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Not the brain alone: The nutritional potential of elephant heads in Paleolithic sites

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ABSTRACT

The presence of elephants, and specifically of elephant head remains, is well demonstrated in many Paleolithic sites in Europe, Africa, and Asia. However, the possible mechanisms for the exploitation of this enormous body part are rarely discussed, and it is often suggested that elephants' heads were exploited specifically for the extraction and consumption of the brain. In this paper, we discuss the nutritional potential that lies within elephants' heads as implied by ethnographic and zoological literature, and present archaeological evidence from Paleolithic sites for the exploitation of proboscideans' heads. The data show that the prevailing view should be re-evaluated, and that the nutritional potential within the elephant's head extends far beyond the brain. We suggest that organs such as the temporal gland, the trunk, the tongue, the mandible and the skull itself were exploited routinely as an integral part of early humans' diet. The nutritional potential of the elephant head provides a parsimonious explanation for the investment early humans put into transporting and exploiting this specific body part at open-air sites but particularly at cave sites, and serves as a significant beacon in understanding Paleolithic human behavior in relation to proboscidean remains.

1. Introduction

The significant role of elephants in Paleolithic faunal assemblages is well demonstrated in many sites in Europe, Africa, and Asia. Proboscideans, as well as other taxa, were exploited by early humans throughout hundreds of thousands of years across the old world (e.g., Klein, 1988; Boschian and Saccà, 2010; Yravedra et al., 2010; Zhang et al., 2010; Anzidei et al., 2011; Echassoux, 2012; Rabinovich et al., 2012; Yuan et al., 2012; Domínguez-Rodrigo et al., 2014b). However, the dietary significance of elephants has not been thoroughly explored (but see Ben-Dor et al., 2011). Given the presence of elephant remains at archaeological sites as described above, we assume that during Paleolithic times elephants, when available, were a constant and significant source of calories for early hominins (however see Smith, 2012, 2013). Notwithstanding its significance, this was only one source of calories among many other (plant based and animal based) food resources used by Paleolithic hominins. However, in our opinion it was a primary one when elephants were available.

While in many Paleolithic sites elephant remains and lithic artifacts are found in association, the human use of elephants for dietary purposes is still debated in some cases (e.g., Villa et al., 2005). Several Lower Paleolithic Acheulian sites, however, provide clear evidence of butchery and defleshing of elephants, such as bones bearing cut-marks and breakage signs (e.g., Goren-Inbar et al., 1994; Wenban-Smith et al., 2006; Yravedra et al., 2010; Rabinovich et al., 2012). In addition, the use of elephant bones in the Acheulian for the production of tools, particularly bifaces that resemble the characteristic stone handaxes, is clear (Biddittu et al., 1979; Dobosi, 2001, 2003; Bruhl, 2003; Boschian and Saccà, 2010; Rabinovich et al., 2012; Beyene et al., 2013; Zutovski and Barkai, 2015). Post-Acheulian as well as Mousterian sites provide further evidence for the use of proboscideans both for dietary purposes, such as meat and marrow consumption, (e.g., Blasco and Fernández Peris, 2012; Yravedra et al., 2012), and for other tasks, such as bone tool production (e.g., Gaudzinski, 1999; Gaudzinski et al., 2005; Boschian and Saccà, 2014).

The role of protein in human diet and subsistence in Lower Paleolithic sites has been demonstrated frequently (e.g., Bunn, 1981, 2006; Shipman and Walker, 1989; Milton, 2003; Morin, 2007; Pante, 2012; Sahnouni et al., 2013). Animal meat and fat are an excellent source of calories, and contain essential amino acids,

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minerals, vitamins, and fatty acids (Friedman, 1996; Milton, 2003; Givens et al., 2006; Williams, 2007).

As early as the Late Pliocene, we are familiar with archaeological sites containing stone tools associated with animal bones, reflecting human activities related to butchery of animals and marrow extraction (e.g. Plummer et al., 1999; Moullé et al., 2001; Ferretti et al., 2003; Ferraro et al., 2013; Lemorini et al., 2014). Hence, it is commonly accepted that Acheulian, and even pre-Acheulian hominins, extracted a significant portion of the calories they consumed from animal meat and fat, and thus were actually dependent on animals for their survival (Kaplan et al., 2007; Ben-Dor et al., 2011; Domínguez-Rodrigo et al., 2012). Hence, carnivory has been a human trait from our earliest stage to today (Psouni et al., 2012).

Elephants were by far the largest terrestrial animal available for Lower Paleolithic hominins, the straight-tusked elephant being about five times larger than the second largest animal found at Acheulian sites in the Levant, the hippopotamus (Ben-Dor et al., 2011). Extinct elephants most likely weighed more than recent elephants (Shoshani and Knight, 1992; Christiansen, 2004; Byers and Ugan, 2005), and therefore the average weight of recent elephants' body organs should be enlarged when discussing Pleistocene proboscideans (Table 1). According to Byers and Ugan (2005), based on recent *Loxodonta africana* samples, the cranium and mandible can exceed 180 kg. The trunk can exceed 110 kg. The brain of an adult elephant can reach 6.5 kg, and the tongue can exceed 14 kg. In total, a complete head of an elephant (Fig. 1), including the ears and tusks, can exceed 400 kg. These figures should be greatly enlarged, if not almost doubled, for Pleistocene extinct elephants.

Table 1
Mass of different head parts calculated according to samples taken from four adult male modern *Loxodonta africana* (Byers and Ugan, 2005).

Head parts	Mass (kg)
Brain	4.0
Cranium/mandible (excluding brain)	176.7
Tongue	13.0
Trunk	113.6
Ears	44.7
Tusk nerves	11.3
Tusks	63.2
Total head	426.5

Fig. 1. A modern elephant head can exceed 400 kg, including internal organs, trunk, tusks and ears. A secretion is visible oozing from the temporal gland. Photo by Nir Geiger, all rights reserved.

Elephants represent an ideal food package with a perfect combination of meat and fat, as half of the potential calories are in the fat (for details see Ben-Dor et al., 2011). While we have no exact data as to the extent to which elephant carcasses were utilized, the abundance of evidence for elephant utilization in Acheulian sites (as well as later Paleolithic sites) is a clear indication that at least part of the elephant's potential energetic value was extracted by early humans. This view is further supported not only by the fact that some elephant bones found in Paleolithic sites bear cut marks (e.g, Goren-Inbar et al., 1994; Yravedra et al., 2010; Rabinovich et al., 2012), but also that many bones were further fractured in order to reach the marrow (e.g, Boschian and Saccà, 2014; Yravedra et al., 2014), indicating further use of the bones for additional fat.

In the Levant, the available data on elephant remains in Lower Paleolithic Acheulian faunal assemblages comes from a number of sites, including Ubeidiya, Evron, Latamne, Gesher Benot Ya'aqov, Revadim and Holon (see Bar-Yosef and Belmaker, 2011; for bibliography). All of these are open-air sites (see Speth, 2012; for discussion), while Acheulian presence in caves in the Levant is scanty. The few cave sites with Acheulian layers are either poor in fauna or not thoroughly studied. Outside the Levant, however, there are a few cases of Paleolithic cave sites bearing elephant remains, such as Bolomor cave in Spain (Blasco et al., 2013), Ma'anshan cave in China (Zhang et al., 2010) and Spy cave in Belgium (Germonpré et al., 2012). In the case of open-air sites, the question of whether hominins gathered near elephant carcasses resulting from natural death and/or hunting, or transported parts of the carcasses to their home base, is difficult to answer. Cave sites with megafauna remains, on the other hand, are clear evidence for transportation of selected body parts from the kill/acquisition site to the cave.

Many Paleolithic sites with elephant remains found in direct association with human activity have yielded elephants' head remains, including mandibles, skull fragments and teeth (e.g., Scott, 1989; Piperno and Tagliacozzo, 2001; Fladerer, 2003; Yravedra et al., 2010, 2012; Rabinovich and Biton, 2011; Rabinovich et al., 2012; Nikolskiy and Pitulko, 2013). However, the nutritional potential of this body part is seldom discussed. On the rare occasions that this is dealt with, it is mostly suggested that the skulls of proboscideans were exploited specifically for the extraction and consumption of the brain (Adam, 1951; Scott, 1989; Goren-Inbar et al., 1994; Germonpré et al., 2008). In the case of the Upper Paleolithic site of Yudinovo (the Russian Plain), for example, it was claimed that, “the broken skulls indicate that humans searched for the fresh fatty brain” (Germonpré et al., 2008). It is our intention to provide evidence that shows that in fact other head parts were obtained and consumed by early humans as well.

This paper deals with the nutritional potential within the elephant's head and its implications as follows: 1. An overview of elephant skull remains in a number of selected Paleolithic sites; 2. The anatomy of specific organs within the elephant's head and their nutritional potential; 3. Ethnographic evidence for the consumption of different head parts of elephants; 4. A re-evaluation of the nutritional potential of the elephant's head and its contribution to the understanding of Paleolithic human behavior.

The elephant's head is a particularly high-quality source of energy, bearing a considerable amount of edible tissues (Byers and Ugan, 2005), and therefore could have been used by early hominins as an important dietary source. Thus, understanding the nutritional potential of elephant heads, combined with the remains of elephant skulls in Paleolithic sites, provides new insights concerning human behavior and subsistence in Paleolithic times.