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A biometric analysis of the pelvic acetabulum as an indicator of sex in bovids

Analyse biométrique de l'acetabulum pelvien en tant qu'indicateur du sexe chez les bovidés

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ABSTRACT

Despite its potential importance in the reconstruction of hunting strategies and subsistence patterns, determining sex in zooarchaeological assemblages is a task that has been often neglected because the assemblages consist mainly of fragmentary bones. Only a limited amount of research has been focused on sexing individuals at archaeological sites. Although dimorphic elements in skeletal anatomy (e.g., horns) are the most widely used indicators for sexing, other skeletal parts, such as the pelvic acetabulum provide valuable information to identify sex. The present work builds upon previous research and indicates the most useful indicators in the pelvic acetabulum to distinguish sex in bovids, with the goal of providing an analytical basis to expand interpretations of carcass acquisition strategies by humans.

RÉSUMÉ

En dépit de son importance potentielle dans la reconstitution des stratégies de chasse et des systèmes de subsistance, la détermination du sexe dans les assemblages zoo-archéologiques a souvent été négligée, en raison de la nature fragmentaire des assemblages d'os. Seule une partie limitée de la recherche a été focalisée sur la détermination du sexe des individus sur les sites archéologiques. Bien que la présence d'éléments dimorphes dans l'anatomie du squelette (par exemple les cornes) ait été largement utilisée dans la détermination du sexe, certaines parties du squelette apportent des informations très valables en la matière. L'une des plus importantes est l'acetabulum pelvien. Le présent travail est construit à partir d'une recherche antérieure et met en évidence les indicateurs les plus utiles dans l'acetabulum pelvien pour la détermination du sexe chez les bovidés, dans le but de fournir une base analytique pour élargir l'interprétation des stratégies d'acquisition des carcasses par l'Homme.

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1. Introduction

Sex identification of animals accumulated in archaeofaunal assemblages is a potentially useful tool for the reconstruction of hunting strategies and subsistence of prehistoric human groups (Arceredillo et al., 2011; Davis et al., 2012; Greenfield, 2002; Munro et al., 2011; Weinstock, 2000). The difficulties of sexing fragmented archaeofaunal collections have often been stressed in zooarchaeological studies (e.g., Klein and Cruz-Uribe, 1984; Munro et al., 2011). The main reason for this is the state of fragmentation in which archaeologists find faunal remains, or the absence of diagnostic elements. Sexing is possible through particular traits or morphological features (e.g., antlers in cervids, horns in bovids, the presence or absence of canines in equids, the presence of a baculum in carnivores) or the pelvis shape (Davis, 1987; Greenfield, 2002; Klein and Cruz-Uribe, 1984; Munro et al., 2011; Ruscillo, 2003). In addition, sexing can also be approached through the biometrics of certain skeletal parts, such as metapodials.

Sexing archaeofaunal remains could play a major role in the reconstruction of subsistence patterns and hunting strategies by early hominins. Certain carnivores show particular preferences when preying on different taxa. The spotted hyena, for example, displays a preference for males in the case of wildebeests, with a sex ratio of 1.84:1 in the Seregeti (Kruuk, 1972); this is also documented when they prey on Thomson's gazelles (ratio = 3.1:1) (Kruuk, 1972). In contrast, spotted hyenas prefer females when they kill zebras (0.5:1 Seregeti; 0.4:1 Ngorongoro) (Kruuk, 1972), showing that they can be selective hunters.

Lions also prefer males when they kill wildebeest (2:1) in the Serengeti (Schaller, 1974). They show no sex preference when killing zebras and buffalos (1:1), except with older individuals, in which case males are hunted more frequently. In the case of Thomson's gazelle, lions prey on one sex or another depending on the season (Schaller, 1974).

Leopards especially prey on male Thomson's gazelles (73%), but they prefer females when they kill reedbucks in the Serengeti (Schaller, 1974). Cheetahs show no sex preference when they prey on Thomson's gazelle in the Serengeti, but, in contrast to lions, they prey more on females when they hunt older individuals (Schaller, 1974). Wild dogs also show preferences for male Thomson's gazelles (Schaller, 1974).

These few examples show that carnivores are selective hunters when it comes to the sex of the prey. They have preferences among species and frequently display preferences of one prey sex over the other depending on each species (Kruuk, 1972; Mills, 1990; Schaller, 1974). Potential scavenging hominins should display a selection of prey sex coincident with those of the carnivores that they scavenge from. Archaeological examples of sex selection or the lack thereof abound in the zooarchaeological literature. For example, Arceredillo et al. (2011) observed that Neanderthal groups killed more males than females of chamois at the site of Valdegoba (Burgos, Spain). In contrast, Weinstock (2000) concluded that because males and female reindeer were equally hunted at the site of Stellmoor (northern Germany), the groups at this site practiced non-selective hunting.

Sexing specific taxa have been carried out using biometric features (e.g., Arceredillo et al., 2011; D′Errico and Vanhaeren, 2002; Greenfield, 2002; Munro et al., 2011; Tchernov et al., 1990; Weinstock, 2000), statistical methods (e.g., Arceredillo et al., 2011), discrete traits (e.g., D′Errico and Vanhaeren, 2002; Munro et al., 2011; Prummel and Frisch, 1986; Ruscillo, 2003), or using DNA analysis (McGrory et al., 2012, Svensson et al., 2008). Munro et al. (2011) provided a list of traits to distinguish the sex for *Gazella gazella* (mountain gazelle) using traits such as the atlas, whose caudal wings are more robust in males than females; the body, being broader and higher in males than females; the glenoid cavity of the scapula, ovoid in females and round in males; and the pubic symphysis, where the pubic arch is V-shaped in males and U-shaped in females. D′Errico and Vanhaeren (2002) differentiated between red deer males and females through morphological and metrical variables taken from canines. Svensson et al. (2008) and McGrory et al. (2012) analyzed DNA from cattle metacarpals and mandibles, respectively, in order to separate sexes. Prummel and Frisch (1986) proposed how to differentiate male and female sheep through differential pelvic morphology. Greenfield (2002) used different measurements from the acetabulum to determine the sex of cervids and bovids, and some of these characters constitute the bulk of the present study.

The innominate is one of the best indicators of sex in mammals due to the effects of reproduction upon the skeletal structure (Greenfield, 2002). The medial faces of the iliac and the pubic areas have several diagnostic traits that are very useful to determine sex from complete or partially complete specimens (Greenfield, 2002). One of the most important diagnostic characters is the medial wall of the acetabulum, which is thinner and shorter in females and higher and more robust in males. As Greenfield (2002) noticed, this feature was addressed early in both German and English literature (Boessneck et al., 1964; Grigson, 1982; Lemppenau, 1964; Prummel and Frish, 1986; Von Leithner, 1927). However, other acetabular features have been neglected in the literature (Greenfield, 2002).

The aim of the present study is to test the characters used by Greenfield (2002) to determine sex on a wider array of bovid taxa. It will be shown that the sex of individual carcasses can be confidently obtained through several types of measurements of the pelvic acetabulum.

2. Sample and method

The specimens included in the present study belong to adult African bovids. Initially, the goal was to obtain the measurements of as many modern African bovids as possible. However, because of sample size (i.e., limited number of individuals per taxon) and also because portions of the bovid collections curated at museums are not properly sexed (see also Greenfield, 2002), we could only test Greenfield's (2002) diagnostic acetabular characters on a total of eight African bovid taxa. The sample was composed of 109 individuals, including a total of 172 acetabula. This number results from the presence of some