



Diagnostic properties of hammerstone-broken long bone fragments, specimen identifiability, and Early Stone Age butchered assemblage interpretation



Stephen R. Merritt^{a,*}, Kellyn M. Davis^b

^a University of Alabama at Birmingham, Anthropology Department, 1401 University Blvd., Birmingham, AL 35294, USA

^b Colorado State University, Anthropology Department, 1787 Campus Delivery, Fort Collins, CO 80523, USA

ARTICLE INFO

Article history:

Received 3 April 2017
Received in revised form
10 June 2017
Accepted 13 June 2017

Keywords:

Fragmentation
Experimental taphonomy
Butchery
Zooarchaeology
Identification
Actualism

ABSTRACT

Zooarchaeological assemblages in a variety of geographic and temporal contexts are dominated by fragmentary long bone specimens, and precise identification of side, skeletal element, and bone portion underlie archaeological interpretations, including specimen counts for skeletal part profiles, minimum number of element (MNE), and individual (MNI) estimates. Actualistic hammerstone and anvil breakage of domestic goat limb bones was used to document how fragmentation impacts precise identification of skeletal specimens, analysis of assemblage composition, and reconstructions of butchery behavior. Specimens greater than 2-cm in size were assigned to categories that describe the precision with which side, element, upper, intermediate and lower limb segment, and long bone portion could be identified. Results suggest that specimen size is positively related to identifiability, and more identifiable specimens tend to include epiphyses and relatively complete shaft circumferences. Most elements produced a similar number of fragments, including highly identifiable ends that yield accurate skeletal part profiles, MNE, and MNI estimates. However, if density-mediated destruction removes these specimens, analysis of less-identifiable shaft fragments significantly underrepresents element and individual abundance. The number of identified limb specimens (NISP), MNE, and epiphysis-to-shaft ratios in fragmentary archaeological butchery assemblages suggest limb end underrepresentation deflates measures of assemblage abundance and reduces the behavioral resolution of butchery interpretations. However, zooarchaeological analyses can productively incorporate fragmentary, less-identifiable specimens when they define hypotheses that match the scale of archaeological data.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

Although taxonomic lists and reconstructions of butchery and carcass consumption are built upon precisely identified specimens, skeletal fragments that may not be identifiable to taxon or anatomical feature still offer information about which element, limb segment, or long bone portion they originate from (Marean and Kim, 1998). Further, these specimens may provide evidence about the taphonomic agents, processes, and contexts that surrounded their creation (Marean and Spencer, 1991; Blumenschine, 1995; Domínguez-Rodrigo, 1999; Outram, 2001; Pickering et al., 2003; Otárola-Castillo, 2010; Domínguez-Rodrigo et al., 2010;

Gidna et al., 2013; Reynard et al., 2014; Pante et al., 2015). Less identifiable specimens inform carcass consumption interpretations in a variety of temporal and geographic contexts (Grayson and Frey, 2004; Marean et al., 2004; Yravedra and Domínguez-Rodrigo, 2009), including extant hunter-gatherer carcass transport behavior (Lupo, 2001), Neolithic domestic animal processing (Marshall and Pilgrim, 1993; Rustioni et al., 2007), Paleoindian diet breadth and megafaunal extinction (Lyman and O'Brien, 1987; DeAngelis and Lyman, 2016), and the hunting versus scavenging debate in the African Later, Middle, and Early Stone Age (Klein and Curz-Urbe, 1996; Capaldo, 1997; Milo, 1998; Pickering and Egeland, 2006; Pickering et al., 2006).

Analytical methods frequently applied to less identifiable bone fragments include comparing assemblage-scale proportions of butchered or tooth-marked specimens to models of hominin and carnivore activity during assemblage formation (Pante et al., 2015).

* Corresponding author.

E-mail address: stmerr@uab.edu (S.R. Merritt).

These studies sometimes classify specimens as upper, intermediate, and lower limb elements to reconstruct which taphonomic agent gained primary carcass access (Domínguez-Rodrigo, 1999). When element or limb segment cannot be determined, many specimens are still identifiable as epiphyseal, near-epiphyseal, or diaphyseal fragments, and epiphysis-to-shaft ratios address assemblage-scale density mediated destruction caused by carnivore activity or post-depositional processes (Marean, 1991; Cleghorn and Marean, 2004). Skeletal part or element profiles that supplement identified limb ends with shaft specimens are argued to be more accurate, and these analyses support higher-order archaeological inferences about carcass access or transport (Faith et al., 2009).

Many experimental butchery and carnivore feeding experiments investigate the accuracy of skeletal part profiles and element or individual counts that incorporate less-identifiable shaft specimens and explore quantitative and analytical disparities between the identified element or specimen scale (Marean, 1991; Marean and Spencer, 1991; Marean et al., 1992; Stiner, 2002; Pickering et al., 2003; Marean et al., 2004; Yravedra and Domínguez-Rodrigo, 2009; Otárola-Castillo, 2010). Overall, these results suggest that including shaft specimens leads to more accurate minimum number of element and individual estimates, neither scale is inherently more accurate, and both counting units should be considered ordinal values (Marean et al., 2004; Wolvertson et al., 2016).

Although research focuses on the properties associated with accurate anatomical identification, little is known about whether the sets of less-identifiable bone fragments, which are common in many assemblages, are systematically biased in their representation of certain elements or bone portions (Lyman and O'Brien, 1987; Marshall and Pilgrim, 1993; Badenhorst and Plug, 2011; Colaninno et al., 2015; Morin et al., 2016). One hammerstone fragmentation experiment suggests white-tailed deer radii break into more fragments compared to humeri, but both elements frequently produce epiphyseal specimens and shaft splinters (Pickering and Egeland, 2006). Likewise, observations of captive and wild carnivore consumption show that they preferentially modify and delete limb bone ends, but may also introduce additional tooth-marked shaft specimens (Marean and Spencer, 1991; Blumenschine, 1995; Gidna et al., 2013; Domínguez-Rodrigo et al., 2015). Together, these data suggest that the count of specimens or elements in assemblages generated by hominin butchers and scavenging carnivores may be misleading if different elements are not equally identifiable, and moreover, epiphyseal specimens, which tend to be larger and precisely identifiable are likely to be deleted by carnivore activity or other processes that target less-dense specimens.

Here, we use experimental transformation of complete elements into sets of limb bone specimens during hammerstone and anvil fragmentation to illustrate how identifiable properties are distributed across limb bone specimens from different anatomical regions of the appendicular skeleton (limb segment, skeletal element, or long bone portion). We explore analytical biases introduced if fragmentary specimens of certain long bones or portions are inherently more identifiable or differentially affected by taphonomic processes, and offer caveats for quantitative statements about human carnivory based on assemblage-scale abundance estimates, specimen profiles, and minimum number reconstructions.

Early Stone Age (ESA) assemblages from Koobi Fora, Kanjera South, and Olduvai Gorge provide case studies to explore how long bone element and portion identification impact the reconstruction of hominin and carnivore feeding traces. These fragmentary assemblages include few epiphyseal specimens, carnivore bone modification, and abundant traces of hominin butchery, much of which occurs as cut or percussion-marked less-identifiable limb specimens.

This study uses experimental fragmentation evidence to document how epiphyseal and shaft specimen identifiability impacts skeletal part profile accuracy and minimum number of element or individual estimates. These findings generate archaeological predictions that test whether fragmentation and density-mediated destruction distort assemblage composition or underrepresent the true number of elements and individuals. Understanding these biases is necessary for reconstructing assemblage formation and refining paleoecological inferences about hominin and carnivore carcass consumption, but are broadly applicable to any zooarchaeological assemblage that includes less-identifiable specimens.

2. Methods

2.1. Experimental butchery

This set of butchery experiments fragmented small ungulate long bones using replicated Early Stone Age hammerstones and anvils of material found in archaeological contexts at Koobi Fora. The novice butcher (KMD), gained experience as the experiments progressed. Ten fore- and hindlimbs from five domestic goats were purchased from pastoralists near Ileret, Kenya. Skinning, defleshing, and element disarticulation were completed before fragmentation. A single hammerstone and anvil were used to fragment all 60 limb bones.

2.2. Specimen preparation

Following fragmentation of an element, every specimen was placed in a cloth sediment sample bag, macerated in boiling water for 6–12 h, and cleaned of adhering soft tissue by hand and with wooden utensils. This boil-in-bag method ensured that small, less-identifiable specimens were not disassociated from the large, precisely identifiable fragments during preparation and guaranteed that every specimen's original element was known (Pickering and Egeland, 2006).

2.3. Analytical procedure for fragmentary specimens

All specimens over 2 cm in size were measured with calipers to describe their maximum dimension in millimeters, visually examined to assess percentage of shaft circumference using Bunn, 1983 100%, >50%, <50% completeness scale, and identified according to side, element, and portion using reference media and comparative specimens. Bone portions were described according to standard anatomical long bone portions (Lyman, 1994; Blumenschine, 1995). The proximal and distal epiphyses (PEPI and DEPI) included articular and non-articular bone and were bounded by the metaphyseal line, proximal and distal near-epiphyses (PNEF and DNEF) were bounded by the metaphyseal line and the transition into diaphyseal cross-sectional shape and were further identified by the presence of cancellous medullary surfaces. Midshaft (MSH) portions occur between the near-epiphyseal borders and included non-cancellous medullary surfaces. Specimens that could not be precisely identified to proximal or distal location were categorized as epiphyseal (EPI), near-epiphyseal (NEF), and midshaft portions when possible, and specimens were assigned to upper (humerus or femur), intermediate (radioulna or tibia), or lower limb (metacarpal or metatarsal) segments when they could not be precisely identified to element. All specimens bearing multiple long bone portions were tallied as the most proximal or distal non-MSH portion. For example, any specimens bearing PEPI, PNEF and MSH portions would be identified as a PEPI + MSH specimen and be counted as an epiphyseal portion when examining trends in the experimental assemblage. Specimen

Download English Version:

<https://daneshyari.com/en/article/5112015>

Download Persian Version:

<https://daneshyari.com/article/5112015>

[Daneshyari.com](https://daneshyari.com)