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Cover illustration
Buchery marks on goat bones (Photos: S. Badenhorst)

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EDITORIAL

This year has presented many new challenges to all of us both in the academic world and beyond. For museums globally it has challenged us to find new ways to engage with the public with an increasing reliance being placed on the virtual environment. We have all had to struggle with the challenges of balancing domestic and work needs, especially when working from home – how single parents have managed so well constantly amazes me. For some this time has been a struggle, financially, emotionally and even medically. But with the roll-out of vaccinations – the fastest production of vaccinations (or any major medical treatment) in the history of medicine – we can start looking toward a familiar, if changed, future.

For *Indago*, this year has been a challenging time, in its own right, with the appointment of a new editorial committee, consisting of Dr's Brigette Cohen (EiC), Gimo Daniel and Derek Du Bruyn. The previous committee steered the journal through good times and bad including a name and style change and they have made *Indago* what it is today. I would like to thank Mike Bates (EiC), Shiona Moodley and Marianna Botes for all the hard work they have done for the journal over many years. And on a personal level to thank Mike for his kind assistance with the handover process. A new committee means changes and we have made various updates to make *Indago* more accessible and to streamline the submission process. They include uploading the journal's back issues onto the updated museum publication website where they are available as open access documents to the public and researchers alike. Publishing new papers with digital object identifiers. Expanding our scope to cover a wider array of disciplines. *Indago* is one of only a small number of museum journals still publishing (and with an unbroken record of over 60 years) and while 2020 may have been a quiet year for research we already have some exciting new projects on the horizon, including a special issue on Predation Management coming up soon.

Taking on an editorialship (during a pandemic) has been a tight learning curve and I am humbly excited to present volume 36 of *Indago*. I am looking forward to a prosperous tenure as Editor-in-Chief of this remarkable journal.

Dr Brigette Cohen
Editor-in-Chief

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RESEARCH ARTICLES

NATURAL SCIENCES

NATURAL SCIENCES *Indago*, Vol. 36, 2020, pp. 1–12

The Frequency of Butchery Marks on Goat (*Capra hircus*) Remains from Pastoral Khoekhoe Villages at Gobabeb, Namibia

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Abstract

Khoekhoe pastoralists living in Gobabeb, in the arid Kuiseb River Valley of central-western Namibia, keep goats (*Capra hircus*). Several decades ago, palaeontologist C.K. Brain collected modern skeletal remains of goats from these villages. The goats were butchered using pocketknives with metal blades. We investigated the frequency of butchery marks on a sub-sample of this collection, representing 60% of the total assemblage. Most specimens in the collection are weathered. Moreover, most goat specimens from Gobabeb lack butchery evidence and even the use of magnification only marginally increased this number. We compared our results with the frequency of butchery marks documented from Early and Middle Iron Age samples from South Africa, a time when sheep dominated faunal assemblages and were slaughtered using metal knives. The frequency of specimens with butchery marks in the goat sample from Gobabeb is higher than that recorded for the Early and Middle Iron Age samples. The higher frequency of butchery marks on the goat remains from Gobabeb may relate to aspects such as the butchering method and style, as well as the large size of the specimens themselves.

KEYWORDS: actualistic studies, butchery practices, cut mark frequency, arid environment

INTRODUCTION

Butchery marks provide direct evidence of meat-eating by hominins (e.g., Bunn 1981; Blumenschine 1995; Blumenschine *et al*. 1996; Merritt 2012). The frequency of butchery marks on skeletons of animal prey remains an important avenue of research in zooarchaeology (Lyman 1994). Data on butchery are often used by zooarchaeologists to infer the nature of carcass processing from archaeological faunal samples (Egeland 2003). The frequency of butchery marks on animal remains relates to the agents involved in the butchery process (Lyman 2005). These are, first, the animal that is butchered, including aspects such as size, species, age, sex, and preparation of the meat (e.g., Binford 1981; Lyman 1992; Milo 1998; Domínguez-Rodrigo & Barba 2005; Pobiner & Braun 2005; Domínguez-Rodrigo & Yravedra 2009). Second, the tools used also influence the frequency of butchery marks on bone. Important aspects of the tools include the use of retouched vs. un-retouched tools, the type of tool, the raw material used, and hafted vs. hand-held tools (e.g., Walker & Long 1977; Olsen 1988; Greenfield 2008; Domínguez-Rodrigo & Yravedra 2009; Leenen 2011). Third, the butcher and procedures used are additional factors, including the techniques and experience of the butcher, as well his/her age, sex and strength (e.g., Frison 1971; Mooketsi 2001; Parsons & Badenhorst 2004). The frequency of butchery evidence is further distorted by a variety of post-depositional processes (Thompson 2005), such as weathering, scavenging, attrition (Brain 1981; Lyman 1994), analytical, retrieval and excavation biases (Driver 1982; 1991), as well as quantification units (Otárola-Castillo 2010). The use of magnification often results in greater recognition of butchery evidence (Plug 2004; Collins 2013; also Reynard *et al*., 2014). We recently investigated a collection of modern goat (*Capra hircus*) remains from Gobabeb, Namibia to document the frequency of butchery marks.

GOBABEB GOATS

Palaeontologist, C.K. Brain collected goat remains from villages occupied by Topnaar Khoekhoe pastoralists in the Gobabeb region of central-western Namibia in the 1960s (Fig. 1). Brain (1967a, b; 1969; 1981) used this collection to counter the Osteodontokeratic Culture hypothesis of Dart (1957). Brain (1981) was instrumental in determining that animal skeletal parts from archaeological and fossil sites are severely influenced by bone density attrition.

Gobabeb is located 110 km southeast of Walvis Bay in central-western Namibia. Around Gobabeb, the main channel of the Kuiseb River is between 50 and 80 m wide, with a riparian flood plain of 20 to 200 m on each side (Eckard *et al*., 2013). The Kuiseb River is usually dry and only flows occasionally after heavy rains. Subsurface flow is considerable though, allowing for the growth of dense vegetation around the riverbed. The Khoekhoe dig shallow wells in the riverbed, providing for all their water needs. At least 18 villages have existed along the Kuiseb River, with only eight occupied by the 1960s, and a total popu-

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Figure 1. Location of Gobabeb, Namibia (adapted from www.d-maps .com)

lation of less than 150. Daily life of the Khoekhoe revolved around their goat herds. A small quantity of tobacco was grown, but people subsisted entirely on goat milk, goat meat, naras melons (*Acanthosicyos horridus*) and the sale of goatskins. The goats lived entirely on the vegetation of the dry riverbed, in particular from dry seeds of ana trees (*Acacia alhida*). In these arid environments, four miles of riverbed were required to provide the 460 goats in one village with sufficient grazing. A total of 2000 goats were found in the eight villages (Brain 1967b).

Between 1965 and 1967, Brain collected 2373 goat specimens from the eight villages. These were all the available remains visible on the surface at the time. A person's wealth is measured by the size of his goat herd and, as a result, goats were not frequently slaughtered. Nevertheless, Brain (1967a, b) observed and interviewed the Khoekhoe about their butchery techniques. Brain (1967b) noted that the Khoekhoe caused considerable damage to goat bones, during an experimental butchering. In total, 15 caudal vertebrae were chewed and swallowed, while limb bones such as femora and metapodials suffered severe damage at the epiphyseal ends. Based on the number of horns in the sample he collected, Brain (1967b) calculated a minimum of 190 individuals. However, he regarded this number as too high. In arid environments, the horn sheath is almost indestructible, and it lasts for several years after other traces of bone have disappeared. Part of the sample of goat bones came from two deserted villages, which had not been inhabited for over ten years. At these two villages, nearly all the remains left were horn. The Gobabeb region receives less than 25 millimetres of rain per year, and in other regions with higher rainfall, horns would disappear rapidly (Brain 1967b).

METHODS

We recorded the elements, portion of element (after Dobney & O'Rielly 1988) and sides of the goat remains. The ages of the long bones were based on epiphyseal fusion, divided into three categories, namely adults, sub-adults and juveniles. The results were compared to tooth eruption data (Brain 1967a). We noted all butchery (cut and chop) marks using naked-eye observations. We further studied a random sub-sample of bones using an x10 hand-lens for any modifications not visible without magnification. These modifications were quantified by a simple count (present *vs*. absent) and recorded based on skeletal element and portion. For example, a distal humerus shaft with distal articulation containing various cut marks was counted as one modification. We separated cut marks, which are elongated, narrow grooves often V-shaped in cross-section with flat sides; from chop marks, which appear as wide U-shaped grooves (Potts & Shipman 1981; Shipman & Rose 1983, 1984; Marshall 1989). We took the greatest length of all the elements we investigated and grouped them in size categories of 1 cm to determine the general size of the specimens compared to those from archaeological assemblages. We used the Number of Identified Specimens (NISP) to quantify the remains. For the present study, we used a basic three category weathering classification of bones displaying low sun exposure, those that are sun-bleached (appearing white), and those specimens that are severely weathered (showing cracking and a chalky bone surface). Many aspects of the Gobabeb sample remain unstudied, including the length and orientation of butchery marks, detailed weathering stages following Behrensmeyer (1978), long bone breakage, and separating carnivore from human chew marks. These will be dealt with in future studies.

RESULTS

The original assemblage collected by Brain encompassed 2373 specimens (Brain 1967a, b). We studied a sub-sample of this, numbering 1428 specimens, representing 60% of the total assemblage. The remaining 945 specimens consist mainly of skull fragments, horn cores, unidentified bone flakes and loose teeth (Table 1). There is a further slight discrepancy between our sample and that collected by Brain (1967a). The reason for this is that our sample is based on those specimens measured by Badenhorst & Plug (2003), which excluded many shaft fragments and other specimens lacking measurable morphologies. In some cases, our sample contains more specimens than that reported by Brain (1967a). It is possible that Brain (1967a) refitted some specimens, or that a few more bones were collected during his visits in subsequent years.

The sample, weighing a total of 13 258.8 g used in this study, includes young, sub-adult and adult individuals (Table 2). The sample is dominated by spec-

Table 1. Sample comparison with Brain (1967a).

Element	**Number of Specimens Used in This Study**	**Number of Specimens Collected by Brain 1967a**
Skull and Maxilla	69	512
Mandible	148	188
Loose Teeth	0	15
Atlas	14	12
Axis	8	14
Other Cervical	0	12
Thoracic	26	21
Lumbar	45	31
Sacrum	2	1
Caudal	0	0
Other Vertebra	0	24
Rib	183	174
Scapula	34	59
Pelvis	48	55
Humerus	189	196
Femur	115	115
Radius - Ulna	93	207
Tibia	230	237
Metacarpal	64	100
Metatarsal	72	101
Metapodial	12	0
Astragalus	10	16
Calcanium	18	14
Phalange	46	21
Navicular Cuboid	2	0
Bone Flake	0	248
Total	**1428**	**2373**

imens that are classified as adult (n = 688). Aging of teeth also found a dominance of adult goats, although almost half of the limb bones of the original sample derived from immature individuals (Brain 1969). Overall, the most common elements in the sample are tibiae (n = 230), humeri (n = 189), ribs (n = 183), mandibles (n = 148) and femora (n = 115). Most elements are represented in the sample, but the following elements are absent: caudal vertebrae, carpals, tarsals, sesamoids and isolated teeth. Most of the specimens measured between 5 and 120 cm in length, followed by relatively few specimens that measure under 5 cm or above 13 cm (Fig. 2). No specimens smaller than 1 cm were collected, whereas the largest specimen was between 22 – 23 cm.

Most specimens display some form of weathering, mostly sun bleaching (Table 3, Fig. 3). This indicates that few bones were fresh when Brain collected them and that most specimens had been exposed to the natural elements in the arid environment for a few months.

When considering butchery marks on the Gobabeb goat remains, a number of interesting patterns emerge (Table 4, Fig. 4). First, some elements have no evidence of butchery, including cervical (excluding the atlas and axis), thoracic and lumbar vertebrae, and astragali. Second, despite unequivocal evidence that goats were slaughtered and consumed, only 15% of the overall sample contains butchery evidence. Third, cut marks are more common on the goat remains than chop marks, with few specimens showing a combination of the two butchery techniques. Fourth, the incidence of butchery varies considerably between elements, from common (above average in descend-

Table 2. Skeletal elements and age groups of the Gobabeb goats (NISP).

Element	Young	Sub-Adult	Adult	Indeterminate	Total	Mass (g)
Skull	4	2	20	9	**35**	2073
Maxilla	18	-	16	-	**34**	1134
Mandible	6	71	71	-	**148**	3993
Atlas	-	1	13	-	**14**	336.1
Axis	2	-	6	-	**8**	138
Thoracic	8	6	12	-	**26**	56
Lumbar	18	5	22	-	**45**	84.3
Sacrum	-	1	1	-	**2**	25.2
Rib	-	-	-	-	**183**	573
Scapula	5	2	27	-	**34**	488.3
Pelvis	1	2	45	-	**48**	312
Humerus	29	2	139	19	**189**	972.80
Femur	16	4	37	58	**115**	406.4
Radius - Ulna	8	-	63	-	**71**	497.3
Radius	11	1	2	-	**14**	54
Ulna	7	-	1	-	**8**	10.1
Tibia	11	1	72	146	**230**	497.3
Metacarpal	15	4	45	-	**64**	287.2
Metatarsal	22	4	46	-	**72**	995
Metapodial	7	-	5	-	**12**	21.5
Astragalus	1	-	9	-	**10**	56.8
Calcanium	5	-	13	-	**18**	108.2
Navicular Cuboid	1	-	1	-	**2**	7.3
Phalange	24	-	22	-	**46**	132
Total	**219**	**106**	**688**	**232**	**1428**	**13258.8**

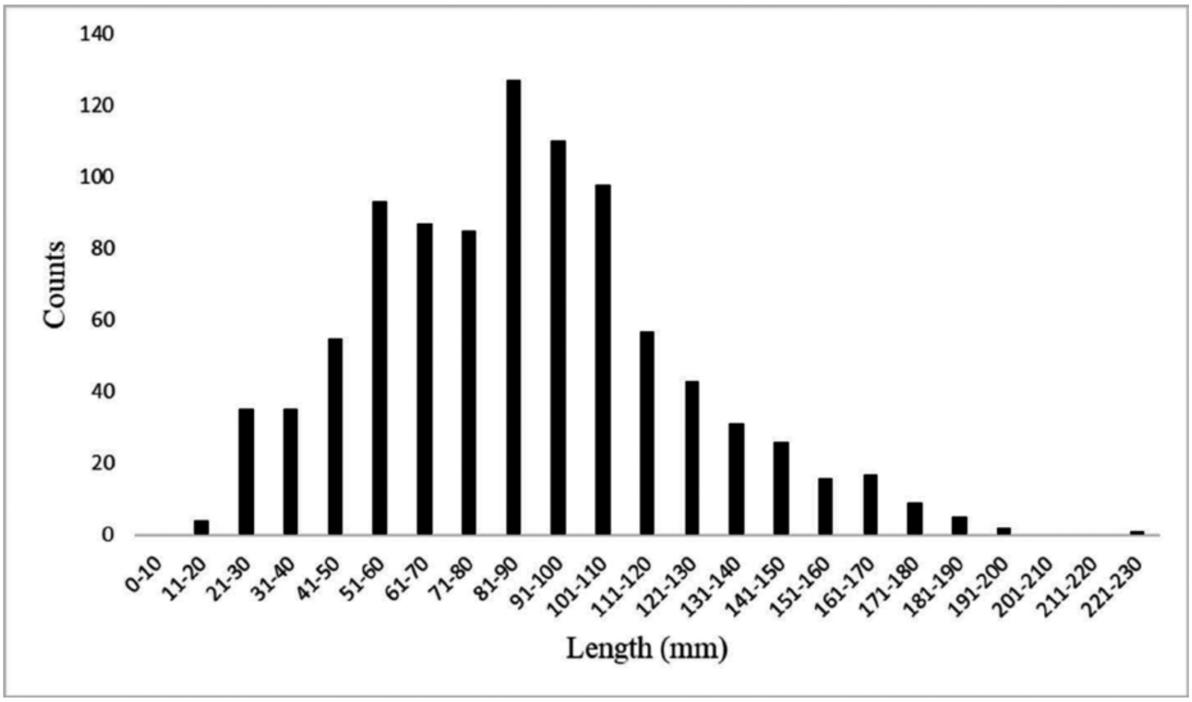

Figure 2. Length categories (mm) of goat remains from Gobabeb.

Table 3. Weathering counts of Gobabeb goat bones (NISP).

Weathering Condition	Number of Specimens	Percentage
Low sun exposure	194	17
Sun-bleached	721	64
Severe weathering	216	19
Total	**1131**	

Figure 3. Examples of goat bones showing (a) sun bleaching and (b) severe weathering.

ing order: axis, sacrum, skull, scapula, metacarpal, atlas, humerus, radius-ulna, mandible and pelvis) to uncommon (below average in descending order: femur, tibia, metatarsal, metapodial, calcaneum and phalange).

When considering the occurrence of butchery on long bones only (Table 5), the highest number of butchery modifications is recorded on the distal articulation of the humerus and the proximal shaft of the radius-ulna (the latter usually found articulated in the collection). No butchery was recorded on the distal shaft or articulation of metapodia. Overall, specimens with higher frequencies of butchery marks correspond to the elements Brain (1969) observed receiving severe damage during slaughtering (Table 6). In some cases, Brain (1969) observed no damage during butchery on elements such as the distal humerus, yet they sustained some of the highest frequency of butchery marks.

We selected a random sample of 100 long bone specimens and studied them with an x10 hand-lens in an effort to increase the number of butchery marks (Table 7). We were only able to identify one additional butchery mark that was missed during the naked-eye analyses.

DISCUSSION & CONCLUSION

The Gobabeb sample displays a high frequency of bones that are weathered. This is to be expected given that the bones were exposed to the sun in an arid environment (Brain 1967a). The degree of weathering, as well as the length of time causing weathering is dependent on factors such as context and geographical location (Behrensmeyer 1978). Weathering affects the preservation of butchery marks (Gifford-Gonzalez 1989) and it is likely that weathering contributed at Gobabeb to the disappearance of butchery evidence, especially on heavily weathered bones whose outer surface had become chalky. Chewing damage by people (Brain 1969) also likely obscured butchery marks. Despite the influence of weathering and chewing damage, the percentage (15%) of butchery evidence on the goats from Gobabeb is higher than that usually recorded for Early and Middle Iron Age sites from South Africa (Table 8) where sheep dominate faunal assemblages (Badenhorst 2018). These

Table 4. Frequency of butchering modification on the Gobabeb goats.

Element	Cut Marks	Chop Marks	Cut + Chop Marks	Total Butch-ering	Total Number in Assemblage	% Butchered
Skull, Maxilla	9	18	-	**27**	69	39
Mandible	11	13	2	**26**	148	18
Atlas	3	1	-	**4**	14	29
Axis	2	2	-	**4**	8	50
Sacrum	-	1	-	**1**	2	50
Scapula	5	7	-	**12**	34	35
Pelvis	-	8	-	**8**	48	17
Humerus	44	4	2	**50**	189	26
Femur	13	4	2	**19**	115	10
Radius - Ulna	14	5	6	**25**	93	20
Tibia	16	4	1	**21**	230	9
Metacarpal	17	3	-	**20**	64	31
Metatarsal	15	-	-	**15**	72	8
Metapodial	1	1	-	**2**	12	8
Calcanium	1	-	-	**1**	18	6
Phalange	2	-	-	**2**	46	4
Total	**134**	**67**	**11**	**212**	**1428**	**15**

Figure 4. Examples of goat bones with traces of butchering under a Veho USB microscope with x40 magnification: (a) specimen showing cut marks on the distal epiphysis of a humerus, (b) specimen showing evidence of cut marks on a distal metapodial, (c) chop and cut mark on a severely weathered long bone mid-shaft, and (d) chop mark on a tibia mid-shaft with low sun exposure.

Table 5. Distribution of butchering marks on goat long bones from Gobabeb.

Element	Proximal Articulation	Proximal-Shaft	Mid-Shaft	Distal-Shaft	Distal Articulation	Total
Humerus	-	1	10	12	27	**50**
Femur	2	6	4	3	4	**19**
Radius - Ulna	4	15	9	2	-	**25**
Tibia	-	3	9	6	3	**21**
Metacarpal	3	11	3	3	-	**20**
Metatarsal	1	4	7	3	-	**15**
Metapodial	-	-	2	-	-	**2**

Table 6. Comparisons between the frequency of butchery marks on the goats from Gobabeb (Tables 4-5) and the physical damage observed by Brain (1969).

Element	Frequency of Butchery Marks Recorded	Damage Noted by Brain (1969)
Skull, Maxilla	High	Horns broken off; occiput smashed; snout and palate broken off
Mandible	High	Undamaged
Atlas	High	Remained attached to the occiput
Axis	High	Part remained attached to the atlas
Sacrum	High	Undamaged
Scapula	High	Undamaged
Pelvis	High	Chopped through pubis and across the acetabulum
Humerus	High	Proximal ends chewed away; shafts broken; distal ends undamaged
Femur	Low	Proximal ends removed and proximal shafts chewed; shafts broken; distal ends removed and distal shafts chewed
Radius - Ulna	High	Shattered by stone
Tibia	Low	Shafts broken; damage to proximal and distal ends
Metacarpal	High	Proximal ends complete; distal ends removed and distal shafts chewed
Metatarsal	Low	Proximal ends complete; distal ends removed and distal shafts chewed
Metapodial	Low	-
Calcanium	Low	Undamaged
Phalange	Low	Undamaged

Table 7. Subsample of goat long bones from Gobabeb examined under x10 hand-lens.

Elements	Subsample	Additional Butchered Marks
Humerus	25	-
Femur	20	1
Radius - Ulna	10	-
Tibia	25	-
Metacarpal	10	-
Metatarsal	10	-
Total	**100**	**1**

Table 8. Frequency of butchery marks on Early and Middle Iron Age sites from South Africa.

Site Name	Total Faunal Assemblage	Number of Specimens with Butchery Marks	% butchered	Reference
Magogo	6078	134	**2**	Voigt 1984
Nanda	7862	173	**2**	Plug 1993
KwaGandaganda	41006	3198	**8**	Beukes 2000
K2	98338	1694	**2**	Hutten 2005
Doornkop	1231	32	**3**	Antonites *et al.* 2014
MNR74	4161	85	**2**	Antonites *et al.* 2016
Gobabeb Goats	**1428**	**165**	**15**	**This study**

sheep were also slaughtered using metal knives, thus providing comparable data. Faunal material recovered from archaeological sites in southern Africa is usually very fragmented (e.g., Voigt 1983). At Gobabeb, the specimens are large, which may have contributed to an increased visibility of butchery evidence. Moreover, archaeological samples contain a variety of animals, and some smaller taxa may not have been butchered at all, but roasted whole over coals (e.g., Henshilwood 1997), potentially biasing any comparisons between Gobabeb and archaeological samples.

Moreover, the reason(s) why butchery marks are more frequent on the goat remains from Gobabeb is complex and likely multi-faceted. Like many other pastoralist communities in Africa, the Khoekhoe of Gobabeb live in an arid environment that does not support crop cultivation, and people rely mainly on milk, blood, and meat (Brain 1967a, b; 1969). Once goats are slaughtered, people consume all edible parts (Brain, 1967a, b). Consequently, this intense utilisation of a carcass may have contributed to a high number of butchery marks as people removed as much meat, sinew, and ligaments as possible.

Various factors affect tenderness of meat, including breed, age, sex and diet (e.g., Schönfeldt *et al*., 1993), which likely cause variation in butchery frequency on skeletal elements (Badenhorst 2012). In the Gobabeb sample, some butchery marks are seemingly inflicted randomly. For example, some bones have cross-sectioned cut marks, while others have deep chop marks inflicted randomly on mid-shafts and epiphyseal ends. These marks may suggest the involvement of different butchers (Stiner *et al*., 2009). The lower leg bones are cooked separately by children at Gobabeb (Brain 1967b). This may suggest the possibility that butchery marks were produced by both adult butchers and, potentially, children. The Khoekhoe skin and dismember a goat while the carcass is suspended by its feet from a branch (Brain, 1969). It is possible that different positions of the carcass during butchering produce different frequencies of butchery marks (Cruz-Uribe & Klein 1994; Leenen 2011).

The relative higher incidence of butchery marks on the goat remains from Gobabeb compared to Early and Middle Iron Age samples is likely due to a combination of factors. Some of the most pertinent factors include the butchering method and style as well as the large size of the specimens themselves.

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