Elephants Avoid Costly Mountaineering

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Abstract

We collected and analyzed high resolution data on the whereabouts and movements of African elephants giving us, for the first time, a look at elephant 'negative' space (i.e., the areas elephants don't go).

Background and Relevance

Understanding the spatial behaviour of African elephants (*Loxodonta Africana*) is vital to successful conservation and management of this unique species throughout Africa. Only recently has high resolution data been collected on the whereabouts and movements of African elephants giving us, for the first time, a look at elephant 'negative' space (i.e., the areas elephants don't go). What becomes immediately apparent is their avoidance of sloping terrain and by extension, hill climbing. In this study we looked at this observation from the elephant's point of view, and found that the energetics of moving up gradients is likely the main deterrent from doing so. Terrain, or more appropriately the energy landscape, influences elephant movements to a large degree and must be a factor in any spatial modeling.

Methods and Data

Global Positioning System (GPS) tracking data was collected from 54 elephants within Samburu National Reserve (SNR) in Kenya over a period of several years (1998 – 2004), giving a total of 137,000 recorded locations. Elephant positions were collected at hourly intervals and the 54 individuals are considered a representative sample of the ~900 elephants who frequent the reserve. A Digital Elevation Model (DEM) was derived from contours from a 1962 Aerial Survey map of the region which represents the most accurate elevation data available. A subset of 20,000 randomly selected positions were chosen and slope values extracted for each position. An elephant fix density (fixes/km^2) was calculated for each unit slope of terrain (degrees) found within the reserve.

Results

An exponentially decreasing elephant fix density was found with increasing hill slope (R^2=0.90). This was attributed to the allometric scaling with body mass of the energy required to move up hilly terrain. An energy landscape was created based on the energy requirements for movement against gravity for both a 100

Kg and 5000 Kg individual. It was found that the energy to move vertically one meter for an elephant was 2500% the cost of it to move horizontally 1 meter and given that the base metabolic intake for an elephant requires up to 17 hours of foraging a day, this puts severe constraints on the amount of hill climbing that an elephant can do.

Conclusion

Owing to allometric scale relationships elephants are the least energetically efficient land mammals at climbing hills. Terrain puts severe energetic restraints on movement and it is very useful for modeling purposes to consider movement around a landscape in energetic terms. This is likely the reason for the exponential decline in elephant incidence with increasing hill slope. This study represents a key step in understanding how these mega-fauna perceive the world around them and the factors/drivers affecting their decisions.

References

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