GAJAH

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JOURNAL OF THE ASIAN ELEPHANT SPECIALIST GROUP

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Annual subscription price for two issues: Sri Lanka: Rs. 200.00. Overseas delivery: US$ 20.00. (inclusive of postage and packing). Subscription orders should be addressed to:-

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JOURNAL OF THE ASIAN ELEPHANT SPECIALIST GROUP

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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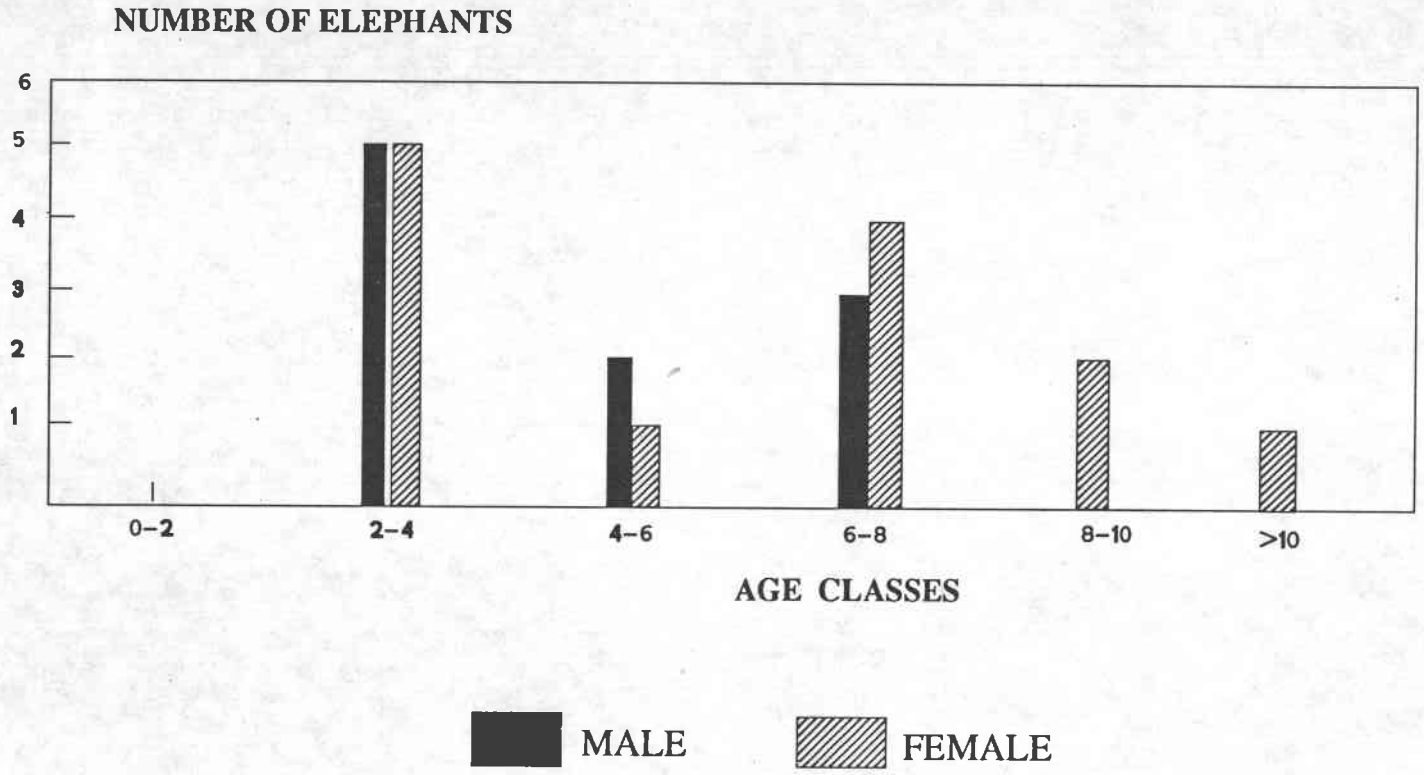

Fig. 1. Age - sex structure of captured elephants

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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:-