

An overview of the methods for enumeration of wild elephants in India

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Introduction

Information on elephant range and numbers is important for the effective conservation and management of elephants in the wild. Despite their large size, counting elephants is not often task. Nevertheless, reliable estimates of elephant numbers, both within protected areas and outside, are necessary to determine whether elephants are increasing, decreasing or remaining stable in an area. In many parts of India, where competition for land is severe between man and elephant, it is important to know how large a protected area ought to be in order to support a viable population of elephants. Furthermore, many management objectives cannot be achieved in the absence of reliable information on elephant range and numbers. The following methods are presently being used for enumeration of elephants in India: (1) Total Direct Count (Northern, North-Eastern and Eastern India), (2) Line Transect with Direct Count (Southern India), (3) Line Transect with Dung Count (Southern India), (4) Block Sample-Direct Count (Southern India) and (5) Waterhole Count (Orissa and Southern India).

Total Direct Count

This method is popular with the forest officers because of its simplicity, but not liked by the scientists as it is not amenable to statistical analysis. It involves two essential steps: (a) searching and counting all the elephants in a given area, and (b) eliminating double counts through suitable precautions and scrutiny of data. Total Direct Count is usually carried out during the dry season when elephants are easy to locate around the limited water sources. In some Protected Areas, grasses are burnt during winter, which increases the visibility, and thus provides an opportunity for enumeration of wild elephants. Such total counts can provide information on the structure and composition of the population (e.g. sex classes, age classes, the number of tuskers and *maknas* or tuskless bulls). The information is usually collected in the following format: Adults (>7"), Subadults (5-7"), Juveniles (4-5"), and Calves (d"4"). Adult and subadult elephants are further classified as tuskers, *maknas*, females and unsexed.

Assam (2002)

Direct counting of wild elephants in Assam was carried out by engaging enumeration parties who traversed the forests either on foot or on domesticated elephants (called *Kunkis*). The

method relies on the experience of the forest staff and mahouts in (a) tracking and locating elephants, and (b) identifying and distinguishing individual elephants and family units from one another. During the enumeration in 2002, total elephant habitat in the State was divided into six zones which were further divided into several 'Counting Blocks' as per feasibility of the terrain, forest type, elephant density, etc. Maps were prepared for all the blocks showing details of important landmarks, boundary, vegetation etc. One counting block was assigned to one enumeration party. The enumeration was done over a period of 7 days (11-17 March in two zones, 15-21 March in one zone and 17-23 March in three zones). Advantage of the dry period was taken for enumeration as the elephants were concentrated around limited water sources and so were easy to locate.

The initial six days were used for positioning of enumeration parties and *kunkis*, preliminary reconnaissance of elephants and their signs and finalization of tracking route. Actual census was done on the last day by traversing from the opposite direction to the regular movement of the herd.

Assam (1997)

During the 1997 census in Assam, elephant habitats were divided into three strata viz., high, medium and low, depending on the density of elephant populations as a pre-census exercise. Enumeration parties covered the high and the medium density areas on *kunkis* and the low density areas on foot on a single day (9 April 1997). An attempt was made to treat the Total Count statistically. Immediately after the enumeration, 10% stratified sampling of the counting blocks was done and counting was repeated in the sample blocks on 10 April 1997. Two sets of counting data (obtained on 9 & 10 April) for the sample blocks were compared to determine the Standard Error, which was then applied to the Total Count to determine the confidence interval.

Western Assam (1979, 1980 & 1981)

The method counting elephants in the Western Assam (1979-1981) adopted by Mr. Deb Roy was inspired by the technique of *Mela Shikar*, the traditional method of capturing elephants in the north-east. *Mela Shikar* is practiced by *phandis* (professional noosers) who chase family groups of elephants on *kunkis*. These *phandis*, over a period of time, develop great expertise in tracking wild elephants and identifying family groups. During the third census (May-June 1981), Mr. Deb Roy deployed two parties — each comprising a *kunki*, a *phandi*, an enumerator and an elephant attendant. The *phandi* was to guide the party and its movement, identify the herds and count the numbers, identify the sex and categorize the animals into different age groups and dictate to the

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enumerator the details of individuals selected for identification of the herd. He was also responsible for locating fresh elephant trails along his path, follow such trails, and approach silently and finally locate the herds. Each party was to move in a general east or west-bound direction in a zigzag fashion, covering much of the area, so that no herds were left out during the exercise. The parties traversed 30-40 km every day, made night halts in the field and covered the entire census area in about 30 days. Mr. Deb Roy recommended that each herd should be given a name, but it is doubtful whether it was actually done.

North Bank of Brahmaputra (1982)

In November 1982, enumeration of elephants was carried out in the eastern part of the north bank of Brahmaputra along the lines of the tracking method suggested by Mr. Deb Roy. This was followed by a sample count on 27 December 1982 under the supervision of Mr. A.H. Choudhury. The entire census area was divided into 6 blocks (strata) on a map, which were then subdivided into 131 compartments of suitable size so that each one could possibly be covered by one enumeration party on an elephant. By using the Random Number Table, 13 compartments representing about 10% of the total census area were chosen from different blocks for sample counting. The sample compartments were then located on the ground and their boundaries demarcated. Attempts were made to cover the whole area of the compartments on 27 December following different trails of elephants. The data was statistically analyzed to calculate standard error of mean population, estimate of coefficient of variation of the total population and finally the confidence interval of the total population. Lahiri-Choudhury (1991) used the stratified ratio method of estimation to re-calculate the estimate of total population of elephants in each stratum separately and also in all the strata together.

Meghalaya (2002)

The six districts having elephant populations were divided into 38 counting zones. The exercise was carried out in two phases. Phase-I involved preparatory work and preliminary surveys. Phase-II involved training of enumeration parties, setting up watchtowers and hides at vantagepoints and actual enumeration. Counting in each zone was carried out from 22 to 31 March 2002. The data collected by the enumeration parties were scrutinized and errors were eliminated.

Northern West Bengal (2000)

The enumeration of elephants in North Bengal, done in March-April 2000 under the supervision of Mr. S.S.Bist, entailed separate counting of unattached bulls and family groups.

Registration of unattached bulls

Counting of unattached bulls was done by the field staff by registering them as to whether they were sighted within the forest or encountered outside the forest during crop raiding. Registration was done by means of a checklist which contained

such important features as tusks, shape of the back, tail, build, height etc. The forest staff filled the checklists either on the basis of their own observations or collected the relevant information from the villagers or the tea garden officials who had seen the elephant in question. Double counting of elephants was eliminated by comparing checklists of elephants from the neighbouring areas and examining other circumstantial evidence such as time and place of sighting, previous history etc. Screening of the checklists was done at the beat-level, range-level, division-level and the sector-level.

Tracking of family groups

Family groups were counted by tracking them inside forests. Special tracking parties on *kunkis* were deployed for counting elephant herds. Each tracking party had 2-6 *kunkis* at its disposal, more *kunkis* being pressed into service where vegetation was dense or chances of encountering wild elephants were good. It was found that tracking parties having two or more *kunkis* could track family groups, observe all the members of a family group and record details about the height and sex of the individual members more conveniently than a party with a single *kunki*. In fact, when one enumerator filled up the checklist of the matriarch or other typical elephants, the other recorded the height and sex of the individual members and yet another could look for the 'hidden' elephants. The enumerators could exchange notes and together collect all the requisite information. The movement of the tracking parties was so regulated that each sector was covered twice during the census period by one or two tracking parties. The tracking parties left for forests before dawn and attempted to encounter the family groups when the elephants were resting. Each party carried a portable wireless set and any information received by the local forest staff and villagers regarding wild elephants was promptly conveyed to them. 'On foot' parties were engaged for covering hilly regions, which could not be traversed on elephant back. It was felt that these arrangements were sufficient to guard against any under-counting of elephants. Over-counting of family groups was eliminated by comparing one or more of the following features: (a) description of one or more of the target animals (i.e., matriarch or other adult cows having any peculiar features) of the group recorded through checklists. (b) size of the group. (c) number of tuskers in the group and their description through checklists. (d) number of cows in the group. (e) number of juveniles and calves in the group, and (f) time and place of sighting. The exercise for detecting double counting was done by the tracking parties themselves and then verified by the supervising officers at different levels. Registration of unattached bulls and pre-census monitoring of family groups was carried out from 24 March to 7 April 2000. Actual tracking and enumeration of family groups was conducted from 0600 to 1300 hrs each day from 8-22 April 2000 with a day off for rest of the departmental elephants.

Northern West Bengal (1986, 1989 & 1992)

In northern West Bengal, total counting of elephants was done in 1986, 1989 and 1992 using the 'Rolling Count' method in which the entire census area was divided into zones and census

was done in one zone at a time moving from east to west. Suitable arrangements were made for monitoring the elephant movement across the adjoining zones to avoid double counting. As soon as enumeration was completed in a zone, some of the resources (e.g. trained elephants, compasses, etc.) were moved over to the next zone.

Orissa (2002)

In the Simlipal Tiger Reserve in Orissa, enumeration of elephants is usually carried out during the monsoon. This is based on a study that has demonstrated that with the least input of time and effort, the success rate in elephant sighting is the highest during August-September. However, during the year 2002, enumeration was done all over the State from 5-7 May. The actual enumeration was preceded by a survey to find out the beats: where elephants are either regularly seen, or elephants were seen during the last one month, or where elephants are known to visit during certain months. All such beats were selected as 'Elephant Census Units'. Each unit was assigned to an enumeration party comprising a Forest Guard and two labourers. During the three days of census, the area of a unit was searched thoroughly. Some observers were also put on watch towers set up close to waterholes and pools along the streams. Analysis of data involved the elimination of overlap in elephant sightings in a particular unit during the same day or different days, and between adjacent units.

Uttanchal (2002)

Counting was done in May 2002 before the rains when the elephants were easy to locate around the limited water sources. The elephant habitat was divided into 'Counting Units' and each unit assigned to one enumeration party. Usually a unit coincides with an administrative beat. Three copies of the map of each unit were prepared on a suitable scale for marking the location of elephants. The enumeration parties traversed the counting units on the appointed day from dawn to dusk and counted all the elephants seen. The counting was repeated second and third time after an interval of 7 days. Simple average of the three counts was calculated to get the 'Total Count'.

Uttar Pradesh (1991 & 1992)

In 1991 and 1992, in the month of May, total count of elephants was repeated three times after intervals of 3-5 days. The data for each year was subjected to statistical analysis to determine its significance (by chi-square test) and to calculate 95% confidence limits for the mean population of males, females, calves and unattached bulls as well as total mean population of elephants.

Sampling

Sampling methods have been tried in India usually when some scientific institute is involved in the enumeration of elephants. Sampling methods may involve direct sighting of elephants in which case information about the estimated range of population as well as composition in terms of age-classes and

sex can be obtained. Sampling methods based on indirect evidence may not give information other than elephant density and population range.

Sampling with Direct Count

Karnataka (2002) & Tamil Nadu (2002)

In Karnataka and Tamil Nadu sample counting was done using the Block Count method (7 & 8 May 2002) and the Waterhole Count method (8 May 2002) under the guidance of the Asian Elephant Research and Conservation Centre (AsERCC). The Block Count was carried out primarily for estimating elephant densities while the Waterhole Count was meant for ascertaining population structure. However, in the final analysis, the data from both methods were pooled together to obtain sex-ratios with larger sample size.

Block Count

Elephants were counted from sample blocks selected uniformly across the entire division. A compartment map of the division was obtained and approximately 30% of the beats demarcated on the map were randomly chosen and designated as census blocks. The sample blocks were systematically surveyed by a team of 2-3 people and all elephant sightings were recorded in the prescribed data sheet. In addition, where possible, the age and sex of all the animals seen were recorded. The mean density and range (confidence intervals) of elephant numbers was calculated statistically for each division.

Waterhole Count

Approximately 30% of perennial waterholes within each division were observed between 0800-1800 hrs by a team located on a watch tower or hide. During this period, all elephants visiting the waterhole were aged and sexed. Elephants were classified into four major age classes based on shoulder heights, viz. calf (< 1 year), juvenile (> 1-5 years), sub-adults (> 5-15 years) and adults (> 15 years). Animals were sexed based on presence or absence of tusks in the case of adults, subadults and juveniles. Care was taken to differentiate *Makenas* (tusksless bulls) from females using body characteristics and shape of genitalia. From this data, sex ratio of adult elephants in each division was computed.

Line Transect Direct Count

In Kerala, enumeration was done in all the blocks by Line Transect- Direct Count method on 9 May 2002 under the supervision of the Kerala Forest Research Institute (KFRI). In each block, a transect of about 2 km long was laid by marking trees with paint or coloured biodegradable ribbons. These transects were covered on foot and the sighting distance (r) and the sighting angle ($\hat{\epsilon}$) to the geometric centre of the herds were recorded. Ocular estimate of the sighting distance was made. The sighting angle ($\hat{\epsilon}$) was measured with the compass. The density estimates were obtained by using the program DISTANCE 4.0. A 5% truncation of the largest distance values was adopted to improve the precision of the

density estimates. The density estimates were developed after adjusting for cluster size bias. The cluster size estimation was by regressing distance function $g(x)$ on the logarithm of cluster size. As reported by the KFRI, the estimates of elephant density found by this method were not reliable in most of the regions because of the high coefficients of variation, which was due to the low number of sightings.

Sampling with Indirect Count

Line Transect-Dung Count (Tamil Nadu & Karnataka, 2002)

In all divisions, line transects were laid in the same blocks as were the case in the 'Block Count' method. In each sample block, a transect of 2 km length was laid across altitudinal gradients and perambulated once on 9 May 2002 to enumerate dung piles. On sighting dung piles from the transect, information such as, perpendicular distance of the dung pile, its status, etc. were recorded. Elephant density was obtained using the program GAJAH (Ver.1.0) by incorporating the dung perpendicular distances, total transect lengths, defecation rate and dung decay rate. A defecation rate of 16.33 calculated by Watve (1992) and a decay rate of 0.0097 calculated by Varman *et al.*, (1995) were used in the analysis. In Karnataka, densities estimated through dung count were substantially different from those obtained from block counts for some divisions when data was analyzed using dung piles recorded up to 10m or 15m (perpendicular distance) from the transect line and excluding outliers. In divisions with very few or no elephants, dung count method yielded much higher estimates of elephant numbers. These differences could be due to sampling errors coupled with the inexperience of the field staff. Therefore, the Dung Count exercise in Karnataka was treated only as an experience for the field staff. However, in Tamil Nadu, only marginal differences across the densities of elephants estimated using these two methods was observed in some prominent Protected Areas which confirmed the reliability of the results. In addition, confidence interval in the Dung Count method was found to be smaller (1059) than the Block Count method (1320).

Line Transect-Dung Count (Kerala, 2002)

Enumeration of elephants by Dung Count method was done in Kerala on 8 May 2003 under the guidance of the KFRI. 2 km long transects were laid in all the blocks. The density of dung belonging to fresh and old stages was estimated by

measuring perpendicular distances to dung piles from the transect. The dung density for each vegetation type was estimated from the transect using the program DISTANCE 4.0. The dung density was converted to elephant density by the method described by Barnes & Jensen (1987). The decay rates of 0.0187 and 0.0192 were used for moist deciduous forests and dry deciduous forests respectively whereas for the other forest types, the decay rate of 0.0146 calculated by Sale *et al.* (1990) was used. The defecation rate of 16.63 calculated by Watve (1992) was used in the computations. A 5% truncation of the largest distance values was adopted to improve the precision of the density estimates. The KFRI has reported the density estimates of elephants to be quite reliable because of the low coefficient of variation of the estimates. However, this has given a very high population growth rate for Kerala as compared to the neighbouring populations in Karnataka and Kerala. The census results are being reviewed.

References

- Barnes, R.F.W. & Jensen, K.L. (1987) How to count elephants in forests. *Technical Bulletin No. 1, African Elephant and Rhino Specialist Group.*
- Lahiri-Choudhury, D.K. (1991) *Direct count of elephants in north-east India. In Censusing Elephants in Forests: Proceedings of an International Workshop. Southern India.* (eds. U. Ramakrishnan., J.A. Santosh & R. Sukumar). pp. 33-45
- Sale, J.B., Johnsingh, A.J.T. & Dawson, S. (1990) Preliminary trials with an indirect method of estimating Asian elephant numbers. Report presented to the IUCN/SC Asian Elephant Specialist Group.
- Varman, K.S., Ramakrishnan, U. & Sukumar, R. (1995) Direct and indirect methods of counting elephants: a comparison of results from Mudumalai Sanctuary. In *A Week with Elephants: Proceedings of the International Seminar on the Conservation of Asian Elephant* (ed. J.C. Daniel & H.S. Datye). pp. 331-339. Oxford University Press, Bombay.
- Watve, M.G. (1992) *Ecology of host-parasite interactions in a wild mammalian host community in Mudumalai, southern India.* Unpublished Ph.D thesis, Indian Institute of Science, Bangalore.

"The croaking of the frogs does not hinder the elephant as he drinks"

Ahmadou Kourouma in *"Waiting for the wild beasts to vote"* Cote d'Ivoire