7.3.1 Report on Animal Bones from Portmahomack, Tarbat, Ross-Shire.

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NOTE by MOHC: This is not an assessment, but the final report. It was edited by MOHC and corrected for spelling in Sep 2012.

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1.0 Introduction

Within the context of European archaeology, faunal assemblages heralding from monastic sites are relatively rare when compared to other settlement types. This is unfortunate as monastic sites arguably represent one of the more interesting 'socio-cultural' settings in which to study animal bone. Aside from the ecclesiastic prohibitions that leave their mark by the absence of specific species, there are numerous economic particulars about such sites that make them valuable for study. Not least is the fact that monastic sites, particularly early ones, were likely functioning as self-sufficient enterprises. Later medieval and post-medieval monasteries operate on a grander scale, often retaining and managing large tracks of land (Ervynck 1997). Furthermore, in much the same way that castle sites demonstrate a pattern of organisation relative to building lay-out, and by inference use, so too is this type of evidence seen on monastic sites. Thus, we have the potential for investigating patterns of consumption, should these exist, as they might relate to different parts of the monastic community (*ibid*).

Situating Tarbat within its wider European context, it is clear that a rather unique assemblage has become available for study. The fact that Tarbat represents one of the earliest Pictish monasteries not only allows for an investigation of underlying food culture as it relates to an early monastic enclave, but also evidence of faunal translocation that may give clues to trade and exchange, providing a better understanding of how early abbey sites functioned. Coupled with these important considerations is the fact that the site itself is situated within an 'ecological niche' that has resulted in a specific, and again arguably unique, landscape-seascape setting resulting in a pattern of faunal exploitation has been able to take advantage of both terrestrial and aquatic resources.

2.0 Method

The zooarchaeological investigation followed the system implemented by Bournemouth University with all identifiable elements recorded (NISP: Number of Identifiable Specimens) and diagnostic zoning (amended from Dobney & Reilly 1988) used to calculate MNE (Minimum Number of Elements) from which MNI (Minimum Number of Individuals) was derived.

Aging of the assemblage employed a combination of Grant's (1982) tooth wear stages and fusion of proximal and distal epiphyses (Silver 1969). Metrical analysis followed von den Driesch (1976). Elements from sheep and goats were distinguished, where possible, based on criteria established for the post-cranial skeleton by Boessneck (1969) and teeth by Payne (1985) and Halstead *et al* (2002).

Identification of the domestic and wild component of the assemblage was undertaken with the aid of Schmid (1972) and Serjeantsen & Cohen (1996). The marine mammal component of the assemblage was identified with the help of Ericson and Storå (1999). Dr Chris Stimpson (Dept. of Arch.; Uni. Of Cambridge) generously provided his time and kindly identified the avian bones. Zooarchaeological reference material from collections of the Grahame Clark Zooarchaeology Lab, Dept. of Archaeology, Cambridge, the Zoology Museum, Cambridge, and the specialist avian collection of the Natural History Museum housed at Thring, Hertfordshire were also used in the analysis of this assemblage.

Taphonomic criteria including indications of butchery, pathology, gnawing activity and surface modifications as a result of weathering were also recorded when evident.

3.0 Results

3.1 Overall Sample Size and Condition of Assemblage

Following an initial assessment of the material, bones from 850 contexts were scanned, producing a total of 32,479 recorded fragments. This represented a sizeable faunal assemblage with much potential for further investigation. The preservation of the assemblages from each context was assigned to one of five grades ranging from excellent to poor. Just under a quarter (236) of the contexts contained bones that were quite well preserved with good surface condition. Bones were moderately preserved, in just over a third (307) of the contexts indicating high levels of both ancient and modern fragmentation, but relatively little surface erosion. The largest number of bones (from 309 contexts) fell into the "poorly preserved" category generally indicating a relatively high proportion of eroded and heavily fragmented bones. There was also a high proportion of burnt elements, often completely calcined. There were very few counts of gnawed bone suggesting that secondary deposition either did not occur to any great extent, or, if it did, the bones were reburied relatively quickly.

Having identified the key components of the global assemblage that merited full analysis, a comprehensive zooarchaeological investigation of materials from both Sector 1 and 2 was undertaken. This resulted in a recorded sample of some 16,731 fragments from 855 [850] contexts, of which 11,763 (70%) were identifiable to element level, and a further 7,035 (42%) were identified to species. Preservation figures for the cohort studied suggested moderate to good levels of preservation (424 contexts) with poorly preserved materials deriving from 310 contexts. However, a more revealing picture is evident from the actual number of fragments overall: some 8,862 bones were classed as moderate to good, whereas 3,445 where considered poor. A further 4424 evidenced 'mixed' levels of preservation.

It was possible to record pathological changes where they occurred as well as incidences of butchery. Although the assemblage had undergone a high degree of fragmentation, only a very small proportion showed evidence of excavator mediated damage.

The remainder of this report deals with Sector 2, Int. 14 & 24: Period 2, only. Of the bones that underwent full analysis, 15,629 (93%) fragments were recorded from Sector 2; furthermore, Sector 2 was associated with specific craft practices that are the focus of this study.

3.1.1 Species representation

As might be expected for an assemblage so closely tied to a specific mode of human habitation, domestic species dominated the recorded species (Table 1).

Table 1: NISP and MNI counts all species present

SPECIES	NISP	%NISP	MNI
Cow	5124	72.8	305
Pig	721	10.2	71
Ovicaprid	355	5.0	28
Horse	199	2.8	9
Dog	270	3.8	9
Cat	11	0.15	2
Fox	33	0.47	4
Wolf	4	0.05	4
Hare	2	0.02	1
Cervid – no species assigned	2	0.02	2
Red deer	97	1.4	3
Roe deer	35	0.49	4
Otter	5	0.07	2
Birds	83	1.2	16
Chicken	20	0.3	3
Anser sp.	34	0.5	8
Raven (*Corvus corax*)	2	0.03	1
Razorbill (*Alca torda*)	7	0.09	1
Lesser black-backed gull (*Larius cf. fuscus*)	1	0.01	1
Cygnus sp.	1	0.01	1
European shag (*Phalacrocorax aristotelis*)	11	0.2	2
Gannet (*Morus bassanus*)	1	0.01	1
Common redshank (*Tringa totanus*)	1	0.01	1
Eurasian curlew (*Numenius arquata*)	2	0.03	1
Western capercaillie (*Tetrao urogallus*)	2	0.03	1
'Wader'	1	0.01	1
Marine mammal (1 unid'd)	94	1.3	9
Whale sized	15	0.2	2
Porpoise / dolphin sized	9	0.1	1
Seal	70	0.99	5
ULM	3431	29.1 (Σ=11763)	-
UMM	1191	10.1 (Σ=11763)	-
USM	1	0.008(Σ=11763)	-
UUB	91	0.07 (Σ=11763)	-
UUF	3	0.02 (Σ=11763)	-
UUM	4968	29.7 (Σ=16731)	-

Key: USM, UMM & ULM = Unid. Small, Medium and Large Mammal / UUB & UUF = Unid. Bird & fish / UUM = Unid. Fragment. NB: Species percentages are out of 7035. These differ from the unidentified counts as these were calculated on the basis of element identification (for UMM & ULM) and total fragments (for UUM) (corresponding to Σ in brackets).

Cattle were by far the most numerous species accounting for 73% of the identifiable portion of the assemblage. They were also the most numerous in terms of MNI, with some 305 individual animals calculated from the MNE. Pig and sheep/goat were also recovered in representative numbers; however, their economic significance was apparently less important than cattle. Of the non-food domestic species, dogs were recovered in greater numbers then horse; however, this is predominantly as a result of a near complete juvenile canid skeleton recovered from context 1319 (Int. 24).

The range of land-based wild species is not as diverse as one might expect for an assemblage of this size. The most abundant non-domesticates are red and roe deer; figures for red deer are inflated due to the presence of a relatively large number of antler fragments. Interestingly, the number of wolf finds is, again relatively speaking, significant, even for an assemblage of this size. Wolf finds are notoriously rare, therefore the recovery of finds indicating four individual animals may be suggestive of specific exploitation.

While the wild faunal component of this assemblage is somewhat restricted, the avian is by contrast markedly diverse. As one might expect given the location, sea birds are present in significant numbers. Geese were recorded in greater numbers then domestic chicken; however, this component included individuals from a range of species as opposed to domestic geese only. From the materials present it was not possible to refine the identification of the geese component to species level. One 'wader' was recorded and this was likely a grey heron (*Ardea cinerea*).

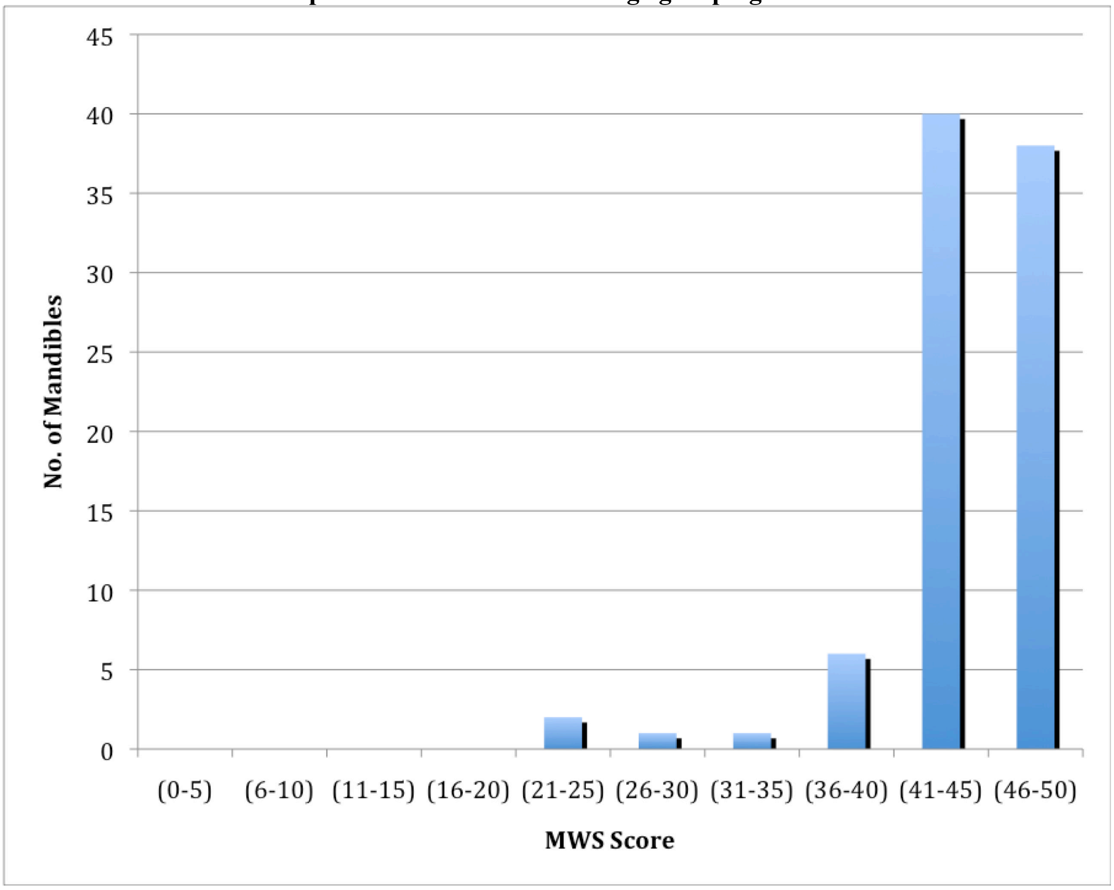
Again in contrast to the land based faunal remains, the marine mammal cohort, although found in small numbers when compared to the overall size of the assemblage, showed a particularly noteworthy level of diversity. Unfortunately, fragmentation – particularly of the largest whale species – and state of preservation made concrete identification problematic. However, it was clear that large (minke whale sized), medium (porpoise sized) and small (dolphin sized) cetaceans, along with seals (common / harbour seal, *Phoca vitulina* and possibly grey seal, *Halichoerus grypus*, identified) were recovered.

3.2 Aging, sexing and metrical data for the main domesticates

3.2.1 **Cattle**

Both tooth wear and fusion data were used to establish an age range for cattle from this sub-assemblage (refer to 'Tooth Wear' sheet in EXCEL file / Graph 1 (tooth wear) and Table 2 (fusion) below). In total, it was possible to determine tooth wear stages from 100 individual mandibles; a significantly great number of fusion counts, 617 in total, were recorded. In combination these data provide a reasonable estimate of the overall age profile of this sub-set. The tooth wear data strongly favours individuals classed as 'Adult" or 'Old Adult' with just three examples of sub-adult animals (estimated to be between 18 to 30 months old). Mandibular wear stages are calculated on the basis of permanent molars, this method is thus not ideal for identifying juvenile specimens. To deal with this, Grant's system includes the recording of deciduous and pre-molar teeth. At least 10 juvenile cattle still retained the deciduous dentition, approximately 10% of the overall 'adult' component. This figure calls for caution in assuming that the cattle cohort is comprised principally of old adults. While this is in fact the case from the evidence we have, the *caveat* must be noted that calves were also present, and in noteworthy numbers.

Graph 1: Mandibular Wear Stage groupings: cattle



The fusion data, which given the greater sample size is likely to be providing a more complete age profile for the site, still favours 'Adult' and 'Old Adult' individuals. However, at least 16 individuals died as sub-adults, under the age of 12 months, as evidence from the unfused distal radii count (see 'Early Fusing' in Table 2).

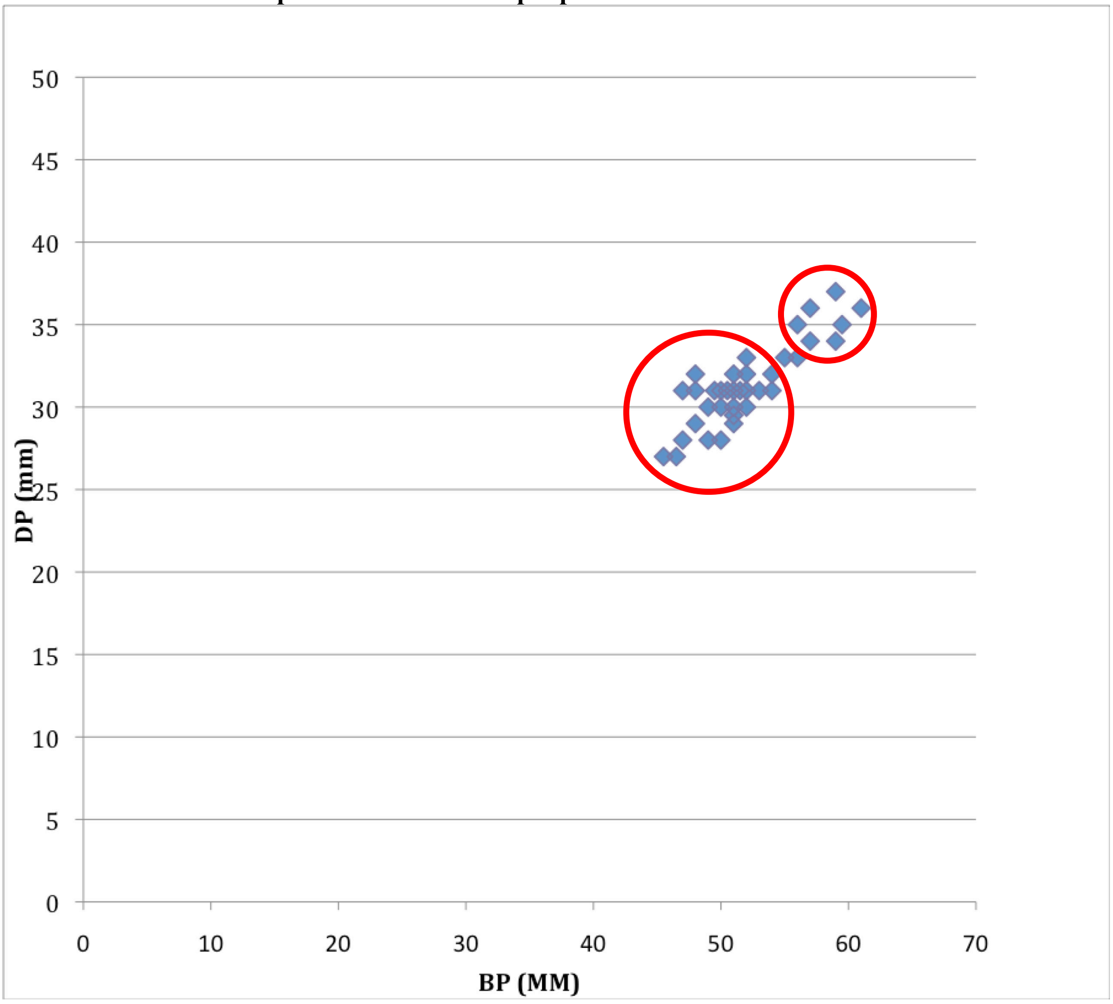
Table 2: Fusion data with estimated ages in months for cattle (after Schmid 1972 & Silver 1969)

	Element	Fused	Unfused	Age at Fusion (Months)
Early Fusing	Scapula, Distal	40	3	07 to 10
	Humerus, Distal	63	4	12 to 18
	Radius, Proximal	54	16	12 to 18
	Phalanx 1, Proximal	49		18 to 24
	Phalanx 2, Proximal	32		18 to 24
Middle Fusing	Tibia, Distal	47	13	24 to 30
	Metacarpal, Distal	99	7	24 to 36
	Metatarsal, Distal	82	2	24 to 36
	Calcaneus, Proximal	26	7	36 to 42
Late Fusing	Radius, Distal	18	18	42 to 48
	Ulna, Proximal	7	5	42 to 48
	Femur, Proximal	19	13	42 to 48
	Femur, Distal	14	16	42 to 48
	Tibia, Proximal	14	15	42 to 48

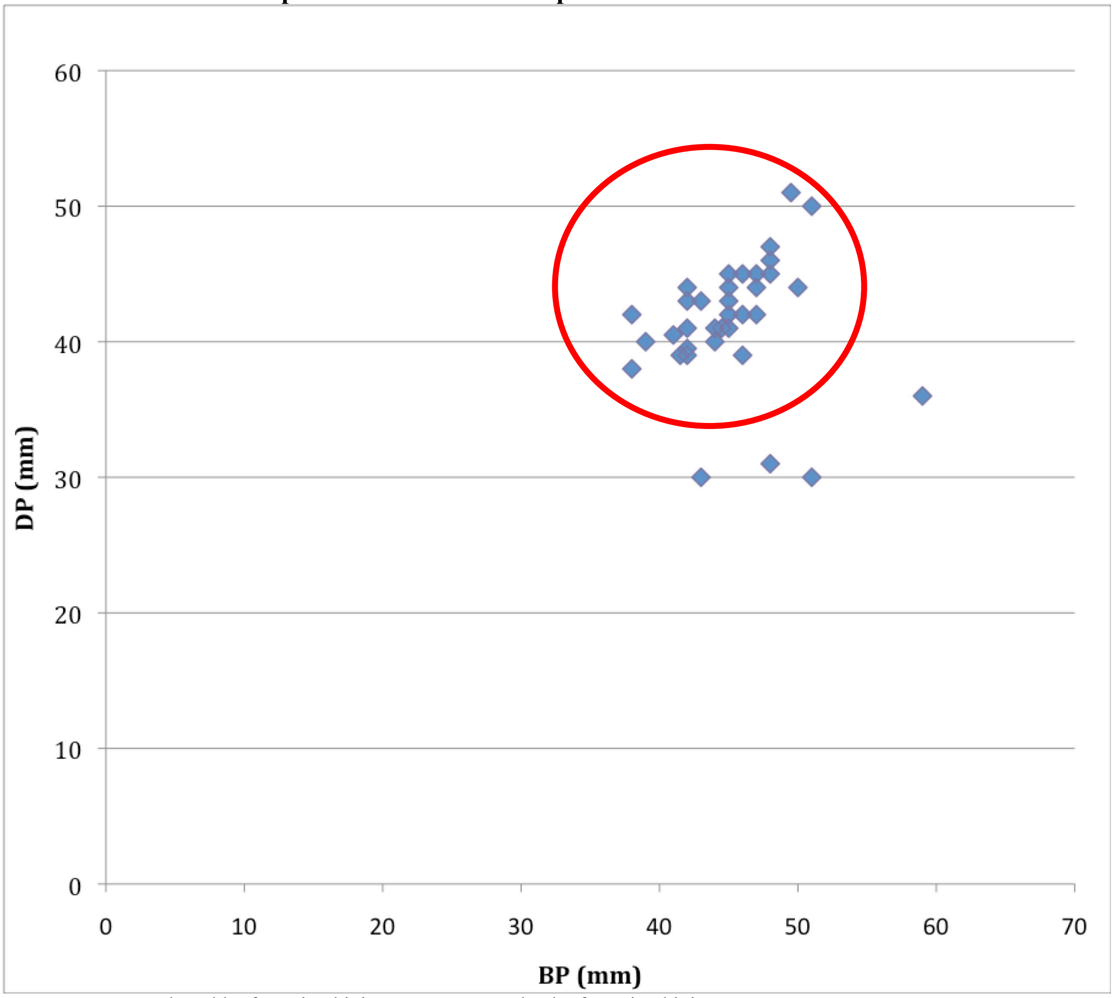
Unfortunately, due to the fragmentary nature of both the recovered horn cores and innominate bones it was not possible to determine the sex of any of the individual animals. The portion of horn core still attached to the cranium suggests that the horns themselves were not particularly large and could have potentially derived from either males or females, thus compounding the problem of accurately sexing individuals. However, in the absence of direct evidence for sex discrimination, metrical analysis has been used to investigate ratios of male and female animals based on size variability (as per graph 2 & 3 for metacarpals and metatarsals respectively).

From the corpus of metrical data it was possible to extract two sub-sets denoting the size variation at the proximal joint of metacarpals (47 individuals) and metatarsals (44 individuals). The results would seem to indicate two relatively clearly defined groups based on size of the proximal joint. From the metacarpal plot (graph 2) it would appear that some 35 individuals, probably representing female animals, are distinguishable from a smaller, approximately 10 individuals, sample of male animals (two individuals fall between the main groupings). In contrast, the metatarsal evidence (graph 3) suggests the reverse, with a larger cohort of bigger, perhaps male, animals.

Graph 2: Plot of metacarpal proximal measurement data



Graph 3: Plot of metatarsal proximal measurement data



Key: Bp = greatest breadth of proximal joint; Dp = greatest depth of proximal joint.

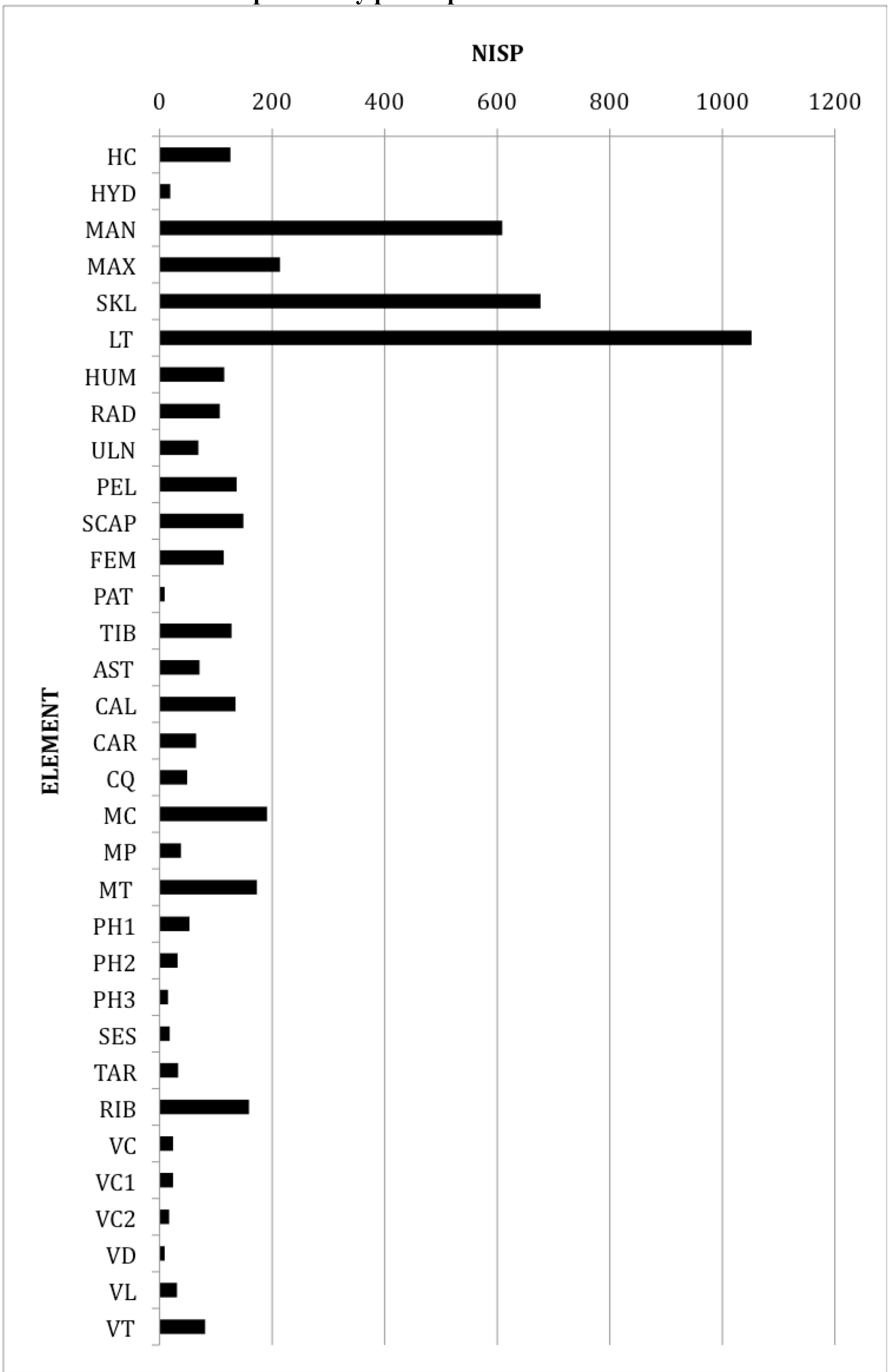
By using the greatest length measurement from the metacarpals and metatarsals (51 in total) and Matolcsi's (1970) correction factor it was possible to estimate the average withers height of the sampled cattle, calculated as follows (after Matolcsi 1970):

Females: Metacarpal GL x 6.03 / Metatarsal GL x 5.33
Males: Metacarpal GL x 6.33 / Metatarsal GL x 5.62

As the sex of the individual animals was not known, each measurement was first calculated using the equation for estimating female stature, then male, then averaged. Overall, the withers height for individuals from the pooled data elicited an average stature of 1.1 meters.

Focusing on body part representation for cow, the results suggest that whilst all parts of the carcass are present, there is a particular bias towards cranial elements (graph 4, below). However, this should not be over interpreted, as it is likely indicative of taphonomic effect (i.e. the greater probability of these parts becoming fragmented).

Graph 4: Body part representation for cattle



Key: HC: Horncore; HYD: Hyoid; MAN: Mandible; MAX: Maxilla; SKL: Skull fragment; LT: Loose tooth; HUM: Humerus; RAD: Radius; ULN: Ulna; PEL: Pelvis; SCAP: Scapula; FEM: Femur; PAT: Patella; TIB: Tibia; AST: Astragalus; CAL: Calcaneous; CAR: Carpal; CQ: Centroquartal; MC: Metacarpal; MT: Metacarpal; PH1,2,3: 1st, 2nd & 3rd Phalanx; SES: Sesamoid; TAR: Tarsal; RIB: Rib; VC1: Axis ; VC2: Atlas; VD, VL, VT, VC: Caudal, Lumbar, Thoracic & Cervical Vertebra.

3.2.2 **Pig**

Aging of pig was again based on tooth wear and fusion data. Some 55 tooth wear stage records were taken, alongside 138 fusion counts. The results are presented in graph 5 & table 3.

Graph 5: Mandibular Wear Stage groupings: pig

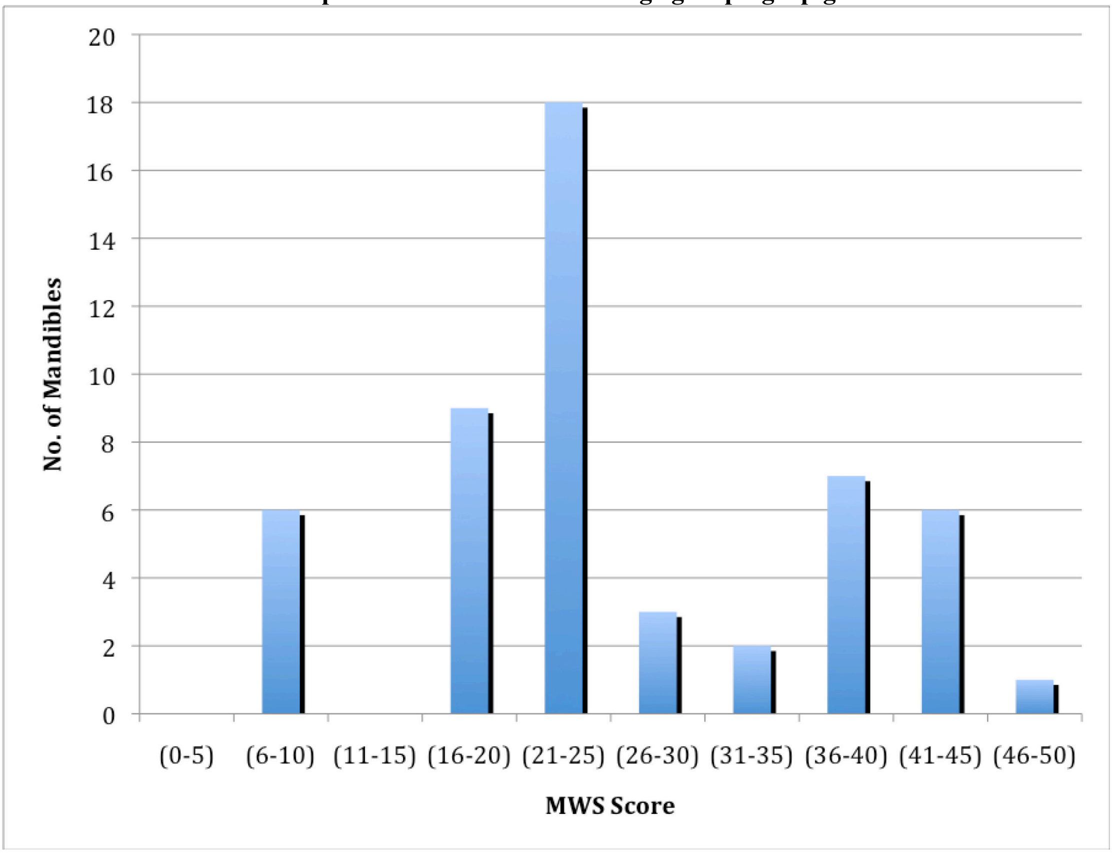
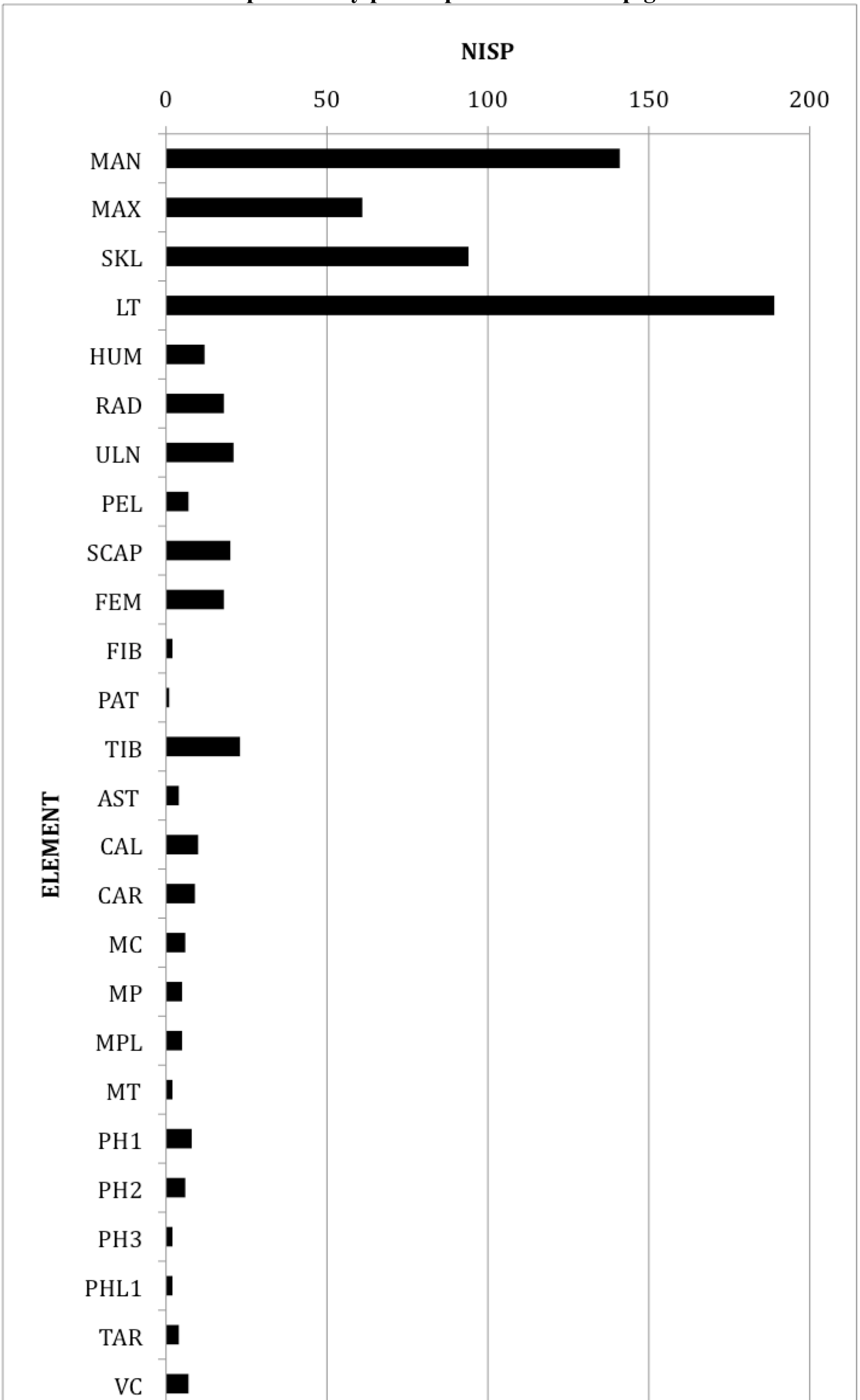


Table 3: Fusion data with estimated ages in months for pig (after Schmid 1972 & Silver 1969)

Element		Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	12	1	12
	Humerus, Distal	6	1	12
	Radius, Proximal	6	1	12
	Phalanx 1, Proximal	6	1	24
	Phalanx 2, Proximal	1	5	12
Middle Fusing				
	Tibia, Distal	3	12	24
	Metacarpal, Distal	1	5	24
	Metatarsal, Distal		2	27
	Calcaneus, Proximal			24 to 30
Late Fusing				
	Radius, Distal	1	4	42
	Ulna, Proximal		8	36 to 42
	Femur, Proximal		9	42
	Femur, Distal	12	1	12
	Tibia, Proximal	6	1	12

Unsurprisingly, given the very different mode of husbandry under which pigs are maintained, i.e. they are kept almost exclusively for meat production, the majority of individuals were killed at between 18 to 30 months of age. The pig cohort actually exhibits a classic cull-profile for this species, with a high number of young animals and a small number of older animals retained for regeneration of the population.

Graph 6: Body part representation for pig



Key: refer to Graph 4, with the addition of FIB: Fibula; PHL1: 1st lateral phalanx.

Unfortunately, sexing was not possible for pigs as the majority of skull and pelvic elements were fragmented. Furthermore, no large canines were recovered that may have indicated large male animals. Again, this is not particularly unusual; only a small number of adult animals would have been maintained relative to the overall number of pigs. Culling would have focused on sub-adult animals that are less likely to have developed sexually distinctive characteristics.

Because of the large number of unfused elements overall and the fact that bones such as the metacarpal and metatarsal are considered 'Middle' fusing (and therefore unlikely to have fused by the time the animals were slaughtered), metrical analysis was not assistive in determining sex.

As with cattle, body part representation (graph 6) for pig indicates that all elements are present on site. Once again, there is an over emphasis of cranial bones and loose teeth, which is likely resultant from taphonomic fragmentation.

3.2.3 **Sheep / Goat**

Tooth wear scores from 20 individuals were recorded, with a further 109 fusion records noted in order to estimate age at death for sheep/goat specimens. These are presented in graph 7 and table 4.

Graph 7: Mandibular Wear Stage groupings: S/G

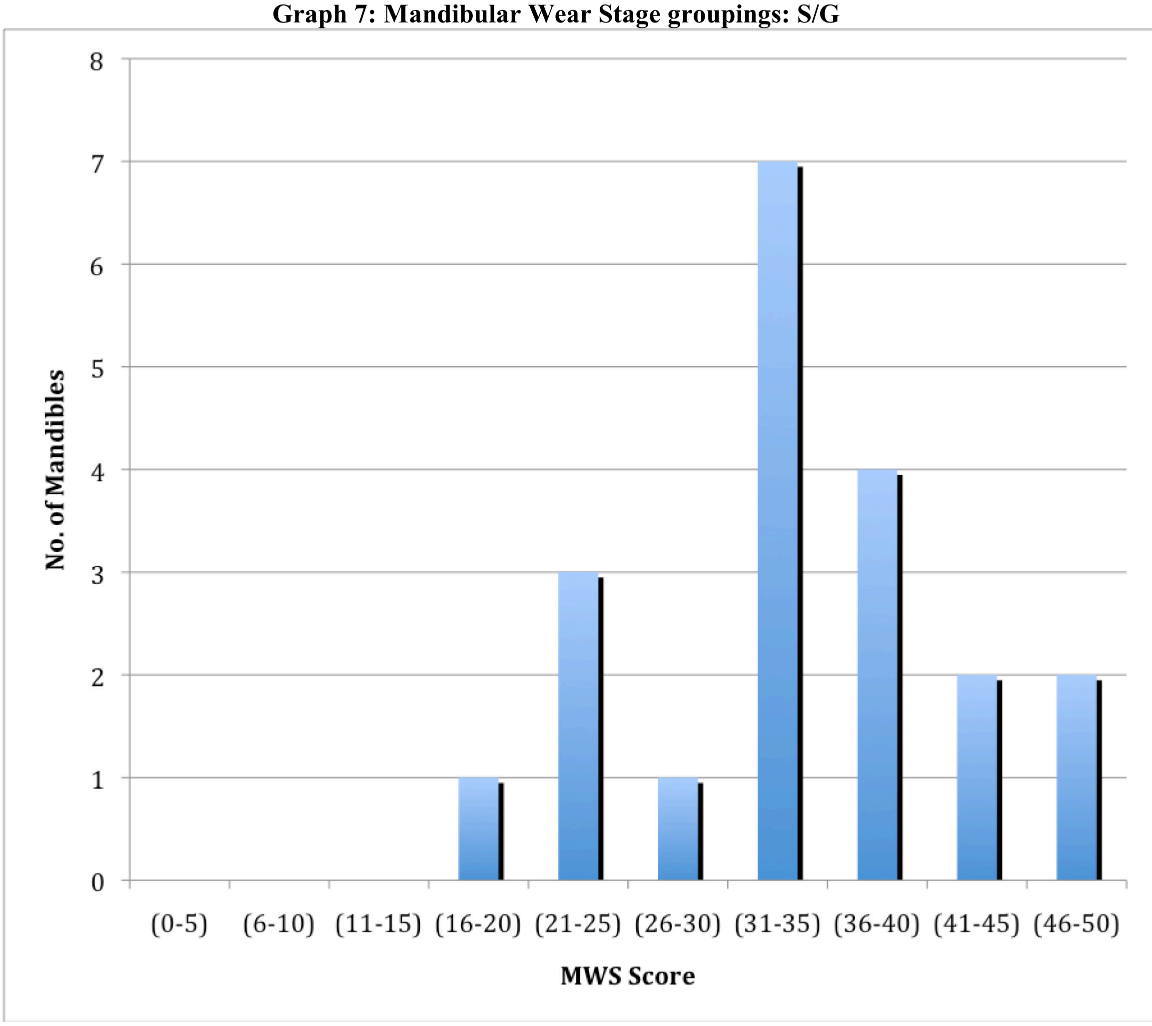


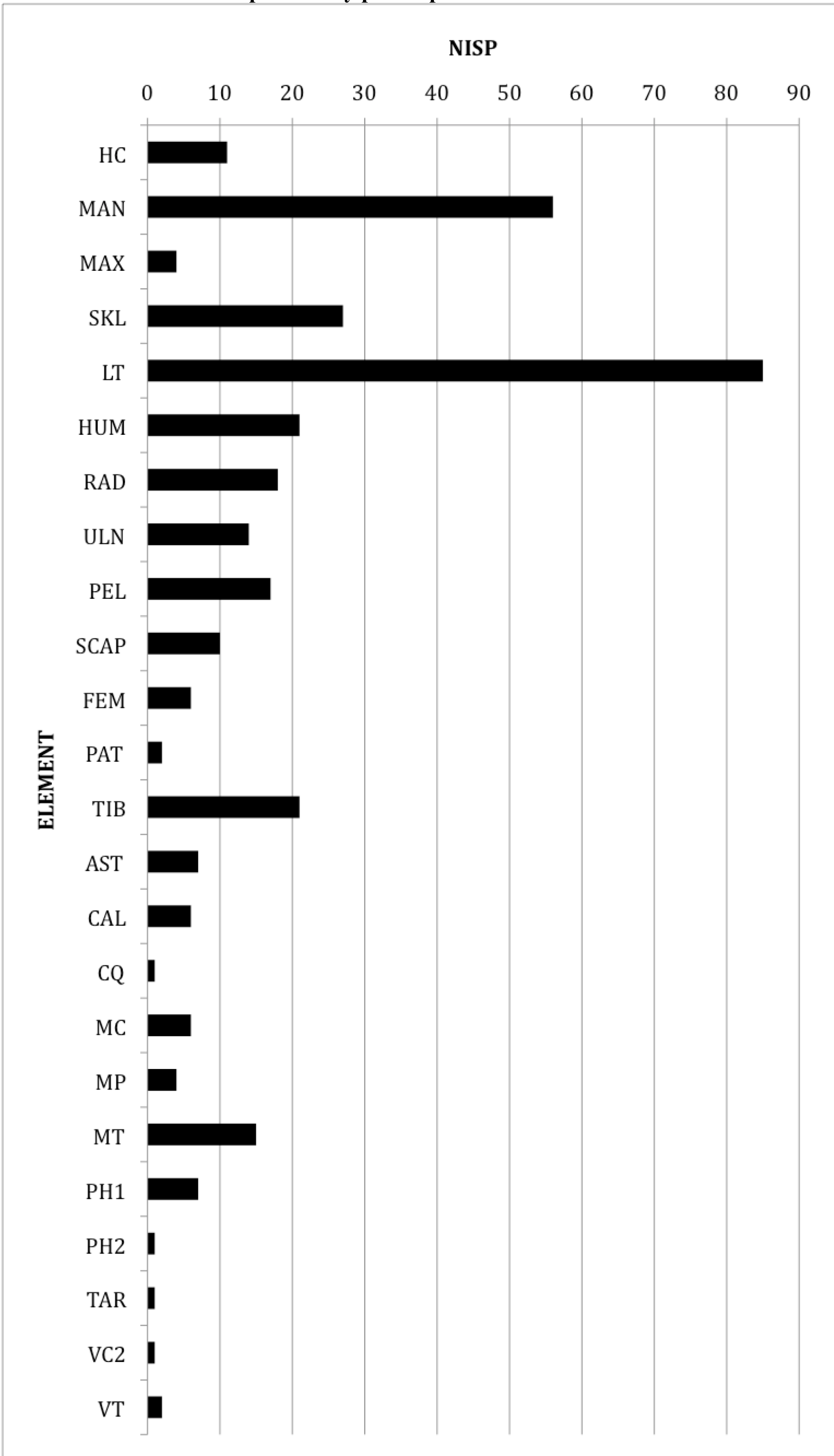
Table 4: Fusion data with estimated ages in months for S/G (after Schmid 1972 & Silver 1969)

Element		Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	7	1	06 to 08
	Humerus, Distal	18		12
	Radius, Proximal	16		12
	Phalanx 1, Proximal	6		24
	Phalanx 2, Proximal	1		12
Middle Fusing				
	Tibia, Distal	14	1	18 to 24
	Metacarpal, Distal	3		18 to 24
	Metatarsal, Distal	5	2	20 to 28
	Calcaneus, Proximal	4	2	30 to 36
Late Fusing				
	Radius, Distal	6	1	36
	Ulna, Proximal	6	2	36 to 42
	Femur, Proximal	4	1	30 to 36
	Femur, Distal	1	2	36 to 42
	Tibia, Proximal	5	1	36 to 42

The cull patterns for S/G is more in line with that observed for cattle, suggesting similar pressures on these species i.e. secondary products. This point having been made, it would also appear that the S/G component reflects a preference towards goats. Where it was possible to identify that the specimen was clearly a sheep or a goat, in all instances – six in total – the individual artefact was noted as being derived from goat.

Body part representation mimics the pattern observed for the other domesticates i.e. all body parts present, with an emphasis on cranial portions (graph 8).

Graph 8: Body part representation for S/G



Key: refer to Graph 3.

3.3 Butchery

Some 679 separate butchery records were noted on 224 individual bones from this assemblage.

Table 5: Proportions of butchery per species

Species	Σ Bones with cuts	% of butchered bone (Σ = 224)
Cattle	161	72
Pig	5	2.2
S/G	10	4.5
Horse	4	1.8
Dog	4	1.8
Red deer	13	5.8
Roe deer	2	0.9
Otter	1	0.4
European shag	1	0.4
Anser sp.	1	0.4
L/M/U marine mammal	17	7.6
Seal	5	2.2

Key: L/M/U = large, medium and unidentified marine mammal. Σ refers to the number of individual animal bones demonstrating butchery not the number of cut marks themselves.

Table 6: Proportions of recorded cut mark typologies

Cut mark type	Σ cut marks	% cut marks (Σ = 698)
Blade insertion (BI)	66	9.4
Chop	149	21
Fine cut	9	1.3
Sawn	33	4.7
Scoop	2	0.3
Point insertion (PI)	439	63

Σ refers to the global cut mark count; in this instance it is greater then the number of records (679) as multiple occurrences were noted on a number of specimens.

Table 7: Proportions of recorded implement marks

Implement type	Σ Implement type	% Implement type (Σ = 173)
Blade	73	42
Cleaver	52	30
Large blade	33	19
Fine blade	10	5.8
Saw	5	2.9

Σ refers to the sum of occurrence of implement type, where one record equates to a count of one assigned to that implement type. Only one tool will be used at any one time.

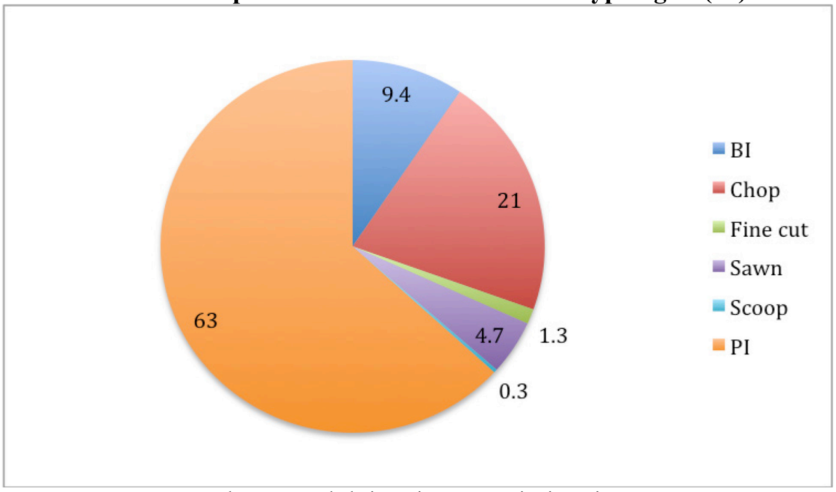
Table 8: Butchery 'Function'

Activity recorded	Σ Function	% Function (Σ = 679)
Bone breaking	28	4
Disarticulation	133	19.6
Filleting	3	0.4
Meat removal	203	30
Pot sizing	28	4.1
Skinning	25	3.7
Working	140	20.6
Undetermined	119	17.5

Σ refers to the total number of recorded 'functional' interpretations of the cut marks.

Looking at the overall corpus of data denoting butchery, one would expect that the proportion of cut marks, frequency of implements noted and the expected function (tables 6, 7 & 8 respectively) would demonstrate some form of relationship. Charts 1, 2 and 3, present the details from the above tables in a more visually effective manner, and in turn, help to identify potential relationships evident from the butchery data.

Chart 1: Proportions of recorded cut mark typologies (%)



Where BI = Blade insertion; PI = Point insertion.

Chart 2: Proportions of recorded implement marks (%)

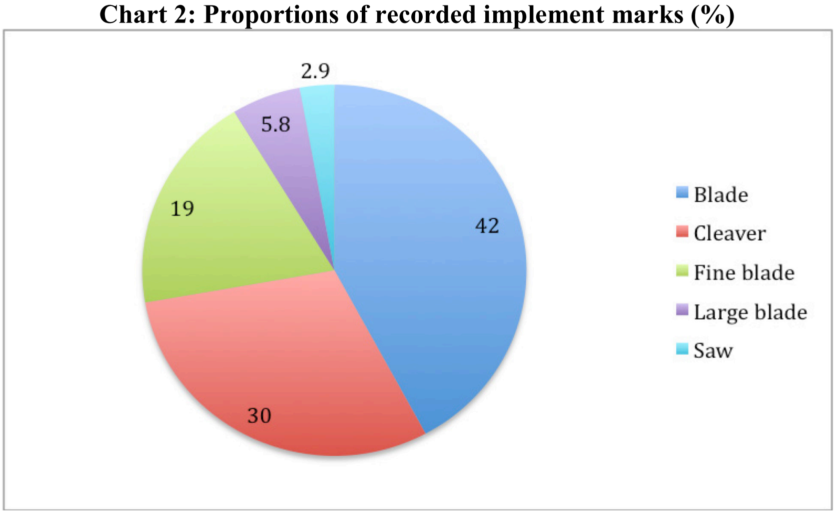
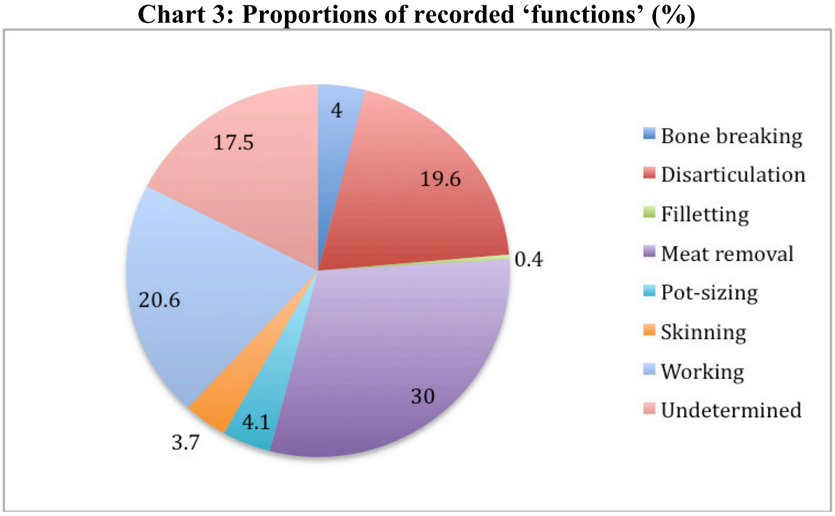


Chart 3: Proportions of recorded 'functions' (%)



In its simplest form, the relationship between the type of cut mark, tool used, and outcome should show a strong correlation. As can be seen from the charts, the majority of marks are either Blade or Point Insertions (chart 1). These types of marks require a standard knife, not a cleaver; chart 2 illustrates that the dominant type of implement noted from this assemblage are 'blades' (large, fine, and standard (indicated as 'blade')). From chart 3 we can see that the majority of functional outcomes point to disarticulation and meat removal; activities that require (in this instance) standard knives, not cleavers (some disarticulation tasks can be undertaken with the cleaver, but these processes were not observed). Chopping was not prevalent and the incidences of cleaver marks are proportional to this. However, even taking the small proportion of cleaver marks into account, there is still a relatively small occurrence of functional outcomes requiring the cleaver (bone breaking and pot sizing – chart 3). An explanation for this is that although chopping for bone breaking must have taken place, the bone often fractures without leaving any discernable mark.

Considering the overwhelming predominance of cattle on this site it comes as no surprise that the majority of cut marks were recorded on this species. The butchery data were highly informative, indicating that a variety of implements were in use ranging from fine blades to cleavers. The evidence from detailed microscopic analysis of the surface of the marks themselves would suggest that some of these blades potentially included steel technology.

Evidence was also forthcoming in relation to the sequence of tasks involved in the butchering process. One skull points to the mode of slaughter: pole axing. This practice was common up to and including the modern period and is noted from the Tarbat assemblage from a skull demonstrating a slightly off-centred 'puncture' with associated circular and spiralling fracture marks. The fractured (but still attached) bone just above the circular indentation indicates that a punch point, with blunt force, was used rather than an actual cut. As indicated above, the majority of cutting took place with smaller blades *at* joints rather than chopping *through* the joints with cleavers or axes. This suggests a more refined approach to the butchery, as well as the likelihood that while regular and repetitive, it was not an 'everyday' task. The carcass was portioned into the main units i.e. shoulder and upper forelimb, leg and upper hind limbs, with the central rib cage and vertebrae left as one unit. Cleavers were used for bone breaking and sectioning of specific parts of carcass only, once it had been broken down into these main units. This subsequent activity took place on large tables or 'blocks'. Evidence for the above derives from a very clear sequence noted on the rib heads and vertebrae. Chop marks were recorded that demonstrated that rib heads and vertebrae were separated whilst they were still joined, using a cleaver. This took place on a block as the cut marks were delivered from above, straight down, travelling from the internal surface of the animal (ventral) to the back (dorsal). Thus, the person performing the butchery was standing over the carcass and chopping straight down. An alternative method to achieve the same separation of ribs and vertebrae would be to chop down along the spine. However, this would have resulted in cut marks travelling from the posterior of the animal to the anterior (tail to head); this was not the case.

Picture 1: Butchery at the rib head vertebrae junction

Picture 2: Details of angle of cut on the head

Picture 1 to 4 show: the rib heads as a group; detail of the individual cuts; the vertebrae as a group; detail of the cuts that separated the ribs from the vertebrae (brisket from the spine). The boxed cuts along the three vertebrae indicate a miss-chop (detail in picture 4), which was then realigned slightly and directed more precisely at the juncture between the ribs and the vertebrae.

Picture 3: Butchery at the vertebrae

Picture 4: Detail of the cut to separate ribs and vertebrae

Fine blades were used to remove small meat scraps, as evidenced from cuts on the internal surface of the ribs. Cranial bones were repetitively, and skilfully, split for brain extraction and reduction of the skull into smaller ‘pot sized’ portions. This is based on the fact that perpendicular cuts were delivered along both sagittal and transverse (top to bottom, and left to right) planes. The chops themselves were too low for horn core removal (see upper two crania in picture 5) and were delivered just above the orbit. The likely sequence would be a sagittal chop in the first instance to separate the two halves of the skull and to facilitate brain removal; this is then followed by a transverse chop to separate the upper cranium from the nasal, maxillary and pre-maxillary portions of the skull. This particular sequence allows for the more nutrient rich lower part of the skull to be sectioned from the boney upper part; this may also have been part of the process to provide horn cores for craft and ‘trade’ purposes. Pictures 5 illustrates five separate skulls processed in the manner described above; picture 6 focuses on the detail of the cuts themselves, in particular, the boxed region highlights the sagittal cut, delivered with a sharp blade accurately through the mid-line of the cranium.

Picture 5: Skulls demonstrating sagittal and transverse chopping

Picture 6: Detail of chop along sagittal plane

Due to the large body of butchery evident for cattle, it was possible to construct clearer sequences for them than for the other species upon which butchery was recorded. However, this latter butchery was also highly informative. Cut marks were noted on a both fur bearing (otter) and game (red and roe deer) species. Despite the frequency of cut marks noted on cattle, the highest occurrence of butchery relative to the number of specimens was recorded on marine mammals from all size categories.

3.4 Pathologies and non-metric anomalies

Pathological changes were noted on some 17 individual elements. These were predominately associated with traction use on cattle distal limb bones, with five examples of eburnation (hardening) noted. A pig mandible showed evidence of an abscess. This was likely the cause of death as no healing of the abscess had occurred. Another infectious pathology was noted on the ulna of a pig, marked by the presence of a festule (tubular bone tract) to release pus. A non-metric anomaly was noted on a lower third molar that demonstrated a missing third cusp; this was not pathological.

4.0 Period-by-Period Comparison

While the overall assemblage has provided a large-scale view of animal exploitation for the site as a whole, this is a relatively diluted perspective. A period-by-period breakdown is essential for evaluation of the pattern of exploitation over time. However, as this effectively requires further division of the global assemblage, it reduces the sample size available for analysis. To counter this problem, and to concentrate on the species that is clearly the most economically important, much of the following focuses on the cattle component of the recorded data.

4.1 Species representation

Some 15,357 fragments could be assigned to a Period. These data are presented below (Table 10).

Table 9: NISP counts for all species present and MNI for food domesticates

	Period 1			**Period 2**			**Period 3**			**Period 4**		
SPECIES	NISP	%NISP	MNI	NISP	%NISP	MNI	NISP	%NISP	MNI	NISP	% NISP	MNI
Cow	100	67.11	8	2289	75.69	102	1261	79.06	56	1032	58.57	87
Pig	30	20.13	3	381	12.60	41	164	10.28	13	113	6.41	12
Ovicaprid	7	4.70	1	100	3.31	6	72	4.51	6	156	8.85	15
Horse	-	-	-	3	0.10	-	16	1.00	-	174	9.88	-
Dog	-	-	-	62	2.05	-	8	0.50	-	198	11.24	-
Cat	-	-	-	2	0.07	-	1	0.06	-	8	0.45	-
Fox	-	-	-	22	0.73	-	1	0.06	-	8	0.45	-
Wolf	-	-	-	1	0.03	-	2	0.13	-	1	0.06	-
Hare	-	-	-	-	-	-	-	-	-	1	0.06	-
Cervid	-	-	-	2	0.07	-	-	-	-	-	-	-
Red deer	1	0.67	-	44	1.46	-	22	1.38	-	24	1.36	-
Roe deer	2	1.34	-	21	0.69	-	7	0.44	-	5	0.28	-
Otter	-	-	-	5	0.17	-	-	-	-			-
Chicken	1	67.11	-	5	0.17	-	6	0.38	-	8	0.45	-
Anser sp.	-	-	-	24	0.79	-	4	0.25	-	4	0.23	-
Raven	-	-	-	1	0.03	-	1	0.06	-	-	-	-
Razorbill	-	-	-	-	-	-	7	0.44	-	-	-	-
Gull	-	-	-	2	0.07	-	-	-	-	-	-	-
Cygnus sp.	-	-	-			-	1	0.06	-	-	-	-
Shag	-	-	-	11	0.36	-	-	-	-	-	-	-
Gannet	-	-	-	1	0.03	-	-	-	-	-	-	-
Redshank	-	-	-	-	-	-	-	-	-	1	0.06	-
Curlew	-	-	-	-	-	-	-	-	-	2	0.11	-
Capercaillie	-	-	-	2	0.07	-	-	-	-	-	-	-
'Wader'	-	-	-	-	-	-	-	-	-	1	0.06	-
Whale size	-	-	-	2	0.07	-	4	0.25	-	7	0.40	-
Porpoise / dolphin size	-	-	-	1	0.03	-	1	0.06	-	7	0.40	-
Seal	8	5.37	-	44	1.46	-	10	0.63	-	7	0.40	-
MMU	-	-	-	2	0.04	-	3	0.12	-	6	0.34	-
ULM	82	30.37	-	1368	28.15	-	732	28.23	-	775	26.87	-
UMM	38	14.07	-	429	8.83	-	261	10.07	-	329	11.41	-
USM	-	-	-	1	0.02	-	-	-	-	-	-	-
UUB	1	0.37	-	35	0.72	-	5	0.19	-	17	0.59	-
UUF	-	-	-	1	0.02	-	-	-	-	1	0.03	-
UUM	33	10.89	-	2960	37.85	-	1270	32.88	-	488	14.47	-
	Σ NISP = 303			**Σ NISP = 7820**			**Σ NISP = 3863**			**Σ NISP = 3372**		

For key refer to table 1. Species percentages are out of 149 (P1); 3024 (P2); 1595 (P3) & 1762 (P4). Element percentages (MMU, ULM, UMM, USM, UUB, UUF) are out of 270 (P1); 4860 (P2); 2593 (P3) & 2884 (P4). UUM percentages are out of 303 (PI); 7820 (P2); 3863 (P3) & 3372 (P4).

As a full descriptive account of the wild and non-food domestic species has been presented above (table 1), the following comparisons will focus on the main domesticates. Table 11 below, along with graphs 9, 10 and 11, represent species proportions based on percentage of NISP, and MNI calculations, categories by period. Before moving onto the food domesticates, one point is worth mention. The horse component of the overall assemblage shows a marked increase in Period 4. A large proportion of loose horse teeth recovered from Period 4 levels accounts for much of this, with 64 teeth recorded; however, this does not explain the whole picture. Whereas the large NISP count for dog remains derived from Period 4 is in the main accounted for by a single associated bone group, no such simple explanation exists for the proportion of horse, which accounts for nearly 10% of the assemblage for this period. Furthermore, the MNI count for the horse component of the whole assemblage (table 1) was calculated to be nine individuals; six of these derive from Period 4.

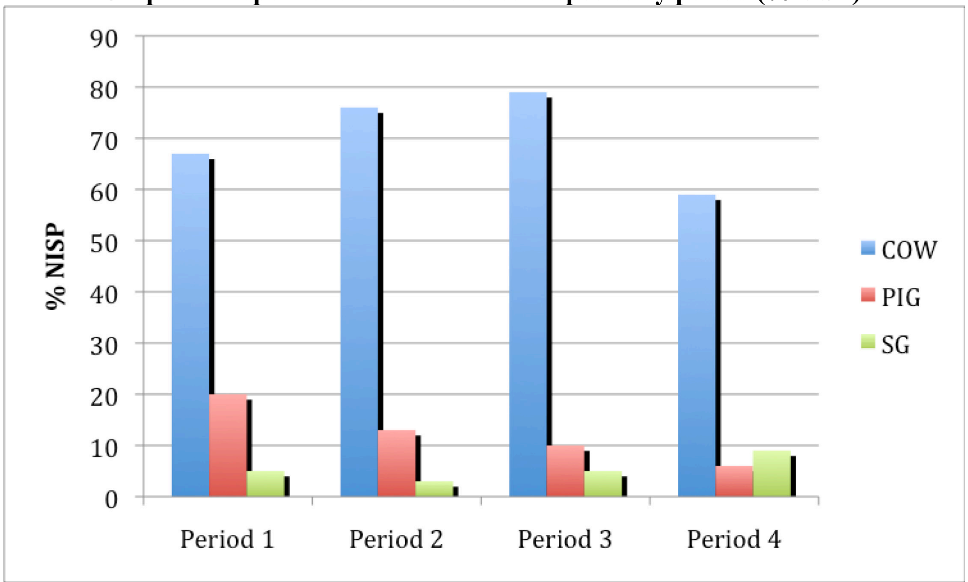
Given the overall domination of the global assemblage by cattle, it comes as no surprise that this species is also the most commonly recovered when assessed on the basis of chronology. Although, as tables 10 and 11 illustrate, it would appear that there is a greater relative representation of cattle in Period 2 and 3, this is likely caused by the smaller sub-sets available for study from Periods 1 and 4, which lead to a proportional overrepresentation of species that occur in smaller numbers.

Table 10: %NISP counts for all species present and MNI for food domesticates

	Period 1		Period 2		Period 3		Period 4	
SPECIES	%NISP	MNI	%NISP	MNI	%NISP	MNI	% NISP	MNI
Cow	67.11	8	75.69	102	79.06	56	58.57	87
Pig	20.13	3	12.60	41	10.28	13	6.41	12
Ovicaprid	4.70	1	3.31	6	4.51	6	8.85	15
SUM of raw NISP fragment count and MNI for food domesticates ONLY								
Σ	**137**	**12**	**2770**	**149**	**1497**	**75**	**1301**	**114**

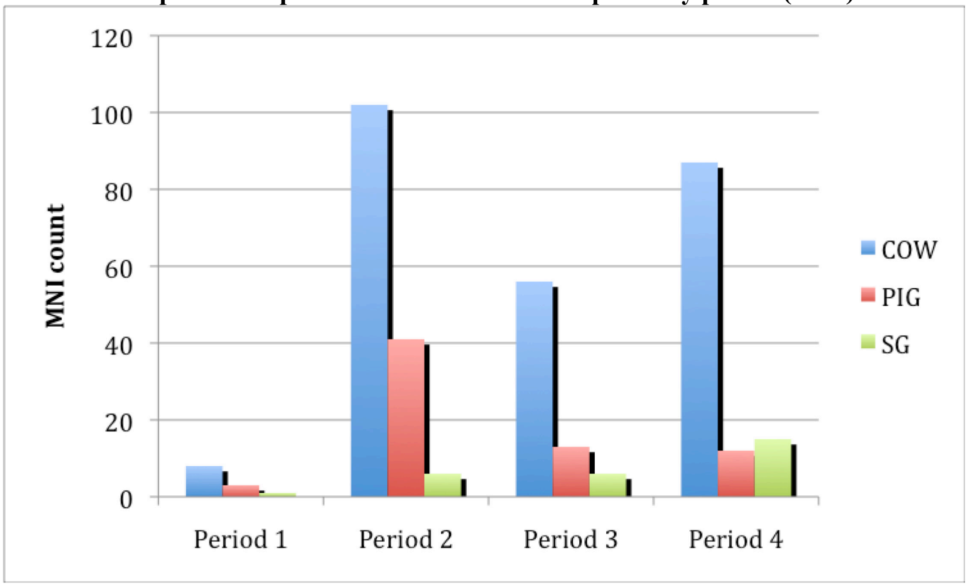
Despite this, there are some indications of subtle variation in relative significance. While cattle dominate, particularly within the context of NISP fragments, there is a slight increase from Period 1-3, and subsequent decrease in Period 4. This is matched by a reduction in numbers of pig, and an increase in the numbers of ovicaprids in later periods.

Graph 9: Proportions of main domestic species by period (%NISP).



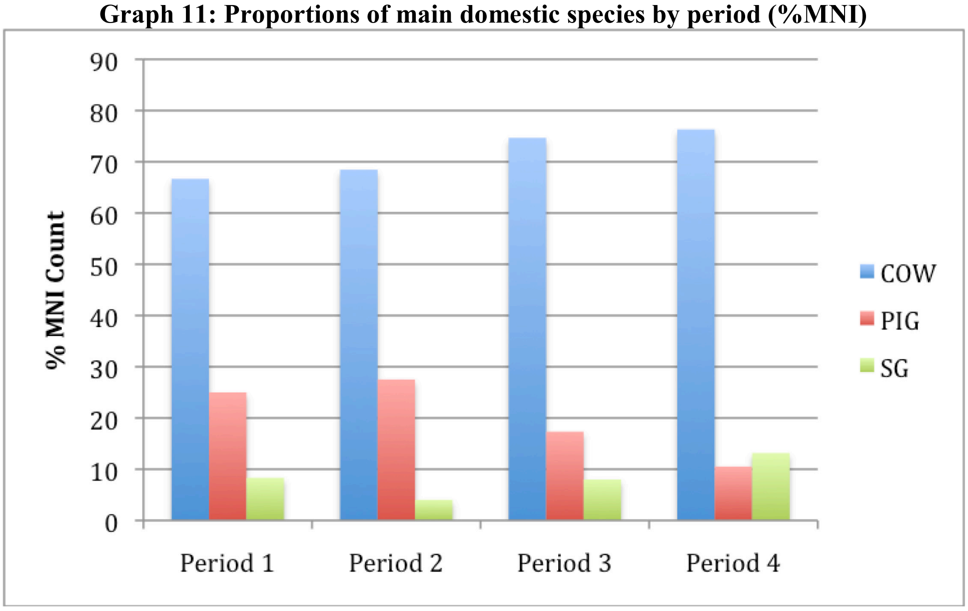
As a point of balance, the more conservative MNI count (raw figures, graph 9), show a greater level of variability by period, with a pronounced dip in cattle from Period 2 to 3, and subsequent rise in Period 4.

Graph 10: Proportions of main domestic species by period (MNI)



However, when these raw data are represented as a proportion of the overall MNI, i.e. as percentages, these fluctuations are generally evened out, although the main trend of an overall increase in cattle and sheep, at the expense of pig, remains consistent and would appear to corroborate the fragment count data.

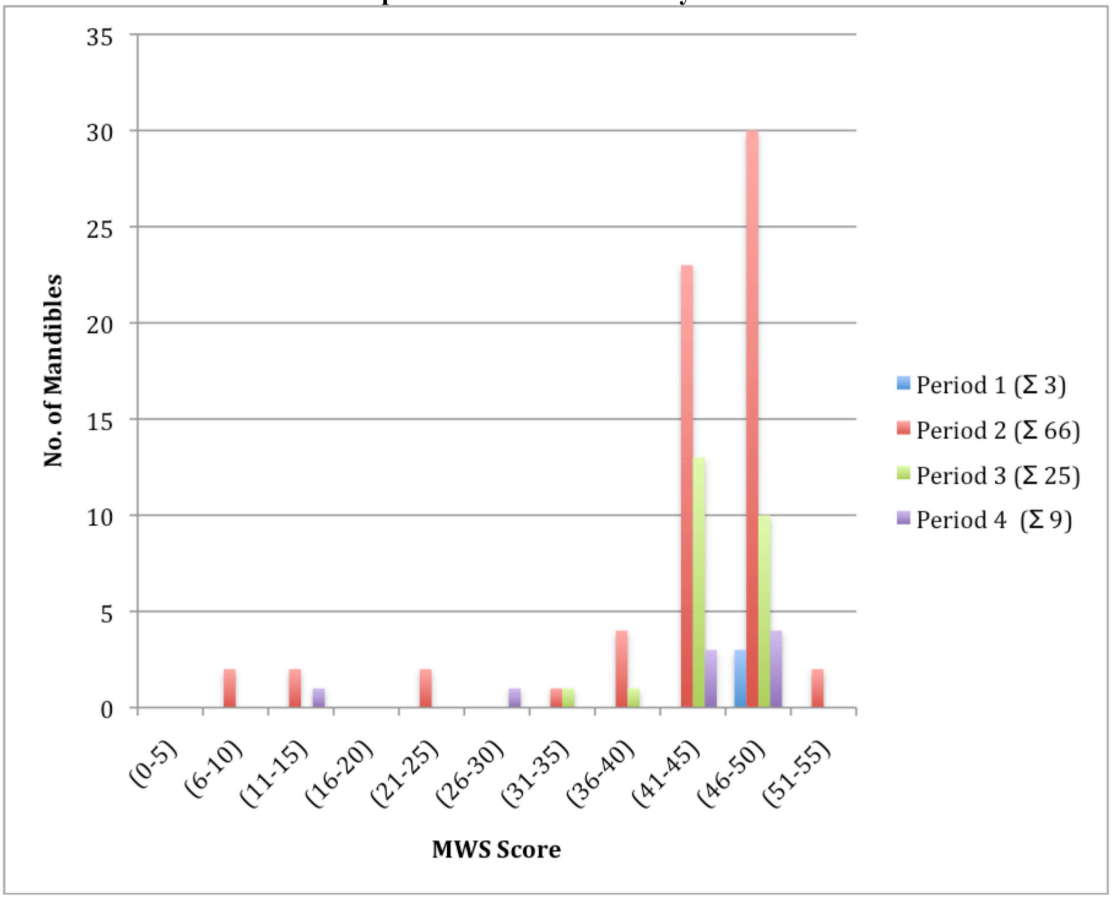
Graph 11: Proportions of main domestic species by period (%MNI)



4.2 Age variation in cattle by period

Due to the problem of a reduced sample size for aging, the following focuses exclusively on cattle toothwear and fusion data. Some 103 MWS stages were calculated from mandibles recovered from the four periods. In addition, a further 608 fusion data points were also assessed to investigate cull patterns over time.

Graph 12: MWS calculation by Period



The overall trend of a predominance of animals falling into the 'Adult' and 'Old Adult' category, as noted from the global assemblage in graph 1, is seen on a period-by-period basis also (graph 12). However, there are a number of fluctuations that occur chronologically. Though subtle, it would appear that there is greater proportion of younger animals being culled from Period 2 to 3. Effectively, whilst Period 2 evidences a trend towards the culling of animals in the 'Old Adult' class, Period 3 shows a decline in this category and a greater number of 'Adult' animals. Furthermore, and as mentioned previously, Grant's wear stages are most effective when studying adult populations. In this instance, juvenile animals with deciduous teeth are recorded as present. Of the 11 juvenile mandibles that were noted as have the deciduous premolar present, none were recovered from Period 1, six derived from Period 2, with a further three from Period 3, and two noted from Period 4. Although these figures are small, they would seem to suggest a greater representation of calves in Period 2, and a decline in Period 3.

However, caution must be noted in that the variation between Period 2 and 3 may be an artefact of sample size and that this is masking a different trend entirely. Unfortunately, there is a marked variation between the raw numbers of mandibles recovered between the periods (graph 12, figures in brackets next to individual Period). This is most pronounced in Periods 1 and 4, where the recovered mandibles are too small to provide meaningful interpretation.

The evidence from the fusion dataset (tables 12-15 and graph 13 & 14) is likely to be more representative given the larger cohort from which it is derived, and the fact that it does allow for the quantification of juvenile animals.

In concert with the toothwear data, the fusion evidence generally points to animals killed as 'Adults'. There is the issue that the age ranges themselves do to corroborate precisely, i.e. 'Adult' derived from MWS relates to animals from 30-43 months, whereas the fusion class includes animals from 24-42 months. In effective, this should only be taken as a general, rather then a precise, indicator of age class.

Table 11: Fusion data for cattle – Period 1

	Element	Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	1		07 to 10
	Humerus, Distal	1		12 to 18
	Radius, Proximal	3		12 to 18
	Phalanx 1, Proximal			18 to 24
	Phalanx 2, Proximal			18 to 24
Middle Fusing				
	Tibia, Distal	5	1	24 to 30
	Metacarpal, Distal	1		24 to 36
	Metatarsal, Distal	2		24 to 36
	Calcaneus, Proximal	1	1	36 to 42
Late Fusing				
	Radius, Distal			42 to 48
	Ulna, Proximal			42 to 48
	Femur, Proximal	2	1	42 to 48
	Femur, Distal	1	2	42 to 48
	Tibia, Proximal	2	1	42 to 48

Table 12: Fusion data for cattle – Period 2

	Element	Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	14		07 to 10
	Humerus, Distal	22		12 to 18
	Radius, Proximal	18	8	12 to 18
	Phalanx 1, Proximal	9		18 to 24
	Phalanx 2, Proximal	4		18 to 24
Middle Fusing				
	Tibia, Distal	19	6	24 to 30
	Metacarpal, Distal	51	4	24 to 36
	Metatarsal, Distal	5	2	24 to 36
	Calcaneus, Proximal	11	4	36 to 42
Late Fusing				
	Radius, Distal	5	7	42 to 48
	Ulna, Proximal	3	2	42 to 48
	Femur, Proximal	10	7	42 to 48
	Femur, Distal	4	10	42 to 48
	Tibia, Proximal	6	6	42 to 48

Table 13: Fusion data for cattle – Period 3

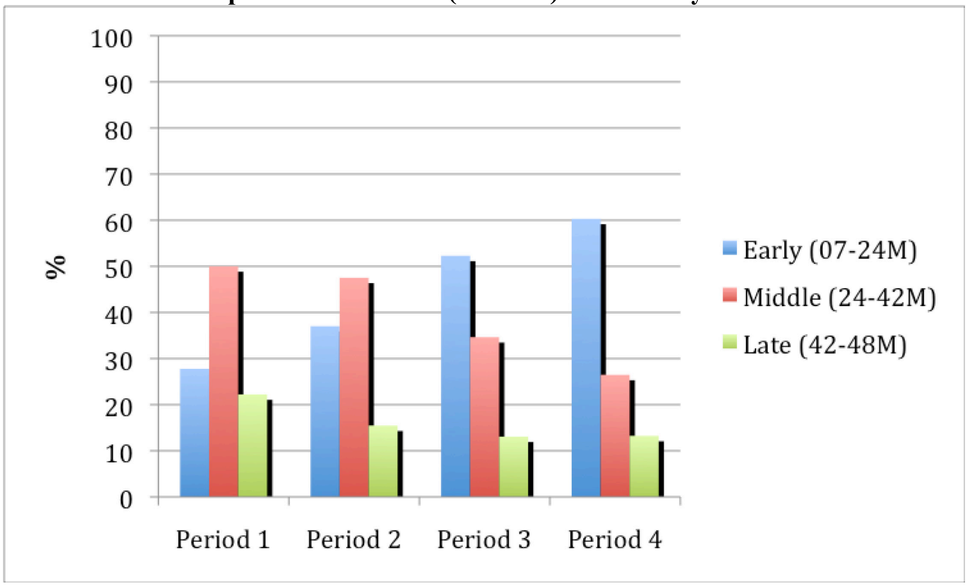
Element		Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	15	1	07 to 10
	Humerus, Distal	19	1	12 to 18
	Radius, Proximal	10	7	12 to 18
	Phalanx 1, Proximal	20		18 to 24
	Phalanx 2, Proximal	16		18 to 24
Middle Fusing				
	Tibia, Distal	12	2	24 to 30
	Metacarpal, Distal	28	2	24 to 36
	Metatarsal, Distal	7	1	24 to 36
	Calcaneus, Proximal	6	1	36 to 42
Late Fusing				
	Radius, Distal	7	10	42 to 48
	Ulna, Proximal	4	1	42 to 48
	Femur, Proximal	4	2	42 to 48
	Femur, Distal	2	2	42 to 48
	Tibia, Proximal	3	3	42 to 48

Table 14: Fusion data for cattle – Period 4

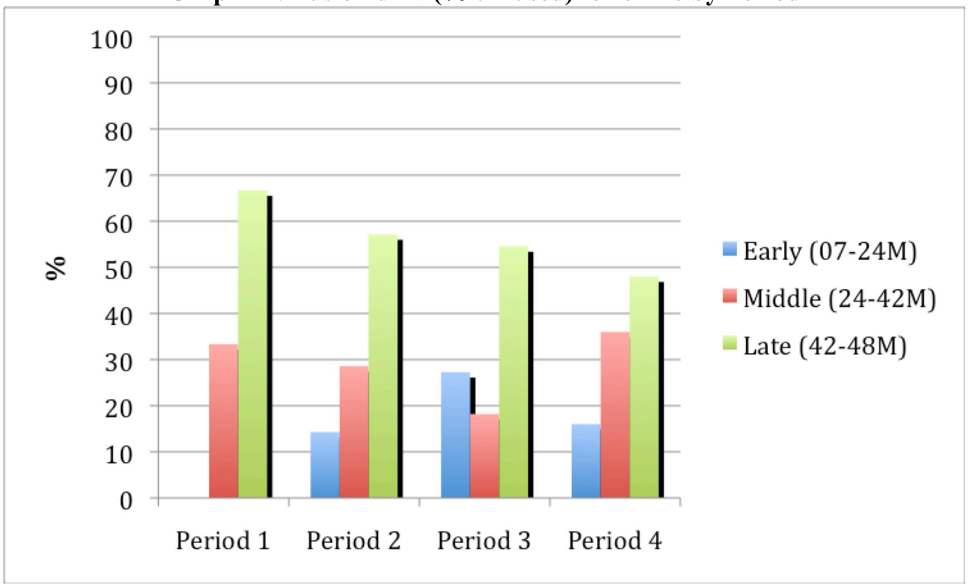
Element		Fused	Unfused	Age at Fusion (Months)
Early Fusing				
	Scapula, Distal	9	1	07 to 10
	Humerus, Distal	20	3	12 to 18
	Radius, Proximal	22		12 to 18
	Phalanx 1, Proximal	19		18 to 24
	Phalanx 2, Proximal	12		18 to 24
Middle Fusing				
	Tibia, Distal	11	4	24 to 30
	Metacarpal, Distal	14	1	24 to 36
	Metatarsal, Distal	4	3	24 to 36
	Calcaneus, Proximal	7	1	36 to 42
Late Fusing				
	Radius, Distal	6		42 to 48
	Ulna, Proximal		2	42 to 48
	Femur, Proximal	3	3	42 to 48
	Femur, Distal	7	2	42 to 48
	Tibia, Proximal	2	5	42 to 48

Looking at the proportions of culled animals, by period, subdivided into Early, Middle and Late fusing (graphs 12 and 13), it is clear that a trend is evident. The fusion data would seem to corroborate the main tendency noted from the toothwear data indicating a general increase in the culling of younger animals in later periods. It is worth noting that the variation is subtle but does represent a noticeable pattern. By presenting the percentages of the collated data, rather than raw counts, graphs 12 and 13 take variations in sample size into account. Thus, the fluctuations observed from one period to the next is not merely a consequence of sample size bias, although this will no doubt have had an impact.

Graph 13: Fusion data (% fused) for cattle by Period



Graph 14: Fusion data (% unfused) for cattle by Period

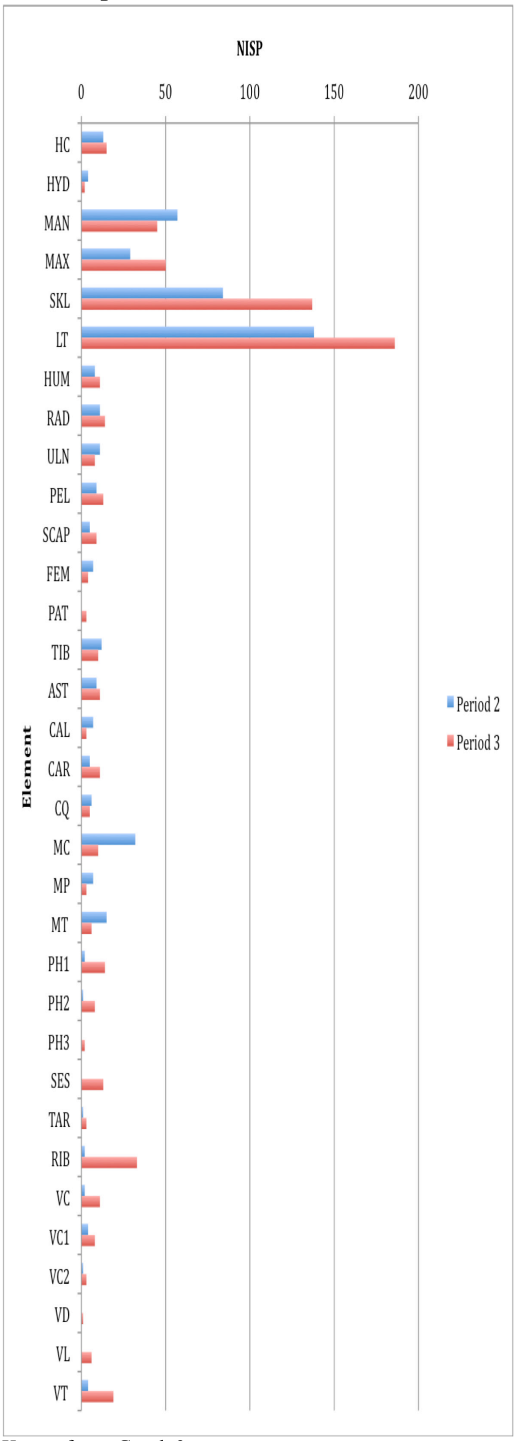


4.3 Body part representation for cattle

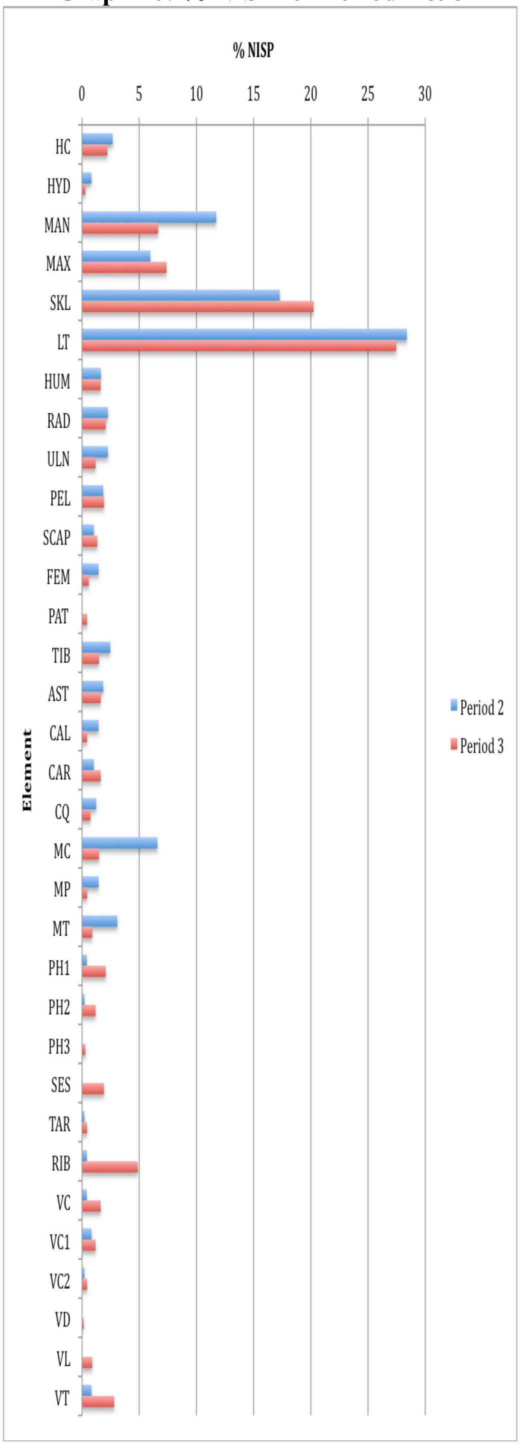
The comparative data for body part representation is focused on Periods 2 and 3 as the small sample sizes derived from Periods 1 and 4 rendered these latter sub-sets unrepresentative of chronological variation.

Little variation exists between the main findings for the whole assemblage, and the findings noted from Periods 2 and 3 (graphs 15 & 16). There is, given the greater propensity for fragmentation, an overrepresentation of skull and maxilla fragments; given their greater abundance, there is also a large number of loose teeth as expected. Although the raw NISP counts would seem to indicate a trend towards a greater proportion of these elements from Period 3 as opposed to Period 2, when the values are converted into percentages (graph 16), it is apparent that this is not the case and the variation is caused by a larger sample from the former.

Graph 15: Raw NISP count for Period 2 & 3



Graph 16: % NISP for Period 2 & 3



Key: refer to Graph 3.

From both periods, the body part representation indicates that all carcass units were present on site; the two periods in question elicit value that are highly similar, which would suggest little variation over time, at least for the phases under investigation.

4.4 Stature estimation for cattle – Periods 2 and 3

Once again, the small sample sizes available for Period 1 and 4 render a chronological comparison of withers height impossible. Only Periods 2 and 3 provide enough data for an assessment (table 15) of stature. The values must be taken with caution given the small sample size from which they derive. However, it would appear that, as with body part representation, little variation is observed between this sub-set and the assemblage as a whole. The withers height average to approximately 1.1 meters for cattle from both Periods 2 and 3.

Table 15: Withers height based on greatest length measurements (after Matolcsi 1970).

Period	Element	Context	Greatest Length (mm)	FEMALE	MALE	AVE
2	MC	3043	182	1097.46	1152.06	**1124.76**
3	MC	1561	177	1067.31	1120.41	1093.86
3	MC	1734	173	1043.19	1095.09	1069.14
3	MC	1734	176	1061.28	1114.08	1087.68
3	MC	1734	175	1055.25	1107.75	1081.5
						1083.56
2	MT	1998	201	1071.33	1129.62	1100.475
2	MT	2000	176	938.08	989.12	963.6
2	MT	2000	213	1135.29	1197.06	1166.175
2	MT	2000	194	1034.02	1090.28	1062.15
						1076.75
3	MT	1734	199	1060.67	1118.38	**1089.525**

5.0 Discussion

5.1 Period-by-period variation

The appraisal based on chronological variation has been hampered by small sample sizes from Periods 1 and 4. In effect, this has shorten the span of time that one is able to study, thus the focus has of necessity been on Periods 2 and 3. Despite this, there are some points worthy of discussion. While cattle remains the dominant species, there is an indication, albeit a subtle one, that a variation in proportions of pig change over time, with a reduction in the numbers of this species. The pig MNI count is interesting for Period 2, indicating 41 individuals. However, this was calculated from the proportion of mandibles, which generally have a high likelihood of surviving, and thus may be overrepresented. The high MNI count is not corroborated by the fragment count, nor is the trend evident when MNI is analysed in proportion to the other species on the basis of percentages (graph 11). The reduction in pig is counter-balanced by a proportional increase in sheep / goat, rather than cattle. This may be indicative of a subtle change in diet, or more likely, the desire to exploit the secondary resources available from sheep / goats to a greater extent.

As mentioned, there is a consistency with regard to cattle husbandry, not only within the context of proportions of animals through time, but apparently, also in the way they are exploited and indeed, in the animals themselves. There is a slight contradiction in the evidence between the results derived from NISP counts and MNI calculations. The %NISP count indicates a reduction in cattle numbers in Period 4 (graph 9), whilst %MNI suggests a consistent increase through time (graph 11). As these variations are subtle, it is unlikely that these slight variations are indicative of specific and defined changes in husbandry. One aspect that is intriguing is the proportion of juvenile and neonatal animals. While the evidence elicited from MWS scores and Fusion data are mostly focused on adults, or at best 'juveniles', this assemblage had a relatively large number of 'neonatal' animals. Only two were recorded from Period 1, although this is likely a result of small sample size. Periods 2, 3 and 4 elicited 30 (19 neonates), 25 (12 neonates) and 20 (9 neonates) juveniles respectively. These values, and those for the juveniles that could be categorised on the basis of MWS and Fusion, show a decline through time. Though small, the trend is an important one. Such finds will always be relatively rare in any bone assemblage, and while it would be a mistake to overemphasise these findings, it is also important not to underemphasise them. These results may indicate a change in husbandry or indeed, a transition in craft exploitation.

While this portion of the report has centred on the food domesticates, the occurrence of horse through time is interesting. As mentioned, there is a marked increase in horse during Period 4 and this cannot be easily explained. Given the evidence, horse would appear to have become an economically more important species in Period 4.

5.2 Ecology vs. husbandry

The range of land-based wild species arguably relates to both the nature of the site (monastic enclave) and the ecological niche it occupies. The lack of diversity, rather then a negative indication of sampling bias, is actually more likely a reflection of specific exploitation, and maximised exploitation at that. The clear and overwhelming bias towards domestic species indicates focused management resulting in reliable meat stocks as well as, and perhaps more importantly, consistent exploitation of secondary products.

There can be little doubt of the economic significance of cattle. Both the fragment count and MNI calculation reinforce this point. However, cattle husbandry, and indeed animal husbandry in general at Tarbat, is complex. It is generally considered that sheep supersede cattle as the most significant economic species during the medieval period. As Tarbat apparently bucks this trend, there must be specific reasons for this. Primarily, sheep (but not goat) become important as providers of wool in the later medieval period. In ecological terms, sheep are also unlikely to thrive in situations that favour cattle, i.e. wet conditions. On a purely speculative, but informed, basis, given the location of Tarbat, one might assume that wet conditions would be the norm thus favouring cattle. Anecdotally, the cohort of sheep / goat finds supports this: all examples from the 'S/G' category that could be definitively identified were goat. This certainly does not rule out the presence of sheep, but it does point to the possibility of the maintenance of goat, a less specialised species.

Other evidence bolsters the overall importance of cattle. The mortality profile of culled animals is informative in that it provides a clear indication that animals were generally raised to old age (with evidence for 'senile' animals also indicated by the tooth wear profile). Although the metrical data is somewhat contradictory – the metacarpals seem to indicate a predominance of female animals and the metatarsals favour males – the overall pattern points towards adult individuals. This firmly points towards secondary product exploitation, and while cattle would no doubt have provided significant quantities of meat, it would appear that they were slaughtered after a long working life. Linking the metrical data with the incidences of pathology, it may be suggested that traction was an important aspect of animal management. The metacarpal data is indicative of dairying; this is further reinforced by the presence of a sizeable component of juvenile animals, accounting for a NISP of 49 and MNI of 7 individuals.

The presence of all elements, including head and distal foot bones, would indicate that the animals were either brought in on-the-hoof and / or raised locally. The fact that this pattern is repeated for all species would reinforce the notion of husbandry and management *in situ*. Furthermore, as the metrical data shows very little variation between individual animals, this could indicate that the animals themselves were drawn from a relatively restricted geographic region, a factor that isotopic analysis could certainly shed light on.

With cattle kept in significant numbers, but apparently for secondary products, and sheep / goat mimicking the pattern for cattle, it would appear that pig was the main meat provider. While this is not in itself a surprise, what is interesting is that despite the wealth of primary animal resources clearly evident from this site, meat does not appear to be the main concern. The fact that pig bones are more common then sheep / goat serves to reduce the importance of the latter; traction, diary products, meat and leather were derived from cattle; pigs were kept in relatively small numbers, and this actually serves to deemphasise the key resource that pigs provide: meat. This is further supported by the fact that pig numbers fall slightly through time. The fact that sheep / goat were apparently kept in smaller numbers then pig perhaps suggests that they were of marginal importance, or where ecologically unsuitable.

The issue of ecology versus husbandry / management / exploitation is an interesting one. There were few small mammal finds, for example, and it is likely that this reflects sampling bias rather than the range of species that would have been present on the site as naturally occurring, or more interestingly, commensals, living closely with the abbey inhabitants. Of the wild species present, the finds are likely indicating species either trapped or actively hunted for specific products. The finds of capercaillie would almost certainly have made their way into the assemblage via hunting, given the type of woodland – dense coniferous – that it favours. This is also likely to have been the case for the other wild species, especially otter and wolf, given their habitats and habits, which are unlikely to bring them into contact with man.

However, the significance of environment is most clearly contextualised from the perspective of marine mammals. The presence of such a diverse range of marine mammals gives some indication of the extent of resource exploitation, and specifically, the fact that this was evidently tied closely to available local resources.

5.3 Craft specialisation

A key component of this investigation has been the desire to elucidate the exploitation of fauna for craft specialisation. At the heart of this matter are the butchery data as they give clues as to the ‘craft’ that both catalyses numerous other trades by providing raw materials (i.e. leather) and are themselves indicative of specific skills. There is clear evidence of a range of specialist implements in use for butchering along with refined and systematic cutting practices. The tools used were predominantly knives – potentially with steel cutting edges – cleavers appear to have been reserved for chopping against a block. The repetitive, and consistent, manner in which the skulls of cattle were processed suggests both a high degree of skill and clear 'guidelines' for the types of butchery required. Thus, in this instance there is lucid evidence for the *outcome* of carcass processing (size of portion per body part) to have been clearly defined from the outset of butchering.

While this may have been a site of specialist processing as well as slaughter, it does not appear to have been that of a butcher's *per se* i.e. a place of retail sale. There is no evidence to suggest that any part of the dismemberment process took place whilst the animal was hanging. Hanging is performed for a number of reasons ranging from saving space to maturation of the meat. While the latter can be done once the animal is processed into units (i.e. half or quarter carcass) actual processing of a whole carcass whilst it is hung requires considerable organisation and specific paraphernalia.

The diverse range of species, including food and (traditionally) non-food domesticates, that had occurrences of butchery is revealing in itself. Skinning marks noted on otter, as well as antler removal 'chops' noted on red deer indicate a diverse range of practices associated with activities not directly related to meat exploitation. Particularly revealing in this regard was the relatively high frequency of cut marks registered from marine mammals. Although the level of fragmentation, which incidentally was as a result of processing, was too great to construct detailed sequences, it was clear that heavy, repetitive and systematic exploitation of a range of marine species was undertaken. This exploitation was for meat as well as blubber.

The confusing matter with regard to craft specialisation is the fact that, whilst present in the assemblage, the numbers of elements with marks indicative of skinning, horn working and antler processing are relatively small. This may suggests that the skills for these tasks were present within the monastic community, but employed on an ad hoc basis. Alternatively, and more likely, is that, as yet the excavations have not revealed the main dumpsites. One would not expect to find skinning waste close to a tanner for example.

One aspect of craft working that is far more evident and supported by the zooarchaeological evidence is for vellum working. Given the presence of a vellum workshop on site, and juvenile cattle bones recovered in some significant quantities, and the possibility of dairying as a distinct mode of husbandry, the evidence strongly supports the presence of this craft at Tarbat. Again, the issue is not a simple one. The finds of juvenile bones certainly support the presence of vellum processing. In fact, the majority of juvenile cattle bones are neonatal, falling into an age range between 185 and 255 days (Prummel 1987). A few examples are older, based on tooth eruption, but overwhelmingly the cattle are very young individuals. The issue is that the number of finds are simply too few. Gameson (1992) suggests that at least 30 individual animals would need to be slaughtered to produce one 246 x 170mm volume with 200 folios. This figure is dwarfed when one considers the number of animals, 1545, required to produce the three volumes of the Codex Amiatinus. Once again, a possibly explanation lies with the extent of current excavation. It is likely, with the large number of adult cattle, that to date the archaeological works have recovered dumpsites of predominantly food, and to a far lesser extent craft, waste. Given the structural evidence for vellum working, as well as tantalising but limited support from the zooarchaeological finds, it would appear that the (likely large) dumps of craft waste have yet to be uncovered.

6.0 Conclusion

The faunal remains from Tarbat have provided a highly informative insight into the economic life of a Pictish monastery. In concluding this report, an underlying notion seems apparent: the residents of this unique site had a long-term exploitative strategy in place. They developed and used specific tools for processing a range of animal resources, including the potential for specialist implements for dealing with large marine mammals. The pattern of exploitation they employed was aimed at capitalising on the breadth of ecological niches present, and further, maximising the available resources (primary and secondary) from both wild and domestic species. There is the clear sense of an economic *venture* unconstrained by fiscal considerations.

7.0 Animal Bone Bibliography

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