Lee G. Broderick

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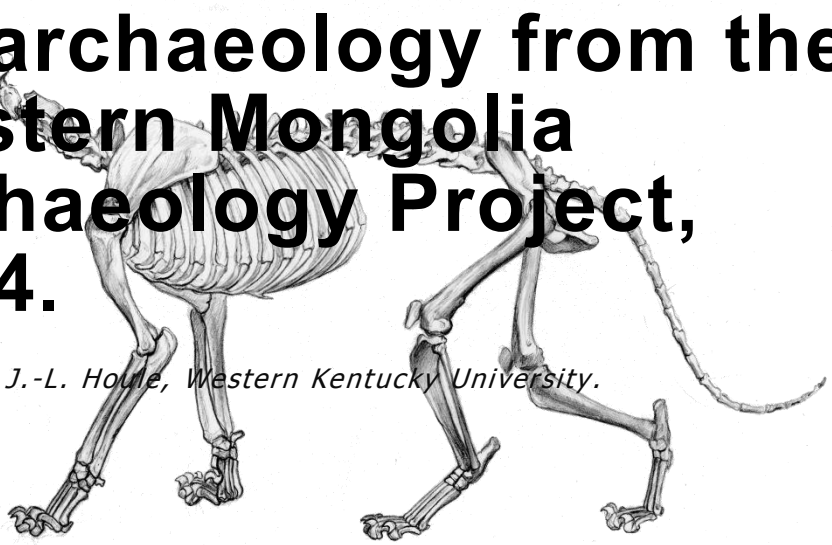
All Present and Correct: Bioarchaeology from the Western Mongolia Archaeology Project, 2014.



Report for J.-L. Houle, Western Kentucky University.

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1. Introduction

Analysis of zooarchaeological assemblages from Bronze Age domestic sites in Mongolia is a practice very much in its infancy. Previous work has been focused on the Khanuy valley, in the Arkhangai province of northern central Mongolia (e.g. Broderick and Houle, 2013). This report examines the remains excavated during the 2014 field season of the Western Mongolia Archaeology Project in Tsaagan Asgaa, Bayan-Ölgii. A single structure, believed to be a Bronze Age habitation site, was excavated during this season, the results of which form the focus of much of this report.

If zooarchaeological research is in its infancy in Mongolia then it seems fair to suggest that archaeobotanical research is nebulous (but see Houle, 2010). The opportunity to asses flora remains from any archaeological site in the country is then one to be seized and an initial assessment of the material recovered from the same site, mentioned above, is also presented here.

A Turkic monumental site was also excavated and the material recovered from that excavation is discussed separately from that associated with the habitation site. Similarly to domestic archaeology in Mongolia, Turkic monuments remain poorly investigated in comparison with those of earlier and later periods in the country.

Research aims and objectives include:

i. To gain information about the wild and domestic animal species exploited in the Bronze Age in the region.
ii. To better understand the palaeoenvironment.
iii. To identify faunal remains associated with Turkic monuments.

2. Fauna

2.1 Methods

A full account of the methods used in identification and recording of the assemblage can be found in the appendices.

The binomial name is used for all species throughout this report. Taxonomy follows Wilson and Reeder (2005) for mammals and Voous (1977) for birds. For convenience, their common (English) name is used in brackets alongside the binomial name when the animal is first mentioned, and a dictionary of all the animals mentioned is provided in the appendices. The word caprine is used when referring to an animal that may be a sheep or a goat.

A full account of the methods used in identification and recording of the assemblage can be found in the appendices. The binomial name is used for all species throughout this report. Taxonomy follows Wilson and Reeder (2005) for mammals and Gill and Donsker (2013) for birds. For convenience, their common (English) name is used in brackets alongside the binomial name when the animal is first mentioned, and a dictionary of all the animals mentioned is provided in the appendices. The word 'caprine' is used when referring to an animal that may be a sheep or a goat.

In brief, all teeth with were counted (maxillary and mandibular) and a pre-determined selection of skeletal parts was recorded for use in minimum number calculations. Specifically, these parts are as follows: zygomaticus; occipital; supraorbital; atlas; axis; scapula (glenoid articulation); distal humerus; proximal humerus; distal radius; proximal radius; proximal ulna; carpal 2-3; distal metacarpal; pelvis (ischial part of acetabulum); distal femur; proximal femur; distal tibia; proximal tibia; calcaneum (sustentaculum); astragalus (lateral side); scafocuboid; distal metatarsal and proximal parts of the 1^{st}, 2^{nd} and 3^{rd} phalanges. At least 50% of any given part had to be present for it to be recorded in the 'bones' database, used for calculating more complex quantification measures such as MNE (Minimum Number of Elements), MAU (Minimum Animal Units) and MNI (Minimum Number of Individuals). Horncores with a complete transverse section were also recorded in this database. The presence of large (cow or horse sized), medium (sheep or pig sized) and small vertebrae and ribs were recorded in the 'fragments' database. Other, more difficulty identifiable, bones were also recorded in the 'fragments' database and included in the NISP (Number of Identified SPecimens) counts.

The separation between *Ovis aries* (sheep) and *Capra hircus* (goat) was attempted on the following elements: mandible; dP_3; dP_4; M_1; M_2; M_3; distal humerus; distal metapodials (both fused and unfused); distal tibia; astragalus and calcaneum, using the criteria described in Boessneck (1969), Payne (1969, 1985), Kratochvil (1969) and Halstead, et al.(2002).

The separation between *Dama dama* (fallow deer) and *Cervus elaphus* (red deer) was attempted on the following elements: scapula; distal humerus; proximal radius; distal radius; proximal metacarpal; distal metacarpal; distal tibia; astragalus; calcaneum; proximal metatarsal; distal metatarsal and first phalanx, using the criteria described in Lister (1996).

Wear stages were recorded for P_4, dP_4, M_1, M_2, and M_3 of *Bos* sp. (cattle), caprines and *Sus* sp. (pig), both isolated and within mandibles. Tooth wear stages follow Grant (1982) and Halstead (1985) for *Bos* sp., Bull and Payne (1982) for *Sus* sp. and Payne (1973; 1987) and Jones (2006) for caprines.

A mammal bone epiphysis is described as 'fusing' once spicules of bone have formed across the epiphyseal plate, joining epiphysis to metaphysis, but while some gaps are still visible between the epiphysis and diaphysis. An epiphysis is described as fused once these gaps along the line of fusion have disappeared. Fusion stages follow Moran and O'Connor (1994) and Zeder (2006). Where mammal bones were fused, or fusing, metapodial measurements were taken according to Davis (1996), measurements for *Sus*

sp. teeth were taken following Payne and Bull (1988), whilst all other measurements taken followed the criteria laid out by von den Driesch (1976).

Equus caballus (horse) bones and teeth are aged according Silver (1969) and Levine (1982) whilst separation between the various equid species was attempted on the molars, premolars, metapodials and astragali according to criteria laid out by Davis (1980).

The assemblage studied is presently kept by the National Museum of Mongolia.

2.1 Results

2.1.1 The habitation site (TA165)

The overall condition of the assemblage was highly fragmentary but in spite of this it was possible to identify 19 of the 87 specimens to species level (21.84%) and a further 24 to size and class, giving a total NISP of 43 (49.43% of NSP [Number of SPecimens]). The fragmentary nature of the assemblage is best demonstrated by their small size, with just seven fragments measuring more than 50mm at their greatest dimension (Figure 1). The abundance of fragments less than 25mm in size may be skewed by the number of specimens recovered from the 1mm wet-sieved flotation heavy residue sample (other specimens were recovered through 6mm dry-sieving) but it is worth noting that this size class is still dominant even when that assemblage is considered in isolation (51.11%). 37 specimens (42.53%) were recovered through the heavy residue in total.

The fragmentation of the specimens appears to have largely occurred when the bones were already long dissociated from any living bodies (Figure 2). This would suggest that much of the taphonomic damage accorded to the bones may mask anthropogenic signatures. Indeed, most of the specimens in the assemblage may have lain on the exposed ground surface for at least four years before eventually being incorporated into the archaeological deposits (Figure 3). Two specimens also appeared to have been bleached by exposure to sunlight. That burial would have been a slow process is further indicated by the amount of root etching identified on the specimens; more than half of the assemblage exhibited signs of this process (Figure 4).

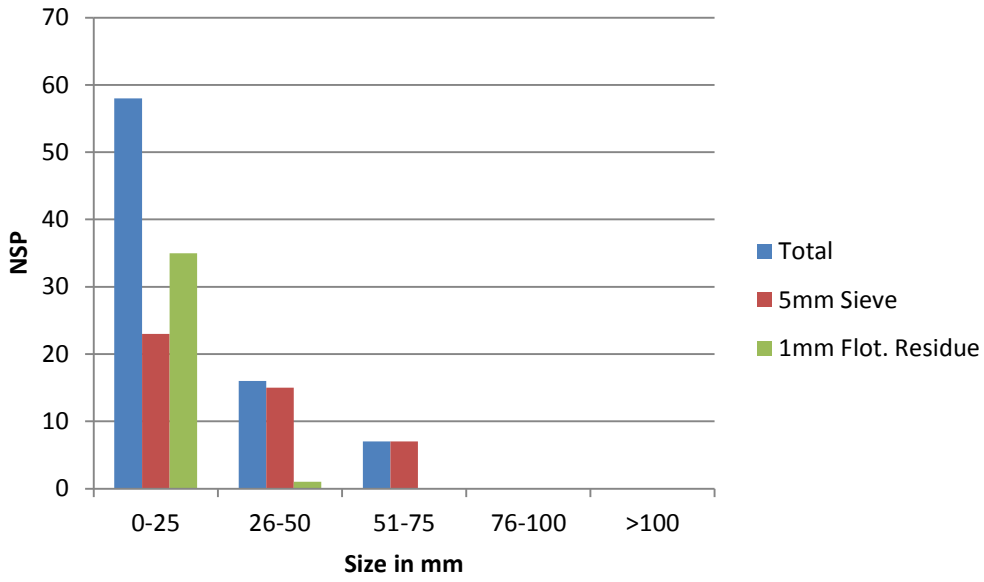

Figure 1: TA165 specimens grouped by size.

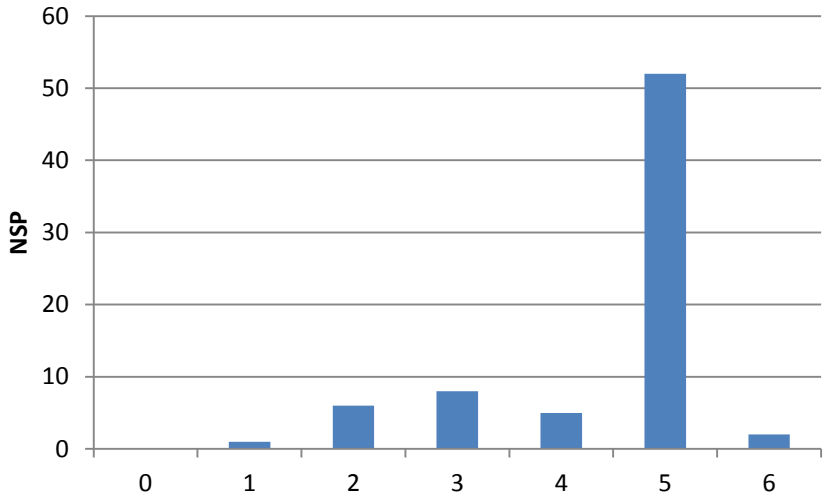

Figure 2: FFI values for TA165 assemblage.

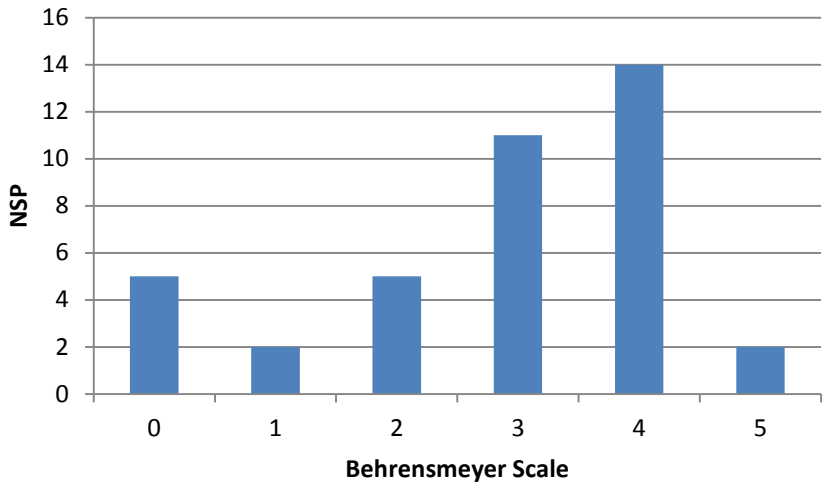

Figure 3: Weathering damage to TA165 assemblage.

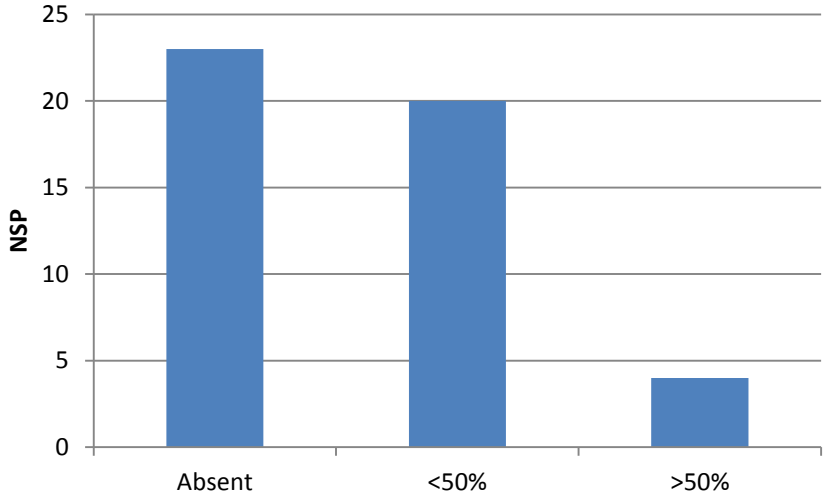

Figure 4: Root damage identified on specimens from TA165, grouped according to whether the damage was absent, covering less than half of the surface of the specimen or more than half.

Signs of possible anthropogenically mediated taphonomic processes were also identified – 24 (27.59%) specimens were burned or calcined and five were polished. Additionally, two specimens had been gnawed by canids.

Class	Size	Order	Family	Binomial Classification (Latin)	NISP
Mammalia	Large	*Perissodactyla*	*Equidae*	*Equus* sp.	1
		Artiodactyla	*Bovidae*	cf. *Bos* sp.	5
				Bos sp.	1
		n/a	n/a	Indet. large mammal	11
	Medium	*Artiodactyla*	*Bovidae*	*Ovis* sp./*Capra* sp.	2
		n/a	n/a	Indet. medium mammal	6
	Small	*Lagomorpha*	*Ochotonidae*	*Ochotona* sp.	2
		Rodentia	n/a	*Rodentia*	4
			Sciuridae	cf. *Marmota* sp.	2
			Cricetidae	*Cricetidae*	2
		n/a	n/a	Indet. small mammal	7
				Total	43

Table 1: NISP from TA165.

Both of these gnawed specimens were from large mammals – one from *Equus* sp. Large mammals generally accounted for 41.6% the total NISP (Table 1). *Bos* sp. was also identified among the large mammal specimens, represented by a loose maxillary second premolar, whilst two more teeth specimens as well as pelvis, ulna and metapodial fragments were identified as cf. *Bos* sp. Despite being so few specimens, this represents limbs, axial and extreme parts of the body. The *Equus* sp. specimen already discussed is a 2nd phalanx, which is notable also for its being an unfused proximal diaphysis.

The most secure identification made amongst medium mammals was of caprine, based on one loose maxillary second molar and one metatarsal.

Among the small mammals, *Marmota* sp. was represented by two tooth fragments, including at least one molar, and *Cricetidae* was similarly represented by two mandibles. One of these mandibles came from the flotation heavy residue, which was wet-sieved at 1mm. The flotation residue also produced both specimens of *Ochotona* sp. – a femur and a tibia. It's worth noting that these latter two specimens as well as a small rodent humerus, third metatarsal and mandible identified were devoid of any signs of root etching or weathering (the metatarsal, recovered in the 6mm dry-sieve, was exceptionally recorded as a '1' on the Behrensmeyer scale, suggesting minimal exposure to the elements).

2.1.2 The monumental assemblage (TA812)

TA812 was a site centred around a Turkic standing stone in a box, the assemblage analysed here came from an associated stone circle outside of the box. Specimens were collected by hand, without any sieving, although, as with TA165, above, this analysis also includes those fragments recovered from the heavy residue of flotation – effectively a 1mm wet sieve. 376 specimens of the total NSP (1010, 37.23%) were recovered through this 1mm sieve, including both of the two most identifiable bones. Despite being a very small sample, we can be fairly confident that the majority of the specimens are those of a medium mammal (94.74% NISP), with an *Ovis* sp./*Capra* sp./*Capreolus* sp. first phalanx being the most precise identification made (Table 2). Other skeletal elements of medium mammal identified were a humerus and a metacarpal. The only specimen identified as something other than medium mammal in the assemblage was of a cf. *Ochotona* sp. maxilla.

Class	Size	Order	Family	Binomial Classification (Latin)	NISP
Mammalia	Medium	*Artiodactyla*	*Bovidae/Cervidae*	*Ovis* sp./*Capra* sp./*Capreolus* sp.	1
		n/a	n/a	Indet. medium mammal	17
	Small	*Lagomorpha*	*Ochotonidae*	cf. *Ochotona* sp.	1
				Total	19

Table 2: NISP from TA812.

Root etching was present on all specimens in the assemblage with the exception of the cf. *Ochotona* sp. maxilla: every other specimen in the assemblage had less than 50% of its surface affected by this taphonomy. Finally, the cf. *Ochotona* sp. maxilla was one of five specimens in the assemblage to show no signs of having been burned (0.50%) whereas 680 (67.33%) had been carbonised and 325 (32.18%) had been calcined (Figure 5).

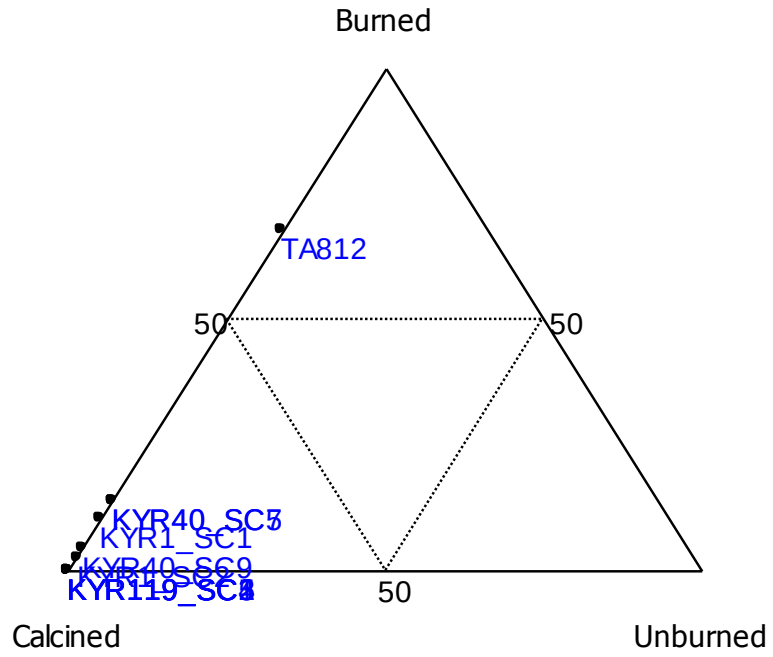

Figure 5: Tertiary plot of unburned, burned and calcined specimens from TA812 compared to assemblages from ten Bronze Age stone circles from the Khanuy Valley, Arkhnagai province.

2.2 Interpretation

Several burrowing species were identified within the assemblage. The firm identification of burrowing species in archaeological assemblages is fraught with difficulty, for obvious reasons. The potential for intrusion of these species is great and they also often have a severe impact upon the artefactual and stratigraphic record (Dunwell and Trout, 1999).

To be consistent, these animals have to all either be included or discounted in the analysis, since the reasons for discounting them should apply to all. Given the extremely low incidence of root-etching and weather exposure evidenced among the small mammal specimens it seems prudent to discard

them from archaeological interpretations of the site even if some, such as *Marmota* sp., have a verified role in human lives today and in the past (Broderick, 2011).

2.2.1 Ecology and environment

Ovis aries is a species which prefers open pasture (Harris and Yalden, 2008, p. 625; Squires, 1975). A wide variety of breeds have been developed since its original domestication, some of which can survive extremes of temperature (Squires, 1975). *Capra hircus* prefers dry ground and is a species descended from one common in Central Asia (Harris and Yalden, 2008, p. 630).

Equus is almost exclusively a grazing genus, and neither *Equus caballus* nor *Equus prezwalski* make use of browse, instead, their diet is dominated by grasses and sedges, which they can access even through snow (Harris and Yalden, 2008, p. 558; Salter and Hudson, 1979). As such, they are well adapted to extreme cold temperatures but can also survive in hot climates provided that there is enough forage and water (Salter and Hudson, 1979).

2.2.2 Economy and human interaction

Bos sp. was the most numerous large mammal, by NISP. In many ways this is contrary to what might have been expected, since *Bos* sp. has been a very rare find in Bronze Age Mongolian assemblages before now, which had led to the belief that it may be a new, exotic animal in this period (Houle, 2010). In Tsaagan Asgaa today, *Bos* sp. and *Equus* sp. are slaughtered in small numbers when first moving to the winter campsite; at this point the animals are in peak physical condition after the summer grazing and so slaughtering then maximises the meat yield (Broderick, n.d.). The meat can then be preserved for storage throughout the ensuing winter and portions of the dried meat are transported and continue to be consumed at spring sites. Slaughtering the animals after arrival at the winter campsite, rather than before leaving the summer campsite can probably be explained by a variation of the Schlepp effect – in essence it's much more energy efficient to make the animal carry its own meat to the winter campsite.

The origins and nature of *Bos* sp. in Mongolia are still poorly understood, two species are present in Tsaagan Asgaa today – *Bos grunniens* and *Bos taurus* – but no method has yet been devised for distinguishing between their skeletal remains.

Equus sp. proximal second phalanges fuse before 9-12 months of age (Silver, 1969) so the specimen identified from TA165 was certainly from an individual less than one year old. In the Khanuy Valley (Arkhangai) today, horses are slaughtered at 2-3 years of age for their meat (Broderick, n.d.), elsewhere in Mongolia, the Khalkha also slaughter their horses for meat at this age (Levine, 1990, p. 730), this represents a recent development however, following a culturally acquired preference for more tender meat, and traditionally horses would have been slaughtered for meat by the

Khalkha at 14-15 years of age, following the end of their useful (working or breeding) lives (Levine, 1990, pp. 730–731). It seems unlikely, then, that the specimen comes from an animal slaughtered for food.

Livestock in the area today are most likely to die a natural death in the spring and young horses are especially vulnerable – steps are taken to fodder these animals today to try and nurture them through late cold snaps when growing vegetation is still sparse (Broderick, fieldnotes, 2014). In conjunction with the large proportion of 'large mammal' specimens in the assemblage (for the reason outlined above) and the use of the area today as a spring campsite, all of the information is suggestive of the site having been occupied in the spring in the Bronze Age, albeit this is an interpretation based on a very small sample size and ethnographic analogues from an unrelated people.

The much smaller proportion of medium mammals on the site might at first be seen as surprising given their commonality in Eastern Kazakhstan at this time (Frachetti and Benecke, 2009; Frachetti, 2012) and recent studies which suggest that caprines were also the most numerous livestock species in Central Mongolia (Broderick and Houle, 2013). In fact, however, the patterns identified here are in keeping with the interpretation of the site as being used in spring – work in the Khanuy Valley (Arkhangai) has supported ethnographic models which predict a smaller proportion of caprines at winter and spring sites than at summer sites (Broderick and Houle, 2013; Houle, 2010). Such models can also now be hinted at in Tsaagan Asgaa, as has been suggested above, and this assemblage might indicate that the economic strategy in the area in the Bronze Age was more akin to that from Central Mongolia than the contemporary pattern in Eastern Kazakhstan.

That two specimens had been gnawed by canids suggests that *Canis familiaris* (dog) was also present in Tsagaan Asgaa in the Bronze Age. This is significant as *Canis familiaris* has only been found once in a Bronze Age archaeological context in Mongolia so far (Broderick and Houle, 2013).

The high frequency of carbonized and calcined bones in the assemblage raises difficult questions for interpretation, owing to issues of equifinality. Early analysis of this type of remain in the Khanuy Valley (Arkhangai) has been interpreted as evidence of use of animal bone for fuel (Viner, 2009), however, animal bones are also burnt as a means of disposing of domestic refuse, and of disposing of fallen livestock in the Khanuy valley today (Broderick, n.d.) as well as in Tsagaan Asgaa, where no record has been found of using bones as fuel (Broderick, fieldnotes, 2014). Any of these interpretations are compatible with the data, although the near ubiquity of the material probably argues in favour of some kind of combination.

2.2.3 The monumental site (TA812)

Past research on stone circles in Mongolia has characterised them as a feature of the Bronze Age monumental package (e.g. Broderick et al., n.d., n.d.) and recent work has suggested that these features principally contain the burned remains of caprines (Broderick et al., n.d.). This assemblage is important then, for representing the first time that a stone circle has been

excavated which is associated with the Turkic period and although there are obvious similarities with those earlier structures there are also subtle but important differences.

The cf. *Ochotona* sp. maxilla is the first small mammal specimen to have been recovered from a stone circle feature in Mongolia but its clear differences from the other specimens in the sample – its lack of any signs of root etching or of having been burned as well as its being the only small mammal specimen identified in the assemblage – suggest that it is probably intrusive, a possibility with all burrowing mammals on archaeological sites.

In light of both their greater availability to humans and the similarity to Bronze Age stone circles it seems reasonable to suggest that the *Ovis* sp./*Capra* sp./*Capreolus* sp. specimen identified is most likely to be either *Ovis* sp. or *Capra* sp. This is the first time that a medium mammal humerus has been identified from a Mongolian stone circle, however (although a *Bos* sp. humerus has been identified from one), with previous assemblages being dominated by head and hoof elements (Broderick et al., n.d.). It has been suggested that Bronze Age stone circle rituals may be distantly ancestral to modern day Mongolian shamanic caprine sacrifices (Broderick et al., n.d.). Rather than the restricted suite of skeletal elements identified from the Bronze Age rituals, however, many modern day sacrifices involve the burning of more meat-bearing parts (Purev and Purvee, 2012, p. 251). If Bronze Age stone circles do represent an ancestral practice then Turkic stone circles may constitute one of several intermediary stages in an evolving ritual.

Apart from the skeletal elements identified in the assemblage the most significant discrepancy between this and Bronze Age stone circles studied previously is the proportion of carbonised to calcined bone. Although material was originally hand collected during the excavation, the 1mm wet-sieving of a 4 litre bulk soil sample confirmed the general pattern of there being more carbonised than calcined bone in the deposit; the stark white colour of calcined bone means it is probably more likely to be seen and recovered than the black carbonised bone when finds are recovered by hand anyway. We can be fairly confident then that this is a picture which represents the reality of the activities that took place. Calcined bone has been burned at a much greater intensity than carbonised bone (Shipman et al., 1984) but TA812 is the first stone circle excavated to show signs of burned soil (Bayarsaikhan & Woodley, pers. comm.). The quantity of charcoal recovered from the feature is less than would be expected if the material had been burned *in situ*, however (see below, Flotation of Bulk Soil Samples *(Danielle de Carle)*). This suggests that although the material had been burned elsewhere, as is the case with Bronze Age stone circles, the material was transported to the stone circle before burning was complete – i.e. while it was still hot. This is interesting in light of the role that smoke plays in some modern day caprine sacrifice rituals in Mongolia (Bayarsaikhan, 2009).

2.2.4 A note on the flotation heavy residue

Since flotation is not routinely carried out in many Mongolian excavations it might be relevant to discuss its usefulness here as it pertains to understanding the zooarchaeological record. It should come as no surprise that the majority of samples recovered belonged to small mammals, these being the most easily overlooked when recovery is by hand only and most likely to fall through a wide gauged sieve (Payne, 1972; Quitmyer, 2004). The process is, however, time consuming and so an assessment must be made as to its usefulness.

Although small mammals can be very useful palaeoecological indicators and can also be useful in reconstructing pastoralist habitation site use (Weissbrod, 2010) this can only be when they are from stratigraphically secure contexts. Taphonomic indicators here and excavation experience from elsewhere in Mongolia (e.g. Houle et al., 2013, 2012, 2010) suggests that such secure contexts are rare in habitation environments in the country. This is concerning for the questions it raises about the reliability of the other excavated material – the inordinately large proportion of small mammal remains compared to other vertebrate species in the heavy residue samples might indicate a large amount of bioturbation occurring on the sites.

The most useful data acquired from the current samples has been shown to be that from the stone circle assemblage – a special type of deposit which was not expected to feature any stratigraphy anyway. It is perhaps customary now for bioarchaeologists to call for routine fine sieving, and not without reason. If the sample analysed here is truly representative of the wider picture in Mongolia however then fine sieving and flotation cannot be recommended for faunal analysis alone, particularly on habitation sites, due to the time taken by the work. Where it is used for other reasons, however (and here see 3. Flotation of Bulk Soil Samples ***(Danielle de Carle)*** as well as a forthcoming report on the archaeobotany of Tsaagan Asgaa), then the resultant fauna material should still be identified, recorded and analysed. Although information gained is not considered great enough to warrant such procedures for its own ends there is data that might be added from them where they are being employed anyway.

3. Flotation of Bulk Soil Samples *(Danielle de Carle)*

Primarily to recover charred plant/wood remains, 13 bulk soil samples from the 2014 excavations were processed in the field by a version of the 'wash-over' bucket flotation technique (cf. Fuller, 2010). Twelve contexts were processed from the habitation site (TA165) and a single sample from within the stone circle at the monumental site (TA812). To date, only limited archaeobotanical work has been conducted in Mongolia (for examples from central Mongolia see Houle, 2010). It was also hoped that flotation would

provide additional information on context taphonomy and the efficacy of on-site finds recovery.

Samples from TA165 were selected to cover a range of the available context types, beyond those where charred material was visible during excavation. Details of the processed samples can be found in Table 3. Samples were between 1-11 litres of sediment. Prior to flotation a small subsample of soil (<200ml) was removed for potential future study, these have been retained with the project finds in the site archive.

Water for flotation was taken directly from the river, adjacent to the project camp; in order to reduce contamination the water was filtered through a close weave textile before use. During flotation the light, floating material (flot) was collected in sieves of approximately 2mm and 0.5mm. The two fractions of flot material, tending to contain a large proportion of grass roots, were kept separately, transferred to textile packets and left to air dry in the shade.

Following flotation the remaining sediment and stones (heavy fraction), retained in the buckets, were then wet sieved on a 1mm mesh, air dried and later sorted by staff and students for charcoal, animal bone and possible artefacts before being discarded. On return to Ulaanbaatar the coarse fraction (>2mm) of the floated material, for all samples, were briefly scanned by eye (DdC). A short assessment of residue finds and coarse flot contents is included in Table 3. Finds recovered through flotation add to those recovered by hand and on-site sieving (see above). For sample TA165 1.008 Copper Alloy slag and possible metal waste/droplets were recovered, the mesh sizes used for flotation were smaller than the standard sieves used on-site and therefore this material had not been previously noted. In addition, as the residue is washed it is easier to see and asses the contents than at the point of excavation. The flotation samples support a lack of cultural material from particular contexts, further supporting the observations made in the field (Peter Woodley pers. com.).

The majority of the charcoal recovered was smaller than 2mm and fragments are only present in any number from the metal working deposit (1.008, TA165) and within the stone circle (TA812), both identified as containing charred material in the field. However, these two samples and a few others (including 1.021 and 1.023) may still be suitable for limited species identifications and dating, in a region where little material has previously been recovered and published this would still be of value. Possible charred seeds observed in the coarse fractions of some of the samples will require further study using magnification to ascertain if they are archaeologically relevant. The finer flot material (<2mm) from the samples have yet to be assessed as there was no access to suitable microscope, but on the basis of those found in the coarse flots, are likely to contain smaller charred remains.

Context	Grid-square	Context Description (Peter Woodley field notes)	Sample Volume (Litres)	Sample Weight (Kilograms)	Heavy Residue (>1mm)	Assessment Coarse Flot (>2mm)
1.005	S2E6	Possibly sterile deposit. Abuts earlier phase of construction. Predates later phase. Possible hiatus in occupation.	2	3.5		
1.008	S4E3	Ashy deposit. Mixed with lower topsoil horizon. Final or penultimate phase of occupation.	1	1	Bone fragments (rare), Ceramic (rare), Charcoal (rare), Copper Alloy Slag/Droplets (occasional)	Charcoal (frequent)
1.009	S4E3	Possible remnant of occupation surface from final or penultimate phase of occupation.	5	5.5	Bone fragments (rare)	Seeds?, Charcoal (rare)
1.011	S7E2	Subsoil deposit. Predates habitation feature. Deposit on which earliest phase of construction was built. Probably sterile.	9.5	10.5		
1.012	S6E2	Contiguous with 1.005. Abuts stone platform 1.010.	9	9.5	Bone fragments (rare, burnt)	
1.013	S6E2/ S7E2	Deposit overlying 1.011 (sterile) and abutting wall 1.003 and stone platform 1.010 (first construction phase).	8	11.5	Bone fragments (rare), Charcoal (rare)	Charcoal (rare)
1.014	S7E2	Fill within cut 1.015 for wall 1.003 (first construction phase).	7	8.5		
1.018		Contiguous with 1.005 (probable sterile deposit - hiatus in occupation).	8	10.5		Seeds?
1.02		Topsoil around interstices of stone platform 1.010.	11	11.5	Bone fragments (rare)	Seeds?
1.021		Powdery, reddish brown fill in cut 1.024 below centre of stone platform 1.010. Possible burnt earth.	8	6.5	Bone fragments (rare)	Charcoal (rare)
1.023		Lower fill deposit below 1.021 within cut 1.024. Soft, strong brown soil, possibly burnt earth.	8	8.5	Bone fragments (rare, burnt)	Charcoal (occasional)
1.026		Dark reddish brown soil (burnt earth) from *in situ* burning in cut 1.027. Last phase of ephemeral occupation (outside stone ring).	7	6.5		
1.002 on 1.010		Lower topsoil (below sod) above stone platform 1.010.	4.5	5		Seeds?
10cm depth		Inside stone circle	4	5.5	Bone fragments (occasional, some burnt)	Seeds?, Charcoal (frequent)

Table 3: Flotation samples context information, assessment of heavy residue finds and coarse flot.

4. Future Work

i. Faunal analysis in Mongolia is still nascent and further detailed excavation and analysis is needed of animal bone assemblages from domestic/habitation sites.
ii. Further work on assemblages from Turkic monumental sites, particularly stone circles, should be carried out in order to test the interpretations made here.
iii. If possible, samples from TA812 should be submitted for C14 dating in order to firmly establish its Turkic nature or else refute it.
iv. The appearance of domestic cattle in Mongolia is an issue deserving of further research. As yet the timing of the appearance of domestic types of *Bos sp.* is unclear, and whether domesticates were allochthonous or autochthonous needs to explored.
v. Related to this, methods need to be developed to distinguish the skeletal remains of *Bos taurus* from *Bos grunniens*. These methods should be inexpensive if they are to be widely adopted.
vi. Further microfaunal studies would complement our understanding of the development of the Holocene environment of the region as provided by macro-scale studies by providing a micro-scale indicator.
vii. Given the fragmentary character of faunal assemblages in the study area, some benefit may be derived from the application of Protein Mass Spectrometry in order to identify bone fragments to genus level, or from histological studies or DNA analysis to identify species.
viii. Specific further sorting of both coarse and fine flotation material from the richer samples from TA165 and TA812 could be useful, with identification of charcoals (possible seeds) to provide information on resources use and environmental availability.
ix. Wider use of further flotation, of larger volumes of sediment, from future excavations is likely to provide more material suitable for absolute dating methods and environmental/economic analysis.

5. Conclusions

Although it is difficult to draw firm conclusions from such a minute assemblage, the zooarchaeological data that we have is consistent with a climate and subsistence strategy in Bronze Age Tsaagan Asgaa similar to that of today. In truth, the data that there is is little more than a catalogue of species but remarkably this catalogue does consist of all the principal domesticates. As such, it is hard to believe that we could say much more about it with any certainty even if the assemblage had been a hundred times larger.

The fauna assemblage from the Turkic stone circles is interesting for its combination of similarities and differences from that previously observed in the comparable Bronze Age structures. There is the possibility that this represents one stage of evolution in an extremely long running ritual activity. As such, the findings are noteworthy and should be investigated further as well as being communicated appropriately to other researchers.

The flotation of soil samples from the stone circle contributed to the interpretations made here but those from the domestic site raised perhaps predictable concerns regarding their archaeological integrity as far as zooarchaeological analysis is concerned. That said, there are indications that the same samples could contribute valuable information from the recovery of small finds as well as further archaeobotanical analysis.

The overall picture suggested at Tsagaan Asgaa is one of considerable longevity of human activity – from economic endeavours to ritual activities – as well as climate.

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Appendices

Appendix 1: Dictionary of animals referred to in the text

Binomial Classification (Latin)	Common Name (English)	Nom en Francais	Монгол Нэр
Bos sp.	cow/yak/zebu	vache/yak/zébu	үхэр/сарлаг/зебу
Equus sp.	ass/horse/onager/zebra	âne/cheval/hémione/zèbre	/адуу /хулан/
Rodentia	large rodent	grand rongeur	том мэрэгч
Marmota sp.	marmot	marmotte	тарвага
Ovis sp./Capra sp.	sheep/goat	mouton/chèvre	хонь/ямаа
Ovis sp./Capra sp./Capreolus sp.	sheep/goat/roe deer	mouton/chèvre/chevreuil	хонь/ямаа /бор гөрөөс
Ochotona sp.	pika	pika	огдой
Cricetidae	hamster/vole/lemming	hamster/campagnol/lemming	үхэр зусаг/оготно/ лемминг
Rodentia	small rodent	petit rongeur	жижиг мэрэгч

Appendix 2: Zooarchaeology Recording Protocol

This system is based on a modified version of that outlined by Davis (1992). A number of revisions have been made which reflect the specific research aims of the current project and that will efficiently explore its characteristics. The elements and zones listed below have been chosen based on a number of criteria including:

1) potential for identification to skeletal element and species by specialists of varying experience.
2) survivability.
3) potential for providing information on the age and/or sex of an animal.
4) potential to provide useful measurements.

The system is based on three main database structures, one for teeth, one for bones recordable under the protocol (countable elements) and one for all other fragments (non-countable elements).

Non-countable elements (fragments) are those specimens which are not used for any high-resolution quantitative analysis and include identifiable but partial bones and all other elements or parts of elements which are not included in the list of regularly recorded teeth and bones (see below). As much information as possible is recorded for these specimens including, where possible, attribution to species, genus, class (for fish and bird) or Large Mammal (*Cervus/Bos/Equus* size), Medium Mammal (*Capreolus/Ovis/Sus* size), Small Mammal (*Oryctolagus/Felis* size) or Micro Mammal (*Mus/Hybomys/Sorex* size).

Countable elements (bones and teeth) are recorded when at least 50% of the articulation or of the occlusal surface is present. Other elements, such as carpals, tarsals and cranial elements are recorded when at least 50% of the element is present. Horn cores and antlers are recorded when a complete circumference is present.

Amphibian bones are recorded when either end of the following bones is present: humerus, radioulna, femur and tibiofibula. The acetabulum is also recorded.

A Fracture Freshness Index is recorded for all countable and non-countable elements, which follows the criteria laid out in Outram (2001; 2002). Butchery and size class recording methods follow Maltby (2010) and Outram (2001), respectively, modified as per the fields below.

For a description of how measurements are taken see Davis (1987, 1996), von den Driesch (1976) and Walker (1980). The following measurements are taken:

TEETH

Equids: L_1, W_a and W_d (only teeth which can be positioned, i.e. we know which tooth it is) (W_d is only taken on molars)
Cattle: dP_4 W, dP^4 W, M^1W, M^2W, M^3W, M_1W, M_2W, M_3L and M_3W
Caprine: dP_4W, M_1W, M_2W, M_3L and M_3W
Pig: dP^4 (L,WP), M^1, M^2 & M^{12} (L, WA,WP), M^3 (L,WA,WC), dP_4 (L,WP), M_1, M_2 & M_{12} (L,WA,WP), M_3 (L,WA,WC, WP), H.
Carnivores: P_4, M_1 (L & W), P^4 (L, WA, WP), P_1-M_3L (canids), P_3-M_1L (felids), P_2-M_3L (canids), P_1-P_4 L (canids), P_2-P_4L (canids), P_4-M_1L (canids), M_1-M_3L (canids), M^1-M^2L (canids), H.
Rodents: M_1-M_3L, M^1-M^3L (P_4-M_3L, P^4-M^3L in dormice and P_3/P_4-M_3L, P^3/P^4-M^3L in squirrels)

BONES

Horncores and antlers: min. (Dd) and max. (Bd) diameter of the base
Cranium: birds = GL, GB, GH, LP
Atlas: mammals = H, BFcr (only for pig)
Scapula: mammals = SLC
birds = GL, Dic
Coracoid: birds = GL, Lm, Bb, BF
Humerus: mammals = GLC, Bp, BT (ungulates), Bd (all other mammals), HTC, SD
birds = GL, Bd, Dd, SC (when GL is taken)
reptiles = GL, Bd, Dd, SD (when GL is taken)
Radius: mammals = GL, Bp, Bd, SD (when GL is taken)
Ulna: mammals = DPA, SDO, BPC
birds = GL, Bp, Did, SC (when GL is taken.
Metacarpal: bovids and cervids = GL, SD, BatF, Bd, Bp, WCM, WCL, DEM, DVM, DEL, DVL
other mammals = GL, SD, Bd, Dd, Bp
birds = GL, SC, Bd, Bp
Pelvis: mammals = LAR (LA)
Femur: mammals = GL, Bd, Bp, DC, SD (when GL is taken)
birds = GL, Lm, SC, Bd, Dd
Tibia: mammals = GL, Bd, Dd, Bp, b, SD (ant-post, when GL is taken)
birds = GL, La, SC, Bd, Dd
Astragalus: bovids and cervids = GLl, GLm, Bd, Dl
pig = GLl, GLm
equids = GH, GB, BFd, LmT
other mammals = GL
Calcaneum: mammals = GL, GD
Metatarsal: bovids and cervids = GL, SD, BatF, Bd, Bp, WCM, WCL, DEM, DVM, DEL, DVL
Other mammals = GL, SD, Bd, Dd, Bp
birds = GL, SC, Bd
Phalanx 1: equids = GL, Bp, Dp, SD, Bd, Dd
other mammals = GL/GLpe, Bp, Bd
Phalanx 2: mammals = GL, Bp, Bd
Additional measurements may be taken, and are included in the “comments” field when recorded.
The sheep/goat distinction is attempted on the following elements:

horn core
dP_3, dP_4, M_1, M_2 & M_3
Humerus
Metacarpal
Tibia
Astragalus
Calcaneum
Metatarsal
The frog/toad distinction is attempted on the pelvis and tibia.

LIST OF FIELDS FOR THE THREE DATABASE STRUCTURES:
Teeth
ID = automatically generated specimen record number
SITE = site code
YEAR = year of excavation
BOX = box number
CTX = context
ERA = period
CAT # = catalogue number
COL = type of collection
EL = maxilla or mandible
LJ=loose tooth or jaw
SIDE
TAX = taxon
I1
I2
I3
I (=I/C in ruminants)
dI1
dI2
dI3
dI (=dI/dC in ruminants)
C
dC
PM (premolar or molar)
P
P1
P2
P3
P4
P4L (L_1 in equids)
P4W (W in carnivores)
dP2
dP3
dP4
dP4L
dP4W
M
M12 (first or second molar)
M12L (P4/M1 L in canid mandibles)

M12WA
M12WP
M1
M1L (L_1 in equids) (C in cattle upper tooth)
M1WA (W in caprines and carnivores) (Wa in equids)
M1WP (Wd in equids)
M2
M2L (L_1 in equids) (C in cattle upper tooth)
M2WA (W in caprines) (Wa in equids)
M2WP (Wd in equids)
M3
M3L (L_1 in equids) (C in cattle upper tooth)
M3WA (W in bovids) (Wa in equids)
M3WC (Wd in equids)
M3WP
PATH
P1/M3 L (P3/M1 L in felids)
P2/M3 L
P1/P4 L
P2/P4 L
M1/M3 L
H
Comments = recording of all additional discernible information and photo' log records

Bones
ID = automatically generated specimen record number
SITE = site code
YEAR = year of excavation
BOX = box number
CTX = context
ERA = period
CAT # = catalogue number
COL = type of collection
SIZE = size class
EL = anatomical element
SIDE
TAX = taxon
FUSP = proximal fusion
FUSD = distal fusion
WTHR = weathering
ROOT = root etching
FFI = Fracture Freshness Index
BUTCH = butchery
BURN = burning
GNAW = gnawing
GL (=GLl in astragalus) (=GH in equid astragalus) (=GLC in humerus) (=H in atlas)
Bd (=GB in equid astragalus) (= BT in humerus) (=BFcr in atlas)
Dd (=Dl in astragalus) (=BFd in equid astragalus) (=3 in metapodials) (=DC in femur) (=GD in calcaneum)
HTC (=LmT in equid astragalus) (=GLm in astragalus) (=6 in metapodials)

LAR
SD (=SC in birds) (=SLC in scapula)
Lm (=La in tibiotarsus)
BatF
a
b
1
4
Comments = recording of all additional discernible information and photo' log records

Fragments
ID = automatically generated specimen record number
SITE = site code
YEAR = year of excavation
BOX = box number
CTX = context
ERA = period
CAT # = catalogue number
COL = type of collection
SIZE
TAX GRP = taxonomic group
TAX = taxon
EL = element
WTHR = weathering
ROOT = root etching
FFI = Fracture Freshness Index
BUTCH = butchery
BURN = burning
GNAW = gnawing
Comments = recording of all additional discernible information and photo' log records

CODES
ERA (=period)

Era List	
Code	**Period**
BA	Bronze Age
CH	Chinese
EBA	Early Bronze Age
EIA	Early Iron Age
EM	Early Mediaeval
EMOD	Early Modern
HM	High Mediaeval
IA	Iron Age
LBA	Late Bronze Age
LIA	Late Iron Age
LM	Late Mediaeval

Era List	
Code	**Period**
LR	Late Roman
M	Mediaeval
MBA	Middle Bronze Age
MIA	Middle Iron Age
MOD	Modern
MR	Middle Roman
R	Roman
T	Turkic

COL (=type of collection):
HC = hand collected
CS = from coarse sieving
FS>10 = from fine sieving (>10mm fraction)
FS>5 = from fine sieving (>5mm, <10mm fraction)
FS<5 = from fine sieving (<5mm fraction)

SIZE (=size class [greatest dimension of specimen])
1 = 0-25mm
2 = 25.1-50mm
3 = 50.1-75mm
4 = 75.1-100mm
5 = >100.1mm

EL (=anatomical element):

Element List				
Code	**Element**	**Section**	**Body Portion**	**Recorded For Taxa**
AR	articular		head	fish
AS	astragalus		hindlimb	mammals
AT	atlas		head	mammals
AX	axis		head	mammals
C3	carpal 3 or 2+3		forelimb	mammals
CA	calcaneum		hindlimb	mammals
CER	ceratohyal		head	fish
CL	cleithrum		head	fish
CO	coracoid		forelimb	birds, reptiles
CR	cranium		head	birds, reptiles, amphibians
DD	dermal denticle		torso	fish
DN	dentary		head	fish
FE	femur	distal	hindlimb	mammals, birds, reptiles, amphibians

Element List				
Code	**Element**	**Section**	**Body Portion**	**Recorded For Taxa**
FI	fibula	proximal	hindlimb	mammals
HC	horn core or antler		head	mammals
HU	humerus	distal	forelimb	mammals, birds, reptiles, amphibians
HYO	hyomandibular		head	fish
MC1	metacarpal/carpometacarpus	distal (proximal for birds)	forelimb	mammals, birds
MC2	half metacarpal in artiodactyls, 2nd metacarpal all others	distal	forelimb	mammals
MCIII	third metacarpal	distal	forelimb	mammals
MCIV	fourth metacarpal	distal	forelimb	mammals
MCV	fifth metacarpal	distal	forelimb	mammals
MP1	metapodial	distal	limb	mammals
MP2	half metapodial	distal	limb	artiodactyls
MT1	metarsal/tarsometatarsus	distal	hindlimb	mammals, birds
MT2	half metatarsal in artiodactyls, 2nd metatarsal all others	distal	hindlimb	mammals
MTIII	third metatarsal	distal	hindlimb	mammals
MTIV	fourth metatarsal	distal	hindlimb	mammals
MTV	fifth metatarsal	distal	hindlimb	mammals
N	mandible		head	mammals when teeth are present in jaw, or else fragment
OC	occipital		head	mammals
OP	opercular		head	fish
OTHFE	femur	proximal	hindlimb	mammals, birds, reptiles
OTHMC	metacarpal	proximal		
OTHMT	metatarsal	proximal		
OTHRA	radius	proximal	forelimb	mammals, birds, reptiles
OTHTI	tibia/tibiotarsus	proximal	hindlimb	mammals, birds, reptiles
OTHU	humerus	proximal	forelimb	mammals, birds, reptiles
P1	first phalanx	proximal	limb	mammals
P2	second phalanx	proximal	limb	mammals
P3	third phalanx	proximal	limb	mammals
PA	patella		hindlimb	mammals
PARA	parasphenoid		head	fish

Element List				
Code	**Element**	**Section**	**Body Portion**	**Recorded For Taxa**
PE	pelvis	acetabulum	hindlimb	mammals, birds, reptiles, amphibians
PMX	pre-maxilla		head	fish
POP	preoperculum		head	fish
POT	post temporal		head	fish
QU	quadrate		head	fish
R	rib (or other spine in fish)		torso	mammals, birds, reptiles, amphibians, fish
RA	radius	distal	forelimb	mammals, birds, reptiles, amphibians
SC	scapula	proximal	forelimb	mammals, birds, reptiles
SCU	scafocuboid/scafoid/cuboid		hindlimb	mammals
SH	shell		-	molluscs
SP	spine		torso	fish
SU	supraorbital arch		head	mammals
TI	tibia/tibiotarsus	distal	hindlimb	mammals, birds, reptiles, amphibians
U	urohyal		head	fish
UL	ulna	processus anconaeus	forelimb	mammals, birds, reptiles
V	vertebra		torso	fish
VC	causal vertebra		torso	fish
VOM	vomer		head	fish
VPC	pre-caudal vertebra		torso	fish
X	maxilla		head	fish (and mammals when teeth are present in jaw, or else fragment)
XCT	carpal/tarsal		limb	
XFE	femur	shaft	hindlimb	
XFI	fibula	shaft	hindlimb	
XHU	humerus	shaft	forelimb	
XMC	metacarpal	shaft	forelimb	
XMP	metapodial	shaft		
XMT	metatarsal	shaft	hindlimb	
XPE	pelvis	shaft	hindlimb	
XPH	phalanx	shaft	limb	
XRA	radius	shaft	forelimb	
XSC	scapula	shaft	forelimb	

Element List				
Code	**Element**	**Section**	**Body Portion**	**Recorded For Taxa**
XT	tooth		head	
XTI	tibia	shaft	hindlimb	
XUL	ulna	shaft	forelimb	
ZY	zygomaticus		head	mammals

Note: Mandible and maxilla only recorded in teeth database, not bones database. Shaft sections (marked star), proximal metapodials, ribs and vertebrae (unless from fish) are not recorded as countable elements under the protocol. The fragments database is used to calculate NISP figures, in conjunction with the other database structures (teeth and bones) but is not used for any other quantification exercises, in order to avoid duplication of material.

L/J (=loose or in jaw)
L = loose tooth
J = in jaw
A jaw is defined as a tooth having adjacent to it at least another half tooth/alveolus or an equivalent length of bone

SIDE
L = left
R = right

PATH (=pathology)
C=calculus
H=hypoplasia present (one line)
HH=hypoplasia present (two or more lines)
CH=calculus and hypoplasia present (one line)
CHH=calculus and hypoplasia present (two or more lines)

TAX GRP (=taxonomic group)

Taxonomic Group	
Code	**Description**
A	Amphibian
B	Bird
F	Fish
LM	Large Mammal
MM	Medium Mammal
MS	Mollusc (Shell)
R	Reptile
SM	Small Mammal

TAX (=taxon):

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
ACJ	Chordata	Mammalia	Carnivora	Felidae	Acinonyx jubatus
ACJ?	Chordata	Mammalia	Carnivora	Felidae	cf. Acinonyx jubatus
ACN	Chordata	Aves	Falconiformes	Accipitridae	Accipiter nisus
ACN?	Chordata	Aves	Falconiformes	Accipitridae	cf. Accipiter nisus
ALA	Chordata	Aves	Passeriformes	Alaudidae	Alauda arvensis
ALA?	Chordata	Aves	Passeriformes	Alaudidae	cf. Alauda arvensis
AMP	Chordata	Amphibia			Amphibia
ANA	Chordata	Aves	Anseriformes	Anatidae	Anas sp.
ANA?	Chordata	Aves	Anseriformes	Anatidae	cf. Anas sp.
ANS	Chordata	Aves	Anseriformes	Anatidae	Anser sp.
ANS?	Chordata	Aves	Anseriformes	Anatidae	cf. Anser sp.
APO	Chordata	Mammalia	Rodentia	Muridae	Apodemus sp.
APO?	Chordata	Mammalia	Rodentia	Muridae	cf. Apodemus sp.
APS	Chordata	Mammalia	Rodentia	Muridae	Apodemus sylvaticus
APS?	Chordata	Mammalia	Rodentia	Muridae	cf. Apodemus sylvaticus
ART	Chordata	Mammalia	Rodentia	Cricetidae	Arvicola amphibius
ART?	Chordata	Mammalia	Rodentia	Cricetidae	cf. Arvicola amphibius
ATA	Chordata	Mammalia	Rodentia	Hystricidae	Atherus africanus
ATA?	Chordata	Mammalia	Rodentia	Hystricidae	cf. Atherus africanus
B	Chordata	Mammalia	Artiodactyla	Bovidae	Bos sp.
B?	Chordata	Mammalia	Artiodactyla	Bovidae	cf.Bos sp.
BOV	Chordata	Mammalia	Artiodactyla	Bovidae	Bovidae
BOV?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Bovidae
BUB	Chordata	Aves	Ffalconiformes	Accipitridae	Buteo buteo
BUB?	Chordata	Aves	Ffalconiformes	Accipitridae	cf. Buteo buteo

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
BUF	Chordata	Amphibia	Anura	Bufonidae	Bufo bufo
BUF?	Chordata	Amphibia	Anura	Bufonidae	cf. Bufo bufo
BUU	Mollusca	Gastropoda	Caenogastropoda	Buccinidae	Buccinum undatum
CAC	Chordata	Mammalia	Artiodactyla	Cervidae	Capreolus capreolus
CAC?	Chordata	Mammalia	Artiodactyla	Cervidae	cf. Capreolus capreolus
CAF	Chordata	Mammalia	Carnivora	Canidae	Canis lupus familiaris
CAF?	Chordata	Mammalia	Carnivora	Canidae	cf. Canis lupus familiaris
CAH	Chordata	Mammalia	Artiodactyla	Bovidae	Capra hircus
CAH?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Capra hircus
CAS	Chordata	Mammalia	Rodentia	Castoridae	Castor sp.
CAS?	Chordata	Mammalia	Rodentia	Castoridae	cf. Castor sp.
CB	Chordata	Mammalia	Artiodactyla	Bovidae/Cervidae	Bos/Cervus sp.
CCC	Chordata	Aves	Passeriformes	Corvidae	Corvus corone corone
CCC?	Chordata	Aves	Passeriformes	Corvidae	cf. Corvus corone corone
CD	Chordata	Mammalia	Artiodactyla	Cervidae	Cervus sp./Dama sp.
CEE	Chordata	Mammalia	Artiodactyla	Cervidae	Cervus elaphus
CEE?	Chordata	Mammalia	Artiodactyla	Cervidae	cf. Cervus elaphus
CEP	Chordata	Mammalia	Artiodactyla	Bovidae	Cephalophinae
CEP?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Cephalophinae
CER	Chordata	Mammalia	Primates	Cercopithecidae	Cercopithecidae
CER?	Chordata	Mammalia	Primates	Cercopithecidae	cf. Cercopithecidae

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
CES	Chordata	Mammalia	Artiodactyla	Bovidae	Cephalophus silvicultor
CES?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Cephalophus silvicultor
CIR	Chordata	Aves	Falconiformes	Accipitridae	Circus sp.
CIR?	Chordata	Aves	Falconiformes	Accipitridae	cf. Circus sp.
CLG	Chordata	Mammalia	Rodentia	Cricetidae	Myodes glareolus
CLG?	Chordata	Mammalia	Rodentia	Cricetidae	cf. Myodes glareolus
CO	Chordata	Aves	Passeriformes	Corvidae	Corvus sp.
CO?	Chordata	Aves	Passeriformes	Corvidae	cf. Corvus sp.
COC	Chordata	Aves	Passeriformes	Corvidae	Corvus corax
COC?	Chordata	Aves	Passeriformes	Corvidae	cf. Corvus corax
COF	Chordata	Aves	Passeriformes	Corvidae	Corvus corone/frugilegus
COF?	Chordata	Aves	Passeriformes	Corvidae	cf. Corvus corone/frugilegus
COL	Chordata	Aves	Columbiformes	Columbidae	Columba sp.
COL?	Chordata	Aves	Columbiformes	Columbidae	cf. Columba sp.
COM	Chordata	Aves	Passeriformes	Corvidae	Corvus monedula
COM?	Chordata	Aves	Passeriformes	Corvidae	cf. Corvus monedula
CRI	Chordata	Mammalia	Rodentia	Nesomyidae	Cricetomys sp.
CRI?	Chordata	Mammalia	Rodentia	Nesomyidae	Cricetomys sp.
CRP	Chordata	Mammalia	Carnivora	Herpestidae	Crossarchus platycephalus
CRP?	Chordata	Mammalia	Carnivora	Herpestidae	cf. Crossarchus platycephalus
CRU	Chordata	Mammalia	Artiodactyla	Bovidae	Cephalophus rufilatus

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
CRU?	Chordata	Mammalia	Artiodactyla	Bovidae	cf.Cephalophus rufilatus
CTC	Chordata	Aves	Galliformes	Phasianidae	Coturnix coturnix
CTC?	Chordata	Aves	Galliformes	Phasianidae	cf. Coturnix coturnix
CV	Chordata	Mammalia	Carnivora	Canidae	Canis sp./Vulpes sp.
CV?	Chordata	Mammalia	Carnivora	Canidae	cf. Canis sp./Vulpes sp.
DAD	Chordata	Mammalia	Artiodactyla	Cervidae	Dama dama
DAD?	Chordata	Mammalia	Artiodactyla	Cervidae	cf. Dama dama
DAK	Chordata	Mammalia	Artiodactyla	Bovidae	Damliscus korrigum
DAK?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Damliscus korrigum
DC	Chordata	Mammalia	Artiodactyla	Cervidae	Capreolus sp./Dama sp.
EQ	Chordata	Mammalia	Perissotactyla	Equidae	Equus sp.
EQ?	Chordata	Mammalia	Perissotactyla	Equidae	cf. Equus sp.
EQA	Chordata	Mammalia	Perissodactyla	Equidae	Equus Asinus sp.
EQA?	Chordata	Mammalia	Perissodactyla	Equidae	cf. Equus Asinus sp.
EQC	Chordata	Mammalia	Perissodactyla	Equidae	Equus ferus caballus
EQC?	Chordata	Mammalia	Perissodactyla	Equidae	cf. Equus ferus caballus
ERE	Chordata	Mammalia	Erinaceidae	Erinaceinae	Erinaceus europaeus
ERE?	Chordata	Mammalia	Erinaceidae	Erinaceinae	cf. Erinaceus europaeus
F-AA	Chordata	Actinopterygii	Anguilliformes	Anguillidae	Anguilla anguilla
F-AA?	Chordata	Actinopterygii	Anguilliformes	Anguillidae	cf. Anguilla anguilla
FAC	Chordata	Aves	Falconiformes	Falconidae	Falco columbarius

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
FAC?	Chordata	Aves	Falconiformes	Falconidae	cf. Falco columbarius
FAL	Chordata	Aves	Falconiformes	Falconidae	Falco sp.
FAL?	Chordata	Aves	Falconiformes	Falconidae	cf. Falco sp.
F-CC	Chordata	Actinopterygii	Anguilliformes	Congridae	Conger conger
F-CC?	Chordata	Actinopterygii	Anguilliformes	Congridae	cf. Conger conger
F-CH	Chordata	Actinopterygii	Clupeiformes	Clupeidae	Clupea harengus
F-CH?	Chordata	Actinopterygii	Clupeiformes	Clupeidae	cf. Clupea harengus
FE	Chordata	Mammalia	Canivora	Felidae	Felidae
FE?	Chordata	Mammalia	Canivora	Felidae	Felidae
FEC	Chordata	Mammalia	Canivora	Felidae	Felis catus
FEC?	Chordata	Mammalia	Canivora	Felidae	cf. Felis catus
F-G	Chordata	Actinopterygii	Gadiformes	Gadidae	Gadidae
F-G?	Chordata	Actinopterygii	Gadiformes	Gadidae	cf. Gadidae
F-GM	Chordata	Actinopterygii	Gadiformes	Gadidae	Gadus morhua
F-GM?	Chordata	Actinopterygii	Gadiformes	Gadidae	cf. Gadus morhua
FISH	Chordata				*Pisces
F-MM	Chordata	Actinopterygii	Gadiformes	Merlucciidae	Merlucciud merluccius
F-MM?	Chordata	Actinopterygii	Gadiformes	Merlucciidae	cf. Merlucciud merluccius
F-MME	Chordata	Actinopterygii	Gadiformes	Gadidae	Merlangius merlangus
F-MME?	Chordata	Actinopterygii	Gadiformes	Gadidae	cf. Merlangius merlangus
F-PP	Chordata	Actinopterygii	Gadiformes	Gadidae	Pollachius pollachius
F-PP?	Chordata	Actinopterygii	Gadiformes	Gadidae	cf. Pollachius pollachius
F-PV	Chordata	Actinopterygii	Gadiformes	Gadidae	Pollachius virens
F-PV?	Chordata	Actinopterygii	Gadiformes	Gadidae	cf. Pollachius virens

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
F-RC	Chordata	Chondrichthyes	Rajiformes	Rajidae	Raja clavata
F-RC?	Chordata	Chondrichthyes	Rajiformes	Rajidae	cf. Raja clavata
F-S	Chordata	Actinopterygii	Salmoniformes	Salmonidae	Salmonidae
F-S?	Chordata	Actinopterygii	Salmoniformes	Salmonidae	cf. Salmonidae
F-SP	Chordata	Actinopterygii	Perciformes	Sparidae	Sparidae
F-SP?	Chordata	Actinopterygii	Perciformes	Sparidae	cf. Sparidae
F-SS	Chordata	Actinopterygii	Perciformes	Scombridae	Scomber scombrus
F-SS?	Chordata	Actinopterygii	Perciformes	Scombridae	cf. Scomber scombrus
F-T	Chordata	Actinopterygii	Scorpaeniformes	Troglidae	Triglidae
F-T?	Chordata	Actinopterygii	Scorpaeniformes	Troglidae	cf. Triglidae
F-TT	Chordata	Actinopterygii	Perciformes	Carangidae	Trachurus trachurus
F-TT?	Chordata	Actinopterygii	Perciformes	Carangidae	cf. Trachurus trachurus
GAG	Chordata	Aves	Galliformes	Phasianidae	Gallus gallus
GAL	Chordata	Aves	Galliformes		Galliformes
GAL?	Chordata	Aves	Galliformes		cf. Galliformes
GAN	Chordata	Aves	Charadriiformes	Scolopacidae	Gallinago gallinao
GAN?	Chordata	Aves	Charadriiformes	Scolopacidae	cf. Gallinago gallinao
GAR	Chordata	Aves	Passeriformes	Corvidae	Garrulus glandarius
GAR?	Chordata	Aves	Passeriformes	Corvidae	cf. Garrulus glandarius
GN	Chordata	Aves	Galliformes	Numididae/Phasianidae	Gallus sp./Numida sp.
GNP	Chordata	Aves	Galliformes	Numididae/Phasianidae	Gallus sp./Numida sp./Phasianus sp.
GNP?	Chordata	Aves	Galliformes	Numididae/Phasianidae	cf. Gallus sp./Numida sp./Phasianus

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
					sp.
GP	Chordata	Aves	Galliformes	Phasianidae	Gallus sp./Phasianus sp.
HY	Chordata	Mammalia	Rodentia	Hystricidae	Hystricidae
HY?	Chordata	Mammalia	Rodentia	Hystricidae	cf. Hystricidae
HYC	Chordata	Mammalia	Rodentia	Hystricidae	Hystrix cristata
HYC?	Chordata	Mammalia	Rodentia	Hystricidae	Hystrix cristata
HYM	Chordata	Mammalia	Carnivora	Mustelidae	Hydrictus maculicollis
HYM?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Hydrictus maculicollis
KOE	Chordata	Mammalia	Artiodactyla	Bovidae	Kobus ellipsiprymnus
KOE?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Kobus ellipsiprymnus
KOK	Chordata	Mammalia	Artiodactyla	Bovidae	Kobus kob
KOK?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Kobus kob
LA	Chordata	Aves	Galliformes	Phasianidae	Lagopus sp.
LA?	Chordata	Aves	Galliformes	Phasianidae	cf. Lagopus sp.
LAG	Chordata	Mammalia	Lagomorpha		Lagomorpha
LAG?	Chordata	Mammalia	Lagomorpha		cf. Lagomorpha
LE	Chordata	Mammalia	Lagomorpha	Leporidae	Lepus sp.
LE?	Chordata	Mammalia	Lagomorpha	Leporidae	cf. Lepus sp.
LEC	Chordata	Mammalia	Lagomorpha	Leporidae	Lepus capensis
LEC?	Chordata	Mammalia	Lagomorpha	Leporidae	cf. Lepus capensis
LEE	Chordata	Mammalia	Lagomorpha	Leporidae	Lepus europaeus
LEE?	Chordata	Mammalia	Lagomorpha	Leporidae	cf. Lepus europaeus
LRO	Chordata	Mammalia	Rodentia		Rodentia
LU	Chordata	Mammalia	Carnivora	Mustelidae	Lutra sp.
LU?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Lutra sp.
LYP	Chordata	Mammalia	Carnivora	Canidae	Lycaon pictus

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
LYP?	Chordata	Mammalia	Carnivora	Canidae	cf. Lycaon pictus
MAR	Chordata	Mammalia	Rodentia	Sciuridae	Marmota sp.
MAR?	Chordata	Mammalia	Rodentia	Sciuridae	cf. Marmota sp.
MEC	Chordata	Mammalia	Carnivora	Mustelidae	Mellivora capensis
MEC?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Mellivora capensis
MEM	Chordata	Mammalia	Carnivora	Mustelidae	Meles meles
MEM?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Meles meles
MES	Chordata	Aves	Anseriformes	Anatidae	Mergus serrator
MES?	Chordata	Aves	Anseriformes	Anatidae	cf. Mergus serrator
MIM	Chordata	Aves	Falconiformes	Accipitridae	Milvus milvus
MIM?	Chordata	Aves	Falconiformes	Accipitridae	cf. Milvus milvus
MUE	Chordata	Mammalia	Carnivora	Mustelidae	Mustela erminea
MUE?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Mustela erminea
MUM	Chordata	Mammalia	Rodentia	Muridae	Mus musculus
MUM?	Chordata	Mammalia	Rodentia	Muridae	cf. Mus musculus
MUN	Chordata	Mammalia	Carnivora	Mustelidae	Mustela nivalis
MUN?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Mustela nivalis
MUP	Chordata	Mammalia	Carnivora	Mustelidae	Mustela putorius
MUP?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Mustela putorius
MUX	Chordata	Mammalia	Carnivora	Mustelidae	Mustela erminea/Mustela nivalis
MUX?	Chordata	Mammalia	Carnivora	Mustelidae	cf. Mustela erminea/Mustela nivalis

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
NEB	Chordata	Mammalia	Artiodactyla	Bovidae	Neotragus batesi
NEB?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Neotragus batesi
NUA	Chordata	Aves	Charadriiformes	Scolopacidae	Numenius arquata
NUA?	Chordata	Aves	Charadriiformes	Scolopacidae	cf. Numenius arquata
O	Chordata	Mammalia	Artiodactyla	Bovidae	Ovis sp./Capra sp.
O?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Ovis sp./Capra sp.
OCC	Chordata	Mammalia	Artiodactyla	Bovidae	Ovis sp./Capra sp./Capreolus sp.
OCC?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Ovis sp./Capra sp./Capreolus sp.
OCH	Chordata	Mammalia	Lagomorpha	Ochotonidae	Ochotona sp.
OCH?	Chordata	Mammalia	Lagomorpha	Ochotonidae	cf. Ochotona sp.
ORC	Chordata	Mammalia	Lagomorpha	Leporidae	Oryctolagus cuniculus
ORC?	Chordata	Mammalia	Lagomorpha	Leporidae	cf. Oryctolagus cuniculus
ORO	Chordata	Mammalia	Artiodactyla	Bovidae	Ourebia ourebi
ORO?	Chordata	Mammalia	Artiodactyla	Bovidae	Ourebia ourebi
OVA	Chordata	Mammalia	Artiodactyla	Bovidae	Ovis aries
OVA?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Ovis aries
PAA	Chordata	Mammalia	Primates	Cercopithecidae	Papio anubis
PAA?	Chordata	Mammalia	Primates	Cercopithecidae	cf. Papio anubis
PEP	Chordata	Aves	Galliformes	Phasianidae	Perdix perdix
PEP?	Chordata	Aves	Galliformes	Phasianidae	cf. Perdix perdix

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
PHC	Chordata	Aves	Suliformes	Phalacrocoracidae	Phalacrocorax carbo
PHC?	Chordata	Aves	Suliformes	Phalacrocoracidae	cf. Phalacrocorax carbo
PIP	Chordata	Aves	Passeriformes	Corvidae	Pica pica
PIP?	Chordata	Aves	Passeriformes	Corvidae	cf. Pica pica
PL	Chordata	Aves	Charadriiformes	Charadriidae	Pluvialis sp.
PL?	Chordata	Aves	Charadriiformes	Charadriidae	cf. Pluvialis sp.
PLA	Chordata	Aves	Charadriiformes	Charadriidae	Pluvialis apricaria
PLA?	Chordata	Aves	Charadriiformes	Charadriidae	cf. Pluvialis apricaria
PLS	Chordata	Aves	Charadriiformes	Charadriidae	Pluvialis squatarola
PLS?	Chordata	Aves	Charadriiformes	Charadriidae	cf. Pluvialis squatarola
PSF	Chordata	Aves	Passeriformes		Passeriformes
PSF?	Chordata	Aves	Passeriformes		cf. Passeriformes
PUP	Chordata	Aves	Procellariiformes	Procellariidae	Puffinus puffinus
PUP?	Chordata	Aves	Procellariiformes	Procellariidae	cf. Puffinus puffinus
R	Chordata	Reptilia			Reptilia
RA	Chordata	Mammalia	Rodentia	Muridae	Rattus sp.
RA?	Chordata	Mammalia	Rodentia	Muridae	cf. Rattus sp.
RAN	Chordata	Amphibia	Anura	Ranidae	Rana sp.
RAN?	Chordata	Amphibia	Anura	Ranidae	cf. Rana sp.
RAR	Chordata	Mammalia	Rodentia	Muridae	Rattus rattus
RAR?	Chordata	Mammalia	Rodentia	Muridae	cf. Rattus rattus
RAV	Chordata	Mammalia	Rodentia	Muridae/Cricetidae	Rattus sp./Arvicola sp.
RAV?	Chordata	Mammalia	Rodentia	Muridae/Cricetidae	cf. Rattus sp./Arvicola sp.

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
REF	Chordata	Mammalia	Artiodactyla	Bovidae	Redunca fulvorufula
REF?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Redunca fulvorufula
S	Chordata	Mammalia	Artiodactyla	Suidae	Sus sp./Potamochoerus sp.
S?	Chordata	Mammalia	Artiodactyla	Suidae	cf. Sus sp./Potamochoerus sp.
SCR	Chordata	Aves	Charadriiformes	Scolopacidae	Scolopax rusticola
SCR?	Chordata	Aves	Charadriiformes	Scolopacidae	cf. Scolopax rusticola
SMI	Chordata	Mammalia	Rodentia	Cricetidae	Cricetidae
SMI?	Chordata	Mammalia	Rodentia	Cricetidae	cf. Cricetidae
SMU	Chordata	Mammalia	Rodentia	Muridae	Murinae
SMU?	Chordata	Mammalia	Rodentia	Muridae	cf. Murinae
SOA	Chordata	Mammalia	Soricomorpha	Soricidae	Sorex araneus
SOA?	Chordata	Mammalia	Soricomorpha	Soricidae	cf. Sorex araneus
SRO	Chordata	Mammalia	Rodentia		Rodentia
STE	Chordata	Aves	Charadriiformes	Sternidae	Sterna sp.
STE?	Chordata	Aves	Charadriiformes	Sternidae	cf. Sterna sp.
STS	Chordata	Aves	Charadriiformes	Sternidae	Thalasseus sandvicensis
STS?	Chordata	Aves	Charadriiformes	Sternidae	cf. Thalasseus sandvicensis
STV	Chordata	Aves	Passeriformes	Sturnidae	Sturnus vulgaris
STV?	Chordata	Aves	Passeriformes	Sturnidae	cf. Sturnus vulgaris
TAL	Chordata	Mammalia	Soricomorpha	Talpidae	Talpa sp.
TAL?	Chordata	Mammalia	Soricomorpha	Talpidae	cf. Talpa sp.
TES	Chordata	Reptilia	Testudines	Testudinidae	Testudinidae
TES?	Chordata	Reptilia	Testudines	Testudinidae	cf. Testudinidae
THS	Chordata	Mammalia	Rodentia	Thryonomyidae	Thryonomys swinderianus

Taxa List					
Code	**Phylum**	**Class**	**Order**	**Family**	**Binomial Classification (Latin)**
THS?	Chordata	Mammalia	Rodentia	Thryonomyidae	cf. Thryonomys swinderianus
TRS	Chordata	Mammalia	Artiodactyla	Bovidae	Tragelaphus scriptus
TRS?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Tragelaphus scriptus
TSP	Chordata	Mammalia	Artiodactyla	Bovidae	Tragelaphus spekei
TSP?	Chordata	Mammalia	Artiodactyla	Bovidae	cf. Tragelaphus spekei
TU	Chordata	Aves	Passeriformes	Turdidae/Sturnidae	Turdus sp./Sturnus sp.
TU?	Chordata	Aves	Passeriformes	Turdidae/Sturnidae	cf. Turdus sp./Sturnus sp.
TUI	Chordata	Aves	Passeriformes	Turdidae	Turdus iliacus
TUI?	Chordata	Aves	Passeriformes	Turdidae	cf. Turdus iliacus
TUM	Chordata	Aves	Passeriformes	Turdidae	Turdus merula
TUM?	Chordata	Aves	Passeriformes	Turdidae	cf. Turdus merula
URS	Chordata	Mammalia	Carnivora	Ursidae	Ursus sp.
URS?	Chordata	Mammalia	Carnivora	Ursidae	cf. Ursus sp.
VAV	Chordata	Aves	Charadriiformes	Charadriidae	Vanellus vanellus
VAV?	Chordata	Aves	Charadriiformes	Charadriidae	cf. Vanellus vanellus
VUV	Chordata	Mammalia	Carnivora	Canidae	Vulpes vulpes
VUV?	Chordata	Mammalia	Carnivora	Canidae	cf. Vulpes vulpes

FUS (=fusion):
F = fused
G = fusing
H = fused/fusing
UD = unfused diaphysis
UE = unfused epiphysis

UX = unfused diaphysis + epiphysis
J = juvenile (for birds)

WTHR (=weathering)
0
1
2
3
4
5
X (if specimen is calcined, burnt, cancellous, cartilaginous, bird, reptile, amphibian, fish, mollusc or tooth)

ROOT (=root etching)
A = absent
P = present, <50% bone surface marked
PP = present, >50% bone surface marked

FFI (=Fracture Freshness Index)
0
1
2
3
4
5
6
C = complete
B = butchered
N = new break
X (if specimen is fish, mollusc or tooth)

BUTCH (=butchery):
"blank" = absent or not recordable

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
A1	Astragalus	Chop	Oblique/horizontal chop through proximal end (usually in anterio-posterior direction).
A10	Astragalus	Cut	horizontal knife cuts on anterior aspect at distal end.
A11	Astragalus	Chop	superficial axial chop marks.
A12	Astragalus	Chop	superficial horizontal chop marks on posterior aspect running medio-laterally.
A13	Astragalus	Chop	superficial horizontal chop marks on medial aspect.
A14	Astragalus	Chop	superficial horizontal chop marks on lateral aspect.
A15	Astragalus	Cut	knife cuts on medial surface.
A16	Astragalus	Cut	knife cuts on lateral surface.
A17	Astragalus	Cut	knife cuts on posterior surface.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
A18	Astragalus	Chop	axial chop through bone in medio-lateral direction.
A19	Astragalus	Cut	Knife cut on distal end
A2	Astragalus	Chop	superficial oblique/horizontal chop marks at proximal end.
A20	Astragalus	Chop	axial chop through medial side of distal end
A22	Astragalus	Chop	oblique chop through proximal en (lateral-medial direction)
A3	Astragalus	Chop	oblique/horizontal chop through centre of bone (usually in anterio-posterior direction).
A4	Astragalus	Chop	superficial medio-lateral chop marks on anterior of centre of bone.
A5	Astragalus	Chop	Oblique/horizontal chop through distal end (usually in anterio-posterior direction).
A6	Astragalus	Chop	superficial oblique/horizontal chop marks at distal end of bone.
A7	Astragalus	Chop	axial/oblique chop through bone in anterio-posterior direction.
A8	Astragalus	Chop	repeated axial/oblique chops through bone.
A9	Astragalus	Cut	horizontal knife cuts on anterior of centre of bone.
C1	Calcaneus	Chop	oblique/medio lateral chop through calcaneal tuber.
C10	Calcaneus	Cut	knife cuts on calcaneal tuber.
C11	Calcaneus	Chop	superficial axial chop/blade mark
C2	Calcaneus	Chop/Saw	superficial chop/saw marks on calcaneal tuber.
C3	Calcaneus	Chop	oblique/horizontal chops through distal end.
C4	Calcaneus	Chop	superficial chop marks on distal end.
C5	Calcaneus	Chop	oblique/horizontal chops through centre of bone.
C6	Calcaneus	Chop	superficial chop marks on centre of bone.
C7	Calcaneus	Cut	knife cuts on lateral and/or posterior aspect of centre/distal part of bone.
C8	Calcaneus	Cut	knife cut at distal end.
C9	Calcaneus	Chop	axial chop through bone.
F1	Femur	Chop	proximal articulation chopped through (ball joint).
F10	Femur	Cut	knife cuts on medial aspect of proximal end.
F11	Femur	Cut	other knife cuts proximal end.
F12	Femur	Cut	horizontal knife cuts on shaft.
F13	Femur	Cut	horizontal knife cuts around distal end.
F14	Femur	Chop	axial chop through distal lateral and/or medial condyles running in medio-lateral direction.
F15	Femur	Chop	superficial horizontal/oblique chop marks on shaft.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
F16	Femur	Chop	proximal lateral aspect chopped through.
F17	Femur	Cut	oblique knife cuts on shaft.
F18	Femur	Chop	superficial axial chop distal end.
F19	Femur	Chop	axial chop through distal condyles running obliquely/posterio-anteriorally.
F2	Femur	Chop	superficial chop marks on and around proximal articulation.
F20	Femur	Chop	horizontal/oblique chop through shaft.
F21	Femur	Chop	superficial axial chop marks proximal end.
F22	Femur	Chop	horizontal/oblique chop through proximal end.
F23	Femur	Chop	other superficial chop marks – proximal end.
F24	Femur	Cut	axial knife cuts – distal end.
F3	Femur	Chop	axial chop through proximal running in anterio-posterior direction.
F4	Femur	Chop	axial/oblique chop through shaft running in anterio-posterior direction.
F5	Femur	Chop	axial chop through distal running in anterio-posterior direction.
F6	Femur	Chop	repeated axial/oblique chops through distal running in anterio-posterior direction.
F7	Femur	Chop	superficial horizontal chop/saw marks around distal end.
F8	Femur	Chop	horizontal (or oblique) chop through distal end.
F9	Femur	Cut	superficial axial blade marks on shaft.
FB1	Fibula	Chop	Chop through proximal end
FB2	Fibula	Chop	Chop through shaft.
FB3	Fibula	Chop	Chop through distal end.
FB4	Fibula	Chop	Superficial chops at proximal end.
FB5	Fibula	Chop	Superficial chops on shaft.
FB6	Fibula	Chop	Superficial chops at distal end.
FB7	Fibula	Cut	Knife cuts at proximal end.
FB8	Fibula	Cut	Knife cuts on shaft
FB9	Fibula	Cut	Knife cuts at distal end.
H1	Humerus	Chop	axial chop through distal articulation (trochlea) running in anterio-posterior direction.
H10	Humerus	Cut	knife cuts medial aspect of distal end.
H11	Humerus	Chop	superficial axial chop/blade marks on shaft.
H12	Humerus	Chop	other superficial chop marks on shaft.
H13	Humerus	Cut	other knife cuts on shaft.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
H14	Humerus	Cut	knife cuts near proximal end.
H15	Humerus	Chop	horizontal chops through proximal end.
H16	Humerus	Chop	axial chop on medial or lateral part of distal articulation running anterio-posteriorally.
H17	Humerus	Chop	horizontal/oblique chops through distal articulation.
H18	Humerus	Cut	horizontal knife cuts near distal end (not on medial).
H19	Humerus	Chop	other superficial horizontal chop marks distal end.
H2	Humerus	Chop	horizontal/oblique chop through distal surface of medial epicondyle.
H20	Humerus	Chop	horizontal/oblique chop through shaft.
H21	Humerus	Chop	Other superficial chop marks on distal articulation.
H22	Humerus	Chop	superficial axial chop mark
H23	Humerus	Chop	horizontal/oblique chop through or near distal end
H3	Humerus	Chop	axial/oblique chop through proximal articulation.
H4	Humerus	Chop	repeated axial chops through distal articulation running in anterio-posterior direction.
H5	Humerus	Chop	axial/oblique chop through shaft running in anterio-posterior direction.
H6	Humerus	Chop	repeated axial/oblique chops through shaft.
H7	Humerus	Chop	oblique/ anterio-posterior superficial chop marks on medial of distal articulation.
H8	Humerus	Chop/Saw	superficial chop/saw marks near proximal end.
H9	Humerus	Chop	axial/oblique chop through medial or lateral aspects of distal end.
J1	Mandible	Cut	dorso-ventral (or oblique) knife cuts – lateral diastema.
J10	Mandible	Cut	knife cuts on other parts of ramus.
J11	Mandible	Chop	cranio-caudal chop marks – lateral ramus near condyle.
J12	Mandible	Chop	chop/saw marks – caudal ramus on or below condyle.
J13	Mandible	Chop	chop/saw marks on other parts of ramus.
J14	Mandible	Cut	knife cuts below cheek tooth row (buccal).
J15	Mandible	Chop	superficial chop marks below cheek tooth row (buccal).
J16	Mandible	Chop/Saw	chop/saw marks on medial aspect of ramus near condyle.
J17	Mandible	Cut	knife cuts below cheek tooth row (lingual).
J18	Mandible	Chop	superficial chop marks below cheek tooth row (lingual).

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
J19	Mandible	Chop	dorso-ventral/cranio caudal chop through symphysis.
J2	Mandible	Cut	dorso-ventral (or oblique) knife cuts – medial diastema.
J20	Mandible	Cut	superficial blade marks on ventral or lateral of ramus/body
J21	Mandible	Chop	superficial chop marks on ventral or dorsal of diastema.
J22	Mandible	Chop	body chopped through
J3	Mandible	Cut	cranio-caudal knife cuts – lateral diastema.
J4	Mandible	Cut	cranio-caudal knife cuts – medial diastema.
J5	Mandible	Chop/Saw	dorso-ventral (or oblique) chop/saw marks – lateral diastema.
J6	Mandible	Chop/Saw	dorso-ventral (or oblique) chop/saw marks – medial diastema.
J7	Mandible	Chop	dorso-ventral/cranial-caudal chop though medial diastema.
J8	Mandible	Cut	cranio-caudal knife cuts – lateral ramus near condyle
J9	Mandible	Cut	other knife cuts on caudal part of ramus
M1	Metapodials	Chop	axial chop through proximal end in anterio-posterior direction.
M10	Metapodials	Cut	medio-lateral knife cuts on or near anterior aspect of proximal end.
M11	Metapodials	Cut	medio-lateral knife cuts on or near posterior aspect of proximal end.
M12	Metapodials	Cut	horizontal or oblique knife cuts around centre of shaft.
M13	Metapodials	Cut	horizontal knife cuts on or near distal end.
M14	Metapodials	Cut	superficial axial blade marks on shaft.
M15	Metapodials	Chop	superficial horizontal chop marks on medial/lateral aspects of proximal end.
M16	Metapodials	Chop	oblique chop through medial or lateral distal condyle running in posterio-anterior direction.
M17	Metapodials	Cut	Axial knife cuts.
M18	Metapodials	Chop	Superficial horizontal chop marks on or near distal end
M19	Metapodials	Cut	knife cuts on medial or lateral aspects of proximal
M2	Metapodials	Chop	axial chop through shaft in anterio-posterior direction.
M20	Metapodials	Chop	Axial chop through shaft in medio-lateral direction

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
M21	Metapodials	Chop	oblique/horizontal chops through proximal end.
M3	Metapodials	Chop	axial chop through distal end.
M4	Metapodials	Chop	repeated axial chops through proximal end.
M5	Metapodials	Chop	superficial medio-lateral chop marks on posterior aspect of proximal end.
M6	Metapodials	Chop	superficial medio-lateral chop marks on anterior aspect of proximal end.
M7	Metapodials	Chop	superficial horizontal chop marks on shaft.
M8	Metapodials	Chop	horizontal chop through shaft.
M9	Metapodials	Chop	horizontal chop through distal end.
P1	Pelvis	Chop/Saw	chop/saw marks on iliac tuberosity (articulation surface with sacrum).
P10	Pelvis	Chop/Saw	superficial chop/saw marks on shaft of ischium.
P11	Pelvis	Cut	superficial blade marks on ilium shaft.
P12	Pelvis	Cut	knife cuts on lateral aspect of shaft of ilium.
P13	Pelvis	Cut	other knife cuts on ilium.
P14	Pelvis	Cut	knife cuts in and around acetabulum.
P15	Pelvis	Cut	knife cuts on shaft of pubis.
P16	Pelvis	Cut	knife cuts on shaft of ischium.
P17	Pelvis	Cut	superficial blade marks on ischium.
P18	Pelvis	Chop	chop through ischial tuberosity.
P19	Pelvis	Cut	knife cuts under acetabulum
P2	Pelvis	Chop	dorsal-ventral/latero-medial chop through shaft of ilium.
P3	Pelvis	Chop/Saw	superficial dorso/ventral chop/saw marks on shaft of ilium.
P4	Pelvis	Chop/Saw	other superficial chop/saw marks on shaft of ilium.
P5	Pelvis	Chop	chop through acetabulum.
P6	Pelvis	Chop/Saw	superficial chop/saw marks in and around acetabulum.
P7	Pelvis	Chop	cranio-caudal/oblique chop through shaft of pubis.
P8	Pelvis	Chop/Saw	superficial chop/saw marks on shaft of pubis.
P9	Pelvis	Chop	chop through shaft of ischium.
PH1	Phalanges 1 & 2	Cut	medio-lateral knife cuts on anterior aspect of proximal end.
PH10	Phalanges 1 & 2	Chop	superficial chop marks on posterior aspect of shaft.
PH11	Phalanges 1 & 2	Chop	Axial chop through bone in anterio-posterior direction.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
PH12	Phalanges 1 & 2	Chop	superficial chop marks on lateral/medial aspects of shaft running in posterio-anterior direction.
PH13	Phalanges 1 & 2	Chop	superficial chop marks on lateral/medial aspects of proximal running in posterio-anterior direction.
PH14	Phalanges 1 & 2	Chop	superficial axial chop marks.
PH15	Phalanges 1 & 2	Chop	proximal chopped through obliquely or horizontally
PH2	Phalanges 1 & 2	Cut	medio-lateral knife cuts on posterior aspect of proximal end.
PH3	Phalanges 1 & 2	Cut	anterio-posterior knife cuts on peripheral aspect of proximal end.
PH4	Phalanges 1 & 2	Cut	medio-lateral knife cuts on anterior aspect of shaft.
PH5	Phalanges 1 & 2	Cut	medio-lateral knife cuts on posterior aspect of shaft.
PH6	Phalanges 1 & 2	Cut	anterio-posterior knife cuts on peripheral or medial aspect of shaft.
PH7	Phalanges 1 & 2	Cut	knife cuts at distal end.
PH8	Phalanges 1 & 2	Chop	superficial medio-lateral chop marks on posterior aspect of proximal end.
PH9	Phalanges 1 & 2	Chop	superficial medio-lateral chop marks on anterior aspect of proximal end.
Q1	Centroquartal	Chop	axial chop through bone running in anterio-posterior direction.
Q2	Centroquartal	Chop/Saw	superficial chop/saw marks posterior/lateral surfaces.
Q3	Centroquartal	Chop/Saw	superficial chop/saw marks anterior/medial surfaces.
Q4	Centroquartal	Cut	knife cuts on anterior aspect (+ medial and lateral).
Q5	Centroquartal	Cut	knife cuts on posterior aspect.
Q6	Centroquartal	Chop	axial chops in medio-lateral direction.
R1	Radius	Chop	axial chop through proximal articulation running in anterio-posterior direction.
R10	Radius	Chop	horizontal superficial chop marks at distal end.
R11	Radius	Cut	horizontal knife cuts on medial aspect of proximal end.
R12	Radius	Cut	horizontal knife cuts at distal end.
R13	Radius	Cut	knife cuts on shaft.
R14	Radius	Chop	superficial axial chop/blade marks on shaft.
R15	Radius	Chop	superficial axial chop/blade marks at proximal end.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
R16	Radius	Chop	horizontal/oblique chop through shaft.
R17	Radius	Chop	horizontal chop through proximal end.
R18	Radius	Chop	horizontal chop through distal end.
R19	Radius	Chop	axial chop on lateral part of proximal articulation running anterio-posteriorally.
R2	Radius	Chop	axial chop through proximal articulation running in medio-lateral direction.
R20	Radius	Chop	axial chop on anterior part of distal end running medio-laterally..
R21	Radius	Chop	superficial axial chop marks on distal posterior running medio-laterally.
R22	Radius	Chop	superficial chop mark on proximal articular surface
R23	Radius	Cut	knife cut on proximal end (not medial aspect)
R24	Radius	Chop	other axial chops through distal end.
R25	Radius	Chop	oblique chop through proximal end.
R26	Radius	Saw	horizontal/oblique saw through shaft
R3	Radius	Chop	repeated axial chops through proximal articulation running in anterio-posterior direction.
R4	Radius	Chop	repeated axial chops through proximal articulation running in anterio-posterior and medio-lateral directions.
R5	Radius	Chop	axial chop through distal articulation running in anterio-posterior direction.
R6	Radius	Chop/Saw	superficial chop/saw marks on shaft.
R7	Radius	Chop	axial chop through shaft running in anterio-posterior direction.
R8	Radius	Chop	repeated axial chops through shaft running in anterio-posterior direction.
R9	Radius	Chop	superficial horizontal chop marks on medial aspect of proximal end.
RB1	Ribs	Chop	dorsal end chopped through
RB2	Ribs	Chop	superficial chop marks on and around dorsal end.
RB3	Ribs	Chop	shaft chopped through horizontally.
RB4	Ribs	Chop	superficial chop marks on lateral of shaft.
RB5	Ribs	Chop	superficial chop marks on medial of shaft.
RB6	Ribs	Cut	knife cuts on or around dorsal articulation.
RB7	Ribs	Cut	knife cuts on lateral aspect of shaft.
RB8	Ribs	Cut	knife cuts on medial aspect of shaft.
S1	Scapula	Chop	axial/oblique chops through glenoid cavity running in latero-medial direction.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
S10	Scapula	Cut	axial knife cuts on medial and posterior aspects of blade.
S11	Scapula	Cut	other knife cuts on lateral and anterior aspects of blade.
S12	Scapula	Cut	other knife cuts on medial and posterior aspects of blade.
S13	Scapula	Cut	knife cuts near proximal end.
S14	Scapula	Chop	other superficial chop marks on medial aspect of blade.
S15	Scapula	Chop	superficial chop marks running posterio-anteriorally on glenoid cavity.
S16	Scapula	Chop	axial chop through lateral or medial edges of glenoid cavity running posterio-anteriorally.
S17	Scapula	Chop	superficial chop marks on posterior of shaft running medio-laterally or obliquely.
S18	Scapula	Chop	axial chop on anterior or posterior edge of glenoid cavity running medio-laterally.
S19	Scapula	Punch	perforation in blade.
S2	Scapula	Chop	repeated axial/oblique chops through glenoid cavity running in medio-laterally.
S20	Scapula	Chop	horizontal chop through neck or glenoid.
S21	Scapula	Cut	knife cuts on neck.
S22	Scapula	Chop	oblique/horizontal chop through blade.
S23	Scapula	Chop	superficial chop marks on neck
S24	Scapula	Chop	superficial chop marks on glenoid cavity running medio-laterally
S3	Scapula	Chop	horizontal superficial chop marks around rim of glenoid cavity.
S4	Scapula	Chop/Saw	axial chop/blade/saw marks lateral spine.
S5	Scapula	Chop/Saw	other axial chop/blade/saw marks on lateral aspect of blade.
S6	Scapula	Cut	superficial axial chop/blade marks medial/posterior and anterior aspects of blade.
S7	Scapula	Chop/Saw	other chop/blade/saw marks on lateral aspect of blade.
S8	Scapula	Cut	horizontal knife cuts around rim of glenoid cavity.
S9	Scapula	Cut	axial knife cuts on lateral and anterior aspects of blade including spine.
SK1	Skull	Chop	frontal/parietal/occipital chopped through centre in cranio-caudal direction.
SK10	Skull	Cut	knife cuts on nasal.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
SK11	Skull	Chop	zygomaticus chopped through.
SK12	Skull	Chop	maxilla chopped through horizontally.
SK13	Skull	Chop	oblique chop through back of skull.
SK14	Skull	Chop	superficial horizontal chop mark on occipital condyles or sphenoid.
SK15	Skull	Cut	vertical or horizontal knife cuts on premaxilla or front of maxilla.
SK16	Skull	Cut	Blade marks on maxilla, zygomatic or frontal.
SK17	Skull	Cut	Knife cuts on or around occipital condyles.
SK18	Skull	Cut	Other knife cuts on frontal or parietal.
SK19	Skull	Chop	Other superficial chop marks on zygomatic or temporal.
SK2	Skull	Chop	horn core base chopped through.
SK20	Skull	Chop	Chop marks on nasal or lacrimal.
SK21	Skull	Chop	maxilla/premaxilla chopped through vertically
SK3	Skull	Chop	superficial chop marks at base of horn core.
SK4	Skull	Chop	occipital condyle and/or sphenoid chopped through.
SK5	Skull	Chop	chop mark through frontal in medio-lateral direction.
SK6	Skull	Cut	cranio-caudal/oblique knife cuts on zygomatic or temporal.
SK7	Skull	Chop	superficial chopmarks on top of skull (frontal/parietal).
SK8	Skull	Cut	cranio-caudal/oblique knife cuts on maxilla.
SK9	Skull	Cut	knife cuts on frontal near horn core.
T1	Tibia	Chop	superficial horizontal/oblique chop marks at proximal end.
T10	Tibia	Cut	horizontal knife cuts on shaft.
T11	Tibia	Cut	horizontal knife cuts at distal end.
T12	Tibia	Cut	superficial blade marks on shaft.
T13	Tibia	Chop	other superficial horizontal/oblique chop marks on shaft
T14	Tibia	Chop	horizontal/oblique chop through distal end.
T15	Tibia	Chop	horizontal/oblique chop through proximal end.
T16	Tibia	Chop	horizontal/oblique chop through shaft.
T17	Tibia	Cut	oblique knife cuts on shaft.
T18	Tibia	Cut	oblique knife cuts near distal end.
T19	Tibia	Chop	axial chop through distal in medio-lateral direction.
T2	Tibia	Chop	axial chop through proximal usually running in posterio-anterior direction.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
T20	Tibia	Chop	axial chop on edges of proximal articulation.
T21	Tibia	Chop	axial chop on edges of distal articulation.
T22	Tibia	Chop	superficial oblique chop mark on distal end
T3	Tibia	Chop	repeated axial chops through proximal.
T4	Tibia	Chop	axial chop through shaft running in posterio-anterior direction.
T5	Tibia	Chop	repeated axial chop through shaft.
T6	Tibia	Chop	Axial chop through distal running in posterio-anterior direction.
T7	Tibia	Chop	repeated axial chops through distal end.
T8	Tibia	Chop/Saw	superficial horizontal chop/saw marks on distal end.
T9	Tibia	Cut	knife cuts around proximal end.
U1	Ulna	Chop	Oblique/horizontal chop through olecranon.
U10	Ulna	Cut	Horizontal knife cuts at distal end.
U11	Ulna	Chop	superficial horizontal/oblique chop on shaft.
U12	Ulna	Chop	superficial horizontal/oblique chop marks on olecranon.
U13	Ulna	Chop	superficial horizontal/oblique chop marks on proximal articulation.
U14	Ulna	Cut	knife cuts on proximal joint surface.
U15	Ulna	Chop	axial chop through proximal running medio-laterally
U16	Ulna	Cut	knife cuts on posterio/anterior of olecranon
U17	Ulna	Chop	Superficial horizontal chop to top of tuber
U18	Ulna	Cut	knife cuts on proximal end (above articulation)
U2	Ulna	Chop	Axial chop through proximal joint surface.
U3	Ulna	Chop	Horizontal chop through proximal joint surface.
U4	Ulna	Chop	Axial blade/chop marks on posterior of shaft.
U5	Ulna	Chop	Oblique/horizontal chop through shaft.
U6	Ulna	Chop	Horizontal chop through distal end.
U7	Ulna	Cut	Oblique/horizontal knife cuts on medial of olecranon.
U8	Ulna	Cut	Oblique/horizontal knife cuts on lateral of olecranon.
U9	Ulna	Cut	Knife cuts on shaft.
V1	Vertebrae	Chop	axial chop through centre of bone in a cranio-caudal direction.
V10	Vertebrae	Cut	axial knife cuts on lateral aspect of body.
V11	Vertebrae	Chop	horizontal chop through body.
V12	Vertebrae	Chop	other superficial chop marks.
V13	Vertebrae	Cut	cranio-caudal knife cuts on body.

Butchery Codes			
Classification	**Element**	**Type**	**Definition**
V14	Vertebrae	Cut	knife cuts on dorsal.
V15	Vertebrae	Cut	other knife cuts.
V16	Vertebrae	Chop	oblique chop through body.
V17	Vertebrae	Chop	chop through dorsal.
V2	Vertebrae	Chop	axial chop through body of bone towards lateral in a cranio-caudal direction.
V3	Vertebrae	Chop	axial chop through lateral of bone in a cranio-caudal direction.
V4	Vertebrae	Chop	axial chop through bone in a medio-lateral/oblique direction.
V5	Vertebrae	Chop	superficial axial/cranio-caudal chop on centre of body.
V6	Vertebrae	Chop	superficial axial/cranio-caudal chop towards lateral of body.
V7	Vertebrae	Chop	superficial medio-lateral/oblique chop across body.
V8	Vertebrae	Cut	knife cuts on lateral surface.
V9	Vertebrae	Cut	medio-lateral knife cuts across body.
XP	*Extra	Chop	other chop mark
XS	*Extra	Saw	other saw mark
XT	*Extra	Cut	other cut mark

BURN (=burning):
S = singed
B = burnt
C = calcined
"blank" = absent or not recordable

GNAW (=gnawing):
C = gnawed by carnivores
D = partially digested
R = gnawed by rodents
U = gnawed by ungulates
H = gnawed by humans/primates
F = gnawed by felids
CR = gnawed by carnivores and rodents
"blank" = absent or not recordable

I1, I2, I3, I (all other than horse), dI1, dI2, dI3, dI, C (other than pig), dC , P1, P2, P3, P, dP2, dP3, P/M, M:
P = present
"blank" = absent

I1, I2, I3, I (horse):

U = unworn
W = worn
RI = round infundibulum
WI = worn with infundibulum
VW = very worn
EW = extremely worn

C (pig):
M = male
F = female
AM = male alveolus
AF = female alveolus
P = present
"blank" = absent

P4, dP4, M1, M2, M3, M12(=M1 or M2):
wear stage
P = present, but wear stage not recordable (or not recorded)
"blank" = absent

PATH:
C = calculus
H = hypoplasia (one band)
HH = hypoplasia (two or more bands)
CH = calculus and hypoplasia (one band)
CHH = calculus and hypoplasia (two or more bands)

Measurements:
All in tenths of millimetres.