants - gigantic animals which just on sight give happiness to both children and adult *Homo sapiens.*

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GAJAH 17:41-44

THE WILD ELEPHANTS OF THE ROYAL BARDIA NATIONAL PARK, NEPAL

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INTRODUCTION

Very little is known of the wild elephant population of Nepal. In the last two years, however, there has been a steady increase of wild elephants in the Royal Bardia National Park where previously no resident populations were recorded. Could there be a resident population of elephants? The Royal Bardia National Park encompasses a total area of 968 km^2, which makes it the largest protected area in western Nepal. It is situated in the Bardia and Banke districts of southern and mid-western regions of Nepal (Upreti, 1994). Due to a diverse topography the area consists of numerous habitat types which are equally rich in flora and fauna. There are five main types of vegetation found in these ecosystems, namely, riverine forest, evergreen forest, 'Sal' *(Shorea robusta)* forest, Grassland and pine forest.

The Churia Hills to the north of the Park mark the boundary of the area, followed by the foothills of the Bhabar area, then the alluvial flat land, and the riverine flood plains on its southern boundary. The Geruwa river, which stems off the Karnail river, and the Babai river, are the dominant river systems of the Park.

The main species of wildlife found are spotted deer, barking deer, hog deer, swamp deer, samber, wild boar, sloth bear, jackal, jungle cat, tiger and leopard. Amongst the endangered species of fauna are the blue bull, rhinoceros, gangetic dolphin, hispid hare, striped hyena and the Asian elephant. There are also over 300 species of birds and 60 species of fish (Upreti, 1994). The Royal Bardia National Park officially earned its title in 1988 and has become one of Nepal's finest protected areas.

The presence of wild Asian elephants in the Royal Bardia National Park makes this area one of the last habitats in Nepal where these giants still roam. An actual population status is unknown, as it was believed that many of the elephants were temporary residents when migrating from India. Although Nepal used to support a large population of elephants, most of these have all but vanished due to habitat destruction. The few existing resident herds can be found in the Royal Chitwan National Park, and the adjoining Parsa wildlife Reserve in mid-western Nepal. Recently however, the Royal Bardia National Park witnessed a sudden increase in wild elephant numbers. Where these elephants were coming from, and why the sudden increase in number is unknown. An assumption can only be correlated when relating an increasing amount of habitat destruction in India, to the movement of elephants into Nepal. If these elephants are in search of better habitat, and have arrived

in the Royal Bardia National Park, could this mean that they are here to stay? Will their numbers steadily increase in the coming years? As no attempt has ever been attempted to study the migratory herds of elephants between India and Nepal borders, a brief investigation was made at the Royal Bardia National Park to collect the details of elephant movement and use of the National Park's area. The information was collected from various sources working in the Park.

The following account is an assimilation of data collected in the three day investigation. Although the information may appear rudimentary, this report is an attempt at opening the way for future study on the wild elephants of Nepal. If the conservation of the wild Asian elephant is of importance, their needs should be met across country borders. This means migrating elephants from India to Nepal should be a matter of concern, when seeking to protect the remaining habitats available to these herds. Moreover, should the resident population of wild elephants in Nepal increase, what kind of management will be needed to be implemented in such protected areas as the Royal Bardia National Park? It is hoped that this brief investigation and report would create an awareness amongst the wildlife managers, elephant specialists and related governments, about the need to carry out research on the wild population of elephant in Nepal, before any conclusion be made on their status in the country.

STATUS OF THE WILD ELEPHANTS

Between 30-40 years ago much of the terai area in south-western Nepal was covered by thick jungle. The area was mostly unsuitable for human habitation due to the prevalence of malaria. For this reason the government decided to clear large tracts of forest in order to eradicate malaria. This attracted people from the hills to settle down there, which caused further degradation of the natural forest cover. By the end of the 1960's, up to 80% of the natural habitat was fully destroyed (Santiapillai & Jackson, 1990). As a result the wild elephant population of Nepal was nearly exterminated. The last resident herd of elephants in the Royal Bardia National Park was seen in 1975, after which the only elephants seen were sporadic migrants from India.

Raja Gaj and Kancha

Until recently, the only resident elephants of the National Park were two large bulls named "Raja Gaj" or King elephant and "Kancha" a name given to a younger one. What is peculiar about Raja Gaj is that he may be one of the largest Asian bull tuskers ever recorded. He stands 11.3 ft. tall at the shoulder and has a massive body weight. His appearance has been compared to that of a mammoth due to his high bi-domed shaped head. The forehead and domes are more prominent than other in asian bull elephants. Both animals have good sized tusks, which ages them to be more than 50 years old. These bulls were first spotted in 1985 and have been in the Park ever since. They usually roam the Park's area together and make occasional visits to the females. They have also been seen visiting the paddy fields of nearby villages.

A British expedition of wildlife film producers who came across these bulls while on a visit to the National Park claimed Raja Gaj to be the largest bull elephant ever recorded in Southeast Asia. On what grounds this claim was made is vague as no further scientific investigation was done. Although picture documentaries and articles have been made on this large bull, the information has not been properly channeled. It is ironic to think that if Raja Gaj is the largest Asian elephant and is claimed to be "mammoth - like," that the Government of Nepal and other concerned departments are not aware of it. Why these bulls have chosen to remain in the Royal Bardia National park where they, until recently, were the only resident elephants, is questionable. Further research on these bulls should be carried out to verify the claims made about them.

Recent arrivals

In the last two years the number of resident elephants in the Royal Bardia National Park has increased. According to sources, five elephants were seen entering the Park in November 1993 while one year later sixteen elephants entered the Park. In May/ June of 1995 the total number of elephants counted in the Park was 41. This was the largest number to be recorded in many years. All the elephants were seen entering the Park from its most western boundary, where the village of Gola is situated. Here the elephants crossed over the agricultural plots in to the Royal Bardia National Park. The elephants have now dispersed into various herds inside the park, and have not yet left the area. Complaints of crop-raiding have already been made by the villages located on the fringe area of the National Park. According to the former wildlife warden, the elephants have recently been seen occupying the Babai valley area. The habitat of this valley is well-suited to the elephants' needs since water is plentiful here, as is the growth of bamboo, wild banana and elephant grass. The Babai river flows from east to west for 40 km, inside the Park, as it paves its way to create this pristine valley. It is the remotest area of the Park and therefore makes up the core zone (Upreti, 1994).

Nothing else is known about the herds which have come to stay within the boundary of the Royal Bardia National Park. They do not appear to be in the Park on a temporary basis, as was formerly believed. On October 14, 1995 a 10 cm footprint was recorded in the Park, which shows that the elephants may be breeding in the Park.

CONCLUSION

In investigating the route by which the elephants are migrating into Nepal there are two possible routes: *1.Dhudwa National Park - Sukla Phanta Wildlife Reserve - Churia Hills - Royal Bardia National Park:* The elephants are migratory, coming from the Dhudwa National Park in Uttar Pradesh, where they enter the Royal Sukla Phanta Wildlife Reserve, directly on the western border of Nepal, and Bardia National Park. According to sources, from the Royal Sukla Phanta Wildlife Reserve, moving north-east, the elephants have to cross approximately 8 km of villages/ agricultural lands before entering the protected area of the Churia Hills, belonging to the Royal Bardia National Park.

2. *Kaarnian Ghat - Royal Bardia National Park:* The elephants may be coming from Katarnian Ghat, which is situated south of the National Park in Uttar Pradesh. There is a small wildlife sanctuary here which may act as one of the corridors through which the elephants migrate, while on their way to Nepal. Here again the elephants need to cross human habitation before entering the protected area of the Royal Bardia National Park.

These are the two ways by which the elephants are believed to be moving. The first way seems to be more evident, since the elephants were seen entering the Park on its western boundary. Also, the Royal Sukla Phanta Wildlife Reserve is one of the main areas where migrating herds from Dhudwa National Park move in yearly. Therefore it could well be that these herds have made their way to the Bardia National Park from Sukla Phanta Wildlife Reserve. There are many questions to be addressed when asking where these herds are coming form. Was there a formerly existing migratory route between Dhudwa National Park and Royal Bardia National Park, which is why these herds have found their found way back there ? Why have these herds come and will their number continue to increase, if it is due to lack of good habitat in India?

The total resident population of elephants at the Royal Bardia National Park now stands at 41. Could a resident population of elephants have a future in the Park and if so, what is the minimum viable population of elephants for the area? In order to answer these qustions long term research will need to be intiated to come up with asuitable management plan for both the migratory and resident elephants of the Royal Bardia National Park. Moreover, if the Park is home to one of the largest bull elephants in Southeast Asia, attention should be given to protect his lineage.

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GAJAH 17:45-46

IMMOBILIZATION AND RADIO-COLLARING OF ELEPHANTS IN MUDUMALAI WILDLIFE SANCTUARY, INDIA

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INTRODUCTION

The Bombay Natural History Society had been carrying out studies on the ecology of the Asian Elephant in Mudumalai Wildlife Sanctuary with the assistance and co-operation of the Tamul Nadu State Forest Department. Locating known elephants (especially males) regularly, obtaining precise data on social organization, behaviour and reproductive strategies was found to be difficult. Large areas utilised by the animals, dense forest cover prevent continuous tracking by sight. For this purpose permission was obtained from Government of India to radio- collar five elephants by the Drug Immobilization technique. After obtaining the concurrence of the Government of Tamil Nadu the dates for immobilization and radio collaring the first set of two elephants was fixed in in cousultation with the wildlife Warden at Ooty for between 25-28 February 1991.

METHODS

The target animals were continuously tracked so as to locate them in a suitable place for approaching them close enough for darting and immobilising them to facilitate fixing of radio collars. The help of departmental elephants (koonkies) was used as ground support. One of the known elephants, namely a cow with a torn ear tip was to be darted. As she was having a young suckling calf of less than two months of age, it was decided to choose another female from the same group which was neither pregnant nor nursing a calf. Similary one young male with converging tusks (croosed tusker) was to be darted and collared, but it was found that due to the presence of a big male in musth in the same area, the intended animal moved away from the area and could not be located. Hence it was decided to dart one of the new arrivals which had caused injuries to five of the captive elephants of the Sanctuary. But ultimately another young bull had to be darted since we could not succeed in darting the male in musth.

Radio-collaring of the first elephant

After locating the herd containing the young cow elephant to be radio collared the movement of the herd was continuously monitored. On the morning of the 26th February 1991, the herd containing this cow elephant was found to have split into two groups and the group containing this target animal was located in compartment 8, close to the Circular road. The animal was approached on foot and darted from arange of about 5 m. On being darted the animal moved

away and after travelling over a distance of about one and half kilometers, fell down unconscious near the Moyar river. It was tracked with the help of *koonkie* and elephant trackers. The animal was approached and its physical condition was observed. The measurments of the animal were recorded. A radio-collar was fixed around its neck, after administering antibiotics and giving another supportive therapy,the animal was revived by giving an antidote. The entire operation was completed within an hour.

Darting of the second animal

On 27th February 1991, our efforts in tracking and darting the tusker in musth could not succeed, mainly due to weapon failure, i.e. misfiring of the dart - gun at a crucical moment. On 28th February 1991 while going in search of the bull in musth, another known tusker aged about 18 - 20 years was located in Compartment - 13 near Mandradiar Avenue. This animal was found in the company of another young tusker. It was decided to radio collar this animal, as this too was suitable for the study. The animal was stalked on foot and approached close enough,and with the support of two *koonkie* elephants, was darted from the ground. The animal did not travel more than 50m and within seven minutes, it sank down unconscious. The physical condition of the animal was observed and body measurements recorded. The animal had a deep sinus wound (1 cm deep) in the middle of the neck. Antibiotics and other supportive therapy were given. After the radio collar was fixed, the animal was revived by injecting the antidote. The entire operation was completed within 45 minutes.

In both cases the drug used for chemical immobilization was IMMOBILON (combination of Etorpine and Acepromazine) and REVIVON (Diprenorpine) was used by as antidote. Fixing of the drug dosage and loading the dart was done by Dr. V. Krishnamurthy and Dr. Jacob V. Cheeran and the darting was done by Mr. Ajay A. Desai, with the support on ground by Sri Sivaganesan and Laxmanaswamy, and trackers Chenna and Krishnan. After revival, both animals were closely observed, until they started their normal physiological functions like feeding, defaecation, urination etc. Subsequently the animals were monitored by tracking them with the help of Directional Antenna and Receivers.

GAJAH 17:47-48

PARALYSIS OF THE TRUNK IN ASIAN ELEPHANTS

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Paralysis of the trunk in Asian elephants, either partial, complete and sometimes transient was observed in both male and female elephants. The occurrence of this condition, though infrequent, may be due to any one of the following reasons :-

1. Trauma: as a result of
   (a) awkward fall landing on the face of trunk, sustaining serious injury to the nerve
   (b) fight between the animals,
   (c) gun shot injuries,
   (d) mishanding by the mathouts or indiscriminate use of the hook or the spear.
2. Exposure to severe cold.
3. Heat stroke.
4. Brain lesions, such as meningitis, brain tumours etc.
5. Due to toxaemia, either endotoxins of bacteria or phytotoxins.
6. Specific diseases such as Tetanus, Rabies, Anthrax, Trypanosomiasis *(Trypanosoma evansi,* casual agent).
7. Rarely due to hypoglycaemia.

Fortunately the incidence of trunk paralysis in captive elephants has been observed only on rare occasions and occurrence was not confined to any particular age, class and sex. In the case of captive elephants, I have come across this condition (over a period of 30 years) only on a very few occasions, viz. in two young calves, two cow elephants, one tusker and one sub adult male. One of the calves died due to snake bite *(Vipera russeli)* in which paralysis of the trunk was observed. Another calf died due to hypoglycaemia in which the first symptom observed was partial paralysis of the trunk. One of the cow elephants belonging to the Palani temple developed paralysis of trunk after being sick for some time.

Another depertmantal cow elephant *'Bommi"* used to develop partial paralysis of trunk, apart from bilateral opacity of cornea and suspected for trypanosomiasis, on treatment totally recovered from the condition.

One sub - adult tusker *'Ashoka'* developed this condition and subsequently followed by paralysis of the throat muscles and later on paraplegia. This was diagnosed as a case of Tetanus. This animal died within three days after developing the symptoms. One of the truskers in Mudumalai, named *'Arjun'* had paralysis of the trunk after accidentally chewing a *Tapioca* tuber in which a country bomb was concealed (meant for killing wild pigs). The animal suffered severe burn injuries in the buccal cavity apart from paralysis. The animal was lucky enough to survive after prolonged treatment and the animal recovered. It is also seen in the case diary of an elephant named *'Sarder'* an outstanding tusker from Wynaad died of rabies in 1949. The first symptom to be observed along with salivation was paralysis of the trunk. Subsequently the animal developed paraplegia. Laboratory findings confirmed the disease.

In wild elephants, several cases of animals suffering from gun shot wounds have been observed and some of them were showing symptoms of paralysis of the trunk, and in such cases gun shot wounds were observed at the base of the trunk. Many instances, where serious fights have developed between wild tuskers, the animals were observed moving in the forests exhibiting deep multiple gored wounds. In some cases where the animals have shown such injuries in the head, face and the base of the trunk have developed paralysis of the trunk. Many of them have succumbed due to the severity of the injuries.

In 1970 a report was received from the District Forest Officer, Madurai informing about the death of a large number of elephants within a short period in Gandamanur valley. On investigation into the cause of death involving 17 elephants of various age classes and sex, the death was found to be due to consuming ergot infested millet crops - *'Paspalum scrobiculatum'*. Most of the animals died after lingering for two or three days. In many of these cases, paralyis of the trunk was obseved. In 1952 a herd of 6 elephants died near Surulipatti village in Cumbum valley of Madurai District as a result of consuming the ergot infested plant locally known as *"Varagu"* a kind of millet. Since the animals which consume this grass like plants exhibited nervous symptoms (including paralysis of trunk) the plant is locally known as *"Kirukku Varagu"* (the millet that causes lunacy). Forensic laboratory findings confirm the cause of death of these animals due to ergot poisoning *(Claviceps purpurea)*.

In all the above mentioned cases, paralysis of the trunk had been one of the symptoms. It has also been reported that in some cases where elephants are exposed to malicious use of electricity for killing the crop raiding elephants, animals which do not die instantaneously develop symptoms of paralysis including the trunk and such animals had to be euthanised. In captive elephants, timely diagnosis and subsequent veterinary care have shown good results and the animals have recovered completely after treatment.

GAJAH

ISSN 1391-1996

JOURNAL OF THE ASIAN ELEPHANT SPECIALIST GROUP

Number 17, January 1997

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Printed by Bravi Press, 274, D. S. Senanayake Veediya, Kandy, Sri Lanka.