*Gajah 31 (2009) 21-24*

# Elephant Movement in Karra C.D. Block – A Spatio-Temporal Analysis

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## Introduction

An increasing number of large mammal studies have used species distribution maps and related analysis to convey their message about conservation priorities (e.g. Hatough-Bouran & Disi 1991; Smith & Mishra 1992) and elephants are those important large mammal species which are subject of, a concern for conservationists world-wide.

Globe over, elephant habitat is rapidly getting fragmented and eroded by various factors including competing land uses, which needs to be taken into consideration to gain a long term perspective on elephant movement patterns and their management.

In this paper, GIS has been used to systematize, standardize and manage the enormous amounts of spatial data generated by the movement of elephant in the background of disturbance to the landscape. Real time habitat use information by elephant along with the spatial distribution of habitat and temporal changes has been analysed for habitat evaluation. Limitations of conventional methods of physical survey have been avoided by using remote sensing and G.I.S. technology.

The study area has been a hotbed of intense con ict between elephants and men for many years, forcing wildlife managers to have a relook at their approach and strategy.

The main objective of this study was to nd out, how elephants in study area were distributed and further their utilization pattern of different areas in different seasons to assess management implications.

## Study area

The study area forms part of Singhbhum Elephant Reserve (84°55'E and 85° 15'E, 22° 55'N and 23° 20'N), and comprises a forested area of 567 km$^2$, (though honeycombed) and its part is spread over the Karra Community Development (CD) Block of Ranchi district, as shown in Figures 1 & 2. The average elevation of the tract is 600 m; the general slope of the tract is from northeast to southwest. The area presents a vista of grassland and forest vegetation interspersed with agriculture. The major geological formations of the area are recent, tertiary to recent, upper cretaceous and dharwar. The region has one major drainage system: the Karo river. Given the general northwards aspect in this area, most of the streams ultimately reach the river Karo, which ows in a southward direction.

The study area has little variation in climate, due to minimal change in relief and topography.



**Figure 1.** Cadastral map of Karra CD Block.

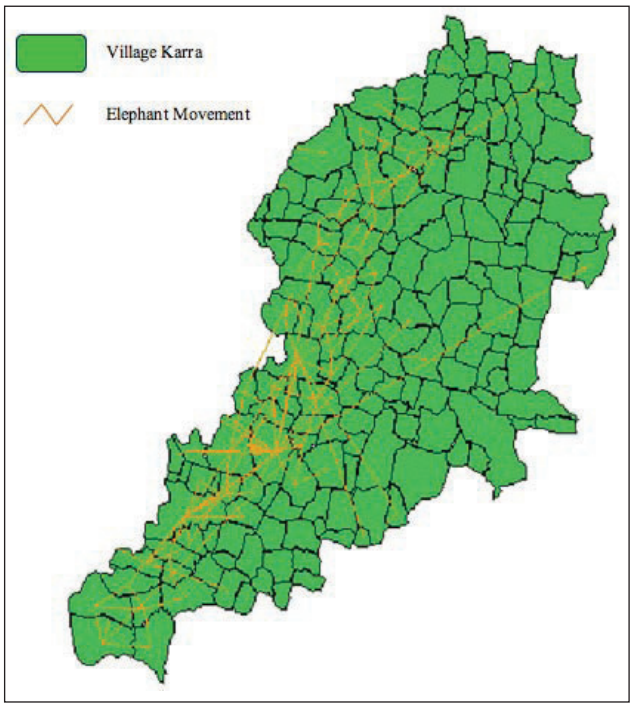



**Figure 2.** Elephant movement in different villages in Karra CD Block.

Temperatures begin to drop rapidly from November. December is the coldest month. After February the temperatures rise steadily till May. With the end of the south-west monsoon by the end of September, temperatures begin to drop.

The study area is comparatively  atter than other parts of the district and is honey combed with cultivation, chie y of paddy. Besides this, the villages also have groves of fruit bearing trees, mainly of jackfruit and mango. The basic vegetation type, as de ned by Champion & Seth is (3b/c $B_2$a) Northern tropical moist deciduous forest' containing mainly Sal. In addition, many plantation forests of acacia and eucalypts etc. are present in scattered manner. Human impact has converted most of the primary forest into secondary forms, degrading into scrub in the vicinity of settlements.

The fauna in the study area includes the elephant, the dominant wild mammal in terms of biomass. Besides elephants, chital (*Axis axis*). barking deer (*Muntiacus muntjac*) leopard (*Panthera pardus*), wild pig (*Sus scrofa*), sloth bear (*Melursus ursinus*), macaque (*Macaca mulatta*) and the common langur (*Presbytis entellus*) etc. are also present.

## Methods

Twenty-four hour trackers were employed for monitoring the movements of elephants, starting from April 1998. The trackers moved to villages frequented by the elephants in the study area and noted down the details of elephants, movement; description and size of the herd and from which village they came; their stay, and departure destination on day to day basis. This movement data was compiled for the period April 1998 to December 2000. Later this movement pattern was overlaid on the map of study area, with the village boundaries, using ARCVIEW. The length of movement (distance covered and as measured on map) - falling in each village boundary was considered important parameter, which was observed in the  eld and then transferred to the map. This length of movement also has a time attribute, hence it also helped in seasonal analysis of movement. This relatively simple approach was adopted, taking into consideration the constraints faced in the  eld for such type of research.

The factors, which most closely correlated with elephant distribution were tested and used to predict their distribution, by using GIS for integration and analysis of environmental elements associated with elephants. Thus without a long history of previous survey work idea of habitat distribution could be had. However, limitations in collecting comprehensive elephant data made trend analysis dif cult.

The Environmental Systems Research Institute's (ESRI) ARCVIEW3.1 was used for the current analysis exercise. Karra C.D. block map along with the village boundaries at a scale 1:50,000 were digitized. Spatial information within the study area was stored in vector format in which features are represented by points, lines and polygons.

## Results and discussion

The null hypothesis ($H_o$) was that the dependent variable ($Y_1$) "elephant" movement in a village" is affected by independent variables i.e. the "population density", "area available

for agriculture in the village", "forest density", "temperature", "relative humidity", and "rainfall". The alternative hypothesis ($H_1$) was that elephant movement is not affected by the above said independent variables. The village wise movement data of elephants were recorded for the different villages of Karra C.D. block of Ranchi District.

The correlation coefficient between the dependent variable and each independent variable was calculated separately (Table1).

The significance of the above correlation coefficients was tested by applying the t-test. The calculated values of |t| for all the correlation coefficients did not exceed their corresponding tabulated values. Hence the correlation coefficients tested were not significant and the null hypothesis ($H_0$) was accepted.

The importance of rainfall and temperature together was tested using multiple correlation coefficients. The calculated value of "F", where sum of square of deviation from the mean of elephant movement and s=sum of square of deviation from the "mean of rainfall" and "mean of temperature" was less than the tabulated value of F at 5% of level of significance. Hence the rainfall and "temperature" were not taken into consideration for multiple correlations.

Multiple regression equations for the dependent variable, i.e. elephant movement and the two independent variables "area available for agriculture" and "forest density" were developed, on the basis of data for summer season 1998, winter season 1998, and rainy season 1998 and complete Year 1998 as follows:

(I) $Y = 35.22 - 0.28X_1 - 0.25X_2$
(on the basis of data of summer season 1998)

(II) $Y = (-)\ 1.72 + 0.23X_1 - 0.25X_2$
(on the basis of data of winter season 1998)

(III) $Y = (-)\ 58.8 + 2.7X_1 - 0.91X_2$
(on the basis of data of rainy season 1998)

(IV) $Y = (-)\ 2.7 + 0.28X_1 + 0.25X_2$
(on the basis of data of winter season 1998)

Where Y = Elephant's movement in the block
$X_1$ = Area available for agriculture
$X_2$ = Forest density
= [Forest area] / [Village area]

To validate it, by applying the above equation, the predicted values of elephant's movement for year 1999 and 2000 were calculated and the difference of averages of actual value and predicted values was tested by applying the t-test. The difference of mean of actual movement and predicted value for the year "1999" and "2000", "winter season" were not significant. But the average differences in "summer season" and "rainy season" were significant.

The calculated value of F (1.18) was less than the critical (tabulated) value of F (3.13, 3.63) for 5% and 10% levels of significance respectively with $n_1 = 2$ and $n_2 = 69$ d.f. Hence the null hypothesis ($H_0$) was accepted. Therefore, it could be said that independent variables 'area available for agriculture' and 'forest density', taken together have an effect on elephant movement.

## Conclusion

The results about elephant movement intensity and seasonal distribution patterns are useful to the wildlife managers in following way-From G.I.S. analysis, it appears that during summer, winter and rainy seasons, elephants have preference for certain areas, demonstrated by the frequency of visit to these areas in particular seasons (Figs. 2 & 3), where the intensity of movement has been obtained using "surface-contour" module.

**Table 1.** Correlation co-efficient between dependent and independent variables.

| Sl. No. | Dependant variable | Independent variable | Correlation coefficient |
|---|---|---|---|
| 1. | Elephant's movement | Population density | 0.08 |
| 2. | Elephant's movement | Area available for agriculture | 0.1 |
| 3. | Elephant's movement | Forest density | 0.05 |
| 4. | Elephant's movement | Mean monthly temperature | 0.2 |
| 5. | Elephant's movement | Relative humidity | 0.06 |
| 6. | Elephant's movement | Mean monthly rainfall | 0.1 |

Figure 3 shows the spatial distribution patterns during summer season (March-May), rainy season (July-September) and winter season (October-February).

The concentration of elephant movements in the summer season was found to be high inLapa, Bakaspur, Nagra and Gosa, in rainy season Barwadag, Dehkela, and Limra, and in winter Nagra, ChotkaRegre, Barwadag and Limra villages of Karra C.D. Block.

In these villages special wildlife management practices should be adopted for elephants and at the some time the people should be trained and equipped to protect crops and live with the elephants with minimum damage to each other.

## References

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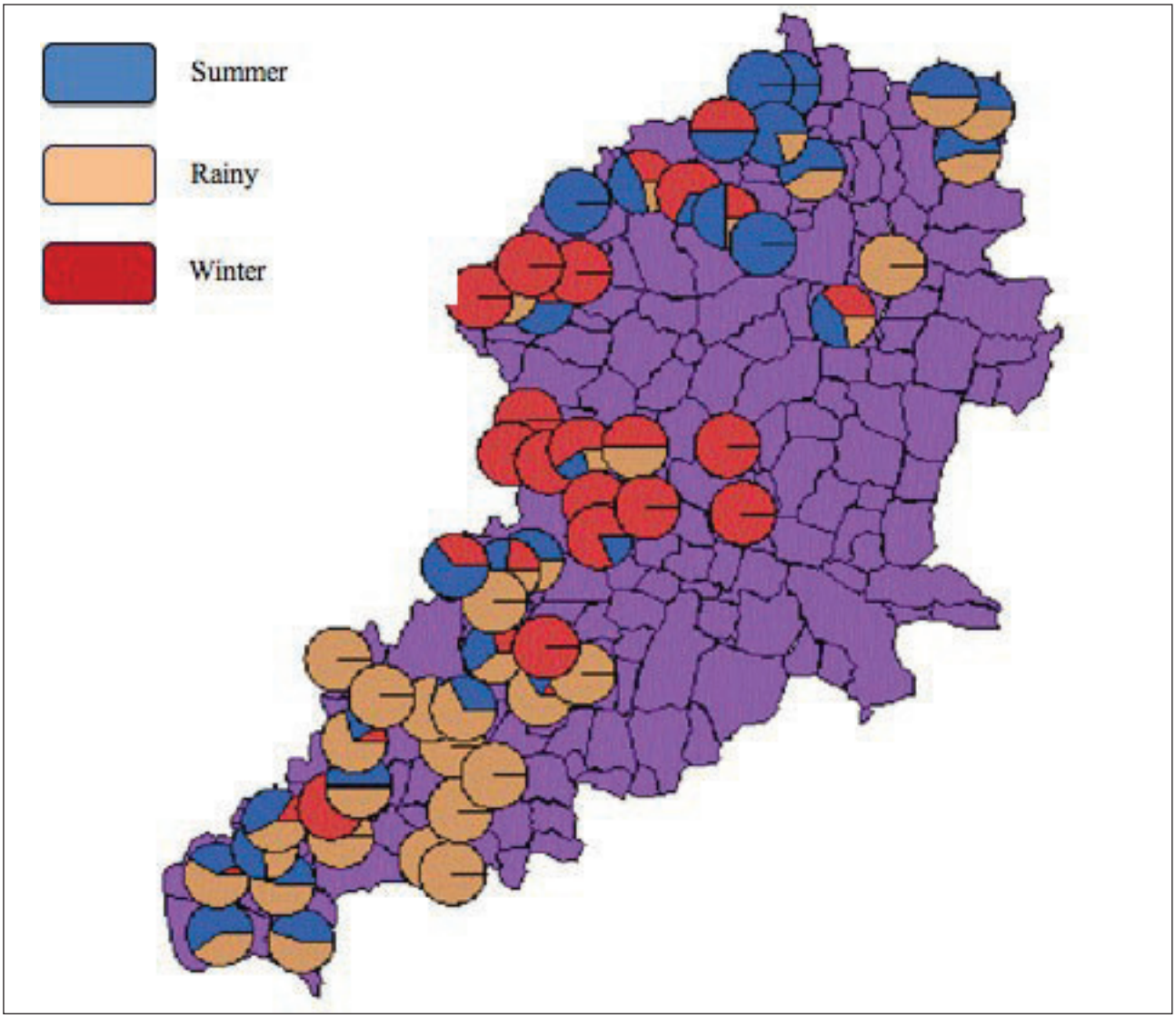



**Figure 3.** Elephant movement in different seasons in Karra CD Block.