REPORT ON
ELEPHANT CENSUS IN MEGHALAYA

By:-
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PAPER PRESENTED ON THE OCCASION OF WORKSHOP ON ELEPHANT MANAGEMENT IN THE WILD AND CAPTIVITY HELD IN JALDAPARA,WEST BENGAL FROM 10TH TO 17TH DECEMBER,1982

Although the elephants are available in different parts of the Forest bearing areas in Meghalaya in a scattered manner mostly in areas outside the Government Reserved Forests which constitute hardly 3.6% of the total forest areas of the State but the traditional way of shifting cultivation by clear felling the areas and burning resorted by the people of the State is not only acting as an inflicting interference to this species of Wildlife which being disturbed in the process keep on moving from one place to another causing large scale devastation to crops and household but at the sametime this traditional way of shifting cultivation is to a great extent responsible for fast rate shrinkage of elephant habitats in the State.Regular Mela shikar mahals used to be operated all over the state till the adoption of the wildlife(Protection)Act,1972 by the State Legislature during 1976 to keep control of population within the carrying capadity of the species habitats and also to minimise the extent of raid of the cultivated fields of the poor villages by the elephants in their endless search for food,shelter and probably water.With the adoption of the Wildlife (Protection)Act,1972 and further with the transfer of the species from Schedule II to Schedule I,however the operation of Elephant Mahals were discontinued.This added to the miseries of the people residing within and around the forest areas.As a measure of relief to those effected people,hunting of elephants were permitted till last year by the competent authority under the provision of section 11 of the Act.It became a grave concern of the Forest Department of Meghalaya whether to continue permitting hunting of this endangered species,the population of which in all its distributional ranges is now threatened with degree of decline.The concensus opinion of the general people is that the elephant population in the state is fast

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increasing and it needs harvest of the excess population.It was therefore imperative on the part of the Forest Department of Meghalaya to conduct the Systematic census of the species and habitats identification in the State to find out the excess population; if any;before considering any scientific harvest of the species. When the action plan for such census is phases was being framed by the Department,the Asian Elephant Specialist Group of North-Eastern region joined hands into our line of action and series of meetings were held at Shillong between the Forest Department of Meghalaya and the Co-ordinator of the Asian Elephant Specialist Group of IUCN/SSC for North East India Region to finalise the action plan for conducting systematic census of elephant population in the State.In persuance of the decisions taken in the meetings,the Pre-census assessment of the elephant population and its zonation at grass root level by collecting information from the villagers,the phanlis of Mela shikar koonkie elephants and the Forest Staffs posted at different interior places was taken up simultenеously all over the state during later part of 1979 and completed by the early part of 1980. The Asian Elephant Specialist Group for the region was partly associated with the work.This Pre-census assessment of the population was mainly aimed towards getting a picture of elephant holding Zones in the State besides getting a rough population of the species,so that the follow up action of conducting the actual census towards the pre-census assessement could be chalked out on priority basis i.e.giving priorities to major concentration Zones over the lesser concentration zones.The Pre-census assessment of the population in the State came to 2,333 elephants and as follow up action to this pre-census assessment,the first phase of census was taken up in the Balphakram proposed Wildlife Sanctuary area during April-May'81 as the area was found harbouring a major concentration of Elephant population due to its richness in floristic composition, inaccessibility and sparse human population besides protection being afforded to the area by the people themselves from the point of view of their sentimental attachment to the area on mythological beliefs.This census initially planned for a period of 10 days starting from 23rd.April'82 could not be completed within the time schedule as it was decided in the field to conduct the census over an additional area of 292 sq.kms which forms the Buffer Zone

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of the initially planned census area of 292sq.km of Balphakram proposed Willlife Sanctuary so as to enable us to get a complete population structure of the species in its South Western distributional range.

The Methodology adopted was direct visual count of each herd or inlivudual from the trained ~~xxx~~ regular mela shikar koonkie elephants' back by dividing the entire area into smaller units designated as "Blocks" and conducting the census simultaneously in all the Blocks.Initially it was decided that a period of 10 days would be devoted for conducting the census and out of those 10 days,9 consecutive days will be utilised for the purpose of locating and counting the herds and the final day that was the 10th day will be exclusively utilised for check counting of the herds located during the first 9 days.However due to late arrival of the koonkie elephants deployed for the census operation to the various reporrting bases, the operation could not be started on scheduled date and simultaneously in all the Blocks of the initially planned census area.Hence in view of the late arrival of the koonkie elephants and after thorough study of the contours of different blocks and the traverses laid down on the block maps it was afterward decided in the field jointly by the Co-ordinator of the project and the Co-ordinator of Asian Elephant Specialist Group of IUCN/SSC of the North East India Region participating in the operation that 6(six) consecutive days will be devoted for locating and counting the herds and individuals and the following 2(two)days for check counting of the herd in each block located during the first 6 days time and as ~~also~~ it was found ~~xxxxx~~ ~~xxxxx~~ possible to traverse the different blocks thoroughly in 6 days time and as also it was found difficult to conduct the check counting of the herds in one day time as was initially planned.

Since the entire area is located in the hilly region of the state it was found difficult to lay out enumeration strips as is being done in plain areas elsewhere in the country.It was on that account that the entire area was devided into smaller units.Each unit was designated as "Block".Initially there were 10 Blocks,each block surrounded and demarcated by natural features like streams and rivulets.But afterwards with the inclusion of an additional area of 292sq.

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Kms as the buffer zone of the proposed sanctuary ultimately there were 15 Blocks and 8 Sub-blocks.The demarcation of blocks by natural features as far as it was practicable was done to ensure avoidance of repeated enumeration of the same herd by different census parties which may lead to an abnormal figure not in conformity with the actual population in the project area.It was further observed that formation of certain blocks demarcated by the natural features was leading to formation of large blocks which would have been difficult to be covered by the census party in Schedule time.Hence to overcome these difficulties those blocks were sub divided into smaller units designated as "Sub-blocks".

Based on the traverses laid down on the Block maps to be covered during census period datewise,camping places for the different block parties on different dates were fixed for the purpose of effective supervision of the works.For the check counting operation traverses as well as base camps were not laid down for the census parties as it depended upon the location of herds during census operation. It was left at the discretion of the leader of the each block census party to decide the traverses to be followed and the camping places during the check counting so as to enable them to do a check counting of all the herds located during census operation.<u>The sighting location of herds during both census and check counting operation;</u> actual traverses followed by the different block census parties and the open jhum areas were plotted by each census parties in the field with different indices on the block maps supplied to each block party so as to enable us to prepare an overall elephant distribution map for the project area.Although the traverses were to be covered on koonkie elephant back but wherever approaching of the herds nearer to get a clear vision was not possible,the counting of those herds was done by the block parties either from a nearer tree top or a high hillock leaving the koonkie elephants at a distance.3(three)classifications were made in counting the herds namely Adult(7' and above),Sub-adult(5'to7') and Calf(below 5').Sex identificationswxx xxx xxxxxxxx xx xxx were made as far as practicable and wherever sex identification was not possible it was classified as un-identified sex.Alongwith the census of elephants,a census of other mammals,birds and reptiles whatsoever could be sighted on the either side of the traverses followed by the census parties were conducted to enable us to get a picture of faunal

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composition of the area.For that purpose a seperate enumeration/observation sheet for day to day observation were maintained.The census participants drawn from various Divisions were briefed well in advance by the Project Co-ordinator as regard the methodology and filling up of proformae etc.

As regard the organisation of census parties,the census party in each block comprised of 3 persons mounted on Koonkie elephants' back in addition to the mahut of the elephant and 2 to 4 local guides accompanying the party on foot.Of these 3 persons,one was designated as "Observer",2nd one as "Enumerator" and the 3rd one as "Recorder".The Observer gave direction to the Mahut of the elephant regarding the traverses to be followed,the Enumerator counted the herds and went on slowly prompting for the Recorder to make corresponding entries in the proformae. As mentioned earlier,the entire area was not initially planned for the census so the man power requirement,elephant deployment etc was therefore not chalked out for the entire area.As a result of this the census in all the blocks of the project area could not be carried out simultaneously and koonkie elephants could not be deployed in all the blocks. In the comparatively easy terrain blocks and also in the blocks where the concentration of the elephants was anticipated comparatively low due to various factors,the census in these blocks were carried out on foot.Moreover the check countings of the herds in those blocks could not be made due to time factor.For the purpose of supervision of the census operation,there were number of zonal Co-ordinators to the rank of ACF/Forest Ranger incharge of a number of blocks who were responsible for supervising the works of the block parties under them and to collect the figures from the block parties/to be submitted ultimately to the Co-ordinator of the project.The Co-ordinator in turn was ultimately responsible for compiling all the figures and submitting the same to the Chief Wildlife Warden in a handy form.As mentioned above, due to non arrival of koonkie elephants in schedule time in different block bases and lack of communication link with the census parties besides adding of an additional area to the initially planned project area,the simultaneous census in all the blocks could not be synchronised.This factor probably had given room to duplication in counting of some herds in adjoining blocks.The probability will however be least in view of the fact that due to abundance of cover,food nd water in the area during the period firstly the elephants are not generally re-

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quired to migrate a long distance in search of food, shelter and water and secondly the factors like difficult terrain, least biotic interference, absence of fire hazards during the period confined the herds in the area comparatively in smaller territory.

There were remarkable variation in sighting locations of some herds during check counting although in case of most of the herds this variations was reasonable. Moreover in course of check counting some variation in herd sizes of some of the herds were noticed. However in those cases the herd sizes were fixed at higher figures of the two countings. Some herds sighted in the blocks along the fringes of the project area could not be sighted during check counting. It was presumed that those herds might have crossed out of the Project area at the time of check counting. The summarised result of the census is as below:-

Census Area:-
Balphakram proposed wildlife sanctuary .....292 sq.kms.
Buffer Zone of ,, ,, ,, ...292 sq.kms
Total.....584 sq.kms.

Population structure:-
Balphakram proposed Wildlife Sanctuary:-

Adult	Sub-adult	Calf	Total
296+3 Solitary.	178	103	577+3=580

Buffer Zone:-

Adult	Sub-adult	Calf	Total
175	58	47	280

Total Census Area:-

Adult	Sub-adult	Calf	Total
471	236	150	860

Ratio of adult, sub-adult and calf (Roughly):-

	Adult	Sub-adult	Calf
Total census area-	3 (3.16)	1 (1.16)	1 (1)
Proposed sanctuary area:-	2 (2.87)	1 (1.73)	1 (1)

The financial implecation in the project was Rs.32,200-00

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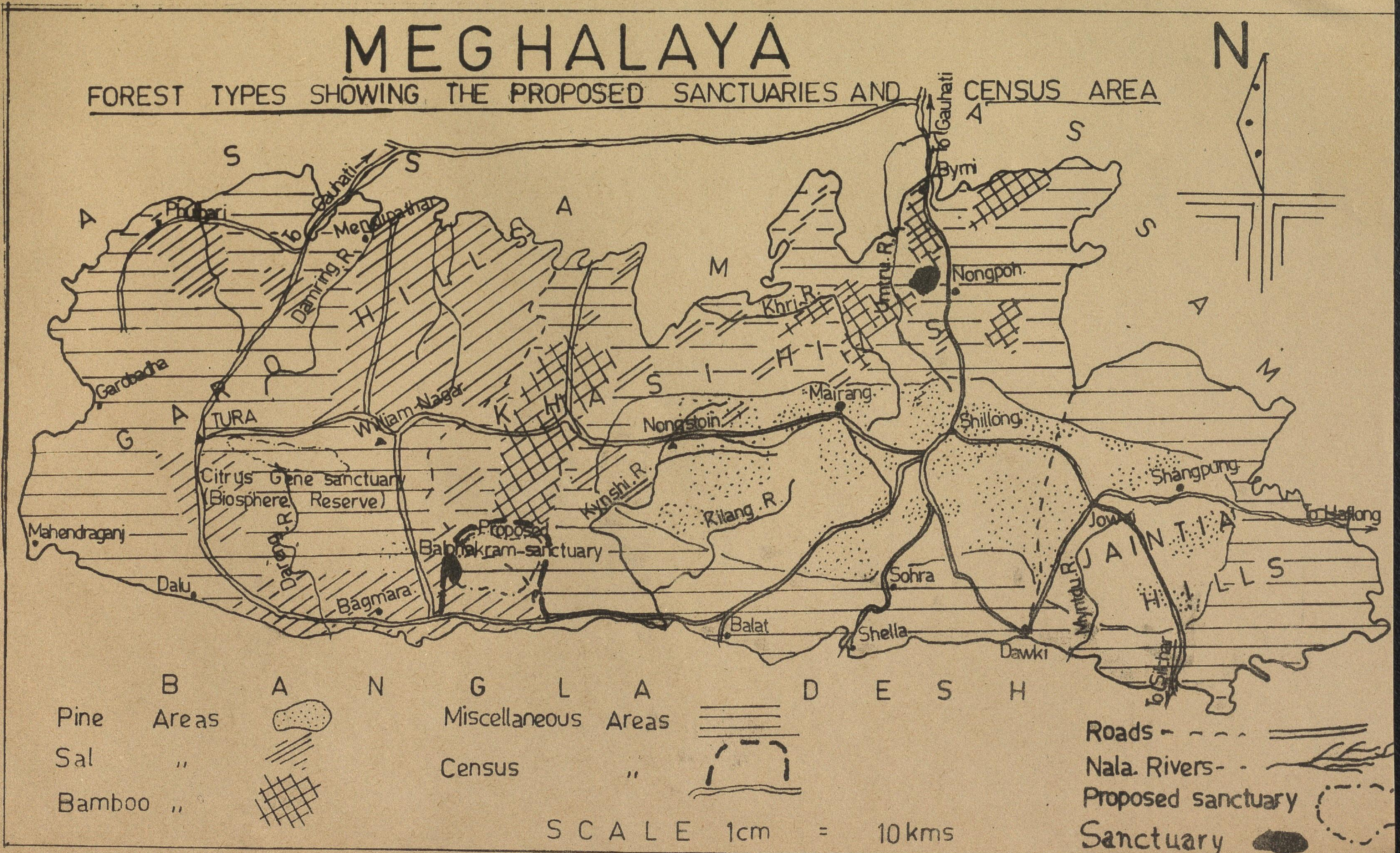
The handicaps faced in the project were manifold such as inadequacy of koonkie elephants, Arms and ammunation, personnels with previous experience in such methodological census, lack of communication link and season choosen for the census etc.

While concluding we would like to submit that inspite of our best efforts in implementing the project there might have been some ommissions and lapses due to the handicaps faced above. Although 3 distinct classifications were maintained at the time of counting of herds but the chances of miscounting and mis-classifying some members of the herd cannot be totally ruled out because of fairly poor visibility and sighting of some herds in fairly covered locations. However the exercise had been of immense benefit since expenrience could be gained for future attempts. The difficulties which could not be anticipated during the operation because of lack of past experience in such methodological census in the state will get due attention in future.


MEGHALAYA
FOREST TYPES SHOWING THE PROPOSED SANCTUARIES AND CENSUS AREA
N
A S S A M
A S S A M
G A R O H I L L S
K H A S I H I L L S
J A I N T I A H I L L S
B A N G L A D E S H
Phulbari
To Gauhati
Mendipathar
Damring R.
Gardobadha
TURA
William Nagar
Citrus Gene sanctuary
(Biosphere Reserve)
Mahendraganj
Dalu
Dareng R.
Bagmara
Balphakram sanctuary
Proposed
Kynshi R.
Nongstoin
Mairang
Rilang R.
Khri R.
Umtru R.
Byrni
To Gauhati
Nongpoh
Shillong
Shangpung
To Haflong
Jowai
Myntdu R.
Sohra
Balat
Shella
Dawki
To Silchar
Pine Areas
Sal ,,
Bamboo ,,
Miscellaneous Areas
Census ,,
Roads
Nala. Rivers
Proposed sanctuary
Sanctuary
SCALE 1cm = 10kms

Status of Elephants in Arunachal Pradesh

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Divisional Forest Officer,
Wild Life, Seijusa.

I am attempting to apprise you with the status of elephant in Arunachal Pradesh in the light of the resolution on Asian Elephant in the Indian Sub-Continent IUCN/SSC Report 1980 -

Conservation of Indian Elephant
ecosystem,

concerned with the continuing destruction of elephant (Elephas maximus) habitat in India due to ever increasing pressure : I like to state that during the inception of North East Frontier Agency, the present Arunachal Pradesh, along its inter-state boundary with Assam contained a vast extent of forests on both the States, also along the international boundary with both Bhutan and Burma. Here the elephants used to roam on the either side of the land which were its usual habitat. But from about early seventies, these areas were occupied by human habitation. With the settlement of people of different locations, popular programme of grow more food campaign and green revolution started. The forest areas were cleared and replaced by the agricultural crops. Since the areas were the elephant's original habitat, the agricultural crops has more aburdance in a compact area and possess the higher palatibility gradient, easy access, hence the crop raiding was taking place at an increased rate. Sometimes the crops were raided even from the granary, store houses, dwelling houses by causing damage and hence the confrontation started with the human agency. In some particular case these animals were scared by age old indigenous method effective in the beginning but later on they became resistant to these methods. Some of them became desperate, especially the solitaries which later on is to be termed as the 'goondas' or rogues. As a remedial measure it is necessary to take the steps to stop the further clearance of forests in foothills side which will not only protect the elephant but also have a long termed effect in the riverain system, in conserving the soil and water down below the catchment area where our rural and national economy greatly involved.

Aware of the concentration and confinment of elephants in isolated pockets - this is not yet the case so far my state is concerned, we have still considerable extent of forests where the elephant can move from one side to other. I impress to stop biotic interferance having the adverse effect if any in this land for the survival of this species.

In this respect I would have liked to give a few references but due to the shortage of time, I refrain from doing so.

The existence of isolated pockets is of little possibility since the animal by habit feeds on excursion and their stay period in any particular locality is directly varied from the availability of their foraging resources. Now-a-days they mainly congregate near the agricultural field during two crop seasons of the year.

Recognition of dependency on conservation of Managment of ecosystem :-

It is already a recognized fact known to all that the civilization follows forest and desert follows civilization. The destruction of wild land and grass land in the alarming scale had changed the ecosystem in our state which we can appreciate even by observing the difference in the yield of the agricultural crop, untimely drying of perennial stream, irregular trends of rains, soil erosion, change of temperature both to the extreme hot and extreme cold. This also effects our aquatic fauna which were reduced from its abundance very rapidly day by day. Since the

elephant is a part of ecosystem this brings considerable effect upon their behaviour and which may in time brings their extinction by continuous confrontation to human interests if adequate measures are not taken.

As regards the change of behaviour, I like to cite the following examples.

(a) Generally the elephants are very scared of fire. But recently at Sejusa the instances are observed right in the Divisional headquarters and at the adjoining villages the elephant (a tusker) starts charging as soon as it notices any light. I personally experienced with this.

(b) The so-called rogue or goonda exhibits such intelligence that in the forests and in the very precipitous land and thick cover it can move maintaining absolute silence. I had experienced this in tracking a rogue in west Kameng district during 1968. Similar incidence was noticed at Dibru area of present East Kameng district while tracking a rogue tusker for more than 3 hours. He could make us roam about within an area of 5.0 acres. Suddenly the coin was in our favour when he comfortably broke a bamboo, the sound of which helped us to bring his end. Mr. S. Deb Roy had also mentioned the advantage and disadvantage of the coined direction with reference to the strong olfactory senses of elephants.

Similarly myself has come across an instance at Pachnoi area of present West Kameng district while tracking a solitary wild tusker which moves along the sandy bank of the river for some distance, then move along the river over water for some distance and then again move along the sandy bank. He had repeated this operation for number of time and thus evades the continuity of his trail to the trackers. From my field experience I am of opinion in saying that the rogues can smell their danger with perfect accuracy.

(c) During 1981 in Chowkham area of Lohit district I was told by the several villagers that in their area they have got a wild elephant which used to chew the tails of all domestic elephants of that locality and today all the elephants of chowkham area with incomplete tails. Although the latter fact is correct but found it hard to believe that the tails of one elephant is chewed by another elephant. I request Dr. Lahiri Chowdhury to give his experience in North Bengal in this pretext.

(d) Elephants are even adopted to move around under heavy artillery firing by army. During 1968 in an artillery firing range myself with an army officer could see the signs of fresh movements of elephant in the break hours of firing while moving inside. Recently I had come across a victim cow elephant which lying dead in a nullah near my sanctuary, where I could see the healed scar mark of old injury in her body during Aug./82. From the information I could gather that this very elephant was injured a year back. After getting the injury she kept herself confined in the agricultural field of the villagers who could see the wound of her back from the fresh to healed up condition. Due to deteriorated condition of her dead body and lack of Veterinary surgeon, I, of course, cannot confirm the reasons of her death.

(e) I was informed during November/81 by the Dy. Commissioner, Lohit District through my Chief Wild Life Warden about the panic created by a wild tusker in a village named Jamnang Pathar under Wansai Circle. On my arrival I found the fact that an owner of cow elephant tied his elephant inside the village area. The elephant was in oestrum and as a result a wild tusker came and as the elephant was chained, they could not move out and remained confined for about 5 days in the village itself. During that period the members of the village had also confined themselves inside their houses and have to face the situation in panic. The female elephant had also starved since neither she could graze herself nor the attendent could supply the fodder due to the presence of wild tusker. The male left her after the satiation of the natural urge.

(f) The devastation caused by the herd of wild elephant I observed during December,1981 in Danney field of Dambuk area of Dibang Valley district where the plight of the people can be visualised from the left over damaged utensils, footwears, damaged sheds, clothes, uneaten foot materials, I was told that the big herds of elephants were grazing in the agricultural field and see its extent of about 4 sq. km. from where not a single grains could be collected by the villagers. This is of course due to the reason of converting extensive elephant habitation in Despani reserve Forests into the cultivation area and the adjoining elephant habitation of East Siang districts for last few years. I got the evidence of raiding the granary of the village by a pair of Maljuries composed of a tusker and a Makhna.

General description of the area:

Out of total geographical area of 83,578 sq. km. of our state we have 51,540 sq. km. of forest land, i.e. 61.67%. In these forest area about 26,000 sq. km. will be elephant bearing area out of which about 17,000 sq. km. will be of hilly terrain and of extremely difficult to communicate.

Methodology: I do not like to comment prematurely. Because the elephants from our area obviously migrates to the adjoining states of Assam, Bhutan, Burma and Nagaland. Until their behaviour of movement so far the seasons, paths are closely acquinted with. Of course if we study to find out the possibilities of elephant pockets it will add to our knowledge.

To ascertain the elephant population I may kindly be allowed to submit very humbly that the methodology adopted for consuing the elephant population of Manas Tiger Reserve appeared to be more workable with certain modification of local factors as well as comparing with the methodology followed in Meghalaya and Karbi Anglay depending upon the nature of locality, vegetation, forest cover in respect of their loafing ground, the foraging ground and the niches. This will enable us to utilise the service of the local expert called phandies who have adequate and informative knowledge about the elephant and its habitat in our area. It was stated of having 2000 elephants in our state. But this figure is variable from season to season. We had made a sample survey in our state during September,1982 and we had arrived a sample figure of 701 Nos. Even it is 1/5th of the total population of elephant in lowest side, we had 3500 Nos. of elephant in our state during that season.

Lastly I may be allowed to conclude my statement with the following extracts from the article published in the 'News Star' of 6.10.82 of topics 'Elephant depridations and Elephant Preservations' by Mr. M.A. Islam, I.F.S. , Retired Chief Conservator of Forests, Assam.

'Since the wild elephant capture had been stopped the existing tame elephant stock are not being replanished and as a result exhorbitant prices are being demanded by lucky elephant owners. For timber haulage in the evergreen forests of Assam, the elephant owners are quotting fantastic rate. But the most disastrous effect will be faced by Assam where the dare devil mahuts and phandies face a very black future. (This is also in case of Arunachal Pradesh so far Khamtis and Singfans are concerned). For generations people trained themselves from childhood to become expert Mahut and Phandies. Moghers in India, such a class of people exists. By stopping capture of the wild elephant their expertise will vanish and in future it may be a serious problem to capture wild elephant.' (Similar remark was passed by Shri S.R. Chosdhury in respect of the skinning technique of crocodiles which is multiplying the captive breeding very satisfactorily).

As a matter of fact it is not depleting the stock of wild elephants but only transforming the elephants from wild stage to the tamed stage, population remaining the same. It will be wise step to capture the wild elephants and let them survive rather than to shoot them down for causing damage to life and property of human being.

If elephant catching is allowed the wild herds would stay away from populated areas. Let the full consequences the stoppage of wild elephant capture be realised before it is too late. Elephants will survive with the full patronage and love of human beings as before without enforcing laws and acts, which in attempt to protect, instead hastens the process of eliminations.'

Lastly, I request kindly to go through the following points of the concluding para of the message dated 18.11.82 of our honourable Prime Minister on the occasion of this very workshop where we assembled from the all parts of the globe bearing the elephant habitat..

"I hope that the International Workshop on the Management of Elephants will study this problem in detail and offer practicable suggestions which can be implemented with the full co-operation of people in and near Forests."

Acknowledgement

1. Shri M.A, Islam, I.F.S.
2. Shri S. Deb Roy, I.F.S.
3. Late S.R. Chowdhury, I.F.S.

SOME COMMAND WORDS FOR ELEPHANTS (NORTH INDIA)

1.	Agat	=	Go forward
2.	Piche	=	Go backward
3.	Dhat	=	Halt
4.	Chei	=	Turn
5.	Dele	=	Pick up things and pass to Mahut
6.	Dele Salam	=	Salute
7.	Dele Dale	=	To break branches overhead
8.	Dele Mar	=	Hit above
9.	Dele Mohra	=	Command to fight
10.	Biri or Chi	=	Leave it
11.	Bait	=	Sit
12.	Khol	=	Lower the back
13.	Thuk	=	Stoop down
14.	Mail	=	Get up
15.	Mar	=	Hit or charge
16.	Mar Thokor	=	Kick
17.	Mail soyta	=	Slide along
18.	Mail Jharap	=	Careful of two sides
19.	Chup	=	Be still
20.	Chhup	=	Drink
21.	Chhup dele	=	Sprinkle water on top
22.	Khol Bait	=	Sit half
23.	Pa Udas	=	Lift leg
24.	Khol kan	=	Spread the ear
25.	Dao	=	Step across
26.	Bhir	=	Go near
27.	Tere Bait	=	Sit leaning to one side
28.	Tere	=	Lie down
29.	Khol Lamba	=	Stretch leg
30.	Dhair	=	Catch hold
31.	Bol	=	Make sound
32.	Dhair Samat	=	Catch hold by mouth
33.	Dhum Rakh	=	Keep tail steady
34.	Chhamle	=	Do not move
35.	Mail Husiari	=	Go carefully
36.	Mail Chikna	=	Careful, slippery path
37.	Dao Lamba	=	Take long step across
38.	Mail Asta	=	Go slow
39.	Chamla Bair	=	Sit straight.

ELEPHANT CENSUS - TAMILNADU

By

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COIMBATORE.

And

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During the meeting of the Southern Task-Force of the Asian Elephant Group at Trivandrum on 3.9.1978, a decision was taken to have the Censusing of the wild elephant populations in all the 3 Southern States of Kerala, Karnataka and Tamilnadu. Accordingly the Census was undertaken on a stratified simultaneous basis - in areas lying South of the Palghat Gap on 15.5.'79; and in areas North of Palghat gap it was done on 29.5.1979. The objective was to determine the number of elephants, at a given time, as accurately as possible, simultaneously in the three States to avoid duplication through movements between contiguous forest areas.

Mr. J.C. Daniel, Curator, Bombay Natural History Society and Chairman I.U.C.N./SSC Asian Elephant Group, convened a meeting of the Forest Officers in charge of Divisions having elephant populations, and explained to them the purpose of the census and the methodology to be adopted.

METHODOLOGY:

For the purpose of survey, the elephant habitats in each of the forest divisions were identified, and divided into convenient blocks of 5-10 Sq.kms. each in area, or a beat, whichever was convenient - as a unit for enumeration. Each block was allotted to an enumerating party consisting of 3 persons, headed by a forest staff or volunteer assisted by a local tribal knowing the locality well.

Preliminary Survey was undertaken 2-3 days prior to the actual census operations day, so as to get acquainted with the terrain and also identify the known elephant habitats and migration paths.

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On the day of census, the enumerators commenced their work by 6-00 A.M. and were in the field the whole day till 6.00 P.M. traversing the entire area of their operations. Maps of the locality were provided to the parties, along with the standardised enumeration sheets in which the actual sightings alone were recorded. The details to be furnished included time of sighting a herd, composition of herd (i.e. Tuskers, Cow elephants, and young ones below 5' in height), description of the locality etc. Parties having areas adjacent to State or range boundaries were directed to commence their work starting from the common bounday and move inwards, in an attempt to avoid duplication.

The recorded observations were collected at each range headquarters and consolidated. The Divisional Forest Officers were also in the field to coordinate the smooth conduct of operations.

RESULTS:

In Tamilnadu, about 10770 sq.km. of the total forest area of 20910 sq.kms. is considered as elephant habitat. These areas were along the slopes of Western ghats and the Mysore Plateau, adjacent to the States of Kerala and Karnataka.

The main forest types of these elephant habitats are the Tropical evergreen, Semi evergreen, Moist deciduous, dry deciduous and tropical thorn type of forests. Open grass lands are seen in high altitudes, on the slopes of Western ghats and Nilgiris.

The elephant populations were seen in Sixteen forest divisions (including 4 sanctuaries) in the revenue Districts of Dharmapuri, Coimbatore, Nilgiris, Madurai, Ramanathapuram, Tirunelveli, and Kanyakumari. According to this estimate, Tamilnadu had a total population of 2994 elephants, consisting of 768 Tuskers (25.6%) 1583 cow elephants (52.9%) and 643 young ones below 5' height (21.5%). The sex ratio between adult male and female was 1:2.1. The young ones were not sexed.

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The census operation revealed many interesting features. In the Southern Districts of Kanyakumari, Tirunelveli, Ramanathapuram, and Madurai the number of elephants sighted were far less than the anticipated number. Some of the traditional elephant habitats did not contain any elephants at the time of census. More than 50% of the total population (1656) were sighted in Coimbatore District alone. Most of these elephants were sighted along the Cauvery basin, consisting of the rivers Cauvery, Bhavani and Moyar. The population density was 1 elephant /3.59 sq.km.

Mudumalai Sanctuary had the maximum concentration of populations (1 Elephant / 0.72 sq.km.)

It was also seen, that in areas adjoining the Periyar Sanctuary, Solitary tuskers were conspicuous by their absence In the adjacent Madurai South Forest Division out of a total population of 165 animals recorded there were only three tuskers and 34 calves. This clearly indicated that poaching had been rampant in these areas.

This census is the first of its kind to be undertaken simultaneously in the entire State, though regular enumeration work has been undertaken in some of the Sanctuaries. The figures collected may not be accurate. It was proposed to repeat the census at least once a year in a different season in each year in order to assess the population trend in each season, in a particular division or range, so that various Conservation programmes can be planned in a more scientific way.

The method of census had following limitations:

1. The area allotted for each enumeration party is about 5-10 sq.kms. or a beat. In certain cases the enumerating party could not traverse the entire area because of the difficult nature of terrain.

2. In areas having dense undergrowth, sometimes there was difficulty in counting the entire herd;

.....4

some of the animals, particularly the yound ones might have been missed.

3. Identification of Makhnas (Tuskless males) was not done in many areas.

4. There was no attempt in verifying whether a particular party had traversed the entire area allotted to it.

It is proposed to have a census operation again in January 1983. During this period the practical difficulties experienced during the previous census operations are to be discussed and eliminated as far as possible.

By repeating the census operations, the areas preferred by elephants, the seasonal concentrations, the migratory patterns and migratory paths can be identified.

MDP/

Operation elephant census in Southern India 1979.

A critical review.

- * -

Whether it is man or beast a head count is a prerequisite for proper planning. Planning the conservation of wild elephants in no exception to this general rule. It was, therefore, only right and proper that the Asian elephant speciast Group of the Species Survival Commission of the International Union for the conservation of Nature and Natural resources should have given this matter high priority in its projects. At a meeting of the Southern task force of the Group in Trivandrum on 2nd September 1978 population estimates based on cursory surveys were given 5500 for the Southern region. The meeting decided to have a proper census, As wild elephants are great wanderers and as most of the elephant habitats are placed on inter state boundaries synchoronisation was necessary.The time chosen was summer 1979. It was heartening to observe the forest departments of the three Southern States of Tamil Nadu, Karnataka and Kerala taking the initiative to formulate the recommendation and assure whole hearted co-operation in the implementation of the decision.

A common enumeration sheet, simple but comprehensive was adopted to ensure uniformity. Composition of herds (animals below 5 being classified as Juveniles),time, place, type of forest were some of the details that were required to be noted.

By common consent the 15th of May was fixed for the census operation for areas lying south of the palghat Gap and 29the May for areas north of the gap.

State level meetings were convened by Mr.Daniel to explain the methodology to the principals concerned. They in turn passed these instructionsdown the line. A trial run was taken a few days prior to the real count to enable the enumerators to get acquainted with their Blocks.

Methodology:In the case of a large diurnal animal such as the elephant a straight forward sight count was thought to be the best and most reliable and it proved to be so. forest divisions were fixed as the apex units and the base unit was the beat of the Forest Guard, roughly 10 - 15 sq kms in extent or smaller blocks where the terrain warranted it.

Enumeration parties were small and compact,the beat guard and or watcher and local guide, usually a tribal well acquainted with the area.

The days chosen for the counts;namely 15th and 29th May dawned bright and beautiful. The enumeration parties were out in the field the whole day; from dawn to dusk. Range Officers were in charge of logistics and supervised the census.

It was an operation of great magnitude and was conducted and completed smoothly. The credit for this goes to the Forest departments of TamilNadu, Karnataka and Kerala.

The operation yielded the following figures:-

Tamil Nadu	-------	2994
Karnataka	-------	1977
Kerala	-------	3555
Total		8526

In an operation of this magnitude one Hundered per-cent accuracy cannot be claimed. Quite rightly so no much claim has been made. One of the reasons being the subjects proctivity to wander. Given the smallness of the beats and the wide time frame errors are bound to occur. The movement of Herds from one beat to the next within the 12 hour period of operation of the count was distinct possibility. The time frame should not be more than half a day. Enumeration parties perambulated their beats. A more accurate method would have been a belt transect method which presuppeses a greater degree of sophistication. Peram.-bulations may again lead to in accuracies. With the experience gained in the last census it should be possible to improve the methodology.

Kerala claimed a 38.2% increase in population in just one year. This is difficult to believe. And no special reasons have been given.

Making allowances for all these factors it can be safely assumed that there are over 7000 elephants in South India.

It is time that the AEG thought of another count in 1983. A different period of the year, say, the first Quarter of the calendar year may be chosen.

The habitat of the elephant has been shrinking and getting fragmented. The extent of this problem is not known. Only guesses are made from time to time. It would be useful to collect this information (particularly the loss between 1979 and 1983) at the time of census not only to high light problem but in order that corr-ective action could be taken early.

E.R.C.DAVIDAR.

ELEPHANT CENSUS CONDUCTED IN KARNATAKA STATE DURING MAY 1979.

		Nos.
BANGALORE CIRCLE:		
Kanakapur	----------	108
Bannerghatta	----------	6
		114
MYSORE CIRCLE :		
Sathanur	----------	102
Chamarajanagar	----------	96
Mysore	----------	90
Tiger Project, Bandipur	----------	1187
		1475
KODAGU CIRCLE :		
Coorg	----------	6
Hunsur	----------	181
Hassan	----------	25
		212
KANARA CIRCLE:		
Honavar	----------	9
Karwar	----------	2
		11
SHIMOGA CIRCLE :-	----------	165

ABSTRACT

1). Bangalore Circle	----------	114
2). Mysore Circle	----------	1475
3). Kodagur Circle	----------	212
4). Kanara Circle	----------	11
5). Shimoga Circle	----------	165
Grand Total	----------	1977

TAMILNADU DISTRICTWISE DISTRIBUTION OF ELEPHANTS.

District	Bulls	Cow-elephants	Juveniles below 5' in it	Total	Remarks
1.Dharmapuri	109	184	83	276	(Dharmapuri and Hosur Dicisions)
2.Coimbatore	123	247	90	460	Coimbatore Central and Anamalais Sanctuary.
3.Periyar	337	655	276	1268	
4.Nilgiris	160	286	129	575	Nilgiris North Nilgiris South Gudalur Divisions and Mudumalai Sanctuary.
5.Madurai	7	151	37	195	Madurai North and South Divisions
6.Ramanathapuram	~~18~~ 4	~~21~~ 22	4	30	Ramanathapuram Division
7.Tirunelveli	15	21	16	52	Tirunelveli Dvn Mundanthurai and Kalakkad Sanctuaries
8.Kanyakumari	13	17	8	38	Kanyakumari Dvn.
Total	768	1583	643	2994	

ELEPHANT CENSUS IN KERALA-1979.

Sl.No.	Name of Divisions	Male		Female		Sub-Adult		Baby		Total	
		1978	1979	1978-79		1978-79		1978-79		1978-79	
1.	Trivandrum	19	28	54	81	45	50	10	18	128	177
2.	Thenmala	65	60	112	126	29	56	21	34	227	276
3.	Punalur	3	1	10	2	1		1		15	3
4.	Konni	44	17	50	24	15	12	18	4	127	57
5.	Ranni.	91	35	217	56	90	30	49	12	447	133
6.	Achencoil		3		4		4				11
7.	Kottaya(P.T)	11	64	185	633	31		16	206	243	903
8.	Kottayam		35		120		62		15		232
9.	Malayattur	10	20	54	76	7	10	1	00	72	106
10.	Munnar	51	74	151	288	19	17	62	85	283	464
11.	Chalakudy	25	37	45	58	30	37	16	28	116	160
12.	Trichur	6	12	3	25		8	1	3	10	48
13.	Palghat	17	27	44	42	14	15	17		92	84
14.	Nemmara	26	3	24		13		7		70	3
15.	Nilambur	38	40	63	127	24	44	26		151	211
16.	Kozhikode	32	31	142	147	56		25	59	~~88~~ 255	~~288~~ 237
17.	Wynad	51	35	51	59	19	6	10		131	100
18.	Palghat(Spl.)	40	37	61	80	37	23	5		143	140
19.	Nilambur(Spl.)	12	15	12	51	11	12	2	6	37	85
20.	Kossikode(Spl.)	11	9	1	15	11	6	2		25	30
21.	Tellicherry(Spl.)		12		22		6		3		43
22.	Parambikulam		18		24				10		52
		552	614	1279	2060	452	398	289	483	2572	3555

Breeding of the

Some observation on the domestic elephants of Jaldapara Wildlife Sanctuary. -

M.S. Rai.

About a score of elephants - male, female and calf are stationed ~~and~~ scattered around Jaldapara Wildlife Sanctuary. The breeding females numbering about ten regularly breed with the wild breeding bulls and the births of calves are also reported regularly. A few resident elephants, among them at least three breeding bulls seem to be adequate for serving the domestic female elephants numbering about ten, since it is observed that three breeding bulls are accompanying a herd of 56 elephants consisting of 23 breeding females which roam about in the area west of river Torsa in North Bengal and this herd is considered to be a normal herd as far as the herd composition sex ratio is considerd (Calf - 5, sub-adult- 15, Dhoi-breeding female - 23, Sarin-female - 10, Breeding bull - 3, Total - 56 Nos.

The birth as indicated by the birth of at least one calf per year for the period studied (1973-82) as per table-I) seems to be regular and normal. Now taking the number of elephants under study to be 8 and the inter calf interval to be 5 years the total birth in a normal case should be 14.4 whereas we get number to be only 13. This is because of the fact that the history of all the elephants under study could not be ascertained for the total period of 1973-82. The actual number may be thus near the calculated number which is in any case not less than-13. Therefore the chances of mating can also be considered regular.

The calves are usually weaned after they attain the age of 2½ yrs. and taking the gestation period to be 22 months the inter-calf interval of 5 years (as shown in table-II) the chances of mating and birth can be considered very reasonable.

The sex ratio at birth comes to 1 male to 2.25 female and the survival percent (for 9 yrs. Nov. 1973 - Oct. 1982) comes to 69% (table - I).

Since the study is confined only for a small period (1973-82) the other paramaters like natality, age-specific mortality etc. could not be definitely studied.

Table - I

Name of elephant	Date of Mating	Birth of calf	Sex	Remarks
1. Chipraranı	No record-ed	24.12.76	female	died 26.12.76
	12.3.80	27.12.81	female	
2. Madhumala	20.5.75	22.3.77	female	separated 25.12.79
	17.12.79	17.10.82	female	
3. Champakali	August'77	6.6.79	female	died 8.9.81
4. Sulochana	Not known	June,74	tusker	died in 1977 after separation
5. Matangini	Not known	7.11.79	female	separated 29.12.81
6. Joymala	Not known	10.2.75	female	separated 30.1.78
	Not known	17.4.80	tusker	
7. Meghangini	Not known	20.11.75	tusker	
	Not known	16.11.80	male (makna)	
8. Gajamati	Not known	9.11.73	female	separated 28.5.76
	30.5-18.6-76	29.7.78	female	separated March,81 died.

Total No. of calves - 13 : female ... 9
tusker ... 3
Makna ... 1

Sex ratio 4 male: 9 female (at birth) 1:2-25

Age at which the calves died :

1 -- 2 days old (female)
1 -- 3 months old (female)
1 -- 3 years old (tusker)
1 -- $2\frac{1}{2}$ yrs. old (tusker)

Survival 9 out of 13 (69%)

Table - II

Name of elephant	Date of mating/ date of birth	gestation period	Inter calf / Interval
I. Madhumala	i) 20.5.75/22.3.77	21 months	
	ii) 17.12.79/17.10.82	22 months	$5\frac{1}{2}$ yrs.
II. Chiprarani	i) - /24.12.76	-	
	ii) 12.3.80/27.12.81	$21\frac{1}{2}$ months	5 yrs.
III. Meghangini	i) - /20.11.75	-	
	ii) - /16.11.80	-	5 yrs.
IV. Joymala	i) - /10.2.75	-	
	ii) - /17.4.80	-	5 yrs. 2 months
V. Gajamati	i) - /9.11.73	-	
	ii) 18.6.76/29.7.78	25 month	4 yrs. 8 months
	average	22 months	5 yrs.

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The line K shows the population size at the carrying capacity of the area: that is, the maximum number of animals that a particular area can support in terms of food supply, places to live etc. At very low density, population growth is greatest, but as the population size approaches K so the rate of population increase declines progressively until at K the rate of population increase is zero.

In the long term populations tend to keep at the equilibrium level dictated by K in the logistic curve. Population size is regulated to the level of K through the relative contributions of births, deaths immigration, and emigration. The accuracy and effectiveness of this regulation can vary, as shown in Figs 2 to 5.

Fig 2

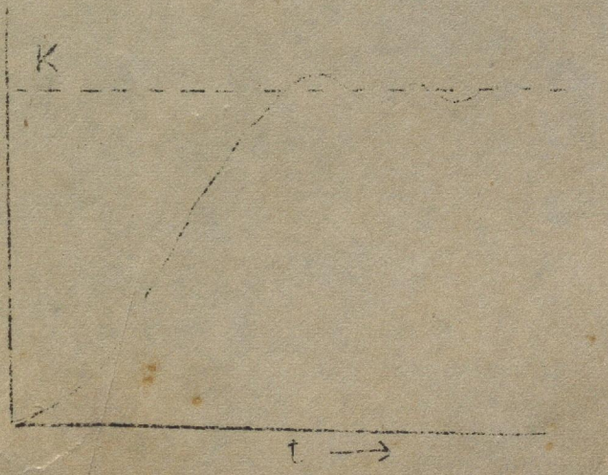


Fig 3

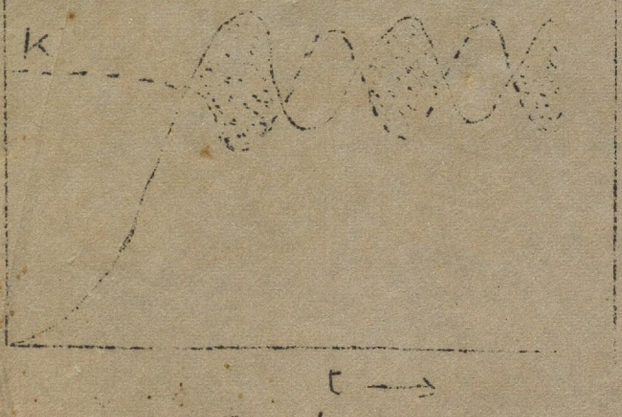


Fig 4

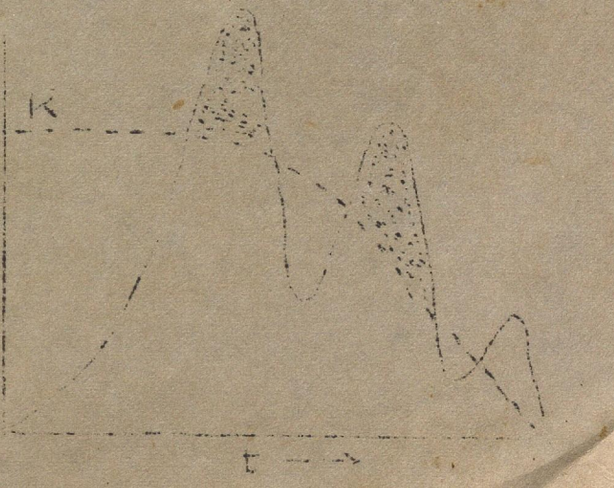


Fig 5

Fig. 2 Shows almost perfect regulation to the equilibrium level with only minor fluctuations about K.

Fig. 3 Shows less accurate regulation at first but gradually the equilibrium level is reached and then maintained.

Fig. 4 Shows a situation where perfect regulation is never achieved: instead the population shows a contrast cycle of change, oscillating with K in a regular way. (This is called a "stable limit cycle").

Fig.5 Shows an extreme case of failure to regulate; the population overshoots K so much that K itself is reduced and eventually the population plunges to extinction.
(Stippled areas in the Figures show when K is exceeded).

While the logistic curve does provide a useful, generalised model of population growth it is, in reality, an oversimplification. It must not be supposed that the food supply is an inert substrate that is depleted in a regular way as the population increases. In fact there is an interaction between the animal population and its food supply, the latter changing in character and structure as the size of the animal population changes.

Fig.6 and 7 show the examples of two different stable interactions between a herbivore population (solid line) and its food supply (broken line).

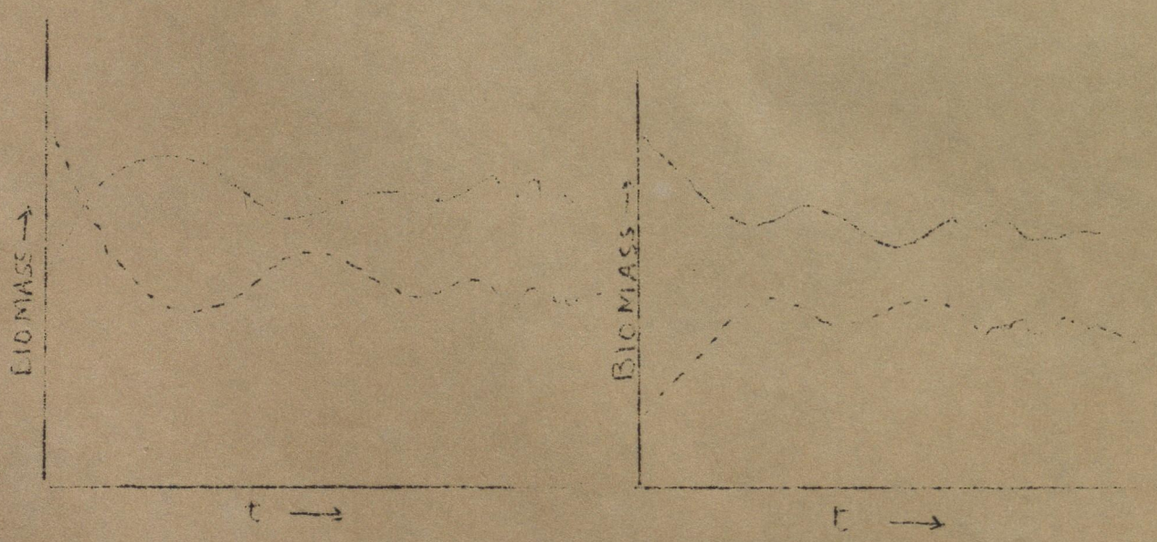
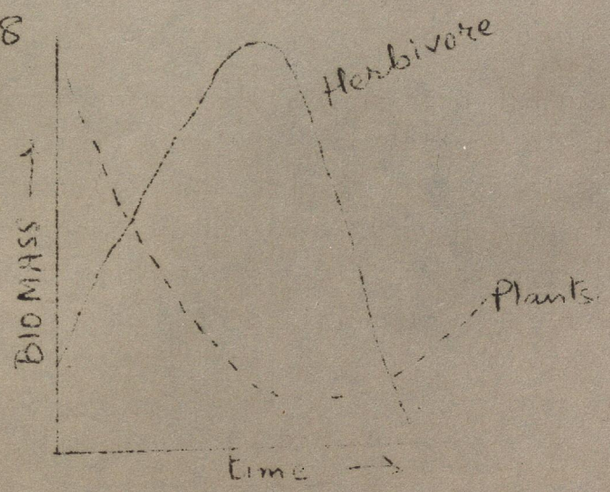


Fig 6. Fig. 7.

The model in Fig. 6 follows a population from a size that is low relative to equilibrium size, whereas the model in Fig. 7 follows a population from a size that is high relative to equilibrium size. Thus in reality a population at "carrying capacity" should not be thought of as one with a constant level, rather it is one that is fluctuating between boundaries, under the influence of many factors such as climate, abundance of other herbivores, and so on. Nor is carrying capacity an average of those fluctuations, although it may be expedient to consider it so for mathematical purposes. A population is at equilibrium if it can persist while fluctuating within certain limits in that environment over a long period of time. The emphasis is on persistance, rather than any steady state.

Figure 8 is complementary to Figure 5 and depicts an unstable interaction where a herbivore population so far overshoots the carrying capacity(perhaps due to artificial removal of predators, or massive immigration due to disturbance outside the area), that it removes photosynthetic material faster than the remaining leaves can obtain energy to replace it, and the food supply is so drastically reduced that the population plunges to extinction. Inherent in this model is the assumption that the density dependent mechanism regulating the herbivore population are unable to operate fast enough to avert the crash.

Fig. 8



Note that initially the characteristics of this system are similar to that shown in Figure 6. The resilience of a Figure 6-type system to collapse depends on a number of actors. These are below,

and it several of these are found to characterise a system it may be considered potentially unstable.

The factors include the biological characteristics of the herbivore. Density dependent regulatory mechanisms are more responsive in r- selected species(small, low biomess, short-lived units with high productivity) than K-selected species(large, high biomess, long-lived units with low productivity). Population response will vary according to whether individuals are solitary, found in small groups, or in large herds, and whether they are resident, territorial or migratory.

The biological characteristics of the habitat and/or food supply are also significant. Changes in woodland(K-selected plant species) are less reversible than in grassland (r-selected plant species).

Other important factors concern the ecological and physical characteristics of the ecosystem. The smaller the range occupied by the herbivore, the more severe the impact to be expected, and the greater the chance of irreversible change. Systems can reach an equilibrium in large enough areas, but not too small. Similarly it will be significant if opportunities for dispersion and migration are removed. Finally topography- steeper terrain is more prone to erosion; soils- sandy soils are less susceptible to the adverse effects of trampling; and climate- arid habitats recover slower; are all relevant factors.

3. ELEPHANT-HABITAT INTERACTIONS

If one considers the characteristics of elephants and their habitats in the above perspective, are quickly realises that, probably to a greater extent than for any other herbivore, even apparently stable interactions are prone to collapse. In other words, and depending on the precise circumstances, the thresholds for a population crash, or for irreversible changes to the habitat, are relatively accessible in elephant systems.

Indeed "elephant problems", where elephant populations appear to exceed carrying capacity with sometimes disastrous consequences to themselves, their environments, or both, have been described in many African situations. As the Asian elephant range becomes more and more constricted, there is increasing concern that similar problems will arise there also in the not too far distant future. This is particularly true of the more arid parts of the range.

Given the very similar ecological and reproductive strategies of the two elephant species, interpretations and lessons derived from Africa are I believe, almost certainly directly relevant and applicable to Asia. There are two major hypotheses to explain the cause of elephant problems, those of Caughley (1976) and Laws (1975). Both are models based on elephant-habitat interaction in which predicted changes are density dependent and related to food. In both, marked long-term habitat changes are involved. The nature of these changes depends on soil, rainfall, as does feed back on the elephant and other animal and plant populations.

3.1 Caughley's Model

This postulates that "elephant problems" (where the population exceeds carrying capacity) are an in-built (and therefore natural and inavoidable) characteristic of the circa 200 year period stable limit cycles by which elephant populations are limited. This model is best illustrated by Figure 4.

The hypothesis thus implies that there can be no stable equilibrium between elephants and trees at a given locality. However, in a natural state before the explosion of human populations, over a large area, cycles could have been out of phase in local sub-populations and so the total regional population and the total forest/bush cover might well have been relatively constant for long periods. Either way, in its pristine state, elephant habitat could be regarded as a mosaic of habitat types, influenced by grazing and browsing (particularly by elephants). In pre-colonial dans before the rapid increase of the human population the nature of this dynamic, cyclical mosaic would have been further complicated by the effects of shifting cultivation.

Indeed some workers believe the essential mechanism stabilising the interaction between vegetation and the elephants eating it may be the patchy aggregation of elephants and the changing, patchy patterns of subsequently recovering vegetation. If so, the size of the region needed for this system stably to persist is not easily guessed. It could be vast.

3. 2 Laws's Model

This postolates that "elephant problems" have been cavsed by human interference over the the last so to 100 years, and are the result of compression or displacement, aggravated in asid regious by climatic cycles of a circa 10 year period. This model is best illustrated by Figure 5, where the stippled areas indicate when a "problem" exists. Note however, that the severity of a problem is relative to carrying capacity (in other words the bottom-right problem in Fig 5 corresponds to the situation in Fig. 8, whereas the top-left problem does not). The hypothesis presumes such situations were not possible earlier, when human populations were smaller.

As the human populations increased and modern settled farming replaced shifting cultivation, so individual components of the mosaic became trapped in one phase of the cycle. Elephants were too restricted and unable to move out of areas that had become unsuited to their needs. A scenovio characterised by human islands in a sea of elephants, changed to one characterised by elephant islands in a sea of humans. These islands have increasingly centred on parks and reserves. In some management is necessary.

While the elephant exhibits a wide range of density dependent regulatory adjustments to declining habitat resources (lengthened calving interval, deferred maturity, increased calf mostality), these have not usually, if at all, been sufficent to compensate for the complession (increased population fensity), habitat change, and consequent ellective changes in carrying capacity. The elephant exhibits an inertia of the adult age classes - ewar with the complete elimination of births the biomass locked up in the adult population persists until mortality or enigration removes it.

If age at first breeding in on ax outelope that normally has its first calf aged two, was felayed by one year, a large effect on birth rate would be immediately apparent. In the elephant however, which first breeds age twelve, with a calving interval of three years, this would not be the case.

Elephant problems, in Africa at any rate, seem to be exclusively problems of over-browsing, rather than over-grazing, and this relates without doubt to the relative K - and r - selectedness of trees relative to grasses. The inertia referred to above means that feeding pressure on bushes and trees is sustained for years. The effect is enhanced in drier areas, in dry seasons, and in drought years. Elephants in semi-arid environments, or worse, may be totally dependent on browse for the majority of the year. The impact of a slowly diminishing elephant biomass (e.g. 2 %) on a more rapidly decreasing standing stock of trees (e.g. 6 %) would progressively increase. The regeneration of trees is slow, and in a reserve that is effectively on island surrounded by human cultivation some plant species (and therefore animal too) may become extinct. In this context it is as well to remember that on over abundance of elephants (unspecialised feeders) may be more hazardous to other (specialised) species.

Thus in Africa, although elephants require substantial quantities of grass, it may be the availability of browse in the dry season that imposes the greatest constraints on the population. Therefore, where elephants are more dependent on browse, as in the lower rainfall areas, compression could lead to a population crash.

However, it should be noted that in the more forested, generally wetter elephant habitats of Asia, relatively high grass productivity is generally associated with relatively dry areas, rather than with relatively wet areas as in Africa.

Therefore, it could be that in Asia, although elephants require substantial quantities of browse, it may be the availability of grass in the wet season that imposes the greatest constraints on the population. ("Over grazing" by elephants in parts of Sri Lanka would support this). As r-selected grass has a much greater regenerative ability than browse, this may explain why comprssed Asian elephant populations, even in low rainfall areas, appear less prone to crashes than their African counterparts.

4. MANAGEMENT IMPLICATIONS

Be the last suggestion as it may, the biological characteristics of Asian Elephants, as well as their continually diminishing range, behove their managers to be on their toes. This is particularly true for cases of apparent over abundance, because unlike cases of apparent under abundance of elephants (which should concern managers equally), decisions on a response are generally very difficult to reach.

For any mammal, over abundance is usually claimed within one or more of the following contexts : -

(1) The animals threaten human life or livelihood (eg. life; health; domestic livestock or crops).

(2) The animals depress the densities of favoured species of plants or animals (one species may drive another to extinction).

(3) The animals are too many for their own good, in the physiological sense. This has to do with physical condition or breeding success.

(4) The system of plants and animals is off its equilibrium.

To some extent, the elephant is susceptible to all the above classes of overpopulation. However the last is the most important, and while the others lean heavily on value judgements to establish their existence or justify a response, this class is the only one involving basic ecological principles, data, and interpretation , as has been indicated in the foregoing sections.

4.1 Monitoring animal-plant equilibrium

Quite commonly, it is difficult to know whether the apparent local abundance is a reflection of overall increase in numbers or densities of animals, is only a local increase, or reflects a change in the behaviour of the animals such that their presence (or the effects of their presence) is more visible. There are a number of pertinent questions that can be posed, the answers to which will allow the manager of a particular habitat to determine whether or not the claim of overabundance is valid:

(a) Is there a trend of increasing population size or density accompanied by a decrease in resources, a change in the habitat, or a decrease in the status of associated populations? (Seperate trends from normal climate induced fluctuations?).

(b) If there is a trend, is it likely to slow down toward a stable situation or continue into an eruption/crash process? (Effectiveness and time-lag of density dependent responses in the population and its resources are key factors).

(c) If an eruption or crash is expected, is it likely to settle down to a stable situation similar to any previous one, or result in extinction or other major changes in the ecosystem?

Four major categories of pertinent measurements to be made in relation to such questions are:

(1)Biological characteristics of the species of prime importance/ interest such as abundance, changes in abundance, birth rate, death rate, growth rate, age structure of populations, body condition and so on.

Counts, even if inaccurate, can at least be used as indices to reveal changes in numbers or trends in abundance over time. Changes in density may be more important than changes in absolute numbers. From the management point of view therefore, there is no need to be obsered with our present inability to determine absolute numbers of elephants accurately (especially in Asia).

(2)Biological characteristics of associated species, competitors, predators, parasites, and most important food species.

To decide when populations of herbivores are over abundant and in need of management intervention we must observe, understand, and predict the responses of the vegetation to variations in the abundance of those herbivores.

(3)Measures which express the integrity of the entire biological community eg. species diversity.

(4)Abiotic measures such as nutriant status of soils, soil erosion, and so on.

A manager has to decide which of these four is most relevant to his situation. The traditional practice has been to concent rate on the first. However this may provide information too late to be of use. An analogy may be a doctor monitoring the numbers of bacteria in a patient's blood but not measuring his body temperature O i.e. their effect on the system).

A manager's concern therefore should be to determine what is the appropriate ecological symptomology in addition to the appropriate ecological cause and effect. The symptomology with other include measures that move beyond the bilogical characteristics of the "target" species. No single measure will suffice. He is advised to make several measures from more than one of the above categories.

Today few areas established as elephant reserves have any routine monitoring of crucial variables. This can lead to disaster, since if noting is measured about the system, there is no way of knowing whether if his changed in a significant way. The mesage to those entrusted with the long-term conservation and management of wild elephants is clear.

4 : 2 Management response

Once an overabundance in any of the four classes thereof described earlier is established, its likely consequences must be considered in order to decide on an appropriate management response. This may be done by considering the factors given at the end of section two earlier.

However, it should be clearly understood at the outset that the decision to retain or create a desired state by manipulation; or to let the system choose its own course, is a judgement of value. All conservation problems involve political and economic complications along with purely biological ones. It is therefore helpful to spell out very fully and explicitly, the main purpose that a given park or reserve is meant to serve. Definition of policy is all important to the management decision making process.

Once a decision has been made correct a local over abundance of elephants there are relatively few management options, each of them with its own attendant problems. To deal with these fully is beyond the scope and purpose of this paper, but briefly the major options are :

(a) Culling

Culling here means the removal of individuals from a population either dead or alive. Killing is probably not a viable option over most of Asia due to cultural and political constraints, and is generally considered to be inherently unacceptable simply because the animal is deemed so precious and rare. An alternative is "scaring" or "driving" causing the animals to disperse, or remove themselves, perhaps selectively from the localities of high density (see Fernando, this workshop). Where there are geographical or behavioural impediments to "natural" di spersal, elephants may be translocated by physically transporting them.

There are two caveats to culling by any method relevant to the Asian Elephant situation. Some "over abundant" populations may be so small in terms of absolute numbers, that any further decrease will enhance the risk of inbreeding depression. Managers should be aware that there would become apparent. It has been estimated that the minimum population size at which a species of large mammal could cope with the effects of inbreeding in the absence of regular introduction of unrelated stock is 50 animals. A population of 50 randomly breeding elephants will take several 100 years to reach a 10% level of inbreeding, whereas in mice this would take less than 10 years.

The second caveat concerns driving and translocation. Local sub-populations of previously widely distributed species are likely to have evolved gene complexes adapted to the local environment. Therefore, these techniques could dilute local adaptation, thus threatening fitness and survival.

It seems there could be circumstances where managers would have to enough worries of inbreeding in small groups against worries about dilution of locally adapted gene complexes.

(b) Habitat manipulation

Management action in this category could have an equivalent effect to culling in ecological terms. The best option, namely to increase the size of the reserve, is normally the least feasible. Manipulation to increase the quantity and quality of the food supply on a long-term basis (ie. carrying capacity) is theoretically possible, but little tried. This technique deserves thought and field trial, if only because it is a valid management response to underabundance as well as overabundance.

However, it should be noted that some habitat manipulations can have adverse effects eg. artificial watering points in dry areas. Natural climatic cycles exercise some constraint on animal numbers. Dry years result in increased mortality and decreased natality; in wet years these reverse. If the constraints of the dry years are removed, the recovery in the wet years is more likely to overshoot (Fig. 8).

Changes in the habitat whether due to human action or the effects of resultant increased numbers of elephants may lead to a general opening up of the habitat. In Africa this has led to increased levels of poaching which have defeated the purpose of the management action in the first place.

Main - elephant confrontation

Composite habitat - restricted road.

Population estimation of elephants (*Elephas maximus*) in Satkosia Gorge Sanctuary - Purnakote and Raigoda ranges of Angul Forest Division, Orissa.

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Introduction

Key to managemental evaluation of a species requires an inquiry into population-estimation and their abundance. A preliminary estimation of elephant (Elephas maximus) population was carried out only in two, Purnakote and Raigoda ranges of Satkosia Gorge Sanctuary, Orissa. Success of any such operation is highly dependent on the careful selection of methodology for carrying out the estimation and enumeration work.

In the present case elephant population estimate is based upon the fact that the water-points which elephant must visit are limited in the summer months of April-May and an attempt could be made to physically count them over such points.

Study Area

General description

The Satkosia Gorge Sanctuary comprising the parts the hill ranges of Eastern Ghat is a recently declared sanctuary (vide notification No.4F(10)35/76-12727/FFH dated 19.5.76) extending over an area of five forest divisions viz. Angul, Rairakhol, Phulbani-Boudh, Nayagarh and Atagarh with a total area of 1273.6 Km^2 (796 sq. miles). The area selected for this study covers the two ranges (Purnakote and Raigoda) of Angul forest division, on the north bank of the river Mahanadi. The area of these two ranges together is 396 Km^2 (approx.).

Both these ranges Purnakote and Raigoda comprise of high-hills & deep valleys extending from Athamalick on the west and Hindol range (Dhenkenal forest division) on the east. The hill ranges are nearly parallel to the Mahanadi river and having South-east and North-west strikes.

The general elevation is from 152 m to 732 m, the lowest being approximately 37 m in Purnakote range near Tikerpada and highest is in Raigoda range approximately 835 m.

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Hill slopes are steep more especially in the forest lying to the eastern side of the sanctuary beyond Angul-Tikerpada road.

Climate

The area experiences a short and mild winter with prolonged hot weather. During summer, from February to mid-June, temperature reaches a maximum of 45.5°C and rarely comes down below 14°C in winter months. Due to prolonged hot weather drought is frequent.

Rain usually breaks in the third week of June and continues till the middle or end of the September. Winter showers may also occur in the months of October or in November. The average number of rainy-days in the year is 101, of which 72 are confined in the months of June to September. The Raigoda side is relatively more humid as compared to other areas. There is heavy dew-fall through out winter and continues till late March.

Habitat

The extensive area of elephant habitat of Raigoda and Purnakote ranges are covered with two types of bamboo viz., Salia (Dendrocalamus strictus) and Daba (Bamboosa arundinacea) in association with other tree species. Salia is found through out the hilly areas of the elephant habitat. In valleys however, along the stream Daba occurs in patches. In Raigoda range due to availability of high edaphic and humid regimes the sp. of B. arundinacea is found more extensively.

For the purpose of classification this dry deciduous vegetation can be divided into three major types:

Type I - Sal type forest;

Sal type habitat are exclusively found in the part of Raigoda range in association with B. arundinacea and such

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other sal (Shorea robusta) associate as: Terminalia tomentosa, Eugenia Jambolana, Adina cordifolia, Bursera serrata, Mitragyna parviflora etc. The under story consists of some common sp. such as: Cassia Fistula, Diospyros montana, Glechidion lanceolarium etc.

Type IIa - Damp type mixed forests;

This is very similar to type I without the sal. It is generally met within parts of Purnakote range and is less in extent. The two most common species of trees which attend a very large height in this habitat are: Terminalia tomentosa and Adina cordifolia. Thorny bamboos may or may not be present but are generally less common than in type I. The canopy in this type is comparatively more open.

Type IIb - Dry type mixed forests;

This is the type most widely represented in the division and is almost invariably associated with Salia bamboo either in greater or lesser extent. It can be said to predominate in whole area except in some parts of Raigoda range. This vegetation types contains large number of tree species. Some economically important trees associated with this type are: Anogeissus latifolia, Termanalia tomentosa, Adina cordifolia, Mitragyana parviflora, Ougenia dalbergoides, Cassia fistula etc. Often sal can be seen in favourable places. The common shrub under growth are: Cipadessa fruticosa, Cassia fistula, Zizyphus Oenoplia, Combretum decandrum, Bauhinia Vahlii, Butea superba etc.

Salia bamboo Dendrocalamus strictus constitutes major food item of elephant which extensively available in this habitat. However, other preferable species needs further investigations.

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Methods

Field work was done during the period May 13th to May 23rd 1982. This was splitted in two places (i) Pre-census work followed by (ii) a final count on the last two successive days over water-points as detailed below:

For pre-census work a habitat map on 1" = 4 miles scale was prepared showing the courses of each and every nala or creek (dry at this time of the year) running through the two ranges of Purnakote and Raigoda. Only river Mahanadi at this time had, as usual low flowing water. However, there is one nala i.e. Halua nala (Raigoda range) somewhat perenial through out its course. An intensive ground survey was carried out to locate pocketed water-points. All water-points such as nalas, game tanks (usually within forests) and village tanks were marked on the map. These were also examined for any sign of old or fresh elephant's presence either by their foot prints or 'bole'. This occupied a period of seven days.

Also, a 24 hour vigilance was kept to ascertain the visiting hours of elephant herd to these water-points and their movement pattern. This indicated that elephants visited the water-points, game tanks and village tanks between 19 hours to 22 hours.

Machans (wooden platforms) were then constructed on each water-point at suitable places for clearly viewing the visiting herd.

Actual count of elephants was undertaken on the last two successive days i.e. 22nd and 23rd May 1982. Each machan was manned by two local villagers and a staff of Orissa Forest Department. Each party was provided with mashal torch to facilitate the counting.

Results and Observations

Drinking behaviour and respond to light

Drinking behaviour of elephants during pre-census

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period indicated that they came only once in a day during hot-season, usually in the late evening (19 hours to 22 hours). In the two ranges Raigoda and Purnakote of Satkosia Gorge Sanctuary due to exploitation of forest products particularly bamboo, disturbance during day hours was heavy which kept elephants away. From Table 2 it is apparent that during census period elephant herd generally visited the water-points game and village tanks between 1900 hours to 2200 hours. The peak utilization by elephant was 2000 hours to 2030 hours, when 70% of elephant herd visited the water-point on 22nd May 1982 - the first counting day. The lesser number visited on the 23rd May - the last day of counting because of sudden rain which made water available widespread on the day.

Before coming to the water-points elephants were always very cautious of any unusual presence and generally kept their calves behind. This could be well understand from what occured on May 14, 1982, when we arrived to investigate their visiting hours on Kodalikhola game tank (Purnakote forest range). Established, information of their movement to this game tank had been collected from local inquiries and this enabled us to reach the tank before expected time of elephant arrival. One and half hour later when they did not come we went for a check round the game tank. Hardly we could reach the other end of the game tank some bamboo breaking sound combined with low deep groan alarmed us. In our excitement we quickly returned to the forest road close to the game tank and waited silently. Five minutes later again their low deep groan (co-ordination call) informed us their arrival on the left edge of the game tank. But for final entry they took almost another 40 minutes.

With the help of two torches we counted 2 adult females, 2 sub-adult (unsexed) into the game tank. Two calves(unsexed) on the edge of the game tank had not entered water. With light

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the herd panicked and disappeared in the high bordering forest.

Population structure, sex ratio and abundance

Population structure on the basis of counting on two successive days are given in Table 2. In all 8 herds (approximately) were present in these two ranges during this period. The smallest herd consisted of one tusker and a female and largest was of 19, consisting of 3 tuskers, 13 females and 3 calves.

An analysis of the countings indicated that the herd of 1 tusker, 3 females and 2 calves observed at Hatibari village tank on the first day was the same one observed at Kodalikhola game tank on second counting day. Duplication was avoided. The total came to 99 elephants consisting of 17 males, 62 females and 20 calves. Since one lone tusker was observed on the second day counting at Raigoda block (Table 2) it was included in the total figure making 100 elephants in the two ranges.

The sex ratio male to female in this population is approximately 1 : 3. Occurence of this population of 100 elephants in an area of 396 km^2 gives an abundance of approximately 1 elephant/4 km^2. Whether elephants had congregated from other area in search of water in the peak summer could only be ascertain from a winter-census.

Discussion

Suitability of present method of enumeration work depend highly upon the existence of few water-points in the habitat and frequency of elephant visit to these water-points. Therefore, climatic factor and animal behaviour to the water-point in association of habitat conditions are of utmost importance.

The Satkosia Gorge Sanctuary lies in the dry realm of climatic zone which due to its prolonged summer allows only

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few water-points to survive. To ensure that sudden cloud burst and early monsoon do not vitiate the result it would be desirable to hold such a census in March (end) - April next year 1983. On our second day counting we could see only 24 against 83 elephants on the first day because the operation was done in May, and unfortunately fell on the second day.

In a night enumeration work of this nature mashal torches were used which quickly illuminate the whole area and quick count could be possible before the herd panicked. Experience further indicated that a census in March - April if done in full moon period would be more reliable.

Worthy of note is the less number of debarking or knocking down of trees in the area. Whereas in other non-bamboo type habitat debarking is frequently seen.

Occurence of 100 elephants (18 tuskers, 62 females and 20 calves) as censused in an area of 396 km^2 indicated an abundance of approximately 1 elephant/4 km^2. Presence of 20% calves shows a healthy trend of population growth. Considering these 20 calves is in age class of 4 years, it provide a reproductive rate 20 ÷ 4 = 5 calves/year. If almost all the females (62 as censused) being adult in a time lag of four years the rate 5 calves/year given an reproductive cycle 62 ÷ 5 = approximately 1 young/12 years. However, this rate of reproductive cycle is on the little higher side since this population is not classified in the category of sub-adults.

It may be mentioned here that elephant census done in May 1979 for these two ranges (Purnakote and Raigoda) by the Orissa Forest Department produced the population figure of 123 (23 males, 70 females and 30 calves). The method used was a physical count by ground trackers by dividing the area into suitable blocks, the season of enumeration being the same as ours. Inspite of two different methods the two figures are not widely divergent.

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Conclusions

It may be concluded that the present method of population estimation on the basis of water-point survey can prove advantageous in all the habitat which have limited water-points and prolonged summer season. As far as other aspect of any estimation is concerned it is most time saving, less labour intensive and low budgeted; therefore, can be considered as a feasible proposition.

Expenditures

Census expenditures from 13.5.82 to 23.5.82

(A) Non-establishment

	Amount Rs. p.
(i) Labour charges for census work	708.00
(ii) Fuel and vehicle maintenance	1,101.41
(iii) Anti-malarial medicines	62.65
(iv) Miscellaneous	534.00
Total:	2,406.06

(B) Establishment

(i) Driver salary	133.00
(ii) Field Biologist salary	353.00
(iii) Salary of helper	80.00
Total:	566.00

Grand Total: Non-establishment + Establishment

2,406.06 + 566.00 = 2,972.06

Census cost = Rs.7.50 /km^2

Managemental considerations

In Satkosia Gorge Sanctuary "game tanks" located inside forests are of special interest since they provide water to elephants during their pinch period. There are five such tanks and elephants were seen only on two. The 'game tanks' are not being maintained and have largely silted up. Elephants have

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therefore, perforce to use the village tanks near human habitations and in future may lead to confrontation with human-beings. Therefore, proper maintenance of these five tanks inside forests are desirable not only for elephants but also for the other heterotrophs in this area.

Acknowledgements

We are greatful to officials of the Orissa Forest Department particularly to Mr. S.N.Das, Chief Conservator of Forests; Mr. U.N.Sarangi, Chief Wild Life Warden; Mr. S.R. Choudhury, Field Director (now deceased), Simlipal Tiger Reserve; Mr. L.N.Chowdhury, D.F.O., WLC Chandbali; Mr. C.G.S. Mishra, DFO, WLC, Nandankanan Biological Park and Mr. N.C. Patnaick, DFO, Angul for their suggestions, encouragements and introduction to us with elephant situation and spread in Orissa.

We are also wish to record our thanks to other field staff of Satkosia Gorge Sanctuary (Angul Division), who's untiring helps could make this enumeration possible. Among them few names need special mention are: Mr. Debobroto Roy, Wild Life Warden; Mr. P.C.Das, Range Officer and Mr. M.Behra, Range Officer, Departmental working.

Table 1 - Climatic regimes during entire census period

Date	Temperature °C		Rain (in mm)	Humidity (%)	
	Maximum	Minimum		Maximum	Minimum
12.5.82	43.0	26.0	-	-	-
13.5.82	40.0	26.0	2.8	-	-
14.5.82	41.0	26.0	-	-	-
15.5.82	41.0	27.0	-	-	-
16.5.82	40.0	25.0	-	-	-
17.5.82	40.0	26.0	7.35	-	-
18.5.82	42.0	30.0	-	-	6.0
19.5.82	43.0	21.0	-	80.0	15.0
20.5.82	44.0	27.0	-	68.0	12.0
21.5.82	44.0	28.0	-	80.0	13.0
22.5.82	44.0	27.0	-	74.0	30.0
23.5.82	42.0	24.0	-	39.0	-
24.5.82	-	24.0	8.75	-	-

Table 2 - Census figure at various water-points in two ranges of Angul Forest Divisions

Range	Block	Name of the water point	Near by place or compartment	1st day final counting (22.5.82)			IInd day final counting (23.5.82			Remarks (Visit of water point and water point conditions
				Tusker	Female	Calf	Tusker	Female	Calf	
Purnakote	Baghmunda	Rawat Bahal game tank	-	-	-	-	-	-	-	Weed developed water very low.
	Maghipara	Kodalikhola game tank	Compartment No.9	1	3	2	-	-	-	visited at 8.00 pm
		Bipridi Nala	Compartment No.2	2	7	4	-	-	-	Visited at 8.00 pm
		Champai Jaharan Nala	-	1	1	-	2	10	4	1st day at 8.15 pm 2nd day at 8.30 pm
Katrang		Ramkote Nala	Compartment No.7	2	11	5	-	-	-	Observed at 8.30 pm
Kuru		Tarva Nala	Compartment No.2 A	-	-	-	-	-	-	-
Tikerpara		Kandharida Game Tank	-	3	13	3	-	-	-	Observed at 7.15 pm
		Hatibari Village tank	-	-	-	-	1	3	2	Observed at 8.00 pm water very less eutriphication started

Range	Block	Name of the water point	Near by place or compartment	1st day final counting (22.5.82)			IInd day final counting (23.5.82)			Remarks (visit of water point and water point conditions
				Tusker	Female	Calf	Tusker	Female	Calf	
		Ramgoan Nala	Compartment border 6 A	-	-	-	-	-	-	-
	Chotomunda	Netai Jhar Nala	-	-	-	-	-	-	-	-
		Satbahi Nala	Compartment No.9(Salour)	-	-	-	-	-	-	-
Raigoda	Tuluka	Gilsinga Nala	Compartments 9, 10, 11 between teak plantation	-	-	-	-	-	-	-
		Bhimdhara Nala	Compartment No. 13	2	13	2	-	-	-	Observed at 9.15 pm
Raigoda	Rasanda game tank		-	-	-	-	-	-	-	Water very less. Colour deep brown with thick soil suspension.
		Water pocket in a nala	Near Kaudali Compartment (14 b)	-	-	-	-	-	-	-
		Halua nala	-	-	-	-	-	-	-	-
		-	Raigoda (Compartment No.14)	-	-	-	1	-	-	-

Range	Block	Name of water point	Near by place or Compartment	1st day final counting (22.5.82)			IInd day final counting (23.5.82)			Remarks (Visit of water point and water point conditions)
				Tusker	Female	Calf	Tusker	Female	Calf	
	Bolong	Kanter singa game tank	Compartment (11 B)	-	-	-	-	-	-	Water become complete green due to algal bloom
		Taripatra Nala	Kurumdam hill	2	1	-	-	-	-	Observed at 2.00 pm
		Water pocket in nala	Sahab Kota Compartment No.17	1	-	-	1	-	-	Observed from 19.5.82 to 23.5.82
		Takersinga Bara Jharan Nala	Kalangi Compartment No. 4 B	1	3	-	-	-	-	Observed at 8.05 pm
			Total:	15	52	16	3	10	4	

SATKOSIA GORGE SANCTUARY

SCALE 1" = 1 MILE

INDEX

1. Sanctuary Boundary
2. Reserve Forest Boundary
3. P. W. D. Road
4. Forest Road
5. Cart Road
6. River and Nala
7. P. W. D I.B and Forest rest house

INFORMATIONS

Total area of Sanctuary 796 sq miles
Extended over Angul, Nayagarh, Phulbani, Athagarh, Rairakhol Forest Division
G.T. Game Tank
N- Nala

ELEPHANTS AND THEIR DISEASES

By
V. Krishnamurthy

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The earliest literature describing the diseases of elephants dates back to more than 2000 years - in the works of Palkapya, Nilkanta written in Sanskrit. Subsequently in Mogul period also some literature was written in Urdu describing the diseases and the mode of their treatment etc.

In English the first known book dealing with diseases of elephants seems to be that of W. Gilchrist (1848) - "A practical treatise on the treatment of the Diseases of elephants". This was followed by a book by Lt.Col.Evans (1901) which is a monumental work dealing with Care and Management of Elephants in captivity. Later A.J. Ferrier (1948) wrote a Book on "Care and Management of elephants in Burma".

Though valuable information is available in ancient as well as current literature, much work is yet to be done on the Diseases of elephants since systematic and studies are still lacking. In this connection, mention has to be made of the excellent work being done by a team of researchers of the College of Veterinary and Animal Sciences, Trichur of the Kerala Agricultural University and also by the Scientists of the Sri Lanka University on various aspects of the Asiatic Elephant.

In elephants, though a certain amount of predisposition to diseases may be assigned to a change from freedom and natural life to domestication, many of the diseases can be attributed to lack of proper management. Many State Forest Departments have codified "The Management Practices" to be adopted for departmental elephants.

For a Veterinarian the elephant is a difficult patient not because of its size, but due to the fact that
a) Elephants are very timid and suspicious creatures difficult and often danagerous for strangers to handle. b) Their power of recuperation is rather slow, and loss of condition is regained only slowly

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c) Difficulty in administration of medicines due to their sensitive nature.

Hence if successful treatment is to be achieved the above facts must never be lost sight of. Further we must be able to differentiate between signs of Health and Signs of indisposition.

Signs of Health: A healthy elephant is always active and is never still. It continuously flaps its ears, swinging its trunk and swishing its tail, swaying the body or the head from side to side and rubbing one leg against the opposite one or swinging it.

The eyes should be clear and bright and there is little or no watering. The palate, tongue and the visible mucous membrane are of a healthy pink colour. The skin is soft and wrinkled; almost black in colour and has no appearance of glaze along the side of spine or hip. A moist secretion exudes around the nails and is easily observed by throwing some dust on the parts. The appetite is good and the general impression is one of contentment. The urine is copious in quantity, of a faint yellow tinge and the odour is not unpleasant. The dung is brownish in colour darkening on exposure to the air, the colour may vary according to the fodder eaten. It is passed in large lumps, which are fairly firm. A healthy elephant will only lie down once or utmost twice during the night, and never during the day.

Signs of Indisposition: The animal looks listless, there is general languor and absence of the incessant motion so characteristic in health. The skin appears greyish in colour, hangs loosely and is dry and sometimes scaly. The trunk presents a shrivelled appearance. The colour of the membranes of mouth and that of the tongue changes to a muddy colour or is deep red with or without blotches on the palate. The eyes are dull, appear retracted and there is frequent or abnormal flow of water from the eyes. The animal may be out of condition, the appetite small, or even wanting. Proper rest is not taken and he may lie down and get up several times. The urine may be less in quantity and

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highly coloured. The dung may look hard and coated with mucous, or diarrhoea may be present. The normal body temperature of an elephant is 35° - 37°C;
Pulse : 28-36/mt : Resp. 6-10/ pmt.

The most important, infectious or communicable diseases found or reported to occur in elephants include Anthrax, Haemorrhagic Septicaemia, Salmonellosis, Tetanus, Tuberculosis, Pox, Rabies, Babesiosis, Surra, Cutaneous filariasis, and Gastro-intestinal helminthiasis.

Cases of viral encephalo Myocarditis, Arterio S lerosis, Choli-lithiasis have also been reported among elephants. Dropsy, Colic due to impaction of colon, Volvulus or intussusseption, Corneal opacity, Cirrhosis are some of the conditions commonly met with in elephants.

Several surgical conditions, on account of ill fitting harnesses, nature of work may be met with. Galls, abscesses, contusions, sprains and strains, Arthritis are commonly seen among elephants. Further, elephants let out for grazing may have gored injuries as a result of fight with wild tuskers and sometimes cases of Dislocation or fractures might be encountered. Foot rot is a common condition met with in animals and always exposed to slush or swampy areas.

Anthrax: This is a very serious disease, and unless prompt measures are taken, mortality will be exceedingly high. It is caused by "Bacillus Anthracis" and occurs in enzootic and epizootic forms in tropical countries and sporadic in temperate countries. The suspicion of the prevalence of this disease should arise, when one or two animals of a herd suddenly die and that too sometimes within a short time i.e. in a couple of hours or so. The disease may manifest in apoplectic, lung, intestinal or skin form.

The general symptoms are shivering, pyrexia, swelling behind the jaws, groins, limbs. The swellings might be hot, painful and doughy at first, and later become cold and painless. Respiratory difficulty, weakening of hind quarters may also be noted. In the gastro intestinal form, Colicy pain,

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bloody diarrhoea, occasional bleeding from mouth are observed. Animal becomes extremely weak and dies within 2 to 24 hours.

Treatment and control: Terramycin and Penicillin can be tried if detected early. As a preventive measure, it is advisable that all elephants should be vaccinated with Anthrax Spore vaccine at least once a year. The vaccine is to be given S/c in the caudal flap at the following doses:-

Elephants above 8' in height	:	3 ml.
7'.0" - 8" height	:	2.5 ml.
6'.0" - 7'.0" height	:	2.0 ml.
5'.0" to 6'.0"height	:	1.5 ml.
Less than 5'	:	1.0 ml.

Calves below 6 months of age, debilitated elephants, and cow elephants in advanced state of pregnancy should not be vaccinated.

Haemorrhagic Septicaemia:- It has been reported that Haemorrhagic Septicaemia was much more common in elephants than it was imagined and many cases were mistaken for Anthrax. Whenever there is an outbreak of this disease among cattle the elephants are likely to get infected if in close contact with the diseased cattle. Even biting insects are likely to transmit the disease. The duration of the disease, which varies from 3 to 36 hours is charaterised by symptoms such as high temperature, pneumonia, oedema of throat and brisket region, patchy swellings all over the body, and death may take place due to convulsions or asphyxiation.

Diagnosis is by microscopical examination of the blood at the height of temperature caused by Pasturella multocida bipolar organism.

Treatment: Sulpham zathinc 200 - 250 Gms. orally will be useful. In addition, administration of 33 1/3% soln. of the above drug either S/c or 1/V will have good results. But care should be taken in parenteyal administration of Sulfa drugs, as many elephants show allergic reaction.

Preventive vaccination using oil Adjuant vaccine 5-10 ml. gives certain amount of protection against Haemorrhagic Sapticaemia.

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Tetanus: Elephants are reported to be very susceptible to tetanus infection. Animals suffering from wounds, cracks on feet if unattended are liable to get the infection. The symptoms are partial lock jaw, dribbling of saliva, stiff gait, a paroxysm or jerky movement running over the entire body, leading to paralysis and death.

Massive doses of Antitetanus Scrum (1.5 to 2.0 lakh units) at frequent intervals sustaining the condition of the animal, by feeding with fluids through tulas may help treating cases of tetanus, if detected early.

As prophylaxis elephants may be given 10,000 to 15,000 units of A.T.Serum S/c. All injuries must be treated properly and kept free from infection.

Tuberculosis: A few cases of Tuberculosis have been reported from domesticated elephants. It is seen that in elephants human type of Mycobacterium tuberculosis is generally found. The disease in insiduous and develops slowly and afterwards runs a protracted course. Many times symptoms are not easily observable. The symptoms when observed might be when the animal is in advanced stage, which normally are unthriftiness, lassitude, slowness of gait, palpitation etc.

Since the disease, in most cases, is of human origin, sufficient care may be exercised in checking the health of the mahouts. When in a group of elephants, when one animal is suspected of the infection it is advisable to conduct Tuberculin test for all the animals.

Protracted course of treatment, rest, and change to a new habitat is necessary. Animals maintained in Zoos are more prone to infection than the forest elephants.

Salmonellosis: In elephant calves, particularly in those orphaned calves which are artificially fed, salmonellosis is attributed as one of the major causes of mortality.

Salmonella javiana, S.butanum, S.Welter-vrden, S.typhimurium, S. dublin etc. are reported to be causative organisms.

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Affected animals show severe diarrhorea and severe weakness, prostration with dehydration. The death is due to enterotoxaemia, and dehydration.

Nitrofurazins, Neomycin, Ampicillin are reported to be useful for treating cases with supportive thorapy with stimulants and fluids to overcome dehydration.

Rabies: Cases of Rabies due to bite of rabid dogs, jackals etc. or contact of saliva with wounds on the body may occur in elephants. In many cases the history of exposure is not known. In wild dogs, jackals the disease runs in an epidemic form, and packs of such affected animals may invade camps and cause infection in more than one animal.

After the onset of the disease, the elephant becomes restless, off feed, and may lie down and get up frequently and make peculiar noises due to partial paralysis of throat. Paraplegia with progressive convulsion is observed in advanced stage with profuse salivation. Death is due to exhaustion.

If it is observed that an elephant has been bitten by a dog, it is advisable to immediately commence giving one course of Antirabic Vaccine 60.70 ml. S/c. for 14 days.

Pox: Number of cases of Pox has been reported from both Asian and African elephants. The causal organism was identified as vaccinia virus. Initial symptoms are pyrexia, increased salivation, and difficulty in mastication and swallowing. Oedema of head or neck occasionally seen. Later ulceration of the buccal mucosa and the inner lining of trunk develop. Secondary complications may develop due to bacterial infection which, if unattended may lead to death. Mortality is nomrally rare. Exungulation of all the four limbs is also reported in severe cases.

It is suggested that persons recently vaccinated against Small Pox should not be allowed near elephants until the post vaccinal reactions subside.

Foot and Mouth Disease: It is a matter of controversy whether elephants are susceptible to Foot and Mouth infection.

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In several outbreaks of Foot and Mouth disease seen in and around Mudumalai Sanctuary, and several other cases, none of the departmental elephants showed symptoms of the infection nor was it observed among wild elephants.

It is reported that Asian elephants are more susceptible to Foot and Mouth Disease caused by Type 'O' virus.

Surra: Surra is a wasting disease, running a chronic course, among elephants characterised by intermittant, remittant and sometimes relapsing fever continuing for various periods. The disease is caused by a protozoan organisms "Trypanosoma evansi"and "T.elephanti", and transmitted by biting flies. The affected animals look dull, listless, and drowsy, and sluggish in their movement. Mucous membranes pale Oedematous swellings appear on throat, brisket, and abdomen. There is progressive emaciation. Sometimes there may be corneal opacity, and nervous symptoms.

Identification of causative agent from blood smear aids proper diagnosis.

Treatment and control: The following drugs can be tried.

Antricide Methyl salt : 10% Soln - 20-25 ml. S/c.

Naganol (Bayers) 30 gms in 150 ml. distilled water by given I/V route slowly and repeat half the dose 7-10 dayslater.

The eradication of the disease is by controlling vector population which is difficult in forest areas. Infected animals even after recovery may act as carriers.

Prophylatic treatment consists of giving Antricide Prosalt 5-7 gms. in 30 ml. distilled water S/c. whenever there is a threat of infection.

Babesiosis: Incidence of Babesiosis is reported to be very rare among elephants. The symptoms reported are anorexia, constipation, dark coloured urine, yellowish coloured mucous membrane, dullness, and weakness.

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Blood Smear of effected animal will reveal piriform type of Babesia organisms in erythrocytes.

Berenil or Babesan are drugs of choice for treating the condition.

Gastro intestinal Helminthiasis: Diseases caused by helminths found in the gastro intestinal tract are found to be more common, and serious in domesticated and wild elephants.

Different species of helminths including some species of filarid worms have been recorded from elephants in the Southern region of our country:

Some of the worms recorded from elephants are:

Flukes ... Pfendarius papillatus, Fasciola jacksoni and Bivitellobilharzia nairi

Tape worms : Anoplocephala manubriata.

Round worms: Murshidia indica, M.falcifera
Quilonia travencra, Q.rennie
Amira pileata, Bathostomum Sangeri
Grammocephalus varedatus, G.clathratus
Bromo cephalus elephanti, Parbronema indica; P.Smithi
Indo filaria pattabiramani, I.elephantis.

The hook worms Bathostomum, Grammocephalus, etc. and the liver fluke Fasciola jacksoni, and the blood fluke Bivitellobilharzia are highly pathogenic and cause severe anaemia, and cirrhosis of the liver.

Important symptoms of helminthiasis are unthriftiness, anoerexia, pica, foetid diarrhoea, oedema of dependant parts paleness or yellowish mucous membrane, yellowish green urine, slight colicy pains before the onset of diarrhoea with occasional cramps in the abdomen and limbs. In severe cases of diarrhoea the animal may die due to dehydration and hypoprotaemia.

The disease can be diagnosed by examining the dung, and detecting eggs or miracidia.

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The following are some of the drugs found to be effective against gestro intestinal parasites.

Against Strongylosis:

1. Tetramisole Hydrochloride (Nilverm)
   3 to 5 mgms / kg body weight - orally
2. Morantel Tartrate (Banminth II)
   2 - 4 mgsm / 1 kg. body weight - orally
3. Parbendazole (Heletac)
   6 - 10 mgms / 1 kg. body weight - orally
4. Thiabendazole - 20 - 30 mgms / kg. body weight - orally.
5. Thiophenate (Nemafax)
   14 mgms / 1 kg. body weight - orally
6. Oxibendazole
   2.5 mgms / kg. body weight - orally
7. Promintic (Methyridine)
   40 mgm / 1 kg. body weight - S/c.
   diluted with equal volume of distilled water
8. Mebendazole - 5 mgms / 1 kg. body weight
9. Phenothiazine -
   80 - 120 gms per animal according to size to be given in 4 divided dose for 4 days.

Against Liver fluke:

Nitroxynil - 10 mgms /kg body weight S/c.

Against Bilharziasis.

Antimosan - 200 ml/animal S/c. route.
(Six injections at weekly intervals)

Against cestodiasis.

Oxyclozanide (Zanil)
3.4 mg/ 1kg body weight - orally.

Adequate and proper measures to be taken for disposal of dung and other infective material by burning to avoid contamination of feed and drinking water by infective larvae or miracidiae, for controlling helminthiasis. Survey of snail populations may also give an idea of type of infection as snails are the intermediary hosts, particularly for flukes.

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Cutaneous filariasis: Quite a number of elephants suffer from cutaneous haemorrhagic nodules, in the body - most commonly on the sides, abdominal region and outer parts of the thighs. They are caused by "Indofilaria pattabiramanii and I.elephantis. An ulcerative dermatitis caused by stephano filaria Srivatsavi has also been reported. The nodules are normally about 1-2 cm. in thickness. A day or two later the nodule slightly bulges and then ruptures and blood oozes out in droplets for 5 -10 minutes and then stops. Fresh nodules are soft and older ones are fibrosed and hard and some of them persist for a long period. Others get absorbed leaving a white spot. The bleeding normally occurs in the day time. The affected animals are always worried by mosquitos and biting flies.

Though no system i.e. disturbance is caused, the animal has intense pruritus and constantly rubs its body against hard rough surfaces. If a drop of blood oozing out of the nodule is examined under microscope, microfilaria can be seen.

Treatment: Arsenical preparations such as Acetyl Arsan 30.40 ml. S/c. 4-5 injns. on alternate days.

Anthiomaline 30.50 ml. S/c - 6-10 injections are required.

Though the treatment is effective, chances of reinfection is always there in the forest based elephants since it is difficult to control vectors.

Other non infectious Diseases.

DROPSY:

It is a symptom wherein there is an accumulation of fluid in the dependant parts either in the submaxillary space, brisket region or abdomen. It may be either of ascending type or desending type.

Dropsy might be due to various factors. It might be of traumatic origin when an elephant is made to use the tusks frequently for pushing heavy loads; It might be due to congestive heart failure which is found in many over worked elephants; or it might be due to anaemic condition or heavy worm burden. In young animals it might be due Cirrhosis.

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Frequent occurrence of Dropsy in an elephant is a serious symptom and needs continuous treatment and prolonged rest. Depending upon the condition treatment is to be given which may consist of administration of Diuretics, Cardiac, Stimulants etc. In all cases of dropsy, it is advisable to deworm the animal, later followed by symptomatic treatment.

An elephant which is prone to frequent occurrence of Dropsy should not be used for logging work, and should be given only light work.

Impaction of Colon: During the dry season, when fodder is coarse and fibrous and animal does not get adequate water may develop impaction or stasis of food material either in small intestines or caecum or colon.

The ailing animal becomes restless and may exhibit colicy pains as a result of constipation and distended abdomen. Sometimes it may lead to intussusception, or voluvulus, [illegible] impaction ulceration of intestines, or a malignant growth, or due to irregular peristalsis. If the rectum is examined by hand it is often empty or balooned. The animal may refuse water and food. In advanced conditions, the animal may become worse, with feeble pulse, and subnormal temperature. Vomition is noticed in certain cases which is a very grave sign.

Proper and safe recovery mainly depends upon correct early diagnosis and proper selection of drugs. Calcium Panto thenate (20-60 ml. 1/M); Pituitrin (20-40 ml. 1/M); Novalgin or Baralgan (30-60 ml 1/M or 1/V); calboral (1000-1500 ml.1/V) Carbachol 5-10 ml.etc. are some of the drugs recommended.

Enema with paraffin or glycerin may give good results. Drastic purgatives should be avoided. It is difficult to administer medicines orally. Administration of 3-10 L. of Dextrose Saline is very useful to counteract dehydration and extreme weakness. If the impacted bolus is found large manual extraction from the rectum will give speedy recovery.

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Heat Stroke:- Elephants, when put to hard work continuously on hot days or when they are put to trying marches on hot days, may suffer from exhaustion and sometimes Heat Stroke. Animals so affected may develop muscular tremors, hyperthermia, and staggering gait and may even fall down and be in a comatosed condition.

It should be the endeavour of those in charge of elephants to avoid working them during the hottest part of the day, and to carry out marches during nights or early in the morning.

When an elephant collapses while at work, the gear, the felters should be quickly removed. The animal should be douched with cold water liberally over head, body, neck and spine. Shade against direct sunlight should be provided. Repeated cold water enema should be given. Efforts may be made to make the animal drink water. Salt may be rubbed on the tongue.

Injections of stimulants like strychnine, Hydrochloride or caffeine citrate may be given. Injection of Largactil may help control excitement.

Cases of heat stroke, if not attended to promptly may lead to paralysis or death.

Mud Sores or Foot Rot:- This is a common condition met with in elephants in captivity, when they are constantly tethered in one place in earth soaked in their own excreta. Elephants, which are being worked constantly in slushy, or marshy areas, and elephants which have soft pad are prone to this condition.

At first, the ulceration of the space between nails laterextending to foot pad results. Sometimes the whole foot pad gets shed exposing the sensitive laminae. The animal will have difficulty in walking normally. Recurrence of the condition is common in many animals.

In such cases, it is better to shift the animal to drier place. Antiseptic foot baths followed by dressing with Triple Sulph Powder, Eusol, or Pix liquida dressing with Supportive therapy to keep up the general condition

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of the animal. Use of antibiotics is also indicated.

Animals, prone to foot rot should never be worked in slushy areas.

Opacity of Cornea:- Apart from the usual causes, beating the animal by the mahout over the facial region is also a very common cause for the development of opacity. In certain cases ulceration may also be present.

Apart from routine remedies such as golden ointment, Cortisone eye ointment etc. Mastalone intramammary, and Bells' resolvent are agents have given good results. Placental extract (Injection) has been reported to be very good.

'Bots'infection:- In many of the forest area, the Bot flies (Cobbadia elephanti) hover around the face and feet of the elephants, and deposit their eggs at the insertion of the tusks or around the feet. The hatched out larvae burrow through the skin, and are found in the upper respiratory passages, and stomach. They cause intense irritation. The elephants may frequently sneeze out the larvae or pass them in dung. The presence of large number of larvae in the stomach may lead to gastritis.

Treatment for Oestrid infestation is not very effective. Preventive measures can be adopted by applying fly repellant oil(Dikkamali oil) every day immediately after bath at the insertion of tusks and around the nails in all the legs.

In addition, many surgical conditions are met with viz. wounds, abscesses, saddle and hobble galls, bullet wounds, punctured wounds, Arthritis, etc.

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ELEPHANTS SEEN BY P.C. BARUA(LALJI)

Fundi's Union

ASSAM		Bengal			Remarks
SIKAR					
Mela	Khedda	Mela	Khedda	Total	Starting from 1937-1981.
403	175+	227	144*	1024	*Govt.khedda Buxa Division with P.C. Barua's men + Kunki Sonepur,Sitamarhi, Khaora,Sideswar, Buddeli.
	75				
Seen elephants in Melas.					
Pre-Indenendence		1794			
From 1947 to 1982		5540		7334	
Domesticated	51	42		93	
Forest Department	Assam	Bengal			
Cooch Behar State	39			35	
Bhutan	15			15	
Mymensingh	20				
Kalinur	25			45	
Muktagacha	15			15	
Gauripur					
Assam	60			60	
Bijni	20			20	
Bagriber	15			27	
Rupshi	12				
Bilashinara	5			9	
Sidli	4				
Lakhipur	35			35	
Public Assam	289	+ Assam Zoo	African 2 India n 5	296	
Public Bengal	41			41	
Wild elephants seen during Mela and and Khedda					
Assam				900	
Bengal				160	
			Total:	10,111	

nts" of an Indian elephant as a guide to recogn
of individual animals in the field.

by
D.K.Lahiri Choudhury
&
P.C.Barua

SUMMARY

The importance of recognizing individual elephants in the field is widely accepted. Douglas-Hamilton in Africa and McKay in Sri Lanka tried identifying elephants by their "unique" features. McKay also tried sexing by the size and structure of the head and the back.

This paper suggests that Asian elephants may be more easily identified by a combination of "typical" features, as recognized by the traditional "points" evaluation system of an Indian elephant. These can be used for identification alongside such "unique" features as torn ears, recognizable physical deformities, measurements of footprints etc.

According to this "points" system, tusks are classified into "types" according to their angle to the ground, plane, parallelness, thickness, and number. Tails are classified into 8 types, according to length, nature of the brush etc; the back-curve into 9 typical shapes; and the body-structure(bāndh)into 8 typical forms

It is suggested that a tally of three points of identification, one point taken from each group - tusks, tail, back-curve, and body-structure - will identify a particular animal with near-conclusiveness. Additionally, easily recognizable "unique" features may also be taken into consideration.

In India this system has the added advantage of being familiar to most mahouts . Burma and Sri Lanka have equally elaborate "points" systems which could be useful there.

For distinguishing mākhās (tuskless males) from females. McKay's criteria of head and body-structure may not always be reliable indicators. The other sign, the penis sheath, is not easily observable. The root of the penis making a convex curve between the hind legs of even a very young male, as different from the hollow, concave curve between the hind legs of a female seems to be a better and a more useful indicator in the field.

INTRODUCTION & REVIEW OF PAST WORK

The importance of recognizing individual elephants in the field has been widely accepted. Even in the course of their routine work, the forest departments in India are obliged to publish the identifying features of a rogue when ordering its destruction.

The first systematic attempt at recognizing individual elephants was, perhaps, made by Iain Douglas-Hamilton in Africa during 1965-70 (Douglas-Hamilton, 1975, Ch. 3). Douglas-Hamilton developed his system by recording " unique ear and tusk patterns of each elephant" in his study area (emphasis added).

For ears, apart from large tears, his most reliable guide was patterns of minute holes in the ear-flap which, however, could be seen clearly only when the ears were spread out in a threat-gesture against a background of sky : by no means a healthy way of identifying individual traits in an elephant; healthy for the observer, that is. Even if one ignored the safety factor, this would hardly be possible with Asian elephants, observed mostly in dense cover. Moreover, Asian elephants do not seem to have these minute holes in their ear-flaps. The principle here, even when marking different tusk shapes, is one of identifying each animal by its "unique" marks.

The same principle of identification by "unique features" was followed by McKay (1973) when studying Asian elephants in Sri Lanka from 1967 to 1969. McKay's diagnostic criteria were : "shape of ear, shape and even presence of hair on the tail, pattern of depigmentation around the trunk base, face, ears and shoulders, folding of the ears, and the presence of tears or holes in the ears." Further, he also noted patterns of cysts on the skin. However, by examining carcasses of dead elephants he discovered that these cysts or large bumps on the skin were actually encysted bullets or pellets from shot-guns. The pattern of these cysts were, therefore, liable to change with fresh injury, and were therefore not a reliable guide.

For determination of sex, a most tricky problem with Asian elephants with a large number of tuskless males (makhnas) in a

pulation. McKay's indicators for sex determination were: (a) penis sheath of the male; (b) vulva of the female; (c) genitalia, readily visible during urination (only reliable indicator, according to McKay, with very young animals); (d) general conformation of the body in adult animals, the adult males (*makhnas* in Sri Lanka) usually having a massive trunk base protruding as a bulge below and infront of the eyes, a second swelling around the narial opening in the skull above the eye, enlarged parietals and occipetals. Females, according to McKay, have a narrower trunk, generally lack the prominent bulge over the eyes and the swelling of the parietals. The head of the female is, thus, more square and relatively more slender in the outline.

Further, McKay observed a sex difference in the shape of the back, the female being generally more box-shaped with a relatively straight back and vertical hindquarters, and the male tending to have a more convex back, curving more gradually into the hindquarters.

McKay's chief criteria for sex determination were tumescence of the mammae in subadult females, enlargement of the head and a distinct penis sheath in the adult male, and the square back in the adult female.

ARGUMENT

This paper suggests that for Asian elephants counting minute holes in the ear-flap (*vide* Douglas-Hamilton, 1975) would be impractical even if they existed. Large tears in the ear are acceptable diagnostic features, as also shape of tail and presence or absence of tail hair (McKay, 1973). Patterns of depigmentation are of little use in the field (McKay, *op. cit.*), unless one is lucky enough to see them immediately after a bath, as McKay did at Lahugulle tank.

As an alternative to this attempt at identifying individual elephants by their "unique" features, it is suggested that Asian elephants may be more easily identified by their "typical" features; or, more precisely, a combination of typical features present in a single animal. For this the traditional system of "points" evaluation of Indian elephants can be a valuable tool, taken in conjunction with such easily identifiable

"unique" features as a large tear in the ear-flap or any other conspicuous physical deformity.

OBSERVATION

SOME ASPECTS OF THE INDIAN "POINTS" SYSTEM:

I. TUSKS : According to the system prevalent in North and North-East India, tusks are classified as follows:

A. According to angle with the ground:

1. Chākuṛā (very short &thick; sometimes without recurving)

2. Pālang (sufficiently recurved to be able to carry a pālang or a seat on them)

3. Surat ("beautiful"; sloping towards the ground, slightly recurved)

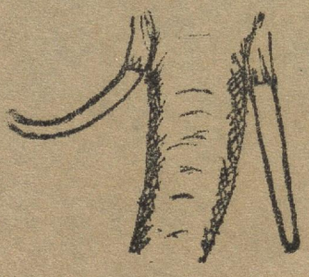
4. Mātikhorā or Pātālpurīā ("earth-digger"; going straight down towards the ground)

5. Mulā-dāntā ("raddish-toothed"; short, thin, straightish tusks of no particular distinction)

B. According to plane :

1. Tāl betāl ("unbalanced"; left or right tusk higher than the other)

2. Ākāsh pātāl ("heaven& hell"; an extreme form tāl betāl; one tusk recurving towards the sky, the other going towards the ground)



Sketch by Karta

C. According to parallelness:

1. Parallel

2. Chips (convergent)

3. Ferka (divergent)

D. According to thickness:

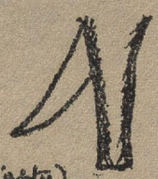
1. Surat or Bhaluka danta (Assam) (Thick and massive like a bhaluka bamboo)

2. Nal-danta (thin tusks, like a tube or "nal")

E. According to number :

1. Ganesh (having only the right tusk, like Ganesh, the elephant-headed Hindu deity)

2. Ekdanta : Having only the left tusk. (Popularly called "Baya Ganesh" (Left) and "Daina Ganesh" (right).



II. Tails are classified as follows:

A. According to length:

1. Pankhi dum ("bird-tail"; short, upto the "knee")

2. Sher dum (tiger-tail; longish, upto "ankle")

3. Jharu dum (brown-tailed - touching the ground)

B. Cut-tail:

1. Bānda or Khārā ("cut-tail")

SKETCHED BY
N. Kanta.

C. According to brush[1] :

1. Bāl Khandi (without tail-hair : usually due to louse; may recover)

2. Full-brush

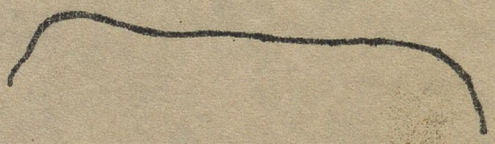
3. "Fish-tail"

4. "Half-fish" or "fin" brush

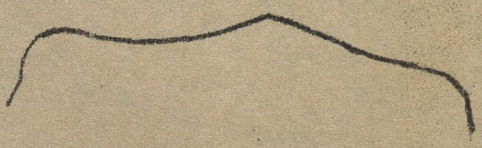
III. Backs are classified according to profile[2] :

1. Dhanu bhānj (bow-backed)

2. Sambal pith (straight-back)



3. "Low-peaked"



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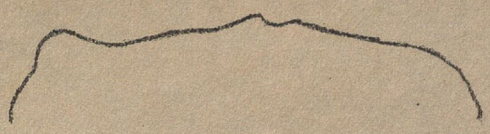
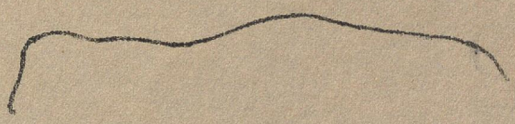
(1) For tails, C, 2, 3, 4 above are the present first author's additions to the traditional classifications.

(2) The Indian traditional system has only two classifications, as represented by III, 1 & 2 above. The Burmese system is much more elaborate (Evans, 1910). The present system has been developed by the first author from the Burmese system with a view to achieving a more detailed and accurate field identification.

4. "Low, broken-peaked"



5. "Medium-peaked"

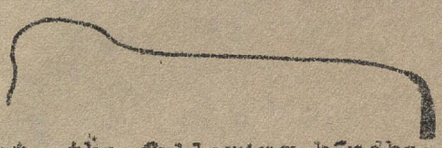


6. "Medium broken-peaked"

7. "High-peaked"

8. Sloping back

9. Square back



IV. Body-structures are classified into the following bāndhs:

1. Koomrāh, or kumeriāh or koomirāh bāndh :
Huge, compact, rounded body-barrel; thick limbs; sloping back ; short hind-legs ; massive head ; most common in Tripura and Cachar, but also found elsewhere.

2. Mirgā bāndh : (Mirgā from Sanskrit mriga (deer)):
Light, flattened body-barrel; light, thin limbs; long legs, small head.

3. Dohār bāndh : Mixture of Koomrāh and Mirgā (Doshālā of Sanderson, 1878). Usually longer, less compact body-barrel than in a Koomrāh; longer legs, particularly hind-legs; large head like a Koomrāh; bone-structure heavier than in a true Mirgā.

4. Bar-mirgā bāndh ("Big deer"): Tall and leggy, but of massive build, and thick bone-structure. Ten-footer Indian elephants are usually of this type; most common in the sub-Himalayan tract.

5. Ekhārā bāndh (lanky, or "weedy" as Milroy (1922) calls them) :Leggy like a bar-mirgā , but of much lighter, emaciated build.

SOME OBSERVATIONS ON THE USE OF TIGER SCENT (URINE) AND TIGER CALLS AS REPELLENTS TO ELEPHANTS

BY

M.K. CHOWDHURY*AND I. ROY†

Drastic shrinkage of habitat and extension of human habitation and cultivation cutting through the seasonal migration routes have placed the elephant population in the sub-montane Duars and Terai zones in a none too happy position. Tongues of cropland extending right upto the forest boundaries tease them constantly and frequently the elephants are tempted enough to move out of shelter and raid the lush paddy and maize fields. Being wasteful feeders, the elephants lay waste a far bigger area of croplands than that they actually consume. In the process, hutments may also get damaged and human lives lost. The problem of man-elephant confrontation has become so acute over the recent past that special efforts like setting up of mobile squads to intercept elephants as they come out of the forests into the cultivation and to drive them back into the forests by bursting crackers, etc. and departmental anchor mela-type operation (without capture), in which trained kunkis are employed to chase the elephants back into the forests, had to be mounted. While both these measures have been extremely useful in tackling the problem, considering the very long stretch of boundary that separates the forests and the cultivations and the frequent scattering of the herd into different groups throughout the belt, adoption of these measures over the entire area is not feasible. Moreover, the elephants are becoming increasingly habituated to traditional scare tactics like cracker burst, light, fire and shouts and the more determined ones among them often charge. It was as such considered necessary to evolve newer techniques for anti

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elephant-depredation works. Erection of fence barrier with electrically charged wires has been planned. Experimentation with some forms of natural repellents that can be used either separately or in combination with other physical barriers has also been taken up. In choosing the repellents the antagonistic relationship, often noticeable between the elephants and the tiger, was kept in mind. Elephants with calves normally fight shy of tiger and incidents of tiger depredation on straying calves, though rare, occur. Since elephants are endowed with a keen sense of smell and have acute hearing, an experiment to test elephant reflex on exposure to tiger scent (urine) and tiger calls was undertaken. Use of tiger scent (urine and scats) as a scare device against monkeys, cattle, damaging crops, is in practice amongst some cultivators of Darjeeling, who collect these from the Darjeeling Zoo.

Materials and methods

Urine of tiger was collected from pits outside the cage housing the Ussuri tigers, Panthera tigris longipilis at the Padmaja Naidu Zoological Garden, Darjeeling. The urine trickles down through a drain and collects into pits. The pits, being in the open, there is a high dilution of the urine by rain water. The urine was collected in jerry cans and transported to the test site. To record tiger calls, the cats were provoked to emit short series of growls and snarls, which were recorded in an ordinary cassette for about three minutes. The tests were carried out on departmental elephants. The number of animals involved in each test has been shown in the respective Tables.

For the purpose of testing the reflex of elephants to different stimuli emanating from tiger, three tests involving (i) tiger urine, (ii) tiger urine and tiger calls and (iii) tiger calls, were carried out. For the purpose of conveying the urine scent, i.e. test (i), two pieces of rags about 90cm.x60cm.

were soaked in tiger urine and hung on a piece of string at about 1m. from the ground level, the string tied to trees at both the ends. The elephants stood at a spot about 150m.-200m. away from the place, where the urine-soaked rags were hung and made to approach the place at a slow amble mostly upwind. In all, twentynine elephants were tested on different dates and their reflex on scenting the urine was noted and classified into 'defensive' and 'not defensive'. An animal was reckoned 'defensive' if it tried to shy away on scenting the urine with tell-tale defensive gestures like inward curling of trunk, snorting and turning tail or backing away from the source of the stimulus. All other reflexes or the lack of it were classified as 'not defensive'. The observations have been tabulated in Table-I below.

Table-I

Test item-I

Stimulus - Tiger scent (urine)

Elephants tested (1)	Not defensive (2)	Defensive (3)	Total (4)
Adult ♂	2	4	6
Adult ♀	2	9	11
Sub-adult ♂♀	2	5	7
Calves (weaned) ♂♀	3	2	5
	9	20	29

For test (ii), an amplifier was kept concealed in a bush near which the urine-soaked rags were also hung. The amplifier was connected with a cassette-player, which the operator, concealed on a machan, switched on as the elephants approached within 6-8 meters of the spot, at a signal from the observer. The reflexes of the elephants were observed and classified into 'defensive' and 'not defensive' and

tabulated in Table-II below.

Table-II

Test item-II

Stimuli - Tiger scent (urine) and tiger call

Elephants tested (1)	Not defensive (2)	Defensive (3)	Total (4)
Adult ♂	-	5	5
Adult ♀	1	4	5
Sub-adult ♂♀	-	3	3
	1	12	13

Thirteen elephants were involved in this test.

In test (iii), only the tiger call was involved and thirteen animals were tested. The reflex of elephants to this stimulus has been shown in Table-III below.

Table-III

Test item-III

Stimulus - Tiger call

Elephants tested (1)	Not defensive (2)	Defensive (3)	Total (4)
Adult ♂	3	2	5
Adult ♀	2	3	5
Sub-adult ♂♀	-	3	3
	5	8	13

The test sequence was 3, 1, 2.

Results and discussion

Data of responses by elephants to different stimuli treatments like tiger scent (urine), tiger scent (urine) and calls, and tiger calls as detailed in Tables I to III were analysed.

Test item (1)	Defensive (2)	Not defensive (3)	Total (4)	Proportion of defensive to total (5)
1	20	9	29	0.69
2	12	1	13	0.92
3	8	5	13	0.62

In testing the significance or otherwise of the proportions from three different test items it was assumed that there was no difference between the 'defensive' and 'not defensive' proportions in all the test items. Under the said hypothesis, the test criteria were computed for individual test item by applying the following formula :-

$$\tau = \frac{p_1 - p_2}{\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}}}$$

Where, p_1 and p_2 are the ratios of defensive reactions for comparable test items and q_1 and q_2 are the ratios of respective 'not defensive' to total and n_1 and n_2 are the total number of observations in each test. τ is the test criterion.

Test item 1 $\tau = \frac{.19}{\sqrt{\frac{.69 \times 31}{29} + \frac{.5 \times .5}{29}}} = 1.50$

Test item 2 $\tau = \frac{.42}{\sqrt{\frac{.92 \times .08}{13} + \frac{.5 \times .5}{13}}} = 2.7$

Test item 3 $\tau = \frac{.12}{\sqrt{\frac{.62 \times .38}{13} + \frac{.5 \times .5}{13}}} = .62$

The table value of normal deviate at .05 level of significance being 2, only test item 2 turns out to be significant at .05 level. This would indicate that exposure

to joint stimuli of tiger scent and call brings out significant defensive reflexes in elephants than either the scent or the call individually, and as such test II can be reckoned as a decisive one.

It appears that the elephants are more concerned and react defensively when they are confronted with both the tiger scent and call simultaneously and less so when only the urine is scented or only the tiger calls are played to them. Elephants sometimes follow definite routes while coming out of the forests at night and raiding crop fields, tea garden labour lines and villages. The routes could be guarded by hanging tiger urine-soaked rags on strings across them and amplifying tiger calls from tape recorders from hides built for the purpose whenever a herd or group is seen or heard approaching. This scare device may be used in areas which can not be covered by the anti elephant-depredation squads or the departmental anchor mela-type operations using kunkis.

The authors, however, accept the obvious limitations of the tests conducted and reported. The elephants used for the test purpose were all domesticated animals having their drivers on them for most of the time. Even though the drivers were instructed to sit passively on their mounts as they approach the test sites, some human influence on the behaviour of elephants during the tests can not be altogether ruled out. Nevertheless as test II has been able to evoke an overwhelmingly defensive reactions from the test animals, the authors would recommend its trial as an anti elephant-depredation method in North Bengal.

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SUMMARY

Depredations by wild elephants often cause heavy loss to crops, properties and sometimes human lives in North Bengal. Various control measures like mobile squads, departmental anchor-type mela operations employing trained elephants (kunkis) to drive the wild elephant back into the forests have been undertaken and experimentation with fence barrier is under way. Testing the efficacy of tiger scent and call in repelling elephants was also considered necessary to supplement control measures. This paper reports the results of observations of the various tests carried out with tiger scent and call.

Sr. No.	Age	Wt.	No. of shots & time		Dose mg/ Dose mg/ton	Remarks
1.	40yr	4.75	1	9.00 a.m.	X .84.00 A10.5	Premedication by baiting with Halpoeridol 53 mg/T. Chlumpromazin 1.263 mg/t and Triperidel 6.3 mg/ton sedation was not satisfactory. There was mahout on the animal who was not allowed to climb down.
2.	40yr	4.00	1	4.25 p.m.	X 100 A 17.5	Sedation satisfactory. In the first shot syringe charge was not exploded.
3.	40yr	4.75	1	4.20 p.m.	X 105, A55	Satisfactory sedation - operation completed with command words,
4.	33yr	3.5	1	5.20 p.m.	X 143, A74	1st shot did not explode properly and 2nd shot given sedation satisfactory.
5.	15yr	2.5	1	3.40 p.m.	X 100 A 48	Crowd approached making noise during the initial period of sedation made the animal to run for 3km. then lied down under sedation.
6.	30yr	3.5	1	4.00 p.m.	X 100	1st shot did not explode satisfactorily. Sedation satisfactory.
7.	40yr	4.75	1	12.40 noon	X 105 A 34	1st shot did not give a satisfactory sedation and hence a 2nd shot was given after 2 hrs. which gave deep sedation. There was a mahout on the elephant who was not allowed to climb down. Doxparam was given 67mg/ton. Cold shower and cracker were used for arosual with little success.
			2	1.43 p.m.	X 105 A 34	
8.	35yr	3.25	1	6.30 p.m.	X 107 A 43	1st shot did not produce enough sedation and hence a 2nd shot after 2 hrs. which gave deep sedation.
			2	8.20 p.m.	X 92 A 25	
9.	40yr	4.75	1	11.50 a.m.	X 105 A 67	Sedation good. But handling was possible only with command works.
10.	17yr	3.00	1	9.45 a.m.	X 117 A 53	1st shot was not enough and 2nd shot after 1hr.was given. No mahouts were available. Sedation satisfactory after 2nd shot.
			2	11.30 a.m.	X 100 A 27	
11.	35yr	S	1	10.00	X 100 A 40 X 80 A 32	Sedation was not satisfactory.with 1st shot and hence 2nd shot after the 45 minuts. Still it took another 45 minuts to handle the animal.
12.	35yr	S	1	11.00	X 100 A 40	Animal could be approached only after 1½ hrs.

X - XYLAZINE
A - ACEPRAMAZINE

IMMOBILIZATION OF INDIAN ELEPHANTS WITH XYLAZINE AND ACEPROMAZINE

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In Kerala a large number of tamed elephants are used for various purposes like timber hauling and in ceromonial and festival occasions. Most of these animals are tuskers and they may bolt causing damage to life and property. These aggressive and uncontrollable conditions is oftem caused by musth or ill treatment by the mahout. Authors had successfully immobilized more than 15 animals using Nocotine alkaloid. However the narraw margin of safety made the authors to try a Central Nervous System depressant in conditions where the latent period of setting the action could be longer and a combination of of Xylazine with Acepromazine was used.

Xylazine in solution (100mg/ml) as well as dry power was used along with acepromazine injectable solution (20mg/ml). The Xylazine was given in a dose rate of 84mg. to 143mg/ton and Acepromazine 10.5mg. to 74mg/ton depending upon the situation.

Sedative doze of Xylazine for elephants recommended is 80 - 140 mg/ton. ~~Fowler M.(1978)~~ and of Acepromazine 50 - 60mg/ton.

A combination of Xylazine with acerpromazine for immobilization had been recommeded as 100mg Xylazine x 25mg. Acerpromazine/ton. From our experience it is found that a higher dose is required for immobilization. In all the experiments the Xylazine was sparingly used while Acepromazine was liberally used due to paucity of the 1st chemical and the availability of 2nd chemical.

Xylazine acepromazine combination has been used by the authors in elephants on several other times for surgical intervention and transportation.

The animals were shoot on foot using Palmer's extra long range projector.

1. Minimum of 100mg. Xylazine/ton and Acepromazine 40 - 50mg/ton is required for immobilization.
2. From immobilization as well as from other experience from using these drugs, it is noticed that animals after injection if exposed to direct sunlight (in animals where injection were given in the morning) leison suggestive of photosensitization may develop. This is more suggestive with Acepromazine.
3. Irreversible penis relaxation was noticed neither in the immobilized animals nor in other animals in which these drugs were used for surgical proposes. But however penis remained relaxed for more than 24 hours in certain cases.
4. One animal showed hyperthermia and discomfort and delirium like symptom when exposed to sunlight for few hours which was relieved by cold shower.
5. Latent period is considerably long from ½ to 1 hour for deep sedation to set in.
6. Even in deep sedation animals responded properly to familiar handling and commands (handling by mahouts) and reacted to strange handling.

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7. Aseemingly sedated animal can explosively be aroused when approached.

8. Heavly sedated animals sometimes can't be aroused although DOXAPRAM in doses of 80mg/ton may find useful.

9. In these dose schedule and ratio combination, the utility of these chemicals in wild elephants is doubtful. But this is a safe and useful combination provided immobilization is not urgently required.

10. Probably higher ratio of Xylazine may have to be used in wild elephants for a better result.

11. The result of these combination which given ANAESTHESIA and analgesia for surgical procedure retaining righting reflexes is highly useful.

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