Elephant landscapes: human foragers in the world of mammoths, mastodonts, and elephants

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SUMMARY: Human groups able to subsist by opportunistic exploitation of proboscideans would be afforded abundant environmental clues to prey health and density, along with superior nutrients and other advantages such as information-rich trail networks.

1. Introduction: Elephants and People

Elephants are keystone species (Owen-Smith 1999, 1989, 1987) whose behavior alters ecosystems. The behavior of extinct mammoths and mastodonts not only partly re-engineered Pleistocene ecosystems, but it also contributed the information and enhancements which made rapid human exploration, dispersal, and colonizations so successful during the late Pleistocene.

2. Elephant Landscapes

2.1 Trackways and dung

Foragers who pay attention to the signs left by proboscideans can gather significant information that will aid in subsistence activity. For example, by examining proboscidean spoor, human foragers can gain crucial knowledge about individual animal sizes, ages, and locomotion speed, without laying eyes on the prey animals themselves. Track-size allows an estimate of elephant shoulder heights (height = ca. twice the front-foot circumference), and shoulder height correlates with animal age. Visual traces of feeding are often abundant, such as broken and debarked trees, excavated roots, and pulled-up grass.

Elephants are bulk feeders and inefficient processors, and only around 50% of intake is digested (Benedict 1936). Adult elephants ingest around 150 kg (330 lbs) of forage every day, feeding at all times of the day, and hence dung is abundant (over 100 kg a day) and well scattered over their daily range (Laws *et al.* 1975; Sikes 1971). Elephants travel at different speeds, ranging from a brisk walk (which approaches the speed of a human run) to a leisurely amble (which is similar to a slow human jog). Dung passed at different locomotion speeds is broken differently upon impact with the ground, providing a clue to the speed of moving animals. Human foragers can examine elephant dung – as do modern biologists who study elephant populations – to determine individual animal sizes, age and sex, locomotion speed, direction of travel, and feeding patterns (Barnes & Jensen 1987). Dung provides important clues about proboscidean health, reflected in the dung's moisture content, unchewed and recognizable plant parts, fiber lengths which reflect the condition of the teeth (Fig. 1), fruits and seeds fed upon over the last 2 days but which may be carried long distances in the gut (Dudley 1999; Janzen & Martin 1982), and the inorganic component in digesta, such as sand, unchewed wood, or other unusual objects, ingested when elephants are very hungry (Fig. 2).

Fig.1 - Unchewed leaves and long bark fibers in dung of *Loxodonta africana*, poorly chewed and undigested when passed.

Fig.2 - The skeleton of an Amethyst or Plum-colored Starling (*Cinnyricinclus leocogaster*) (just above the left end of the 15-cm ruler) in the stomach contents of a very old female African elephant. The bird was swallowed unchewed by a starving elephant.

Dung provides organic matter that replenishes soil nutrients, and feeds many taxa of arthropods such as dung beetles. However, elephants trample soils around preferred water and feeding patches, sometimes with damaging effects, partly offsetting the advantages of high dung input. Elephants also dig for tree-roots, or kick at grass-tufts to pull them up for feeding, thus sometimes seriously disturbing ground cover.

2.2 Trail networks

Modern proboscideans make complex mental maps of water points, mineral sources, forage patches, fruit trees, travel routes, and socializing sites. Their travel routes between these important places can be easily followed by human foragers and other animal taxa. Proboscidean trails are wide, flat, and identifiably distinct from trails created or used by other animal taxa (Fig. 3). Proboscideans frequently move long distances, exploring for new forage, new mates, or new ranges. Proboscideans also habitually re-use old trails seasonally or more often, thus establishing clear networks of widely separated places connected by paths. Such networks of fixed and dependable trails would provide a means to encourage exploratory mobility by human pioneers into new ranges.

Fig.3 - An African elephant trail. Aerial photographs taken over the past 50 years in Zimbabwe show that trails are located in exactly the same locations year after year.

Fig.4 - Deep pit excavated by African elephants feeding on the mineral sediments.

2.3 Modified terrains

Proboscideans physically create and modify landscape features. For example, elephants create and enlarge mud wallows, excavate mineral pits (Fig. 4), enlarge water points through wallowing and removal of sediments, and excavate streambed or seepage wells. Hence, besides acting to attract other animals and different plant associations to the enlarged water or mineral sources, proboscidean modifications to terrains provide clues about general landscape drainage and hydrology even in nearly featureless physiography.

Proboscidean feeding on certain plants such as trees and bushes affects overall range productivity. For example, pruned woody vegetation may grow back vigorously. African mopane (*Colophospermum mopane*) coppices freely when browsed by elephants. Trees with similar habits in the Pleistocene would have responded to mammoth or mastodont browsing with thick new growth. In African woodlands, mopane re-growth is more palatable for herbivores than older growth because it lacks secondary compounds (antiherbivory defenses). Patches where heavily browsed plants coppice in response to proboscidean browsing can be counted on to attract other herbivores besides elephants, reducing human foraging search-times and also providing abundant growth of withes and branches that may be useful as staffs, sticks, or spears. Proboscidean browsing also may be great enough to create and maintain grassy open glades in wooded habitats where nonmigratory grazers could congregate (Owen-Smith 1999). Proboscideans digging up tree-roots and stripping tree-bark in wooded habitats provide human foragers with additional clues to the animals' health and nutrition.

2.4 Refugia

Proboscideans in habitat refugia may provide human foragers with scavengeable carcasses (see Haynes 1991), as well as a tethered population of vulnerable live animals crowded around remnant water sources (Fig. 5), surviving food patches, or micronutrient sources such as mineral springs and cobalt/selenium/iodine sources (Milewski & Diamond 2000; Milewski 2000).

Fig.5 - African elephants at a natural water source during a drought year in Zimbabwe.

In Zimbabwe, elephants aggregate around the last remaining natural water sources during drought years. There they dig deep wells in surficially dry stream channels, thereby providing water – for themselves and other animals – in ranges where no other water can be found. Elephant die-offs take place in such refugia patches, where water is scarce, but the main cause of death usually is starvation rather than severe dehydration, as elephant feeding-pressure mounts to unsustainable levels within walking distance of the last water sources. Recent research indicates that die-off age-profiles do differ measurably when either food or water scarcity causes most deaths.

There may have been important behavioral differences between the recent and the extinct taxa. Modern elephants ingest huge amounts of water, much of which is later urinated. Conceivably, some of the water ingested may provide more than moisture alone, supplying critical micronutrients and minerals, accounting for the apparent excessive water intake (A. V. Milewski, pers. comm.). Proboscideans such as extinct mammoths and mastodonts in habitats that provided ample minerals and micronutrients may not have needed to drink as often or as much as do modern elephants, thus avoiding chronic tethering to water. This sort of possible behavioral difference can be further explored by examining different water intake rates of elephants in different habitats, different distributions of fossil mammoth and mastodont bones correlated with local mineralogy and hydrology, and other such topics.

3. "Elephant" Lanscape in Prehistory

The effects that proboscideans have on landscapes make those landscapes especially appealing to mobile hunter-gatherers. An immense trail network can be followed on exploratory treks, reducing risks of getting lost or of not finding prey on the trails linking patches of high faunal biomass such as dependable water sources or fruit-tree stands.

In North America 11,500 ^{14}C yr BP, fluted-point-making people opportunistically targeted megamammals in habitat refugia during the last millennia of the Pleistocene, and, by exploiting mammoths and mastodonts, expanded their range widely in a very short span of time. The spread and success of fluted-point cultures were primarily due to human exploration of landscapes altered by proboscideans (Haynes 1999).

Similar kinds of opportunistic dispersals of late Pleistocene human groups probably occurred throughout the rest of the northern hemisphere, contributing to rapid human recolonization and megamammal extinctions after the Last Glacial Maximum. Mammoth trails connected water points and led exploring humans to high-biomass patches, making human dispersals much less risky and much more rapid.

4. References

Barnes, R.F.W. & Jensen, K.L. 1987. How to count elephants in forests. *African Elephant and Rhino Specialist Group Technical Bulletin*.

Benedict, F.G. 1936. *The physiology of the elephant.* Washington, D.C.: Carnegie Institution.

Dudley, J.P. 1999. Seed dispersal of *Acacia erioloba* by African bush elephants in Hwange National Park, Zimbabwe. *African J. Ecol.* 37(4): 375-385.

Haynes, G. 1991. *Mammoths, mastodonts, and elephants: biology, behavior, and the fossil record.* Cambridge: Cambridge University Press.

Haynes, G. 1999. The role of mammoths in rapid Clovis dispersal. In G. Haynes, J. Klimowicz & J. W. F. Reumer (eds.) Mammoths and the Mammoth Fauna: Studies of an Extinct Ecosystem. *Deinsea* 6: 9-38.

Janzen, D.H., & Martin, P.S. 1982. Neotropical anachronisms: The fruits the gomphotheres ate. *Science* 215: 19-27.

Laws, R.M., Parker, I.S.C., & Johnstone, R. C.B. 1975. *Elephants and their habitats:*

the ecology of elephants in North Bunyoro, Uganda. Oxford: Clarendon Press.

Milewski, A.V. 2000. Iodine as a possible controlling nutrient for elephant populations. *Pachyderm* 28: 78-90.

Milewski, A.V., & Diamond, R.E. 2000. Why are very large herbivores absent from Australia? A new theory of micronutrients. *Journal of Biogeography* 27: 957-978.

Owen-Smith, R.N. 1987. Pleistocene extinctions: The pivotal role of megaherbivores. *Paleobiology* 13: 351-362.

Owen-Smith, R.N. 1988. *Megaherbivores: The influence of very large body size on ecology*. Cambridge: Cambridge University Press.

Owen-Smith, R.N. 1999. The interaction of humans, megaherbivores, and habitats in the late Pleistocene extinction event. In R.D.E. MacPhee (ed.), *Extinctions in Near Time: Causes, Contexts, and Consequences:* 57-69. New York: Kluwer Academic/Plenum Publishers.

Sikes, S.K. 1971. *The natural history of the African elephant*. New York: American Elsevier.