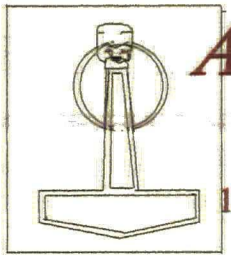

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SDC 97

WATCHING BRIEF AND EXCAVATIONS

IN

FINKLE STREET AND MICKLEGATE,

SELBY,

NORTH YORKSHIRE

FOR

SELBY DISTRICT COUNCIL

VOLUME 5

SDC 97

APPENDIX 4

SDC 97 - Micklegate, Selby

Pottery

Mark Stephens

Introduction

The pottery assemblage consisted of 2797 sherds, categorised as Roman, Saxo-Norman (i.e. 10-11th century), medieval (late 11th - late 15th century), post-medieval (16-18th century) and modern (post 1800). There was also a small number of sherds (21) that were of medieval type, but which cannot be assigned to a particular source.

Methods

Each sherd was examined, using a hand-lens where necessary, and sorted into categories depending on texture, character of mineral inclusions, colour and hardness. Comparisons were made with a reference collection where appropriate.

Roman Pottery

A very small amount of Roman pottery (5 sherds) was represented:

2 sherds of Samian (Central Gaulish)
3 sherds of calcite-gritted ware (in 2 different fabrics)

A 1st-2nd century date would be appropriate for this material.

Saxo-Norman Pottery

Torksey-type ware was represented by 13 sherds. This is a sandy fabric, mainly reduced to dark grey; some sherds had a 'sandwich' affect with grey core and reddish brown surfaces. The date range in York is 10th to late 11th century. 3 sherds from context 3606 showed the complete profile of a small jar.

Stamford-type ware occurred in very small amounts (5 sherds). This fabric is characteristic with an oxidised, hard, fine sandy texture and milky yellow or greenish glaze. Stamford ware is dateable to the 11th and early 12th centuries in York, and also occurs at Beverley at the same period.

Medieval Pottery

Thirteen medieval fabrics were identified, totalling 1787 sherds:

Type	No. of sherds	%medieval total
Splashed Ware	26	1.46
Reduced Chalky Ware	13	0.73
Beverley 1 Ware	147	8.23
Gritty Ware	132	7.39
York Glazed Ware	33	1.85
Beverley 2 Ware	119	6.66
Scarborough Ware	4	0.22
Staxton-type Ware	2	0.11
Brandsby-type Ware	1	0.056

Humber Ware	1290	72.24
Hambleton-type Ware	3	0.17
Raeren/Langerwehe	13	0.73
Siegburg	4	0.224

Splashed Ware (Spl)
This is a gritty fabric with a sparse, pitted brownish or brownish-green glaze, dateable to the late 11th to early 13th centuries. One possible source for the SDC material is from the Hallgate kilns, Doncaster.

Reduced Chalky Ware (RC)
This fabric is known from Beverley, and is a sandy grey ware with characteristic small chalk inclusions. Date: late 11th-12th century.

Beverley 1 Ware (Bev 1)
This fabric is known from the production site at Beverley, and generally is from thin-walled, lightly gritted jugs and jars. Date: 12th century.

Gritty Ware (GW)
Gritty Ware is a hard, generally oxidised fabric with evenly distributed quartz grits. Date range: late 11th - 1st half of 13th century. The SDC vessels are generally from rounded or club-rimmed jars and cooking pots; an example from context 3079 has rouletted decoration. Along with Bev 1, Gritty Ware appears to be dominant in the 12th century material from SDC.

York Glazed Ware (YGL)
A characteristically white fabric (though sometimes reddish or orange) with fairly fine grits, often from elaborately decorated jugs (example from context 3556 has a tubular spout). Date: 12-13th centuries.

Beverley 2 Ware (Bev 2)
This fabric grew out of the Bev 1 tradition at the end of the 12th century. It is a fine sandy Orangeware, with a green glaze. The jugs were highly decorated, examples being a vessel with a Raspberry stamp (context 3549) and a jug with combed and white slip decoration (context 3570). Date: 13-14th centuries.

Staxton-type Ware (Stax)
A hard coarse sandy fabric, not necessarily manufactured at Staxton/Potter Brompton as there was a kiln producing pottery of the same tradition at Hedon. Date:12-?early15th centuries.

Scarborough Ware (SCW)
This fabric is hard with quartz inclusions and a glossy green glaze. The SDC examples are from jugs in the Phase II fabric. Date: 13-14th century.

Humber Ware (HW)
Humber Ware is a sandy hard fabric, usually oxidised on the outer surface to orange, the interior of vessels often being reduced to grey. Although originating in the 13th century, Humber Ware became predominant in the 15th century, this being a process shown by excavations in York, Beverley, Hull and elsewhere. A small number of SDC sherds displayed features from the earlier (13-14th century) production of Humber Ware, an example being a jug with an applied iron-rich pellet (context 3224). Most of

the forms are later in character, such as large cisterns with pie-crusted rims and bung holes (examples from contexts 3486, 3491 and 3711). It is sometimes difficult to distinguish some of the later sherds from 16th century Red Ware or Purple Glazed Ware. Humber Ware dominates the SDC assemblage.

German Stonewares
Types represented are the usually fine light grey Siegburg (**Sgst**) and usually brown-glazed Raeren/Langerwehe (**R/Lst**) types. Date: 15th century for Siegburg, 15/16th century for Raeren/Langerwehe.

Post-medieval Pottery

Fourteen post-medieval fabrics were represented, totalling 772 sherds:

Type	No. of sherds	% post-medieval total
Purple Glazed Ware	144	18.55
Cistercian Ware	63	8.2
Red Ware	429	55.77
Ryedale Ware	3	0.39
Black Ware	25	3.25
Red Slipware	1	0.13
Manganese-mottled	12	1.56
Koln/Freschen	10	1.3
Stafordshire-type Yellow Glazed	11	1.43
Staffordshire-type Slipware	12	1.56
Marbled Slipware	10	1.3
Salt glazed Stoneware	5	0.65
Manganese-glazed Ware	29	3.77
Nottingham-type Stoneware	18	2.34

Purple Glazed Ware (PGL)
A fine sandy (although sometimes coarse sandy) fabric with a characteristically purple glaze. Date: late 15th-16th century. The SDC forms are similar to the late Humber Ware examples, with large jugs and bung-holed cisterns (e.g. from contexts 3637 and 3531).

Cistercian Ware (Ct)
A fine, hard orange to grey fabric, glazed internally and externally, often with applied pads of lighter clay for decoration. Examples from the SDC assemblage include handled cups (e.g. from context 3485). Date: late 15th - 1st half of 16th century.

Black Ware (BW)
Similar in some respects to Cistercian Ware, but with a much more lustrous glaze; forms are also different with mugs, chamber pots and bowls. Date: late 16th-17th century.

Koln/Freschen Stoneware (K/Fst)
This is a grey stoneware with a mottled brown exterior glaze and yellow/buff interior. Forms are handled jugs/flasks; none of the SDC sherds show the characteristic 'Bellarmine' face-mask. Date: late 16th-17th century.

Red Slipware
A fine red sandy fabric with white sgraffito decoration under a clear glaze. Date: 17th century.

Red Ware
A long-lived post-medieval pottery type, which emerged from the Humber Ware tradition. Forms are internally glazed dishes and bowls, plus cisterns and large jugs. (An attempt has been made to separate obviously later types - 19th century Manganese glazed [q.v.] and slipped bowls - from this category). Date: 16-18th century.

Ryedale Ware
Ryedale Ware is a fairly coarse sandy fabric, in effect a sub-division of Red Ware. It has a characteristic greenish-brown pitted glaze. Date: late 16th-17th century.

Staffordshire-type Yellow Glazed Ware
A fine light red fabric with a characteristic yellow glaze; vessels often thin-walled. Date: 17th century.

Staffordshire-type Slipware
Buff to light red fabric, often with a red outer surface. Internally glazed over combed or slip-trailed decoration. Common form is a press-moulded dish with pie-crust rim. Date: 2nd half 17th - early 18th century.

Manganese-mottled Ware
A light brown fabric, often with small voids; rich brown glaze with characteristic speckles and mottling. Date: 17th - early 18th century.

Marbled Slipware
A very hard fine sandy fabric with internal clear glaze over mottled ('marbled') cream/brown slip. Date: mid-late 18th century.

Salt-glazed Stoneware
Fine, clear-glazed stoneware, often with applied sprig decoration and slightly grainy surfaces. Date: mid-late 18th century.

Tin-glazed Earthenware
This is a fairly soft earthenware with thick flaky white glaze, sherds often showing blue or polychrome painted decoration. A single footring sherd was found in the SDC assemblage; this would be 18th century in date and of English manufacture.

Nottingham-type Stoneware
Grey stoneware fabric with external (and sometimes internal) lustrous brown glaze, often with incised decoration. Date:18th century.

Manganese-glazed Ware
A late development from Black Ware and Red Ware. Large bowls in a very hard red fabric with thick vitreous black glaze. Date: 18/19th century.

Modern Pottery
The post -1800 pottery totalled 193 sherds, and included Pearl Ware (Prw), Cream Ware (Crw), brown-washed stoneware (19thst), and cream/white slipped bowls in a hard

sandy red fabric (19thsl). Predominant are white-glazed earthernwares, including transferwares; notable is a sherd with the motto "Crabtree, Nelson Inn" (context 3524).

Conclusions

The small number of Roman sherds would appear to form a residual background to activity of the same date recently revealed by the Abbey Walk excavations at the rear of Finkle Street.

The occurrence of Torksey-type Ware hints at an Anglo-Scandinavian presence in the vicinity of the site, but as this pottery, along with Stamford Ware, straddles the period of the Norman invasion, it is not possible at this stage to categorically state that these sherds represent pre-conquest occupation. The contexts in which these sherds were found also contained pottery of more obviously post-conquest type, and so it is appropriate to assign a late 11th century date to them.

Other late 11th century sherds (Splashed Ware, Reduced Chalky Ware and Beverley 1 Ware) date to the years following the conquest and into the 12th century.

The assemblage shows that for the late 12-14th centuries, the site was receiving pottery from the York and Beverley areas (Gritty Ware plus York Glazed Ware, and Beverley 2 Ware respectively). Only a very little material originated from elsewhere (Staxton/Potter Brompton or ?Hedon, the Humber Basin, Brandsby and Scarborough). These varied sources were largely replaced by Humber Ware in the 15th century, a situation reflected regionally.

The ascendancy of the Humber Ware tradition was continued in post-medieval times by Purple Glazed Ware and Red Ware, which are both believed to derive from the Humber Ware industry.

Recommendations

The assemblage should be retained as a significant addition to the study of ceramics for Selby, a town that has seen little scientific excavation until the 1990s.

When considered with the finished excavation report and final stratigraphic sequence, it would be of benefit to study the pottery by period/phase group rather than as an overall assemblage. Further, more detailed work could include more identification of forms, vessel numbers and cross-ties between contexts.

Catalogue

Context No.	Description	Date range	Date
T1			
3024	HW	14-15th	15th
3026	?	?	?
3027	HW	14-15th	15th
3028	HW, PGL	15-16th	early 16th
3046	HW	14-15th	15th
T2			
3051	BW, Stygl.	17-early 18th	early 18th
3052	PGL	15th-16th	early 16th
3069	Tgl	mid 18th	mid 18th
3088	HW	14-15th	15th
3102	HW, PGL, Rew, Ct	14-16th	16th
3105/6	HW	14-15th	15th
3106	HW	14-15th	15th
T3			
3222	?	?	?
3224 V	Rew, R/Lst	15-17th	17th
3224 V1	HW, Ham, PGL	15-16th	16th
3224 V2	HW	14-15th	15th
3224 V3	Spl, HW	12th, 13-14th	14th
3224 V4	HW, PGL, Ct	14-16th	16th
3226	Bev 2, HW, Wgl (?intrusive)	13-15th; 19th	?15th
3234	Bev 2, HW, Stsl	13-15th; 18th	early 18th
3238	Bev 2, HW, PGL, Rew	13-17th	17th
T4			
3255	Rew	16-17th	17th
3257	Ct, late HW/Rew	16th	16th
3262	Rew, Stygl, Rye	16-17th	17th
3266	Rew	16-17th	17th
3267	HW, Rew	15-17th	17th
3271	Rew	16-17th	17th

3274	Rew, Stsl, Msl, BW, NT, Prlw	16-18th	late 18th
3280	Spl, HW	12, 14-15th	15th
3284	HW	14-15th	15th
3287	late HW/PGL	15-16th	early 16th
3297	Bev 1, HW	12-15th	15th
3297/8	Bev 1, HW	12-15th	15th
3298	HW, PGL	14-16th	16th
3299	Spl, HW	12-14th	14th
3305	HW	14-15th	15th
3326	GW, Bev 2, HW, late HW/Rew	14-17th	?17th
3327	HW, PGL	15-16th	16th
3341	HW	14-15th	15th
3344	HW	14-15th	15th
3389 (3345)	HW	14-15th	15th
3390 (3347)	HW	14-15th	15th
TP1			
3400	BW, Rew, NT, 19thst, 19thsl, Wgl	17-19/20th	19-20th
3403	Ct, K/Fst	16-17th	early 17th
3405	Bev 2, HW, Wgl	13-19th	19th
3406	HW, BW, K?Fst, NT, Rew, Stsl, Wgl	14-19th	19th
3407	Rew	16-17th	17th
3408	Rew, MM, Stsl, Msl, Wgl	16-19th	19th
3409	GL, K/Fst, Rew, Msl, ?	16-18th	mid 18th
3410	Bev 2, HW, R/Lst, PGL, Ct, Rew, K/Fst, Stsl. Wgl	13-19th	19th
3411	HW, late HW/Rew, PGL	14-16th	16th
3413	HW, PGL	14-16th	16th
3415	HW, Ct	14-16th	early 16th
3416	CG, HW	RB, 14-15th	15th
3417	CG, Bev 2	RB, 13-14th	14th

3418	R/Lst	15th	15th
3419	Bev 2, HW	13-15th	15th
TP2			
3420	Rew, Mn, NT, Wgl	16-19th	19th
3421	Ct, Rew, MM, Msl, NT, Crw, Prw, Wgl	16-19th	19th
3422	Rew, MM, Salgl, Mn, 19thst, Prw, Wgl	16-19th	19th
3423	Rew, BW, K/Fst, MM, Msl, Salgl, Mn, NT Wgl	16-19th	19th
3424	GW, R/Lst, HW, PGL, Rew, Rye, BW, K/Fst, MM, Stygl, NT, Msl, Wgl	15-19th	19th
3425	GW, HW, R/Lst, late HW/Rew, PGL, Stygl	16-17th	late 17th
3426	GW, HW, Rew	12-17/18th	17/18th
3429	GW, HW, PGL, ?	12-16th	16th
3431	GW, YGL, HW, Rew	12-16/17th	?16/17th
3436	GW, Bev 1, HW	12-15th	15th
3437	GW, Bev 1, HW,	12-15th	15th
3439	HW	14-15th	15th
3457	Bev 2, HW	13-15th	14/15th
TP3			
3441	Bev 1, HW, BW, MM, 19thsl, Wgl	12-19th	19/20th
3442	Mn. 19thsl, 19thst, Wgl	18-19th	19/20th
3443	Bev 1, Rew, Mn, 19thst, Wgl	12-19th	19/20th
3444	Rew	16/17th	late17th
3445	HW, BW, Rew, Wgl	15-19th	19/20th
3446	HW, Ct, Rew	15-17th	17th
3447	PGL, Rew	16-?17th	17/18th
3448	HW, PGL	14-16th	16th
3448/9	YGL, HW, BW, Rew	12-17th	17th
3450	YGL, Bev 1, Bev 2, HW, ?	12-15th	14/15th
3451	GW, YGL, Bev 1, R/Lst, Hw, PGL, Rew	12-17th	17th
3452	Bev 1, HW, PGL	12-16th	16th

3455	Bev1, Bev 2, HW	12-16th	16th
3456	GW, Bev 1, HW	12-15th	14/15th
3457	GW, Bev 2, HW, PGL, Rew	12-17th	early 17th
3458	CG, Spl, YGL, Bev 1, Bev 2, HW, Ham	RB-15th	15th
3459	TT, GW, YGL, Bev 1, Bev 2, HW	11-15th	14/15th
3510	GW, HW	12-15th	14/15th
3511	GW, Bev 1, Bev 2	12-14th	13/14th
3514	Spl, GW, Bev 2, HW	12-15th	14/15th
3517	GW, Bev 1, HW, PGL	12-16th	16th
3518	HW, Ham	14-15th	15th
TP4			
3692/3735	TT, GW, Bev 1	11-13th	12/13th
3696	TT, Spl, Bev 2, HW, Rew, Mn, NT, Wgl	11-19th	19/20th
3697	HW	14-15th	14/15th
3699	PGL, Rew, BW	16-17th	17th
3700	Stsl, Stygl	17-18th	late 17th
3701	Spl, Bev 2, HW	12-14/15th	14/15th
3702	HW, Rew	14-17th	17th
3703	Sam, GW, HW	RB-15th	14/15th
3704	HW	14-15th	14/15th
3706	HW	14-15th	15th
3707	HW	14/15th	14/15th
3708	HW	14-15th	14/15th
3709	HW	14-15th	14/15th
3710	HW	14-15th	14/15th
3711	HW, PGL	14-16th	16th
3712	GW, Spl	12-13th	12/13th
3713	Bev 1, Bev 2, HW	12-15th	14/15th
3715	HW	14-15th	14/15th

3716	YGL, HW	12-15th	14/15th
3718	Bev 2	13-14th	13/14th
3720	GW, YGL, Bev 1	12-13th	12/13th
3721	YGL, Bev 1, HW, Ct (v. small ?intrusive)	12-16th	?early 16th
3722	HW	14-15th	14/15th
3724	HW	14-15th	14/15th
3727	GW, Bev 1, HW, PGL	12-16th	16th
3728	GW, Bev 1	12-13th	12/13th
3731	GW	12-13th	12/13th
3732	Bev2	13/14th	13/14th
3733	GW, YGL, Bev 1, HW, PGL	12-16th	16th
3735	TT, GW, YGL, Bev1, Bev 2, HW, ?	11-15th	14/15th
3739	TT, GW, Spl, Bev 1, Bev 2, HW	11-15th	14/15th
3741	GW, YGL, Bev 1, Bev 2, HW	12-15th	14/15th
3742	RC	12th	12th
3744	GW	12-13th	12/13th
TP5			
3461	SCW	12-13th	12/13th
3465	HW, Ct, BW, Rew, MM, Stygl, Stsl, Salgl, Wgl	14-19th	19/20th
3468	HW, Sgst, Rew, BW, MM	14-17th	17th
3471	Spl, HW	12-15th	14/15th
3472	late HW/Rew, PGL, NT	15-18th	18th
3473	Bev 1, HW, PGL, Rew, Stygl, 19thsl	12-19th	19th
3474	BT, HW, R/Lst	13-15th	15th
3476	HW	14-15th	14/15th
3542	HW	14-15th	15th
3543	HW, PGL	14-16th	16th
3546	YGL	12-13th	12/13th
3547	HW	14-15th	14/15th

3549	Bev 2, HW, late HW/Rew	13-early 16th	early 16th
3550	Bev 2	13-14th	13/14th
3552	Bev 2, HW	13-15th	14/15th
3553	GW, Bev 2, HW	12-15th	14/15th
3555	Sam, Bev 2	RB-14th	13/14th
3556	GW, Spl, YGL, Bev 1	12-13th	12/13th
3559	RC, YGL, GW, Bev 1, Stax	12-13th	12/13th
3560	YGL	12-13th	12/13th
3566	GW	12-13th	12/13th
TP6			
3482	HW	14-15th	15th
3483	YGL, HW, Rew, Ct, BW, MM, Rew, Wgl	12-19th	19/20th
3484	R/Lst	15th	15th
3485	HW, Sgst, PGL, Ct, late HW/Rew, Wgl	14-19th	19/20th
3486	HW, PGL, Rew	14-16th	16th
3487	HW	14-15th	15th
3489	Bev 2, HW	13-15th	14/15th
3490	HW	14-15th	14/15th
3491	Spl, HW, PGL	12-16th	16th
3493	Spl, Bev 1, HW	12-15th	14/15th
3494	Bev 2, HW	13-15th	14/15th
TP7			
3520	Wgl	19-20th	19/20th
3524	Ct, Rew, Wgl	16-19th	19th
3525	Bev 1, YGL, SCW, HW, Sgst, R/Lst, PGL, Rew, ?st	12-17th	17th
3528	HW, Ct, ?	15-16th	16th
3531	YGL, Bev 1, R/Lst, HW, PGL	12-16th	16th
3532	Bev 2, HW, R/Lst, Rew	13-17th	16/17th
3537	Bev 2, HW, Wgl	13-19th	?19/20th
3538	HW	14-15th	15th

3539	HW	14-15th	15th
3570	Bev 2, HW, PGL	13-16th	16th
3572	YGL, HW	12-15th	14/15th
3574	HW	14-15th	14/15th
3575	HW	14-15th	14/15th
3577	SW, YGL, GW, Bev 1, Bev 2, HW	12-15th	14/15th
3579	TT, Bev 1, Spl, GW, Bev 2	11-14th	13/14th
3600	Bev 1	12th	12th
3601	Bev 1	12th	12th
3606	TT, GW, Bev 1, YGL, Bev 2	11-14th	13/14th
3611	HW	14-15th	14/15th
3617	Bev 1	12th	12th
TP8			
3587	HW	14-15th	14/15th
3588	HW	14-15th	14/15th
3589	GW, HW	12-15th	14/15th
3590	Bev 2	13-14th	13/14th
3593	Spl, Bev 1	12th	12th
3597	YGL, Spl, GW, RC, Bev 1, Bev 2, HW	12-15th	14/15th
3598	GW, Bev 1, HW	12-15th	14/15th
3599	HW	14-15th	14/15th
3641	Bev 1, YGL	12-13th	12/13th
3643	Bev 1, ?	?12th	?12th
3644	GW, RC, Spl, Bev 1, ?	11-early 13th	12th
3646	TT, SW, RC, GW, Spl, Bev 1, ?	11-early 13th	12th
3647	RC, Spl, GW, Bev 1	11-early13th	12th
TP9			
3633	HW, Pgl, Ct, Rsl, Stygl, BW, Rew, Stsl	15-18th	early 18th
3634	Ct	early 16th	early 16th
3635	Bev 1, HW, R/Lst, PGL, Ct, Rew, ?	12-16th	16th

3636	Bev 1, HW, PGL, ?	12-16th	16th
3637	HW	14-15th	14/15th
3639	HW, PGL, R/Lst	15-16th	16th
TP11			
3657	HW	14-15th	15th
3659	Bev1, ?	12th	?12th
3662	HW, PGL	15-16th	16th
3663	HW	14-15th	15th
3680	HW, PGL	15-16th	16th
3684	HW	14-15th	15th

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APPENDIX 4a

Pre-Conquest pottery at Selby, North Yorkshire?

Alan Vince

Excavations on a variety of sites in Selby by Alison Clarke have produced pottery identified as being of 10th/11th-century date. As part of a survey of pre-conquest pottery north of the Humber, selected pottery from these excavations was re-examined by the author. Examples of York Early Glazed Ware, Stamford ware and Torksey-type ware, all of which are potentially pre-conquest in date, were found. All other observed types were likely to be of post-conquest date. The earliest of these were York Gritty ware, Grimston Thetford-type ware (a highly unusual find in Yorkshire, but fitting Selby's riverine location), Reduced Chalky ware, a handmade coarse sandy ware and unsourced shell-tempered ware.

The pre-Conquest wares

The potentially pre-Conquest sherds come from TP4, TP7 and TP8 with TP8 producing the strongest evidence for pre-Conquest material. In each case the early pottery was found in association with mid-12th-century or later wares.

York Early Glazed ware?

A sherd from a large glazed pitcher with a vertical applied strip decorated with diamond roller-stamping was found in layer 3646. The off-white fine sandy, slightly micaceous fabric is coarser than any of the similarly-coloured wares produced at Stamford, Lincolnshire, in the late 9th to 12th centuries but is paralleled in York, principally at Coppergate. In her discussion of the Coppergate vessels, which were found in 10th and early 11th-century contexts, two possible sources were proposed. The first option is that these are local products, utilising the Jurassic white-firing clays which were used in the Roman period at Crambeck and in the late 12th-century and later at sites in the Hambleton Hills. This is by no means impossible although neither Roman or medieval whitewares from that area have quite as silty a body. The second possibility is that the vessels are imports. Samples of 12 of the Coppergate vessels were analysed at Caen and compared with 10th-century material from Rouen. This analysis, however, only included the major elements, which are likely to be broadly comparable for any silty off-white (and therefore low iron) clay. It is proposed to undertake a further analysis using ICPS, which includes a wider range of elements and it would be worthwhile including a sample of the Selby vessel. There was, of course, a major pottery production centre in the Seine valley in the late 12th century, producing Rouen-type ware, but it is not known whether there was an glazed ware production in the area between the 10th/11th century and the late 12th.

Torksey-type ware?

Torksey ware is a sandy greyware produced in the late 9th to 11th centuries at Torksey, on the Trent in Lincolnshire. Torksey wares were widely traded up and down the Trent from their introduction onwards. Petrological and chemical analysis of pottery from St Peter's Church, Barton-upon-Humber, indicates that similar sandy wares were produced outside of the Trent valley, probably in the post-

Conclusion

It is clear that the majority of the pottery examined is of later 12th-century and later date, and that none of the assemblages examined could have been deposited before that date, since later 12th-century or later material was found in each deposit. The three wares identified as being potentially of pre-conquest date are all of types which have possible post-conquest alternative identities. The 'York Early Glazed Ware' might be a later 11th to 12th-century Rouen ware. The 'Torksey-type ware' could be post-conquest date and comparable with the material from Barton-upon-Humber and the 'Early Stamford ware' could be a small fragment of Rouen-type ware, of late 12th or early 13th century date. Indeed, if there had been a pre-conquest component to the Selby assemblages one would have expected it to be similar in composition to that found at Coppergate in York, with perhaps a higher Lincolnshire contribution given the location of Selby. In the absence of York ware, definite Torksey ware and Lincoln-area shelly wares it is more likely that the alternative identifications are actually the correct ones. Nevertheless, in two of the three cases it would be possible to distinguish between the possibilities whilst still leaving a large amount of the sherd for future study and it is therefore recommended that three Selby samples be included in the author's forthcoming Survey of Anglo-Saxon Pottery in the Northumbrian kingdom.

SDC 97

APPENDIX 5

The faunal remains from 1997 excavations at Selby (SDC97

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THE FAUNAL REMAINS FROM 1997 EXCAVATIONS AT SELBY (SDC 97).

Introduction

Archaeological investigation in the Mickelgate and Finkle Street area of Selby was undertaken in 1997 prior to tree planting by Selby District Council. Excavation yielded approximately 150kg of hand-recovered bone and shell from fourteen small trenches, eight of which were selected for detailed faunal analysis (TP1, TP2, TP3, TP4, TP5, TP7, TP8, and TP9). The level of preservation in all areas is generally good, although the effects of dog gnawing are apparent throughout the assemblage. The faunal remains from Selby (SDC 97) appear to represent deposits of industrial waste as well as domestic refuse of mostly medieval date.

Analysis of the pottery from Selby suggests material dating from the Romano-British to Post-medieval periods, as well as some modern deposits. Unfortunately there was insufficient faunal material from closely dated contexts to allow detailed chronological analysis. However, most of the faunal material could be assigned to the following broad periods: Romano-British/Medieval, Medieval, Medieval/Post-medieval, and Post-medieval. The bulk of the faunal material came from medieval contexts, and it is likely that the Medieval/Post-medieval contexts also yielded predominantly medieval material.

Recording Methods

The bones from each context were examined and, where possible, were identified to skeletal element and species using reference material in the Durham University Archaeology Department collection. A zone system was used whereby a fragment was recorded if identifiable to element and species and comprising over 50% of a defined anatomical zone (see Appendix 1). Fragments not possessing a zone were recorded as either "cow size", "sheep size", "small mammal", or "bird" fragments. Fish fragments were recorded but not identified. The presence or absence of marine mollusc shell fragments was noted for each context and for each trench the total weight of shell was recorded.

Also recorded were all loose teeth and teeth present in the jaw, and in the case of cattle, sheep/goat, and pig, wear was recorded for the mandibular cheek teeth using the tooth wear stages defined by Grant (1975). For each recorded fragment any evidence of butchery (cut/chop marks), gnawing or burning was noted as well as the state of fusion and the occurrence of pathologies or abnormalities. Measurements were also taken for the large mammals where appropriate following Von den Driesch (1976), Boessneck (1969), Grigson (1982) and Legge & Rowley-Conwy (1988).

Quantification of the assemblage and the proportions of different species within it has been undertaken using a number of different techniques. The Number of Identified Specimens (NISP) count totals all recorded fragments (including loose teeth) but is subject to bias if the number of bones in the skeleton or the degree of fragmentation differs between species. The Minimum Number of Individuals (MNI) for each species is calculated by taking the most frequent zone of any of the skeletal elements and dividing this by the number of that element in a complete skeleton. This method has a tendency to over represent the rarer species.

A Minimum Number of Anatomical Units (MAU) count reduces the effects of such biases. There are a number of variations in the ways MAU's are calculated by different analysts; the author's method is as follows. Firstly the most common anatomical zone for each element is counted to obtain a minimum number for each element (MNE). The MNE is then adjusted to take into account the different numbers of particular skeletal elements within and between species. For example, each bovid skeleton has two distal radii, but has eight first phalanges and only one atlas vertebra, while each equid skeleton has only four first phalanges. In this method of calculating MAU long bone numbers are left unchanged, while other elements are brought into line with them: bovid first phalanges are divided by 4, while atlas vertebrae are multiplied by 2. This calculation produces MAU's for each element, which are then summed to provide a total MAU for each species.

Preservation and Fragmentation

In general bone preservation was reasonably good. Faunal remains were examined from a total of 160 contexts for which the relative standard of bone preservation was noted. Overall 69% of contexts were recorded as having average preservation, 22% good, and 9% poor; there does not appear to be any significant variation in levels of preservation between different excavation trenches or contexts of

different date. Abrasion of bones was noted in several contexts, this could be indicative of surface exposure and physical weathering of bones prior to burial, it may also be the result of bones being redeposited. The presence of abraded and poorly preserved fragments where bone preservation is otherwise good was noted for several contexts (in particular contexts 3635 and 3636 from TP9, which contained both pale angular fragments and dark abraded fragments). This may be taken as evidence of residuality or mixing of contexts, as not all the bones in such contexts have shared the same history of preservation.

Loose teeth account for 9% of the total hand-recovered assemblage identified to species. This attests to a reasonably low level of fragmentation as it implies that the mandibles have not been broken up. A similar degree of fragmentation (8-9% loose teeth) occurs within the Romano-British/Medieval, Medieval, and Medieval/Post-medieval groups. The Post-medieval sample from Selby contains no loose teeth but is too small to be reliably compared to the larger faunal samples assigned to earlier periods. There is more variation in fragmentation between the different excavation trenches; TP1 and TP4 have a very low incidence of loose teeth (6%) while the remains from TP8 appear to be more fragmented having 15% loose teeth. Low fragmentation is also suggested by the fairly low occurrence of loose teeth in the remaining areas (8-11%), although the low incidence of loose teeth may also be accounted for by the loss of smaller bones and fragments likely to occur if some material has been redeposited from elsewhere.

Comparison of NISP and MAU counts can also provide a rough index of fragmentation that is affected by the loss of smaller bones and fragments in the same way as the percentage of loose teeth; the more complete elements in an assemblage the closer the total NISP and MAU values. Expressing MAU as a percentage of NISP serves as a basic index whereby the higher the percentage the lower the level of fragmentation. The relative levels of fragmentation that are indicated by % loose teeth for the different Selby excavation trenches are similar to those indicated by the MAU/NISP comparison. The overall %MAU/NISP for Selby at 60% is quite high, reflecting reasonably low fragmentation. The %MAU/NISP for TP1 is high (74%), suggesting low fragmentation as indicated by the loose teeth, while TP8 appears more fragmented (%MAU/NISP = 53%).

The fragmentation patterns observed throughout the Selby assemblage appear to be mainly the result of pre-depositional damage by canine attrition and butchery. In contexts where bone is heavily abraded, re-deposition of material may also account for some of the fragmentation, as dry bone is fragile and susceptible to breakage when moved. Although the majority of breaks are old, there are also a number of recent breaks resulting from post-excavation handling and storage. Throughout the assemblage the bones of birds and the smaller mammals (cat, dog, rabbit, rat and hedgehog) are well preserved; surface bone preservation is excellent and where fragmentation occurs it appears to be mainly the result of recent breaks.

Species Present

The hand-recovered collection comprises 4018 recorded bones and teeth, 66% of which have been identified to species. The species represented are listed in Table 1 together with the numbers of fragments recorded. The bulk of the faunal assemblage consists predominantly of domestic species (Cattle, sheep/goat, pig, cat, dog, horse, fowl and goose). Cattle fragments are most numerous followed by sheep and then pig, and these three species constitute 93% of the identified remains. Domestic fowl and then goose are the most abundant among the bird assemblage, but are among the least numerous of the domestic species. Wild species are represented in much smaller numbers by fallow deer, rabbit, rat, stoat, and hedgehog and bird species including duck, owl, and woodcock. Marine molluscs were well represented and small collections of fish and crab fragments were also recovered.

Only one ovicaprid fragment, a metacarpal, could be positively identified as goat on the basis of morphological characteristics. It is possible to distinguish sheep from goat metrically using Boessneck's (1969) measurements "a" and "b" of the lateral distal condyles of metapodials, the percentage a/b being larger in sheep than in goat. Of the 9 metacarpals measured 8 appear to belong to sheep as they fall well above the 63% cut off point given by Boessneck. The single goat metacarpal identified by the Boessneck formula was the same specimen identified by morphological characteristics. All but one of the 11 metatarsals measured fall above 63%, and at 61% the remaining metatarsal still falls within the 59-62.5% overlap range suggested by Boessneck (ibid: 355) for sheep and goat metatarsals. Therefore evidence for the presence of goat in the Selby assemblage is limited to one identified specimen, and although goats may well have been present at the site in greater numbers, for the purposes of this analysis all ovicaprid remains will be treated as sheep.

THE MAMMAL BONES

Quantification

Table 1: Number of recorded fragments.

	Romano-British/ Medieval	Medieval	Medieval/ Post-medieval	Post-medieval	Total
Cow	58	851	478	2	1458
Sheep	25	345	285	1	694
Goat	0	1	0	0	1
Pig	10	182*	104	1	306*
Horse	1	22	13	0	36
Dog	0	8	3	0	11
Cat	9	21	24	0	54
Fallow deer	1	16	13	0	30
Rabbit	0	2	1	0	3
Rat	0	1	1	0	2
Hedgehog	0	1	1	0	3
Mustela sp. cf. Stoat	1	0	0	0	2
Fowl	1	12	14	0	28
Goose	0	7	3	0	10
Duck	0	1	0	0	1
Woodcock	0	0	4	0	4
Owl	0	0	3	0	3
Cow sized	31	565	290	2	937
Sheep sized	8	234	138	1	399
Small mammal	0	1	1	0	2
Bird	0	8	10	0	18
Fish	0	11	1	0	12
Crab	0	3	1	0	4
TOTAL FRAGMENTS	**106**	**2292**	**1388**	**7**	**4018**

*Including 9 fragments of piglet skeleton from context 3647, TP8.

The relative percentages using NISP and MAU counts of the three pain domestic species (cattle, sheep, and pig) are recorded by area tables 2 and 4 and by period in tables 3 and 5. Also recorded are the MNI values for these species (tables 6 and 7). The results show consistent differences between the NISP and MAU methods. The percentage of cattle is consistently higher when using NISP counts than when using MAU, while the reverse is true for sheep. This pattern illustrates different levels of fragmentation between sheep and cattle bones in the recovered sample. Sheep bones appear to have suffered less fragmentation than those of cattle, however this pattern may be the result of retrieval bias against the smaller fragmented sheep remains.

Table 2: % Number of Identified Specimens (cow, sheep, and pig) from different trenches.

		% NISP							
	Total	TP1	TP2	TP3	TP4	TP5	TP7	TP8	TP9
cattle	60	61	58	55	64	71	55	64	58
sheep	28	30	33	28	27	20	30	15	34
pig	12	9	9	17	10	9	16	21	9
n=	2449	202	384	440	283	289	431	107	339

Table 3: % Number of Identified Specimens (cow, sheep, and pig) from different periods.

% NISP

	Romano-british/ Medieval	Medieval	Medieval/ Post-medieval	Post-medieval
cattle	62	62	55	50
sheep	27	25	33	25
pig	11	13	12	25
n=	93	1369	867	4

Table 4: % Minimum Number of Anatomical Units (cow, sheep, and pig) from different trenches.

% MAU

	Total	TP1	TP2	TP3	TP4	TP5	TP7	TP8	TP9
cattle	55	57	52	51	55	69	48	60	51
sheep	35	32	40	34	35	21	36	24	38
pig	11	11	7	14	11	10	15	17	11
n=	1375	150	228	260	184	180	249	56	186

Table 5: % Minimum Number of Anatomical Units (cow, sheep, and pig) from different periods.

% MAU

	Romano-british/ Medieval	Medieval	Medieval/ Post-medieval	Post-medieval
cattle	54	58	50	62
sheep	32	29	41	31
pig	14	13	9	8
n=	67	764	505	3

Table 6: Minimum Number of Individuals (cow, sheep, and pig) from different trenches

MNI

	Total	TP1	TP2	TP3	TP4	TP5	TP7	TP8	TP9
cattle	47	7	7	8	6	12	8	3	6
sheep	22	3	6	5	4	2	4	2	8
pig	11	3	3	3	2	3	3	1	2
n=	80	13	16	16	12	17	15	6	16

Table 7: Minimum Number of Individuals (cow, sheep, and pig) from different periods

MNI

	Romano-british/ Medieval	Medieval	Medieval/ Post-medieval	Post-medieval
cattle	2	30	15	1
sheep	2	10	11	1
pig	1	7	4	1
n=	5	47	30	3

The relative abundance of cattle (60%), sheep (28%), and pig (12%) from the total Selby assemblage is similar to a number of medieval samples from Northeast England. Similar percentages of cattle, sheep, and pig have been recorded from medieval Newcastle (Queen Street, Rackham 1988; Crown Court, Gidney 1989) and Durham (Castle Ditch, Mulville n.d; Leazes Bowl, Hambleton 1998). In contrast, the medieval faunal assemblage from 1993 excavations from Selby town centre exhibited very high

percentages of sheep remains (73%) in relation to cattle (23%) and pig (4%) (Carrott et al 1993). The predominance of sheep in the 1993 assemblage appears to be a reflection of the industrial activity that took place in the area, and need not imply a difference in the dietary importance of cattle and sheep when compared to the 1998 faunal sample.

The NISP, MAU, and MNI counts show cattle remains to be more numerous than sheep, and sheep to be more numerous than pig in the majority of excavated areas. This is also true for all periods with the exception of the MNI values for the Romano-british/Medieval and Post-medieval assemblages, where the sample size is too small to allow any reliable conclusions concerning species proportions to be drawn. Although broadly similar, the proportions of cattle, sheep, and pig do vary between areas and this may well reflect pattern of industrial and domestic waste disposal and, possibly, different preservation conditions. The NISP and MAU counts also show a difference in the proportions of sheep and cattle between the medieval and medieval/post-medieval periods whereby the percentage of cattle decreases and the percentage of sheep increases.

The increase in the ratio of sheep to cattle from the medieval to medieval/post-medieval samples may be indicative of a gradual change in the economic importance of these two species through time seen elsewhere in northern England. Davis (1991) has noted an increasing importance of sheep over cattle for the medieval and post-medieval Newcastle samples as well as other medieval and early post-medieval assemblages from around England. The 1998 Selby sample would appear to share this trend, although without a larger post-medieval sample, and clearer dating of the medieval/post-medieval contexts it is impossible to concluded whether or not there is a definite change in the relative importance of cattle and sheep through time. On the whole the greater abundance of cattle remains in all areas and periods suggests that cattle were undoubtedly of substantially greater economic importance than sheep and pig in terms of available meat weight, and in terms of any industrial activity occurring in this particular area of the town.

Burning

Very little evidence of burning was found on any of the bones. Overall, less than 2% of unidentified fragments and 1% of speciated fragments showed any signs of heat damage. Within the low percentage of identified charred fragments there was no noticeable difference in the incidence of burning between different species. The majority of remains recorded as burned are charred white or black, and only a few fragments appear to have been subjected to sufficiently high temperatures to become calcined. The low incidence of burning would suggest either that bone waste was not disposed of by burning, or that most burnt remains were deposited elsewhere. However it is possible that the low incidence of burning could be partly the result of retrieval bias as burnt bones tend to be fragmented and therefore may not have been recovered.

This low incidence of burning is consistent throughout all areas and periods with the exception of TP8 where the incidence of burning among the unidentified fragments is as high as 12%. The incidence of burning among the identified fragments from TP8 (2%) is not significantly higher than recorded for other areas of the site and there is no evidence to suggest any of the contexts from this area were associated with deliberate burning activity or disposal of burnt waste.

Gnawing

The presence of domestic dog on the site could account for all the observed gnaw marks. Evidence of gnawing is mainly in the form of chewed off epiphyseal ends and marks on shaft fragments. Additional evidence of dog gnawing includes a number of smaller fragments that have suffered extreme surface erosion consistent with having been ingested, and three coprolites from TP7 containing many small fragments of bone. Among the large mammals the later fusing long bone epiphyses, particularly the proximal ulna and proximal humerus, exhibit high incidences of gnaw marks, a pattern typical of canine attrition. No fragments were recorded as bearing marks of rodent gnawing, although rat is represented in the faunal assemblage.

The Selby assemblage appears to have suffered quite heavy canine attrition; at least 24% of fragments identified to species and 27% of unidentified remains were recorded as bearing marks of gnawing by dogs. There are substantial differences in the incidence of gnawing among different species within the assemblage. Sheep fragments exhibit a much higher incidence of gnawing (40%) than cow (18%), which suggests that dogs had greater access to sheep remains than to cattle bones. This is a pattern that might be expected at a site where noxious waste from the butchering of large animals was disposed of quickly while bones from smaller animals such as sheep were "kitchen waste" and more

accessible to dogs. The degree of canine attrition in pigs (24%) is more ambiguous but would seem to imply disposal practices more similar to those of cattle remains than of sheep. Remains of horse, fallow deer, goose, and in one instance dog, also bear gnaw marks.

There is some variation in the amount of gnawing observed in the faunal samples from different excavation trenches. TP5 exhibits a consistently low level of canine attrition among both identified (15%) and unidentified (12%) fragments, while TP2 yielded high percentages of gnawed fragments with 30% of identified and 46% of unidentified remains bearing marks of canine attrition. It is likely that the variation in percentages of gnawed fragments among the different areas of the site is a reflection of differences in species proportions. The overall percentage of gnawed fragments appears greater in areas with a high incidence of sheep remains, which are more affected by dog gnawing than cattle remains, and lower in areas with a lower incidence of sheep remains.

The Romano-british/medieval sample and the post-medieval sample are both too small to reliably determine the level of gnawing. However the large Medieval and Medieval/post-medieval samples exhibit very similar percentages of gnaw marks both within the identified and unidentified samples and when examining cattle, sheep, and pig remains separately. Thus there appears to be no significant difference in the amount of dog gnawing over time.

Butchery

The presence of knife cuts and chop marks was recorded on 21% of identified fragments but only14% of unidentified fragments from Selby. This variation in the amount of butchery evidence between identified and unidentified remains is consistent throughout all areas and periods. The abrasion and fragmentation caused by dog gnawing which rendered many fragments unidentifiable may also have destroyed butchery marks, thus accounting for the apparent differences in the percentage of identified and unidentified butchered fragments throughout the Selby assemblage. There is some variation in the incidence of butchery between different excavation areas; the percentage of butchered remains ranges from 8% of identified fragments from TP8 to 29% from TP3. This may be the result of different levels of abrasion and canine attrition between areas or differential disposal of butchery waste across the site. As mentioned in the previous section, the Romano-british/medieval and post-medieval samples are small and therefore cannot be used for reliable comparison of levels of butchery between periods. However, the percentage of butchered fragments in the medieval and medieval/post-medieval samples are almost identical and do not indicate any changes in the intensity of butchery activity between periods.

There is a marked difference in the level of butchery observed in the three main domestic species. Cattle remains exhibit butchery marks on 30% of identified fragments, while the incidence of butchery in sheep (10%) is substantially lower. A higher incidence of butchery marks among cattle remains was also noted for the Selby 1993 assemblage (Carrot et al 1993). This is unsurprising, as larger animals such as cattle tend to require much more primary processing than the carcasses of smaller animals such as sheep where meat is more often retained on the bone for cooking. The evidence of butchery in pig is low (11%). It is possible that, like sheep, pigs were cooked whole or on the bone and consequently show little signs of butchery, however the consistently low incidence of butchered pig fragments is may also be an artefact of small sample size or the particular range of elements represented. Those areas where the incidence of butchered remains is high may indicate deposits dominated by carcass processing waste from butchery or industrial activities.

Cattle: The locations of cut and chop marks on the post-cranial skeleton are consistent with dismembering and butchery. Vertebrae are most commonly split through the vertebral body down the dorso-ventral axis. Although some vertebrae have been cut laterally it would seem that butchery of the carcass into sides of beef, indicated by the longitudinal splitting of vertebrae, was common practice throughout the medieval and post-medieval periods at this site. Ribs, when recovered, are usually cut or chopped through near the vertebral articulation and at several points along the length, but are not a common element in this assemblage. Those mandibles bearing signs of butchery appear to have been chopped across the tooth row and down the length and across the ramus, possibly to facilitate the removal of the tongue and to extract marrow.

The forelimbs appear to have been detached from the carcass at the shoulder joint by chopping. There are no occurrences of cuts to the articular surface of the glenoid cavity to suggest careful dismembering of this joint, instead scapulae have been chopped down the sides of the glenoid cavity, often removing the tubercle, and across the scapula neck. A similar method has been applied to

the hind limb where there are a number of chops across the acetabulum of the pelvis consistent with the lateral chops slicing off the top of the femoral head. Further subdivision of the pelvis by lateral chops across the shaft of the ilium also occurred. Lateral chops across the proximal shaft and epiphysis of the radius and ulna, are suggestive of the removal of meat and severing of the forelimb at the elbow joint. Also, chopping and cut marks on the astragalus and calcaneum probably resulted from separation of the hind limb bones at this point. A small proportion of long bones and metapodials have been chopped across the shaft or split down the length, probably in order to extract the marrow. Most of the fragmentation of limb bones appears to have been caused by dog gnawing, and there is very little evidence of the fresh bone fractures and "bulbs of percussion" indicative of heavy processing of limb bones for marrow by humans.

There is a very high incidence of butchery marks observed among the cattle cranial fragments from Selby. A number of skulls exhibit cut marks along the top of the cranium and around the eye sockets and base of horn core. Also, lateral chops across the front of the skull between the maxillary tooth row and premaxilla were observed. The most common evidence of butchery was in the form of a lateral chop across the skull below the base of the horn core, indicative of post-mortem removal of the horn. Cattle horn cores bearing evidence of removal from the skull in this manner are among the most common elements to be found in the Selby assemblage and are almost certainly the processing waste associated with specialised industrial activity such as horn working. With the exception of the horn cores, the rest of the butchery evidence for cattle points to the processing of carcasses for food, and it is probable that the assemblage consists of a combination of primary processing, domestic, and industrial waste.

Sheep: As with cattle, the evidence for butchery practices is typical of the late medieval and early post-medieval period. The dorso-ventral splitting of vertebrae is indicative of butchery of the carcass into sides of mutton. The ribs also show some evidence of butchery. The lateral cuts and chops around the distal humerus shaft and epiphysis indicate the separation of the limb at this point, and suggests that the scapula and humerus tended to be included as a single joint of meat. Although chop marks were observed across the neck of a small percentage of scapula fragments, which would suggest that in some instances the forelimb was divided at the shoulder joint. In a number of cases the tibia has been chopped mid shaft, this is another common butchery practice. Butchery marks on the pelvis were mainly located around the acetabulum and are consistent with the removal of the hind limb at the hip joint. Butchery marks on cranial remains are varied and include mid-line chops down the saggital suture and lateral chops across the maxilla, as well as cut and slice marks across the top of the cranium consistent with skinning. Where there is evidence of horned individuals the horn cores have been removed during butchery. The removal of horn cores suggests the use of horn for craft/industrial activities, although horn cores constitute such a small proportion of the sheep assemblage it is unlikely that the butchery evidence represents anything other than domestic processing of sheep carcasses primarily for food.

Pig: The butchery evidence for pig consists mainly of chopped long bones, although there is one example of dorso-ventral splitting in an atlas vertebra. Mandibles also exhibit chops across the cheek tooth row and mandibular symphysis. All marks appear to be the result of processing carcasses for food. The lack of any shallow knife cuts may be a preservation issue as pig remains tend to be sub-adult, and juvenile bone surfaces tend not to preserve as well as adult bones.

Other species: Three fragments of fallow deer bore butchery marks. These include a lateral chop mark across the proximal epiphysis of an ulna, a small lateral chop mark behind the eye socket, and a small lateral cut mark on the anterior proximal shaft of a metacarpal. All these marks are consistent with skinning and dismembering. No other mammal species showed any evidence of butchery, with the exception of horse. A single distal tibia fragment has been chopped medio-laterally and dorso-ventrally, but on its own this cannot be taken as evidence of the butchery of horse for meat.

Representation of Skeletal Elements

The MAU for each skeletal element was calculated using the method described in the quantification section. In order to compare the relative abundance of different skeletal elements both within and between species the MAU's for the different elements were expressed as a percentage of the most abundant element for each species and plotted on graphs. The relative abundance of elements was plotted for all the large mammal species (appendix 2) and the results compared. The representation of

different skeletal elements were also compared for each excavated area and for each period; the results for cattle and sheep are presented in appendix 3 and 4 respectively.

In general there is an absence of the smaller elements such as carpals, tarsals and phalanges. This absence is particularly noticeable in the smaller species and suggests some retrieval bias against small bones and bone fragments. There is a high incidence of distal tibia and humerus compared to the proximal ends of these bones in sheep, cattle, and to a lesser extent pig, probably the result of gnawing by dogs. Very few of the proximal epiphyses of tibia survived from either cattle, sheep or pig, however one of the zones recorded for proximal tibia is on the shaft and does survive gnawing. If this zone had not been recorded the ratio of proximal to distal tibia would have been substantially reduced in all three species.

Cattle

A full suite of elements is represented in the Selby assemblage indicating the presence of whole carcasses at the site. It is likely that both domestic and industrial waste has been deposited in the area to make up this assemblage, albeit in different proportions. Although the cattle assemblage includes elements from both good and poor quality meat joints from all parts of the body, there is a marked abundance of cranial remains, in particular horn cores. The high incidence of the low meat value head elements might be taken to indicate debris accumulated from the initial stages of carcass processing and butchery were it not for the lack of a similar abundance of other "waste" elements from the lower limbs and feet. The large numbers of horn cores, deliberately removed from the cranium, are most probably the waste product of industrial horn working activity that occurred on or close by the site.

The pattern of element representation is broadly similar throughout most areas; horn cores and cranial fragments are the most abundant element but all areas of the body are represented. The one notable exception to this general trend is the sample from TP9 where most elements are fairly evenly represented and, unlike the other excavation areas, horn cores and cranial fragments do not dominate the assemblage. Elements of the axial skeleton, including head, spine, and pelvic girdle, are among the best represented elements from TP9, and the meat bearing upper limb bones are also abundant. Those bones with one hard early fusing epiphysis and one softer later fusing epiphysis exhibit differences in the abundance of proximal and distal elements indicative of canine attrition. The TP9 sample probably represents a mixture of domestic butchery and "kitchen" waste. There is no evidence to suggest any particular concentration of industrial activity in this area, although industrial bone waste may still be included in the sample.

TP8 is the area that yielded the smallest sample of cattle bones, and it is likely that small sample size can explain the total absence of some elements within the assemblage. Even when taking into account the potential bias of small sample size the pattern of element representation is striking. The TP8 sample comprises almost exclusively head and lower limb bones which are the waste products of the initial stages of carcass processing for food. Therefore the TP8 assemblage provides clear indication of the disposal of primary butchery waste in this particular area of the site.

Horn cores and cranial remains dominate the TP5 sample, with all other elements being present in very small quantities. The deposits from TP5, therefore, consist primarily of horn processing waste and are indicative of a concentration of industrial activity in or around this area. Similar patterns are observed for the remaining areas, but with an increased incidence of post-cranial remains which suggests mixed deposits of domestic and industrial refuse. Areas TP2, TP3, and TP4 also have relatively high incidences of metapodials which being elements of low meat value may be primary butchery waste. Alternatively, if left attached to the hide after skinning, it is possible that the quantities of metapodials may be accumulated industrial debris, perhaps from tanning or leather working. One unusual feature of the metapodials from TP2, 3 and 4 is that metatarsals are consistently better represented than metacarpals, although there is no ready explanation as to why this might have occurred.

The skeletal element representation among the samples dated to the medieval and medieval/post-medieval periods are almost identical; horn core and cranial fragments dominate both. There is a slightly higher incidence of post-cranial elements among the later sample but no evidence of any significant change in depositional activity over time. The Romano-british/medieval sample is small and should therefore be treated with caution, but shares an abundance of horn cores with the later periods, although post-cranial elements are also well represented. The post-medieval sample is too small to provide any useful skeletal element information. The representation of different skeletal elements among the cattle assemblage from Selby provides evidence of a mixture of industrial and domestic waste that has experienced some alteration by canine attrition. There is also evidence for

different depositional patterns across the site, possibly associated with areas of particular industrial and domestic activity.

Sheep

As with cattle the sheep assemblage from Selby includes elements from all areas of the carcass. The smaller elements tend to be under-represented which may be due a retrieval bias against smaller fragments. The smaller elements may also have been lost as a result of destruction by dog gnawing. Dog gnawing is also attested to by the low survival of the "spongy" meat bearing proximal epiphyses of humerus and tibia when compared to the harder distal ends which are more resistant to canine attrition. The upper forelimb is well represented, and the occurrence of these and other meat bearing elements suggests the sheep assemblage is at least partly comprised of food debris. Metapodials are abundant, a feature which was also noted in the assemblage from the 1993 excavations, where deposits of complete sheep metapodials were interpreted as waste from leather or skin preparation (Carrott 1993). Cranial bones are also present but, unlike cattle, horn cores are present in only small numbers and do not provide evidence of any concentrated industrial activity.

Most excavation areas exhibit similar patterns of element representation; a high incidence of metapodials and, in most instances, mandibles, as well as the meat bearing upper limb bones, in particular the elements of the shoulder joint. It should be noted that the mandible, metapodials, and distal tibia as well as being "waste" elements are also the elements most resistant to destruction by dog gnawing. It is therefore likely that the abundance of these elements in the sample is a combination of the destruction of the other elements by dogs and recovery bias acting in favour of the more complete bones over smaller fragmented elements. Undoubtedly the sheep assemblage indicates the presence of complete carcasses at the site, and the majority of sheep remains appear to be domestic debris heavily modified by canine attrition. The incidence of metapodials is particularly high in all areas, with the exception of TP9 and possibly TP8, and may well represent industrial waste, although unlike the 1993 excavations there is no evidence of mass dumps of ovicaprid metapodials.

As with the cattle samples, areas TP8 and TP9 differ from the rest of the site in terms of element representation. The TP9 sheep assemblage is dominated by the elements of the upper forelimb and probably represents food debris as these are among the prime meat bearing elements. TP8 produced mainly head and lower limb bones, a pattern of primary butchery waste similar to that seen in the cattle sample from this area, although the sample is too small to be considered reliable.

The Romano-british/medieval sample comprises mostly head and lower limb bones which could be interpreted as butchery waste, although the sample is small and therefore any conclusions only tentative. The post-medieval sample is too small to provide any useful information. The medieval and medieval/post-medieval samples do not differ significantly from each other and represent deposits of domestic "kitchen" and butchery waste, and possibly some industrial waste, all heavily gnawed by dogs.

Pig

The representation of skeletal elements of pig from Selby suggests the presence of whole carcasses rather than just joints of meat as elements from all areas of the body are represented, albeit in different levels of abundance. The head is the most abundant body part, while post-cranial elements, particularly the smaller ones, are more poorly represented. The presence of the upper limb bones is indicative of food waste, while the head bones were probably discarded during initial butchery. The post-cranial elements of sub-adult pigs tend to have much lower survivability than the robust cranium and mandible. It is likely that the pattern of skeletal element representation in this assemblage is largely the result of modification by canine attrition, the post-cranial skeleton being largely destroyed while the head bones survived. The presence of head bones may indicate disposal of primary butchery waste in the area but the high incidence of these elements compared to post-cranial bones is primarily a preservation bias.

Unfortunately once subdivided into different excavation areas many of the samples are too small to provide reliable indication of skeletal element representation. However, the pattern described above does hold true for most areas, with the exception of TP8 which yielded mainly head and lower limb bones, suggestive of butchery waste, and TP3 and TP9 which have relatively high incidences of the meat bearing upper limb bones, which suggests food waste. Reliable comparison of skeletal element representation between different periods is limited by the small sample sizes involved, however the Romano-british/medieval, medieval, and medieval/post-medieval samples do not exhibit any significant changes over time.

Other species

The assemblages of the other mammal species from Selby are too small to be able to provide any detailed information from a comparison of the representation of different skeletal elements. The one exception to this is the cat sample, which suggests the presence of whole skeletons but with a retrieval bias acting against the smaller elements. Although a very small sample, the dog remains show a similar pattern to those of cat. Most areas of the body are represented in the fallow deer and horse samples apart from the ribs and spine. The incidence of elements of the upper forelimb of fallow deer probably indicates food waste.

Ageing

Ageing information in the form of epiphyseal fusion (Table 8) and tooth wear data (appendix 5) was recorded for all areas. Insufficient ageing data was available to be able to compare age information from different excavation areas, however the tooth wear data from the medieval and medieval/post-medieval periods have been examined separately.

Mandibular tooth eruption and wear data was recorded and analysed using Grant's (1975) method for cattle, sheep and pig (figs. 1, 2 & 3). Using the recorded Grant tooth wear stages an analysis of the mandibular tooth wear was undertaken using Payne's (1973) method for sheep, and adaptations of the same method for cattle (Halstead 1985) and pig (Hambleton forthcoming) (fig. 4). Both methods of analysis provided similar results in terms of the overall age composition of the assemblages.

Table 8: The state of Epiphyseal Fusion in Cattle, Sheep and Pig remains from Selby.

	Cattle		Sheep		Pig	
Element	**F**	**U**	**F**	**U**	**F**	**U**
Scapula	24	0	20	0	4	1
Pelvis	40	0	25	0	3	3
Humerus d	29	0	33	0	5	0
Radius p	35	1	25	0	2	0
Phalanx 1	30	2	9	0	1	2
Phalanx 2	36	0	3	1	1	0
%Early Fusing	**98%**	**2%**	**99%**	**1%**	**73%**	**27%**
Metacarpal	10	1	13	5	0	1
Tibia d	21	6	18	3	5	2
Metatarsal	23	8	17	3	1	1
%Middle Fusing	**78%**	**22%**	**81%**	**19%**	**60%**	**40%**
Ulna p	1	3	2	0	0	3
Femur p	8	7	2	2	0	1
Calcaneum	8	4	5	1	0	1
Radius d	11	11	2	3	0	0
Humerus p	1	3	3	1	0	0
Femur d	3	4	2	1	1	2
Tibia p	12	3	5	1	0	6
% Late Fusing	**56%**	**44%**	**70%**	**30%**	**7%**	**93%**

Figure 1: Mandibular tooth wear in cattle (Grant method)
a) all periods b) medieval c) medieval/post-medieval

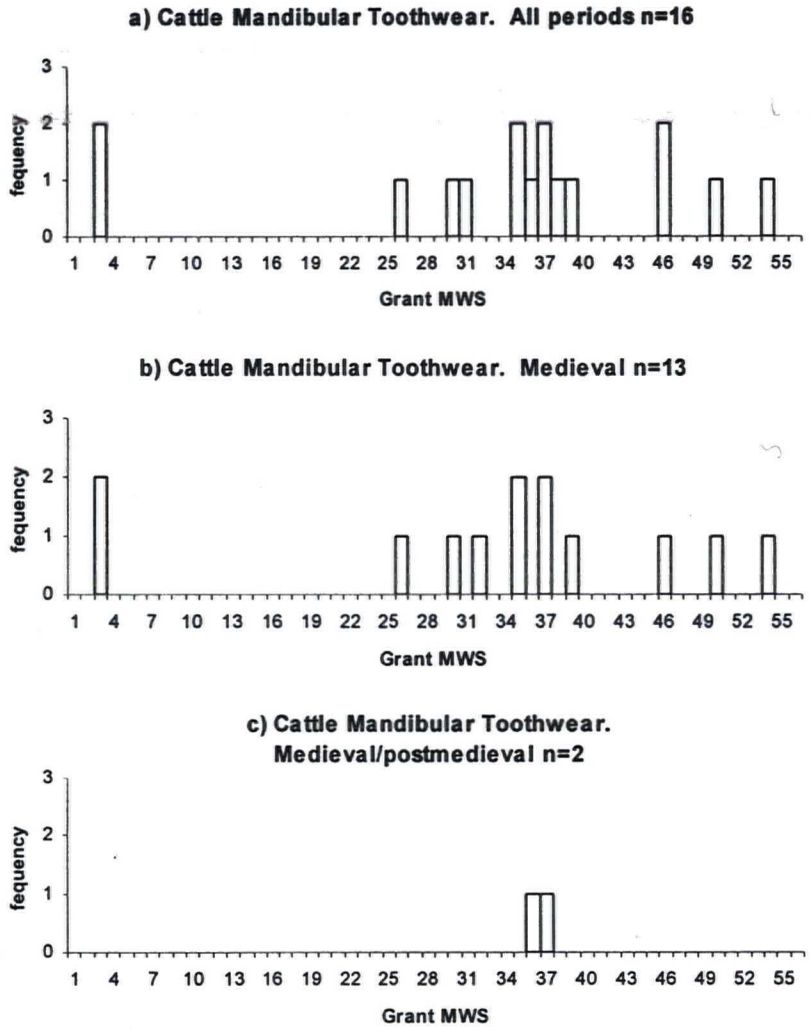


Figure 2: Mandibular tooth wear in sheep (Grant method)
a) all periods b) medieval c) medieval/post-medieval

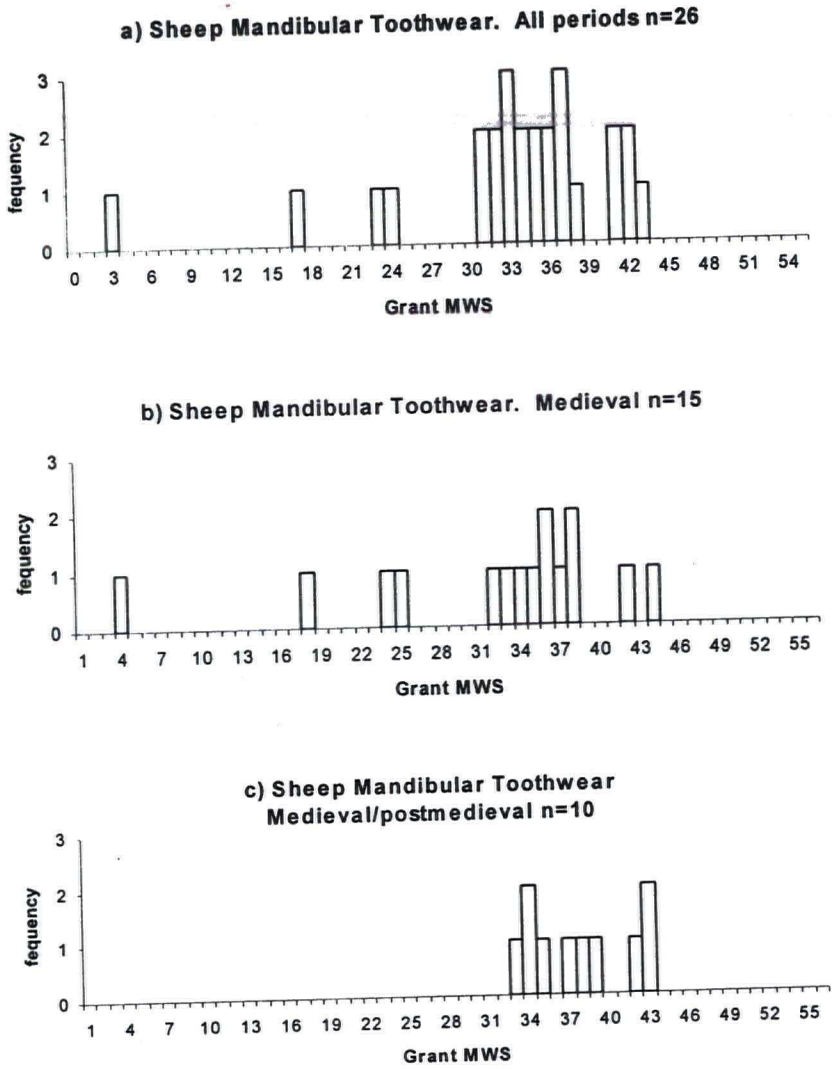


Figure 3: Mandibular tooth wear in pig (Grant method)
a) all periods b) medieval c) medieval/post-medieval

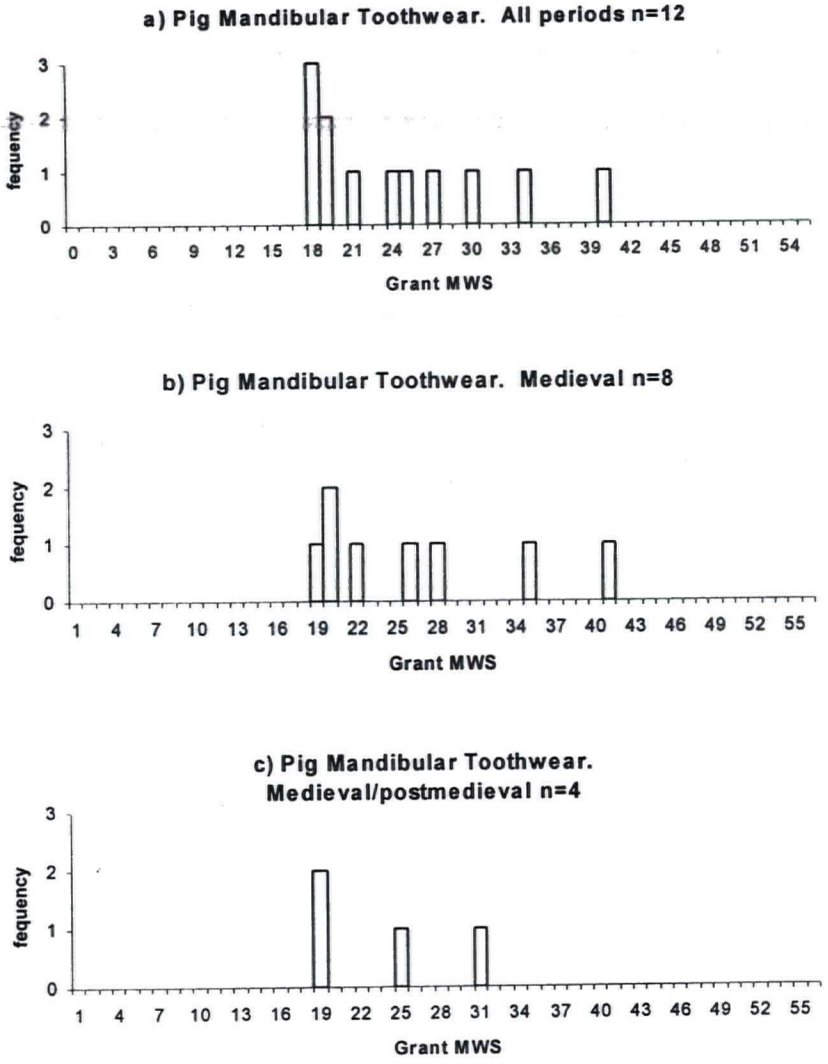
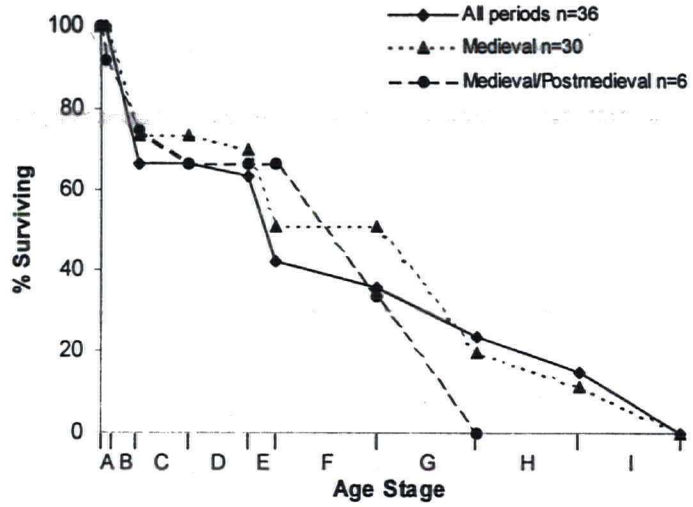
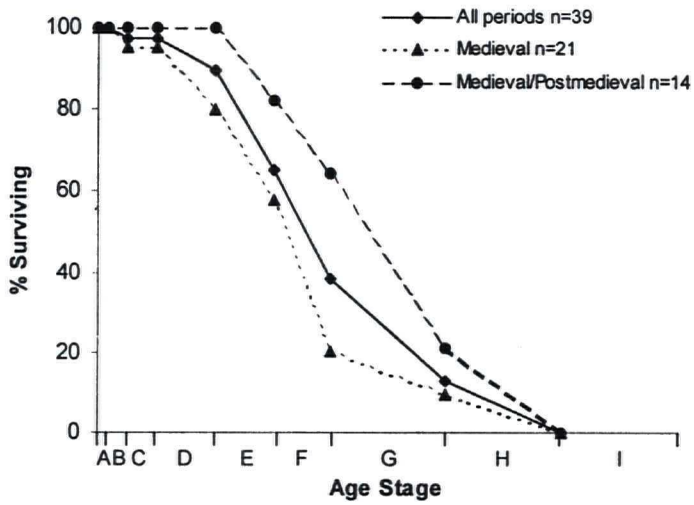


Figure 4: Mortality profiles of a) cattle b) sheep and c) pig (Payne method). (Definitions and suggested ages of wear stages A-I are listed in appendix 6)

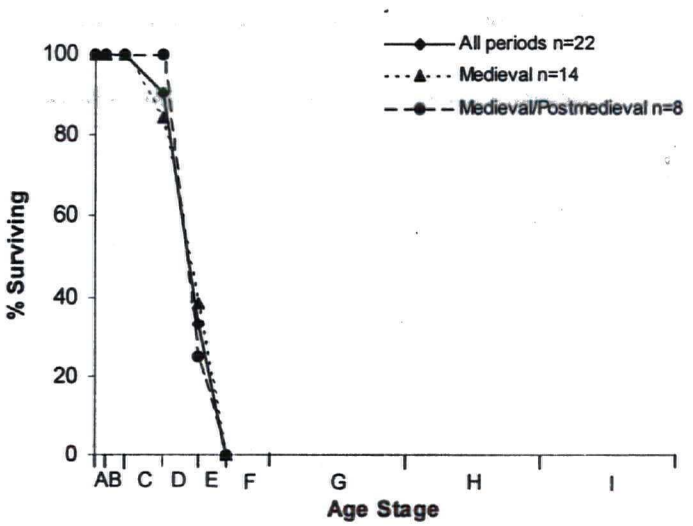
a) Cattle Mortality Profiles Based on Mandibular Toothwear



b) Sheep Mortality Profiles Based on Mandibular Toothwear



C)Pig Mortality Profiles Based on Mandibular Toothwear



Cattle

The percentages of fused and unfused fragments indicate that more than half of cattle survived to adulthood. Very young juveniles/infants do not constitute a very large proportion of the assemblage according to the fusion data, although a number of bones lacking fusion information were recorded as being of juvenile size and appearance. It is possible therefore that young animals were killed in greater numbers than suggested by the fusion record. Just under half of the later fusing elements remain unfused, which would suggest that among the sub-adults, most cattle were killed in late adolescence at prime meat age. The same pattern holds true for the medieval sample. The medieval/post-medieval fusion data is broadly similar to the medieval, although slightly more cattle appear to survive to adulthood in the later sample, approximately two thirds of cattle rather than half.

The ratio of deciduous fourth premolars to permanent fourth premolars (dp4:P4) gives an indication of the proportion of cattle killed before and after the eruption of P4 (28-36 months). The ratio of dp4:P4 from Selby is 15:12 which suggests roughly equal proportions of individuals above and below three years of age. A similar pattern is seen in the medieval and medieval/post-medieval samples, although the latter sample is too small to be considered reliable. The proportion of cattle surviving to adulthood as indicated by the ratio of dp4:P4 is in keeping with the results of the fusion analysis.

The mandibular tooth wear data is limited by small sample size, however it is still possible to make out broad patterns of cattle mortality within and between periods. Between a quarter and a third of cattle die very young, below eight months of age. The majority of these young jaws appear to belong to individuals of approximately 2-8 months old, which is older than would be expected for the infant cull of a large dairy herd. It is likely that the young animals represent veal calves that were surplus to breeding and milking requirements but were kept for a short time in order to provide a succulent cut of meat. Very few cattle were killed between the second half of the first year and 2 ½ years. The majority of cattle remains appear to be those of late adolescents and adults of prime meat age between 2 ½ and 5 to 6 years. There are also some older adults that were probably kept for secondary products. The medieval and medieval/post-medieval samples are too small to provide reliable comparison of mortality patterns over time, however there is no evidence to suggest any significant changes in cattle husbandry strategy at Selby between these two periods. The majority of cattle within the Selby assemblage appear to have been killed for meat either as veal calves or as older beef cattle. Older specimens are present, however, indicating that the cattle economy was not specialised exclusively on primary products such as meat, horn, and leather, but also maintained older cattle, probably as dairy and breeding stock, and as draught animals.

Sheep

From the fusion data, over two thirds of sheep appear to have survived to adulthood. The low incidence of unfused elements from the early and middle fusing categories is evidence that very few younger animals were slaughtered. There is a slight increase in mortality among late adolescents, attested to by the increase in the percentage of unfused elements of later fusing bones. Of the sub-adult sheep, most appear to have been slaughtered in later adolescence, approximately 2-3 years old, at prime meat age. The large proportion of the sheep population kept into adulthood suggests sheep were killed for meat as young adults or kept on for secondary products such as wool, manure, or possibly milk. The same pattern of fusion data occurs in both the medieval and medieval/post-medieval samples. Analysis of the tooth wear data should provide further information concerning the mortality pattern among the adult sheep population from Selby.

The ratio of dp4:P4 in the Selby assemblage is 4:24 implying that the majority of sheep remains are from individuals over two years old (the age at which P4 erupts in sheep). This pattern is also true of the medieval and medieval/post-medieval samples, and is in keeping with the fusion and tooth wear data.

The tooth wear data from the complete Selby sheep assemblage shows very low mortality among individuals in their first year with the majority dying while late adolescents or young adults of between 2 and 4 years, and some older between 4 and 8 years. Although the samples are small there does appear to be a genuine difference in the mortality profiles of the medieval and medieval/post-medieval sheep. The medieval sample consists mainly of prime meat aged specimens killed in their second, third, and fourth years; the emphasis appears to be on meat production with only a small percentage of older animals maintained for breeding stock, although secondary products such as wool and manure would still have been utilised. The medieval/post-medieval mortality profile differs from the earlier period in that while a large proportion are killed at prime meat age between 2 and 4 years, a similar proportion are killed as older adults of 4 to 6 years. Maintaining sheep as adults may be indicative of a greater emphasis on secondary products, and could be interpreted as a change from a

meat-based sheep economy during the medieval period to an increased importance of secondary products, most probably wool, in the later medieval/post-medieval period. The lack of younger infant and neonatal fatalities in the assemblage supports the notion that sheep were not kept at this particular site even if kept elsewhere in the town or surrounding area, and that the Selby sheep assemblage represents primarily food debris and possibly some industrial waste.

Pig

The fusion data suggests that the majority of individuals were killed before reaching skeletal maturity, and that a high proportion of these were killed during the second and third years of life. The ratio of dp4:P4 is 2:12 showing that most individuals survive beyond the eruption of P4 at 12-16 months. The same pattern is apparent in the tooth wear data which suggests all pig remains come from animals under three years of age, the majority being killed in their second year. This pattern is the same for both the medieval and medieval/post-medieval sample. The small sample sizes for both pig fusion and pig tooth wear data mean the results should be treated with caution, however the slaughter of the majority of pigs at prime meat age is a typical and expected husbandry strategy.

Other species

The bones from the remaining mammal species were too few in number to provide much in the way of useful ageing information. None of the fallow deer remains are of very young individuals, but sub-adult as well as adult individuals are represented in the sample. The horse remains are all fused, as is the single goat bone and all rat and mustelid bones. Of the small number of rabbit and hedgehog remains, the majority are fused, and none are from very young individuals.

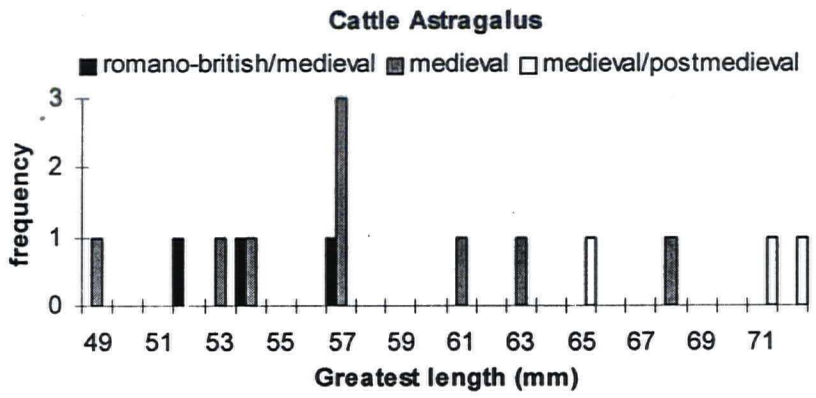
Measurements

The damaging effects of dog gnawing have substantially reduced the number of measurable fragments in the Selby assemblage. Those measurements taken for the main domestic species are listed in appendix 7. An analysis of size and comments on the types of breeds represented is given below together with estimations of sex ratios.

Cattle

No complete long bones were available for the estimation of withers height in the Selby cattle. Of the smaller bones, 15 astragali provided greatest length measurements which, although not used in the calculation of withers heights, have been plotted (fig. 5) to provide a relative indication of size in cattle. Although the samples are small there does appear to be some variation in size of cattle through time, with the Romano-british astragali being among the smaller specimens and the medieval/post-medieval astragali falling at the upper end of the size range. This apparent increase in the size of astragali over time could well indicate an increase in the overall size of cattle throughout the period represented by the Selby assemblage, and possibly even the presence of post-medieval improved breeds among the later sample.

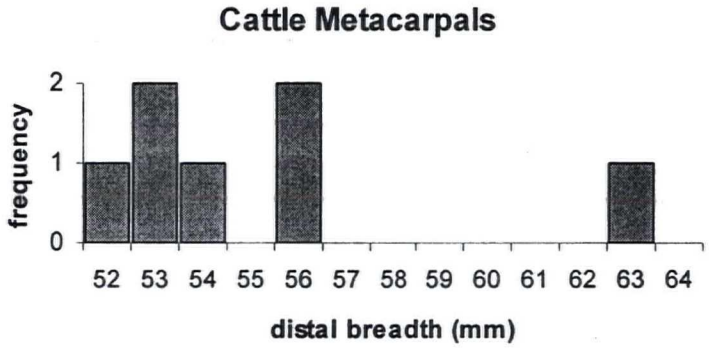
Figure 5: Size distribution of cattle astragali of different periods from Selby.



The distal metacarpal breadth measurements are plotted in figure 6 and have a size range of 52-63mm similar to those from medieval Durham and Newcastle. A single outlying measurement of 67mm has

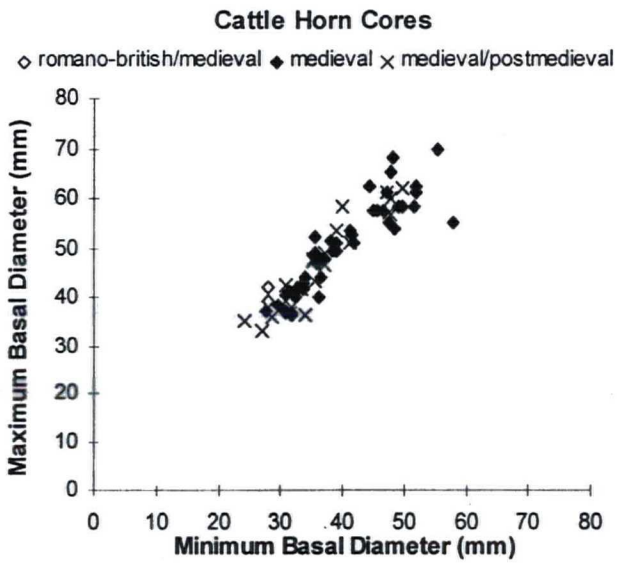
been excluded from the sample as it belongs to a specimen with severe pathological splaying of the distal metacarpal. The distribution of measurements appears to be bi-modal resulting from sexual dimorphism in the distal metacarpal. The measurements suggest a ratio of 6 females/castrates to 1 male. The sample is not large enough to enable comparison of size distribution among different periods, although it should be noted that the majority of distal metacarpal measurements are from the medieval/post-medieval sample. The sample of adult pelves is too small to provide a reliable indication of the sex ratio. Also, measurements and morphological determination of sex in the pelves is likely to be confused by the presence of castrates in the assemblage.

Figure 6: Size distribution of distal metacarpals in cattle from Selby.



A large collection of cattle horn cores were recovered from the Selby deposits, and probably represent the waste from horn working activity. According to the size categories given by Armitage (1982) the cattle are of shorthorn type. When maximum basal diameter is plotted against minimum basal diameter (fig. 7) the measurements separate out into two distinct groups unrelated to period. Horn core dimensions tend to be sexually dimorphic and provide some indication of the sex ratios in the Selby cattle, the group of smaller sized horn cores representing females and possibly castrates, while the group of larger horn cores probably represents full males.

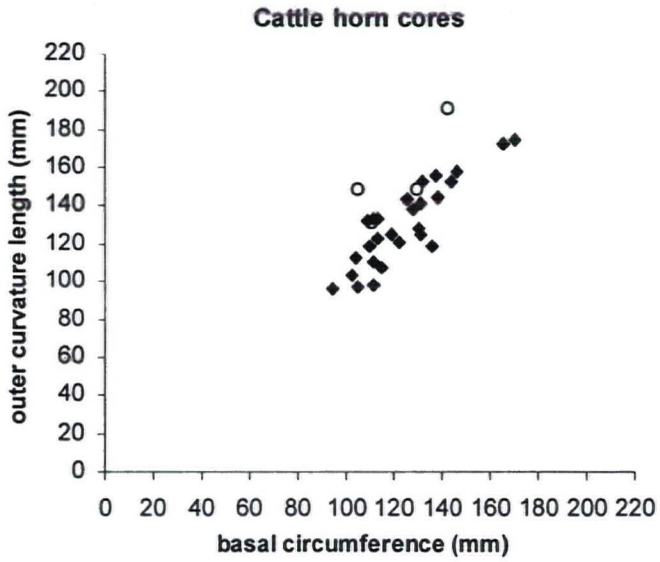
Figure 7: Size distribution of cattle horn cores of different periods from Selby.



The identification of different sex groups within the overall spread of horn core measurements is problematic and may often be confused by the presence of different breeds. This is particularly likely if the assemblage is from an urban market area with a long period of occupation represented in the sample (Dobney et. al 1995), as is the case with Selby. A plot of two different horn core measurements, the basal circumference against outer curvature length (fig. 8), does not show such clear splitting into two groups. However the presence of castrates, or possibly a separate breed, may be indicated by a small

number of longer thinner horn cores peripheral to the main group which were noted as having pronounced striated ridges along the length of the horn core, particularly at the base.

Figure 8: Size distribution of cattle horn cores from Selby (Open circles represent horn cores noted as having deep striations along length).



Sheep

Estimated withers heights were calculated using Teichert's factors (Von den Driesch & Boessneck 1974) for metatarsals, metacarpals humerus and astragalus and are shown in figure 9. The estimated withers heights all fall within a 0.52 - 0.64m range, which equates well with the 0.52 – 0.66m range calculated for the metapodials recovered from the 1993 excavations at Selby. These withers height estimates are similar to those from other medieval assemblages from Newcastle, Durham and elsewhere in England. There is a slight bimodal distribution with two slightly larger specimens at 0.64cm, which may represent full males in an assemblage otherwise dominated by smaller females and castrates. However, the sample is small and greater numbers are required to clarify the presence of two size groups within the Selby sheep. Also, because of the large correction factor on small bone measurements, the withers height estimations from astragali may well be less reliable than the estimations based on long bones, and should therefore be treated with caution. The estimated withers heights for samples of different date (fig. 10) show no change in size of the Selby sheep throughout the period represented by the assemblage.

Figure 9: Estimations of withers heights for sheep from Selby.

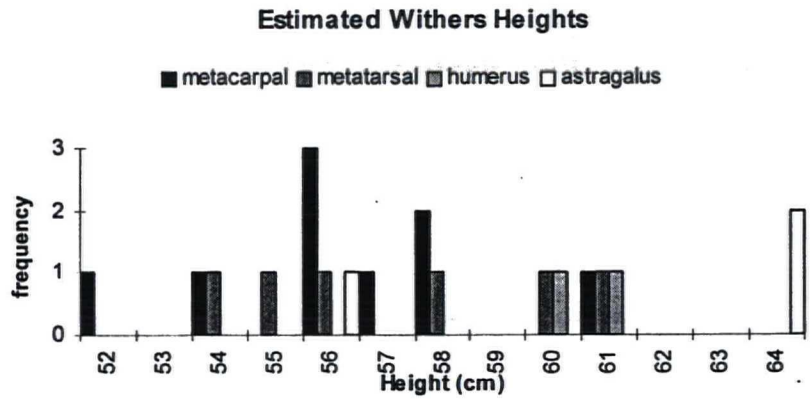
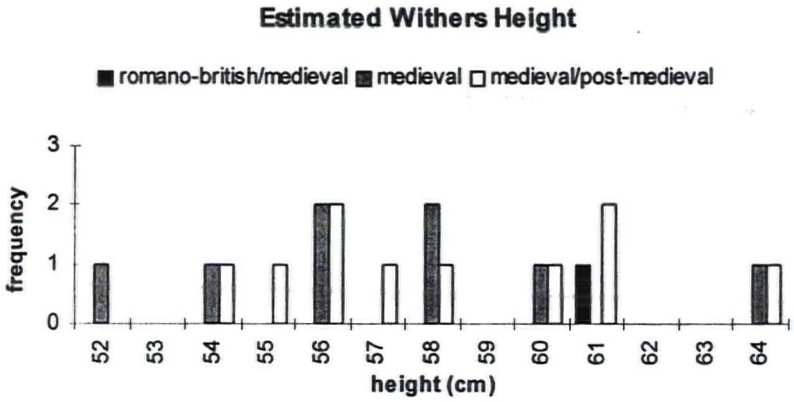
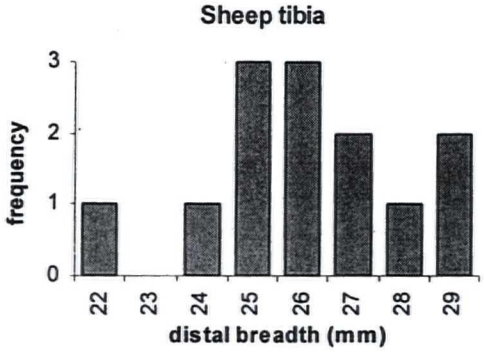


Figure 10: Estimations of withers heights for sheep of different periods from Selby.



The distal tibia breadth measurements from Selby (fig. 11) are comparable to those from the medieval periods at Closegate (ibid.) and other medieval assemblages. The medieval/post-medieval specimens occupy the upper end of the range of measurements (25-29mm) while the medieval specimens occupy the lower end of the range (22-28mm). However, there is no clear evidence to suggest the presence at Selby of the larger improved post-medieval breeds seen at Newcastle Closegate (Davis 1991).

Figure 11: Measurements of sheep distal tibia breadth from Durham Leazes Bowl



There is very little evidence to be able to speculate on the breed/breeds of present in the Selby assemblage. Evidence of polled sheep was found in the form of two crania which had only small buds in place of horn cores and appear to be of a naturally hornless Orkney type (Gidney pers. comm.). A small sample of horn cores and skulls bearing signs of the removal of horn cores were also recovered. The presence of both horned and polled sheep at the same site does not necessarily indicate the presence of more than one breed; it is possible for both polled and horned ewes to occur in a single breed, e.g. in modern Soay (Doney et al. 1974).

Pig

Insufficient measurable pig bones were recovered to enable metrical analysis of size and sex ratios. Three tibias provided distal breadth measurements ranging from 24-31mm, but the sample is too small to warrant further comment. It is possible to determine the sex of pig canine teeth and thus gain an indication of the sex ratios of adult pig in the Selby sample. A total of 16 mandibular canines and 8 maxillary canines were recovered. From the mandibular canines the male:female ratio in pig appears to be 3:1, and the same ratio occurs in the maxillary canines. The slightly lower incidence of females may reflect a tendency to kill males and keep females for breeding purposes, although the high fecundity of pigs usually means that there is no need to retain a large population of breeding females to maintain the pig population.

Pathology and congenital abnormalities

Cattle

Lesions on articular surface of phalanges, metapodials and tarsals. Lesions of Type 1 as defined by Baker & Brothwell (1980: 109-110) were identified on both proximal and distal articular surfaces of several first and second phalanges, distal metatarsals, and one astragalus. The incidences of these lesions are approximately 9% in the distal first phalanges and approximately 14% in the proximal second phalanges. According to Baker and Brothwell these lesions are found most commonly on the phalanges but their occurrence on other elements, such as the metapodials, is not unusual. The aetiology of these lesions is uncertain, but they may result from minor trauma such as walking on hard and uneven surfaces, or from a congenital predisposition. There is a possibility of association with osteoarthritis, which in this instance might be supported by the presence of such lesions in conjunction with "splaying" of distal metapodials, and arthritic indicators on some of the cattle bones. In several instances where Type 1 lesions were noted on splayed joint surfaces the lesions were located at what would have been the original edge of the joint surface.

Other lesions observed in the cattle assemblage are Baker & Brothwell Type 2 lesions on a number of proximal and distal articular surfaces of first phalanges, and on the distal articular surface of second phalanges. The incidence of these lesions on the distal first phalanges is also 9%, and 8% in the distal second phalanges. It is unlikely that the cattle suffered much, if any, discomfort or any disabling effects as a result of these lesions.

Splaying of joint surfaces of metapodials and phalanges. A number of metatarsals and a single metacarpal exhibited abnormally wide "splayed" distal joint surfaces where the outer condyles, most commonly the medial condyle, had extended sideways. The incidence of this condition was particularly high among the distal metatarsals (25%). The splaying of the joint appears to be a compensatory alteration that occurs due to recurrent excessive pressure on the joint, perhaps as a result of traction, stalling, or even heavy weight into old age. As mentioned above, this condition was observed in conjunction with Brothwell Type 1 lesions, and also arthritic changes. Although in itself splaying is not considered an arthritic change, the pressure on the joint that causes splaying is also likely to be a contributory factor in the onset of osteoarthritis. Similar splaying of articular surfaces was also noted among a small number of proximal and distal first phalanges and distal second phalanges, some of which also exhibited early arthritic changes.

Arthritis. Arthritic indicators were present on a range of different elements. One femur exhibited eburnation of the outer edge of the femoral head; one cervical vertebra had pitted anterior and dorsal articular surfaces; two first phalanges exhibited lipping of the joint surface and bony exostoses around the articular ends; and one second phalanx showed eburnation of the anterior and posterior aspects of the distal articular surface. Two severe cases of arthritis were observed on metatarsals. There was severe eburnation, grooving and pitting on the medial condyle, "splaying" of the distal end and irregular bony growth particularly around the posterior distal shaft, in addition to which there was a swelling of new bone formation on the anterior distal shaft resulting from an infection. The second example was a proximal metatarsal, which exhibited pitted lesions, eburnation and lipping of the lateral articular facet and there was also evidence of infection including a swelling of new bone on the anterior proximal shaft and irregular porous bone surface on the medial articular facet. In both instances this would have been painful and it is probable that swelling and the irregular bone growth would have restricted the movement of the joint.

Infection. As mentioned above, two metatarsals showed enlarged patches of new bone formation probably in response to infection that occurred in conjunction with osteoarthritis. It is impossible to say whether the infection had any direct causal association with the arthritis, but it is likely that each exacerbated the symptoms of the other. The only other evidence of infection was in a maxillary molar tooth that had an enlarged, irregular striated and pitted root; there may have been some discomfort but this would have been of little consequence to the overall condition of the animal.

Trauma. There was little evidence of traumatic injury among the Selby cattle. One metacarpal bore signs of a healed splinter of bone shaft, and a single rib also showed signs of a healed fracture.

Irregular growth pattern in horn cores. One juvenile horn core was recorded as having a "thumb print" depression near the tip, while another adult horn core had a narrow constricted tip. These abnormalities probably result from arrested growth and are indicative of periods of stress (Siegel 1976). It is likely

that the periods of stress indicated on the two horn cores correspond to the individuals first winter. The incidence of this pathology among recorded horn core fragments is low (less than 4%).

Irregular tooth wear. There is an irregular pattern of wear on a maxillary molar tooth which has one cusp much higher than the other. The tall cusp is probably due to lack of wear against an occluding maxillary tooth, and therefore provides indirect evidence of ante-mortem mandibular tooth loss.

Enlarged foramina on skull. There was a single occurrence of an enlarged foramina on the occipital bone in line with the saggital suture. This is probably a congenital abnormality of no consequence to the individual concerned.

Depression in surface of mandibular condyle. Two mandibular condyles exhibited a small depression on the medial surface of the mandibular condyle. In one instance the surface of the condyle had the slightly rough appearance of juvenile bone. An example of a similar pit/depression is shown in Baker and Brothwell (1980: 113), where it is noted as non-pathological lesion. A similar trait was observed in many of the cattle mandibles recovered from the medieval deposits at Durham, Leazes Bowl (Hambleton 1998).

Sheep

Lesions on articular surface of phalanges, humerus and radius. Brothwell and Baker Type 1 lesions (as discussed for cattle, above) were observed on the articular surface of one proximal radius in conjunction with arthritic changes. Lesion of Baker and Brothwell Type 2 was also noted on a distal second phalanx, and a similar type of lesion was also noted on the capitulum of a distal humerus. The incidence of all these lesions is low.

Arthritis. Slight lipping and irregularities of the joint surface was noted for one distal radius and probably represents the early stages of arthritis. The other example of arthritic change was on a proximal radius which exhibited lesions on the joint surface and lipping around the edge of the proximal. Neither incidence was severe and probably caused discomfort but no restriction of joint movement.

Trauma. One healed rib fracture was recorded. Also a swelling of new bone growth was observed on the anterior proximal shaft of a metatarsal and the anterior distal shaft of another. This is probably a response to infection, perhaps due to slight trauma such as kicking. The incidence of this pathology in the metapodials from this assemblage is low (less than 2%). This pattern of swelling was also noted in metapodials recovered during the 1993 excavations at Selby (Carrott et al 1993).

Congenital absence of the second mandibular premolar. This was observed in only one of the sheep mandibular tooth rows. This is a low incidence and the trait has been noted previously for cattle and sheep from the medieval period. The congenital absence of the lower P2 is often associated with the presence in the same sample of mandibular M3s with a reduced third cusp, although no abnormal M3s were observed in this particular assemblage. The occurrence of this trait is possibly indicative of a degree of in-breeding.

Vestigial lateral metapodials on proximal metacarpals. Three proximal metacarpals has small spikes of bone protruding down from the lateral proximal epiphysis. These bony protrusions take the form of vestigial growths of lateral metapodials, and is a trait more commonly seen in deer. The growth is non-pathological and would have had no detrimental effects on the individuals affected.

Pig

Pit in centre of glenoid cavity of scapula. There are two incidences of a small pit in the centre of the glenoid cavity. The appearance is similar to that of a Baker and Brothwell Type 3 lesion and is probably a developmental defect of no consequence to the animal affected. The incidence appears to be high (29%) but the overall scapula sample is small so the trait may be over-represented.

Other species.

One pathological abnormality was noted for horse; the fusion of a proximal metatarsal to its adjoining tarsal bones. The fusion of metapodials and carpals/tarsals is not uncommon among horses (Baker and Brothwell 1980), but there is no sign of infection that could infer spavin.

The only other mammal species with pathological conditions was cat. Three metatarsals had healed fractures, the second and third metatarsals being fused to each other at the point of healing. The other, a fourth metatarsal, was from a different context but had the healed fracture in exactly the same place on the shaft and articulated well with the other fractured metatarsals, and it is likely that they all belong to the same individual. The other incidence of pathology was the ante-mortem tooth loss of a mandibular M1.

The overall incidence of pathological features and congenital abnormalities among the identified assemblage was low; less than 3% of cattle, 2% of sheep and 1% of pig fragments bore abnormal features. Splaying and surface lesions in the metapodials and phalanges, which appear to be associated with later arthritic changes, are most common among cattle and probably reflect the higher proportion of older adults among the cattle population than in the sheep and pig populations. With the exception of two cases of combined arthritis and infection in cattle metatarsals, the majority of pathologies are unlikely to have had any detrimental effect on the animals in which they occurred. There are low incidences of severe arthritis, trauma, and infection, and an absence of dental pathologies such as caries and abscesses. All indications are that in general the livestock were in good health, although the cattle horn cores imply some individuals suffered occasional periods of stress.

THE BIRD REMAINS

A small collection of 64 bird bone fragments were recovered from the Selby excavations, 72% of which were identified to species. Bird remains comprised less than 2% of the identified remains from the hand recovered assemblage. Most of the identified remains are complete or almost complete bones. Much of the observed fragmentation appears to have occurred during post-excavation storage and handling.

The bird remains were almost entirely those of domestic species, mainly fowl (61%) but also goose (22%). Duck was represented by mallard, or the domesticated form of this species. Domesticated mallard is known from the medieval period but the remains from Leazes Bowl could just as easily be those of wild individuals. Game species were represented by woodcock, and three fragments of tawny owl were also recovered.

The bird sample was too small to allow reliable comparrison of the distribution of bird species in the different excavation areas and throughout the differents periods represented in the Selby sample, although bird remains were recovered from all excavation areas and all periods except post-medieval. The NISP for the main skeletal elements are listed for all bird species in appendix 8, although the sample is too small to draw any reliable conclusions concerning representation of different body parts.

Two goose bones showed signs of gnawing by dogs. A single pathology was noted; the ulna of a domestic fowl had irregular bone surface growth on the central shaft resulting from infection. Although no measurements were taken it was noted that the domestic fowl exhibited very little variation in size, all remains being a little larger than expected for Bantam, but at the smaller end of the size range of domestic fowl. The bird assemblage consisted almost entirely of adult individuals. For domestic fowl the state of fusion was recorded for 17 fragments, only 4 of which were unfused. No unfused material was recorded for the other bird species. It is possible to distinguish female fowl from males by the absence of a spur on the distal shaft of the tarso-metatarsus. Spurs were present on two of the six distal tarso-metatarsals recorded, suggesting a male: female ratio of 1:3 in domestic fowl.

Birds, primarily domestic fowl and also goose were exploited as a source of meat at the site during the medieval period. Although domestic fowl were probably eaten regularly they contributed only a very small amount to the overall meat diet. Other species represent a negligible contribution to the diet. Birds are not only useful as a source of meat. Domestic fowl were probably kept for their eggs, though how important this resource was is unknown. Feathers and fat are other products that may have been utilised.

MARINE MOLLUSCS

Table 9: Weights of marine mollusc shell recovered from different excavation areas at Selby.

Area	Weight of shell (g)	% of overall bone/shell weight
TP1	927	9%
TP2	1722	10%
TP3	2164	13%
TP4	1532	11%
TP5	1124	10%
TP7	4454	19%
TP8	124	4%
TP9	718	6%
All Areas	12764	12%

A large assemblage of shell fragments was recovered during excavations at Selby, contributing 12% of the overall combined weight of bone and shell. Marine molluscs were represented throughout the site, and in all periods. Shell fragments were present in 74% of all contexts for which bone was examined and recorded. As illustrated in table 9, the incidence of shell varied across the site and was particularly prevalent in area TP7. No detailed analysis of the shell assemblage was undertaken but a cursory inspection revealed that the assemblage consisted predominantly of common edible marine species such as common/edible oyster (*Ostrea edulis*) and mussel (*Mytilus edulis*). These species are littoral varieties and must have been brought in from the coast. Marine molluscs appear to have been exploited as a food resource, and although in terms of overall meat weight the contribution of marine resources was small. they were undoubtedly a regular part of the diet.

SUMMARY AND DISCUSSION

The remains of domestic species, in particular cattle and sheep dominate the assemblage. There is slight evidence to suggest an increase in the importance of sheep from the medieval to medieval/post-medieval periods, although cattle would have been the major contributor to the meat economy throughout all periods represented by the Selby assemblage. Beef dominated the meat diet; lamb/mutton and pork would have been a significant component of the meat diet and shellfish were also eaten regularly. Wild mammals and birds were poorly represented in the sample. There appears to have been very little supplementing of the diet by game species, a feature that might be taken to indicate that lower status households and industrial sites were the main source of the Selby remains.

The skeletal element representation suggests both industrial debris and domestic refuse with a mixture of kitchen and butchery waste. The high incidence of cattle horn cores removed from the skull throughout most excavation areas is particularly indicative of areas of horn working activity and industrial waste disposal in this part of the town. Some areas are dominated by particular types of bone debris, possibly indicative differential activity and waste disposal at the site. Skeletal element representation in cattle, sheep, and pig samples all suggest TP8 as an area of butchery activity anfd the disposal of primary butchery waste, while TP9 is dominated by food debris and domestic butchery and kitchen waste rather than the discards of industrial activity. There are no significant differences among the samples of different periods to suggest any significant changes over time in the types of activity and waste disposal practised in this part of the town.

The animal husbandry strategies employed at Selby do not appear to have altered significantly from the medieval to medieval/post-medieval periods for cattle and pig, although there is some variation in the exploitation of sheep. Sheep appear to have been exploited primarily for meat although at the older end of the prime meat aged groups, which suggests secondary products were of some importance. This trend is more apparent in the medieval/post-medieval assemblage where there is a higher proportion of older animals, which suggests an increased emphasis on secondary products, most probably wool. Pigs were also kept for meat and slaughtered before three years. The cattle remains are a combination of prime meat aged specimens, older animals kept for milk and draught and slaughtered for meat once retired as mature adults, and young veal calves which represent the surplus offspring which were kept a little beyond infancy before being slaughtered for meat. There is no evidence to

suggest the domestic species were imported as meat joints, and the age range of animals suggests domestic species were all kept locally although it is possible that additional animals, were brought in on the hoof as a source of meat.

The health of livestock was generally good. There is a high proportion of mature cattle but most animals appear to have been slaughtered rather than left to lose condition. The assemblage has been subject to extensive gnawing by dogs, and some contexts have suffered abrasion, but the general level of preservation and recovery of faunal remains is good.

This faunal assemblage represents the debris of local industrial activity, specifically cattle horn-working, as well as domestic refuse and butchery waste. The Selby assemblage shares similarities with other urban medieval assemblages from Northeast England and elsewhere in Britain.

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APPENDIX 1: ANATOMICAL ZONES

Anatomical zones recorded for mammal species.

Mandible
1 - Symphyseal surface
2 - Diastema
3 - Lateral diastemal foramen
4 - Coracoid process
5 - Mandibular condyle
6 - Angle
7 - Anterior ascending ramus posterior to M3
8 - Mandibular foramen
9 - Tooth row

Skull
1 - Occipital condyle
2 - Intercornual protuberance or position of such
3 - Petrous part of temporal bone
4 - Frontal sinus
5 - Ectorbitale
6 - Entorbitale
7 - Facial tuber
8 - Premaxilla
9 – Cheek tooth row (maxilla)

Horncore
1 - Base
2 - Tip

Vertebra
1 - Spine
2 - Cranial epiphysis
3 - Dorsal epiphysis
4 - Vertebral body
5 - Neural arch

Sacrum
1 - Wing and auricular articulation
2 - Cranial epiphysis
3 - Dorsal epiphysis
4 - Vertebral body
5 - Neural arch

Scapula
1 - Supraglenoid tubercle
2 - Glenoid cavity
3 - Origin of distal spine
4 - Tuber of spine
5 - Posterior of neck with foramen
6 - Cranial angle
7 - Caudal angle

Humerus
1 - Head
2 - Greater tubercle
3 - Lesser tubercle
4 - Intertuberal groove
5 - deltoid tuberosity

6 - Dorsal angle of olecranon fossa
7 - Capitulum
8 - Trochlea
9 - Radial fossa

Radius
1 - Medial half of proximal epiphysis
2 - Lateral half of proximal epiphysis
3 - Posterior proximal ulna scar and foramen
4 - Medial half of distal epiphysis
5 - Lateral half of distal epiphysis
6 - Distal shaft

Ulna
1 - Olecranon tuberosity
2 - Trochlear notch
3 - Lateral coracoid process
4 - Distal epiphysis

Metacarpus
1 - Medial facet of proximal articulation
2 - Lateral facet of proximal articulation
3 - Medial distal condyle
4 - Lateral distal condyle
5 - Anterior distal groove and foramen
for species with multiple metacarpals:
1 - proximal articulation
2 - distal articulation

First and Second Phalanx
1 - Proximal epiphyseal junction
2 - Distal articular facet

Pelvis
1 - Tuber coxae
2 - Tuber sacrale and scar
3 - Body of ilium with dorso-medial foramen
4 - Iliopubic eminence
5 - Acetabulum
6 - Pubic symphysis
7 - Body of ischium
8 - Ischial tuberosity
9 - Depressionfor medial tendon of rectus femoris

Femur
1 - Head
2 - Trochanter major
3 - Trochanter tertius
4 - Supracondyloid fossa
5 - Distal medial condyle
6 - Lateral distal condyle
7 - Distal trochlea

Tibia
1 - Proximal medial condyle
2 - Proximal lateral condyle
3 - Intercondylar eminence
4 - Proximal posterior nutrient foramen
5 - Medial malleolus

6 - Lateral aspect of distal articulation
7 - Distal pre-epiphyseal portion of diaphysis

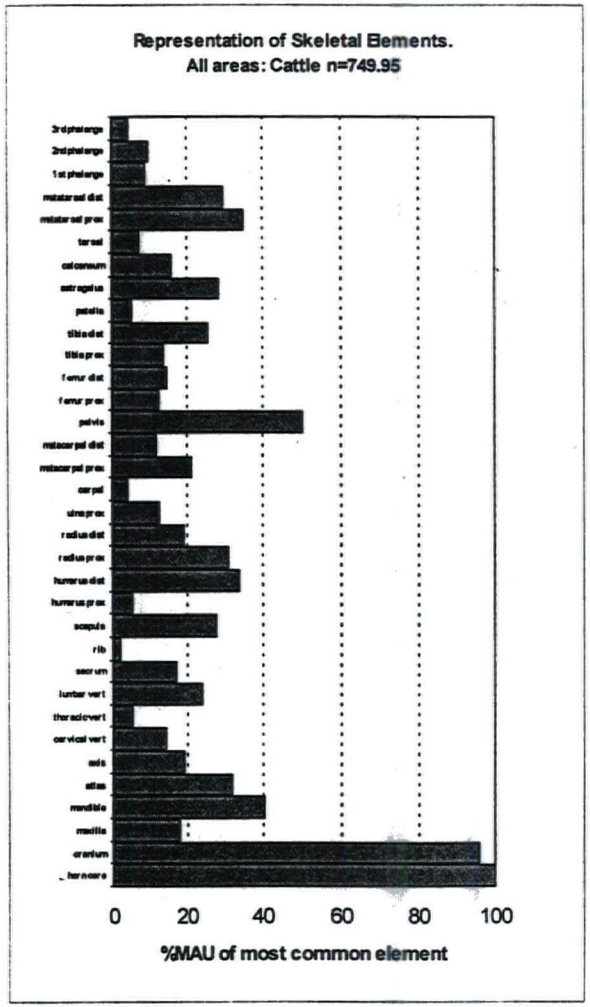
Calclaneum
1 - Calcaneal tuber
2 - Sustentacalum tali
3 - Processus anterior

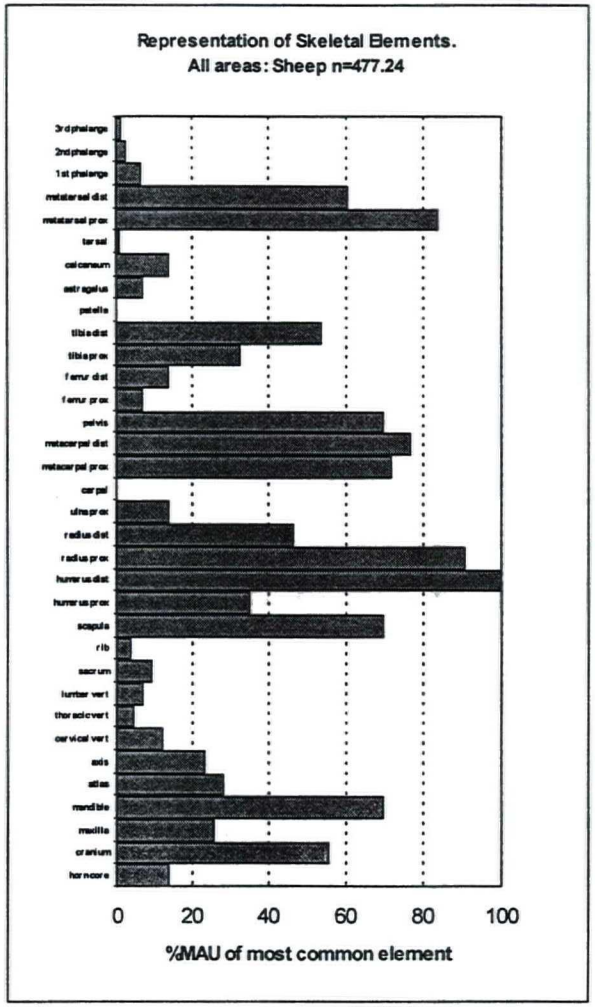
Metatarsus
1 - Medial facet of proximal articulation
2 - Lateral facet of proximal articulation
3 - Medial distal condyle
4 - Lateral distal condyle
5 - Anterior distal groove and foramen
for species with multiple metatarsals:
1 - proximal articulation
2 - distal articulation

Other
1 - Whole bones of Phalanx 3, carpals, tarsals, patella and hyoid. Rib articular end.

All Longbones
0 – Long bone shaft (over 50% full cylinder, identifiable to element but no other zones)

APPENDIX 2:
REPRESENTATION OF SKELETAL ELEMENTS IN LARGE MAMMAL SPECIES


Representation of Skeletal Elements.
All areas: Cattle n=749.95
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
All areas: Sheep n=477.24
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2nd phalange
1st phalange
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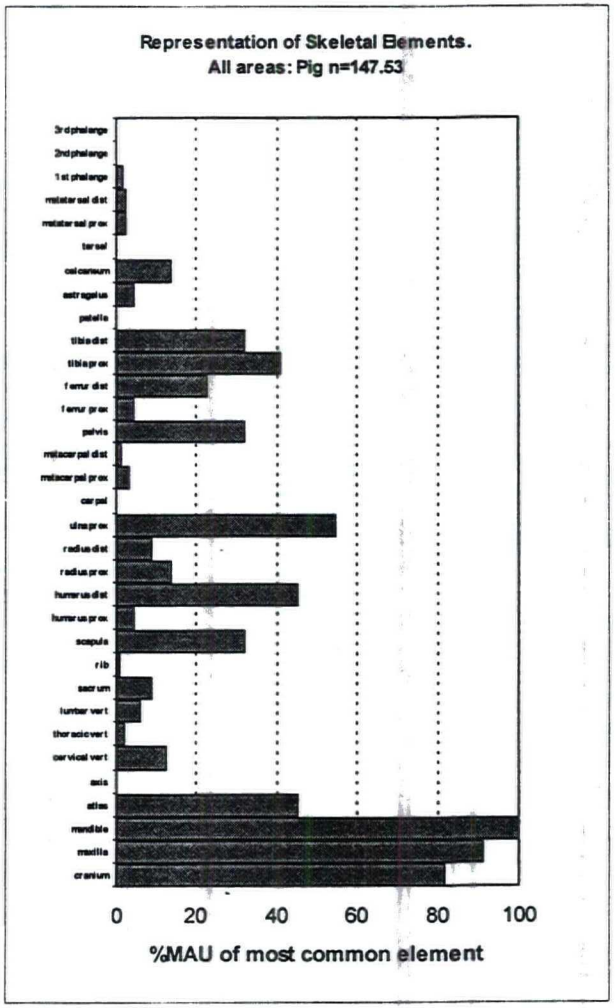
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
All areas: Pig n=147.53
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2nd phalange
1st phalange
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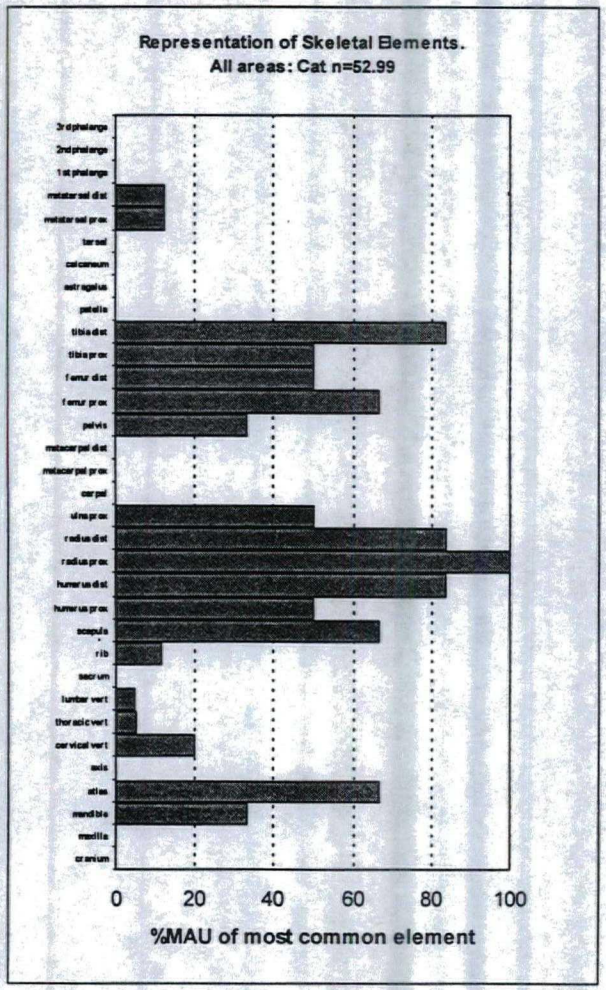
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
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2nd phelange
1st phelange
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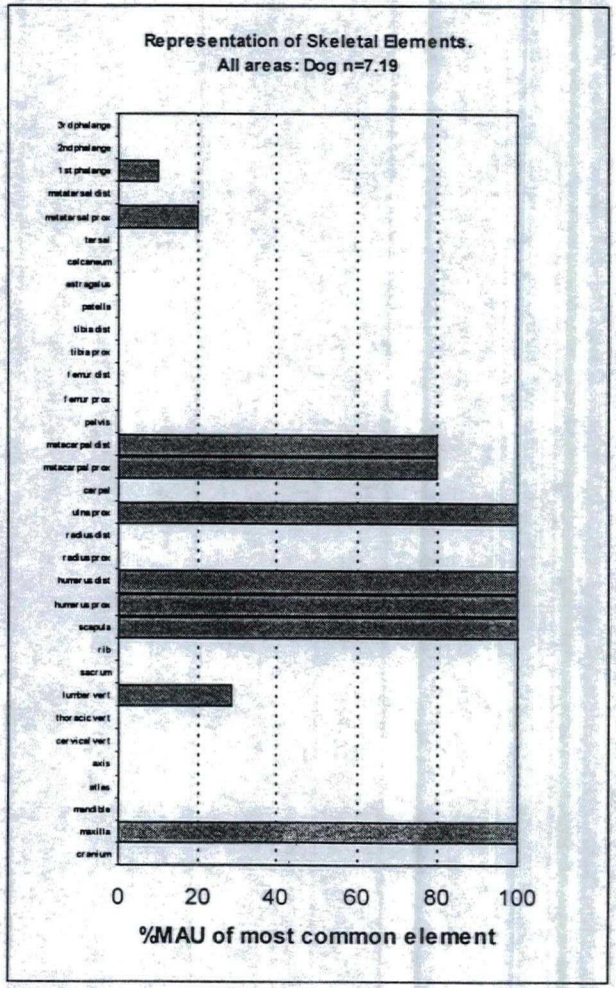
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
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2nd phelange
1st phelange
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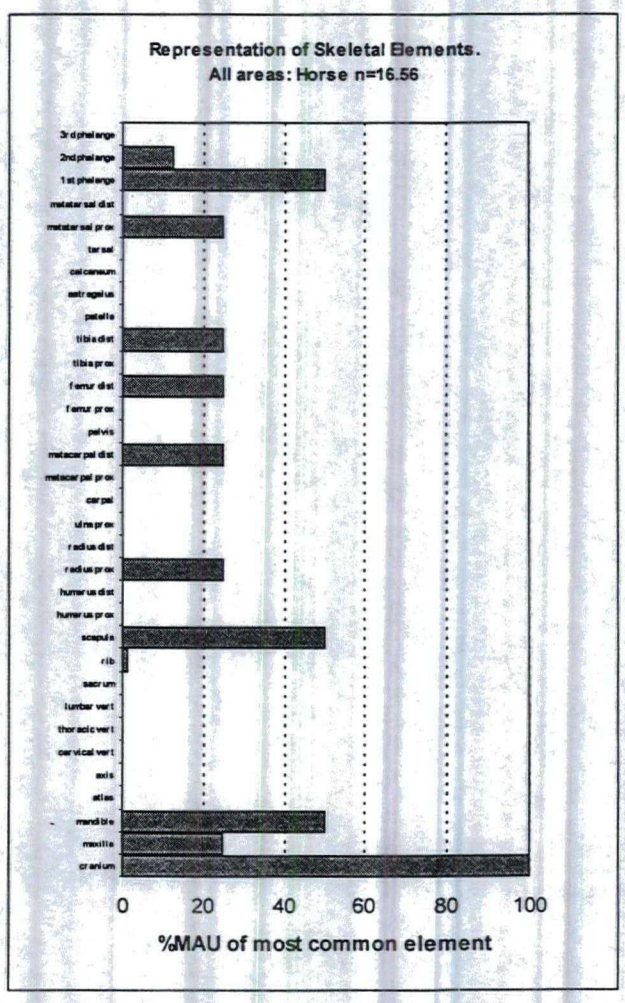
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
All areas: Horse n=16.56
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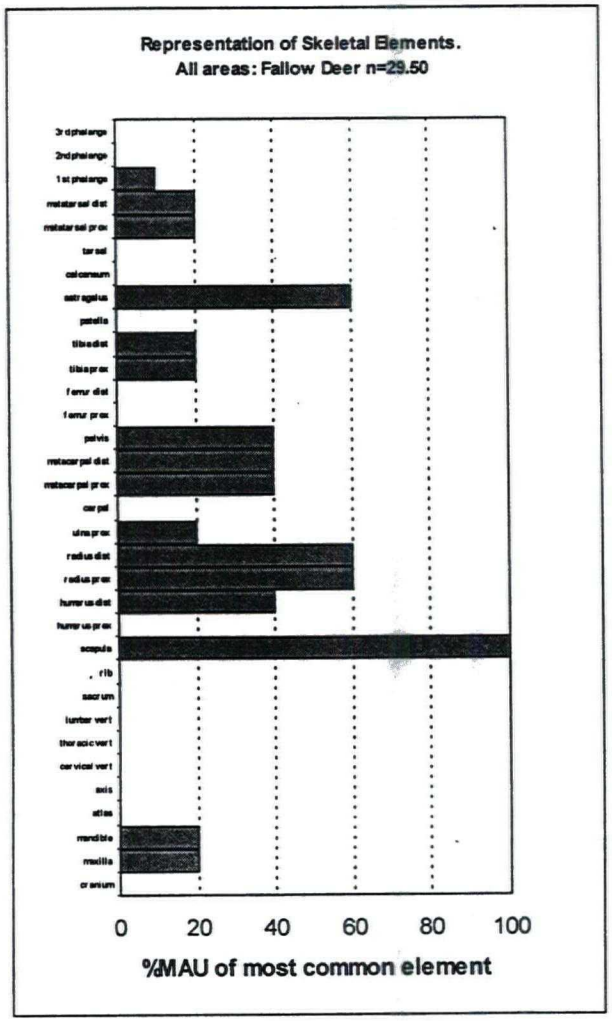
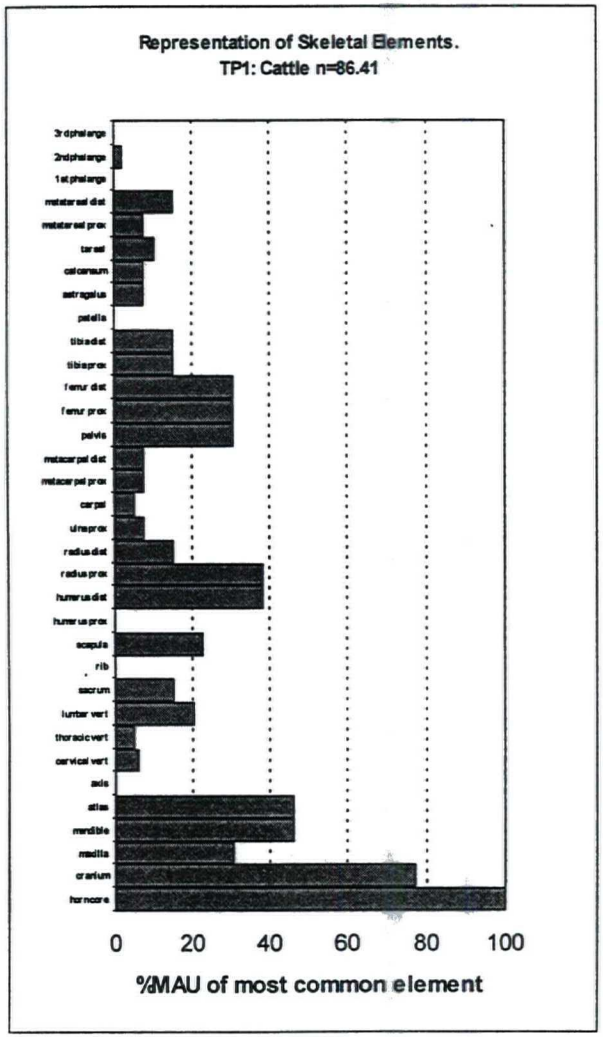
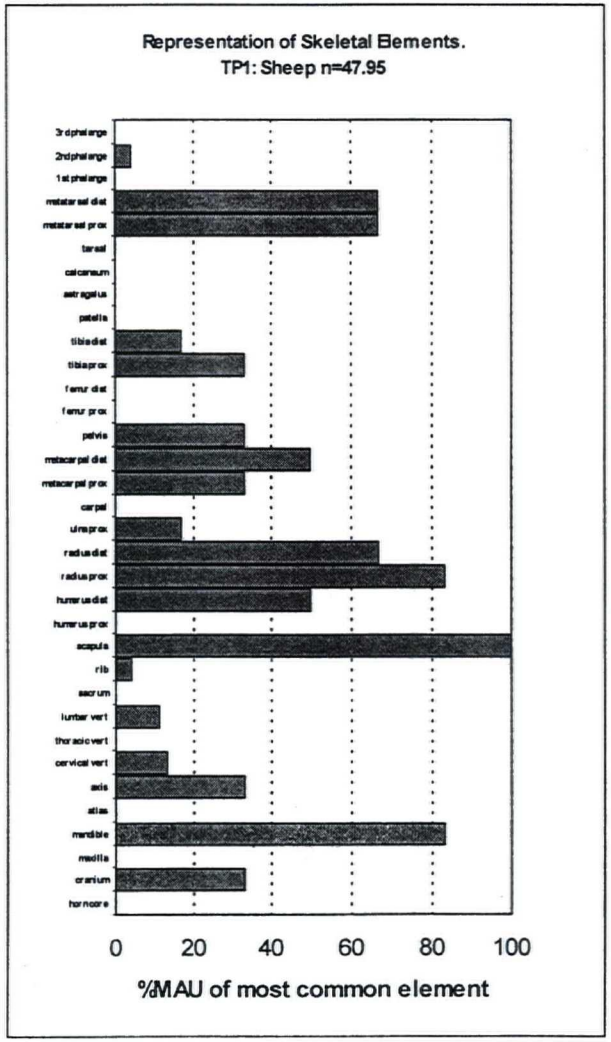
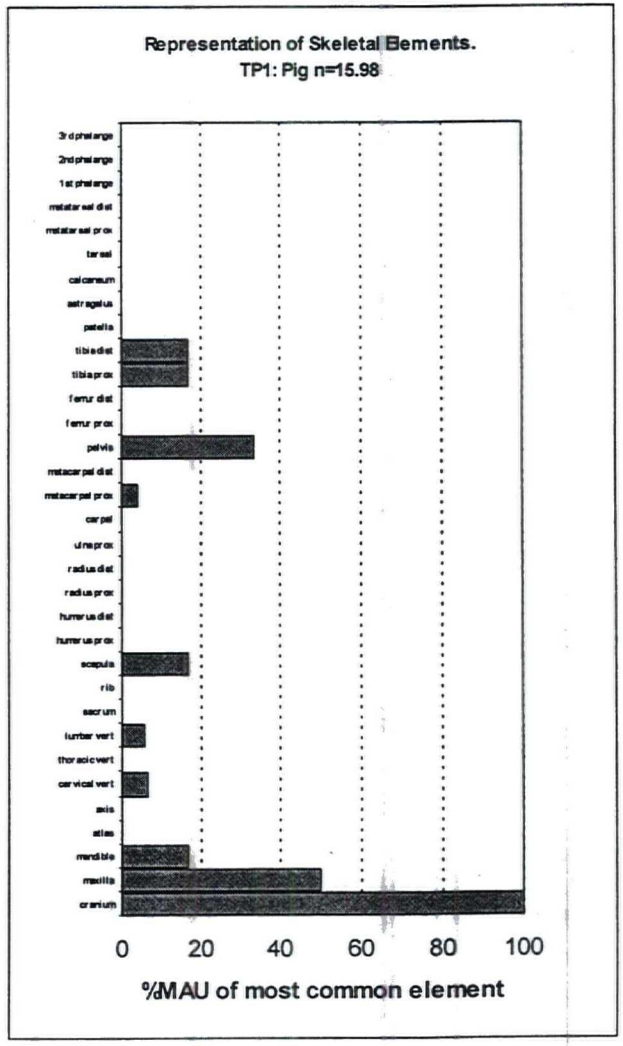
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

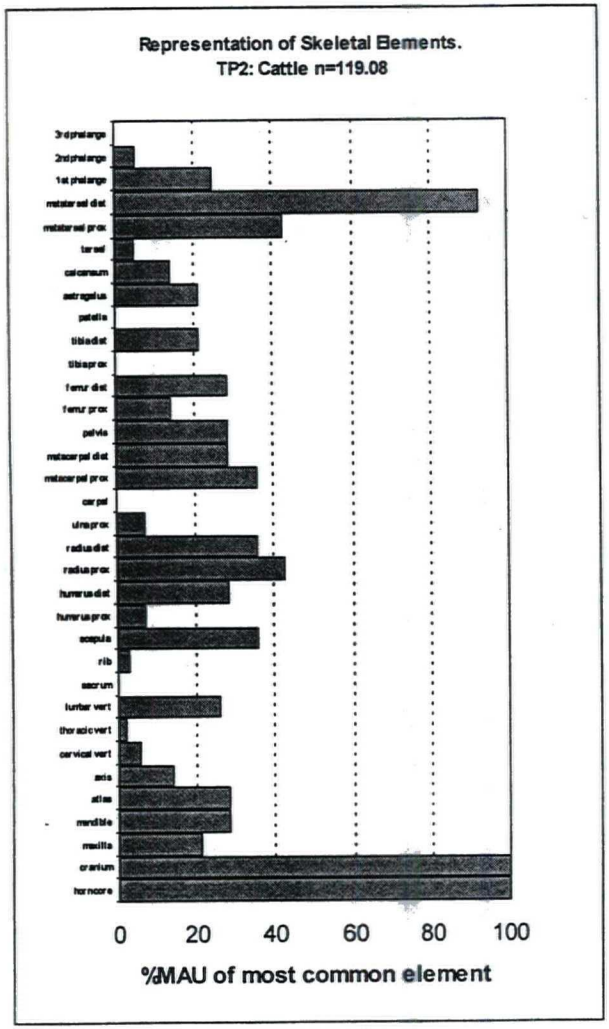

Representation of Skeletal Elements.
All areas: Fallow Deer n=29.50
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

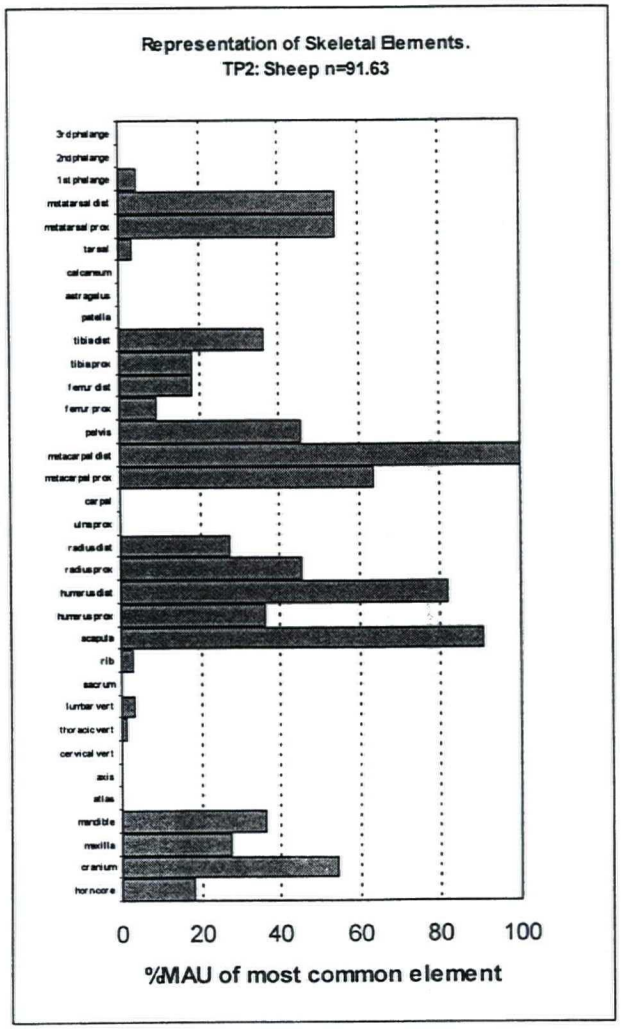
APPENDIX 3:
REPRESENTATION OF SKELETAL ELEMENTS IN CATTLE AND SHEEP FROM DIFFERENT EXCAVATION AREAS

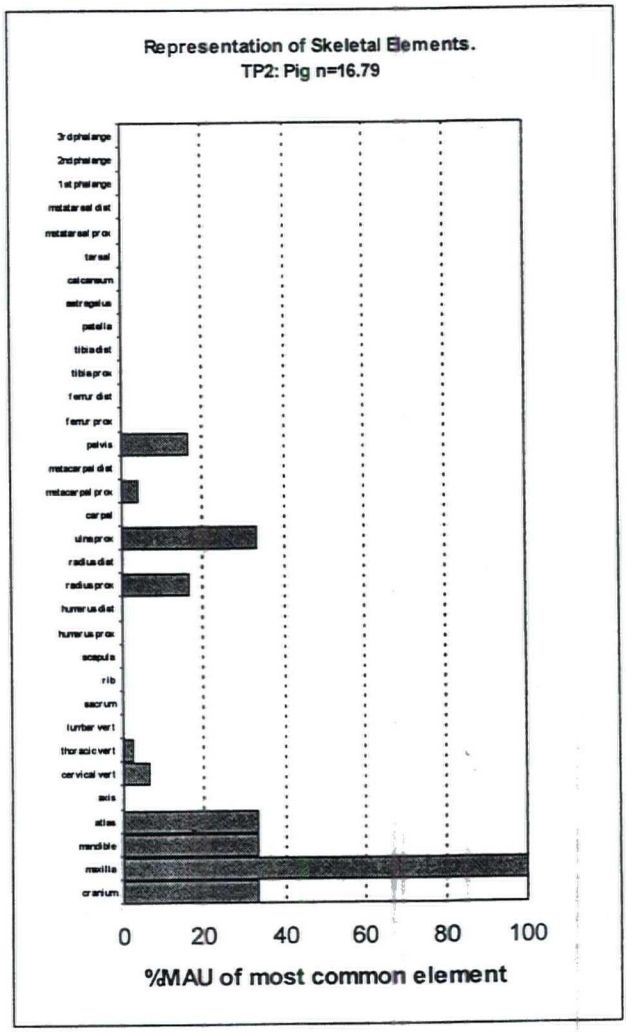

Representation of Skeletal Elements.
TP1: Cattle n=86.41
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

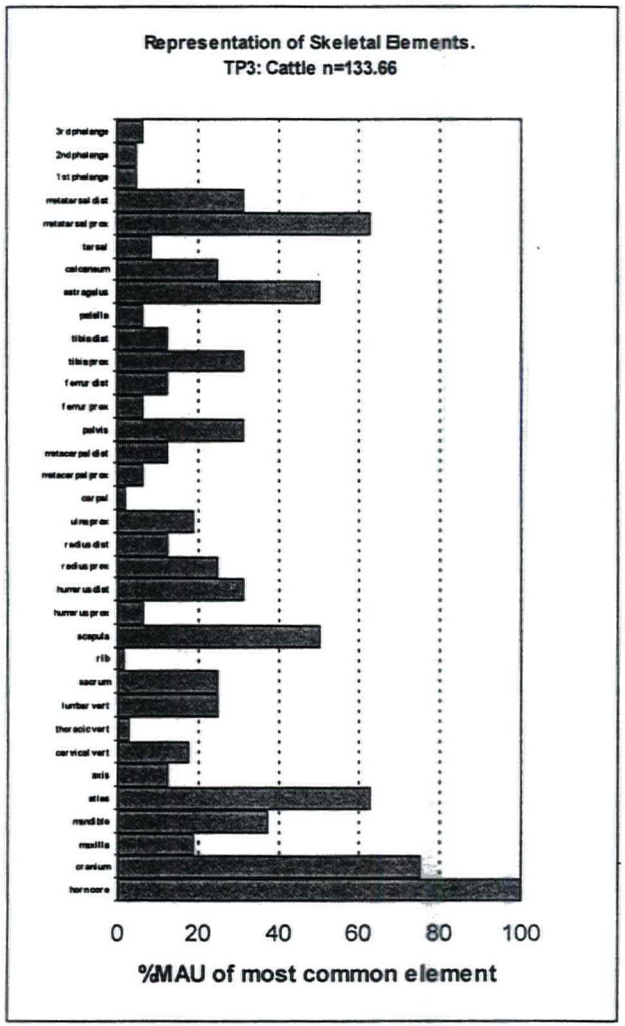

Representation of Skeletal Elements.
TP1: Sheep n=47.95
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

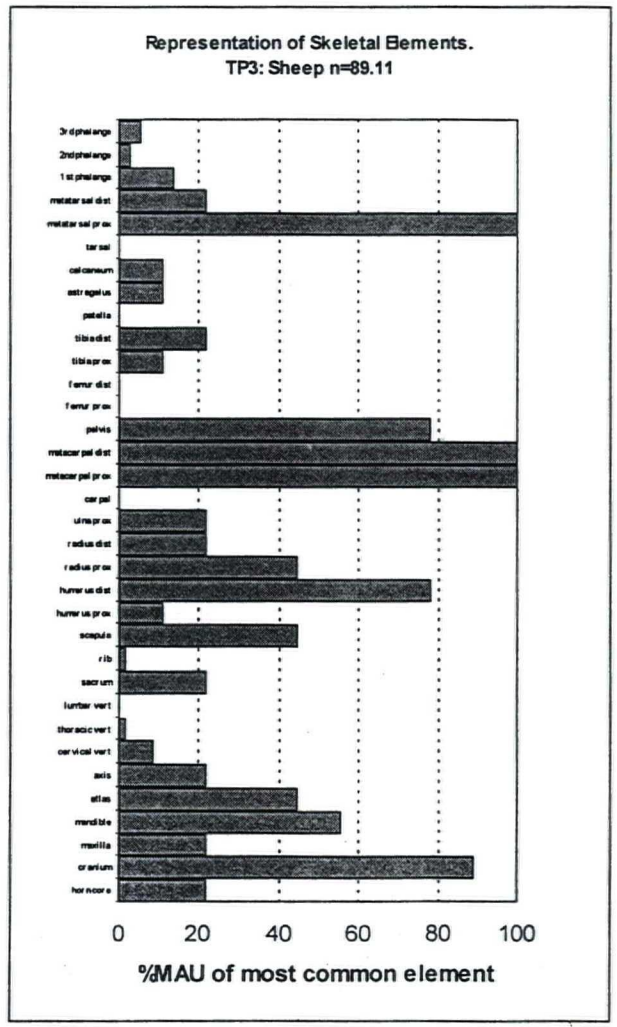

Representation of Skeletal Elements.
TP1: Pig n=15.98
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

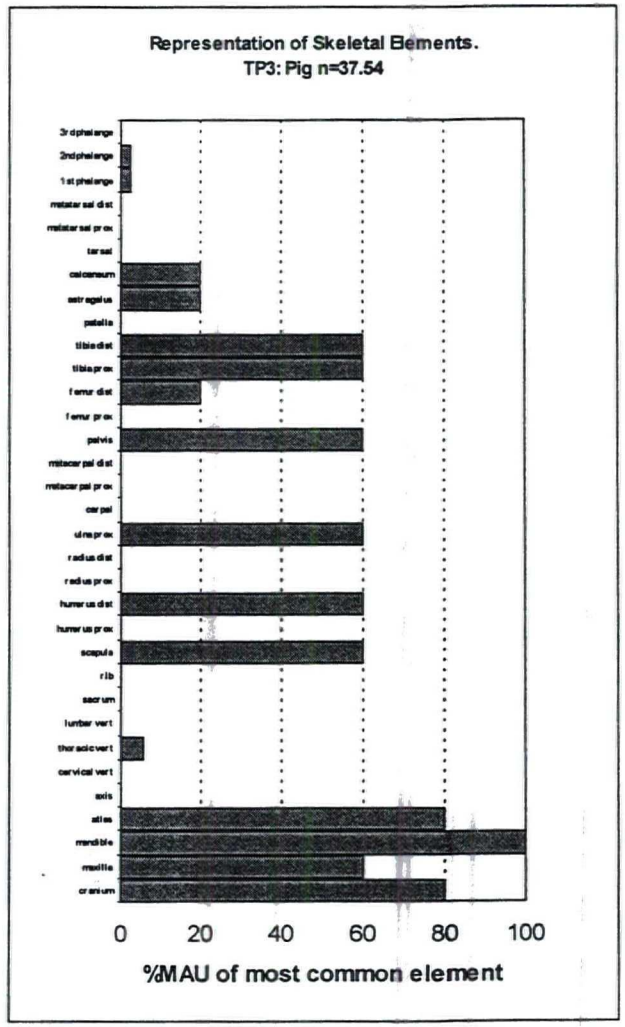

Representation of Skeletal Elements.
TP2: Cattle n=119.08
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

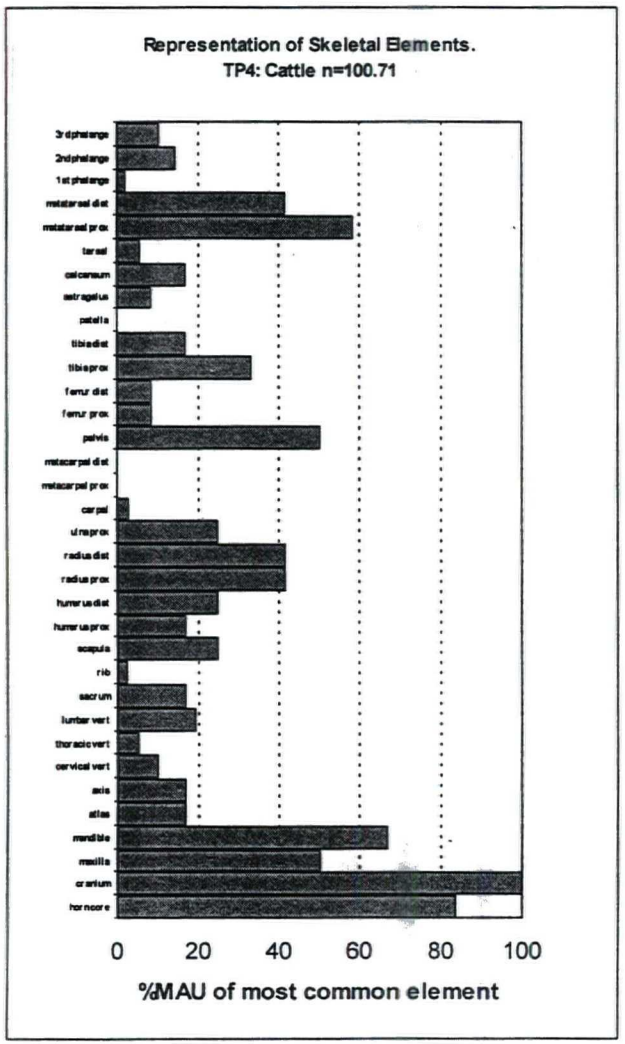

Representation of Skeletal Elements.
TP2: Sheep n=91.63
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

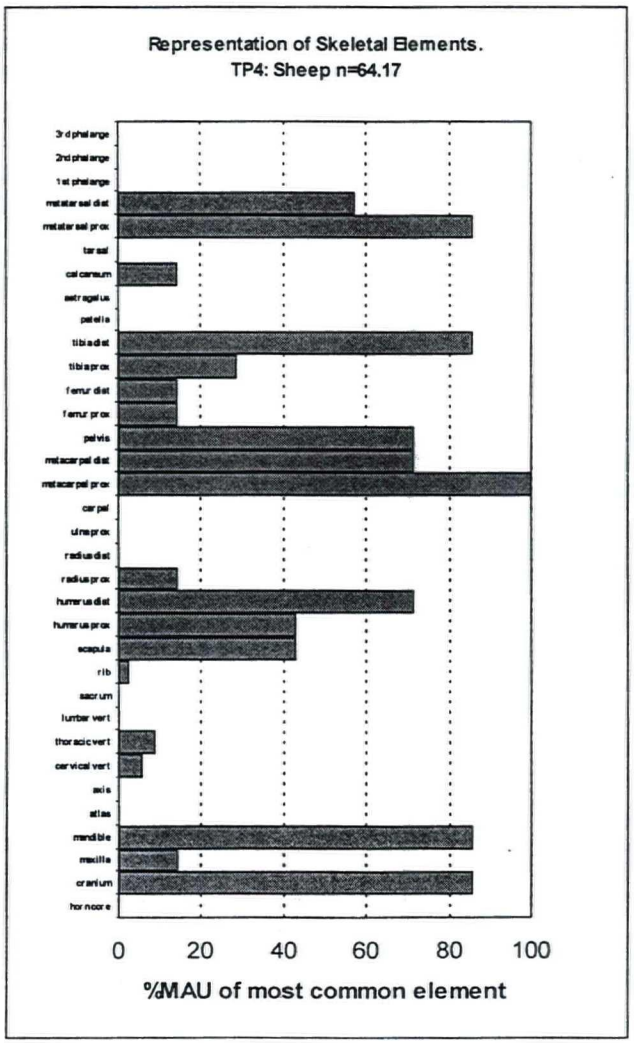

Representation of Skeletal Elements.
TP2: Pig n=16.79
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

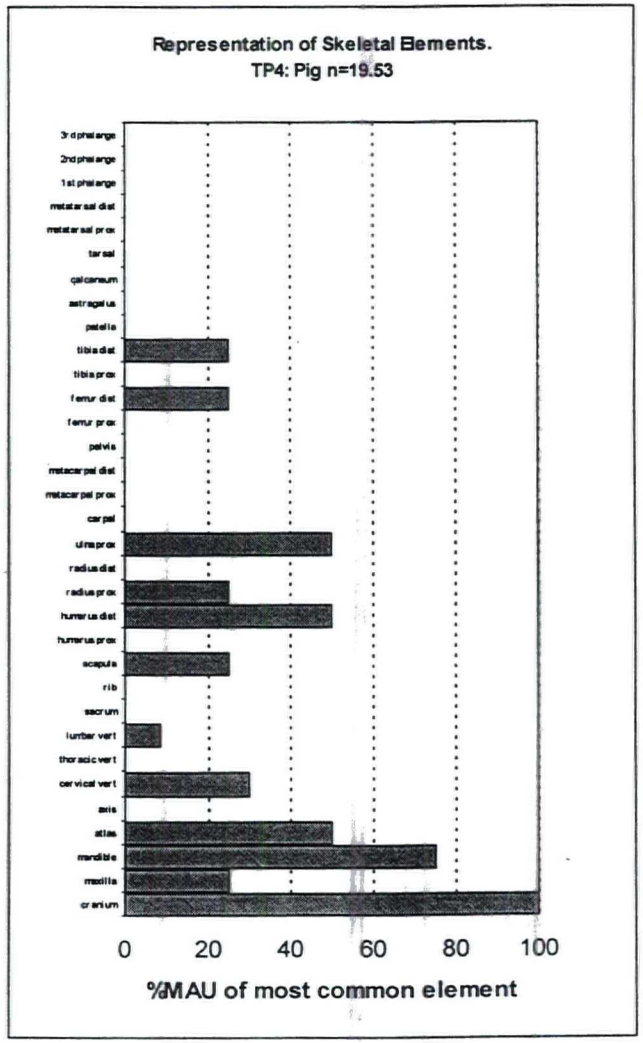

Representation of Skeletal Elements.
TP3: Cattle n=133.66
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

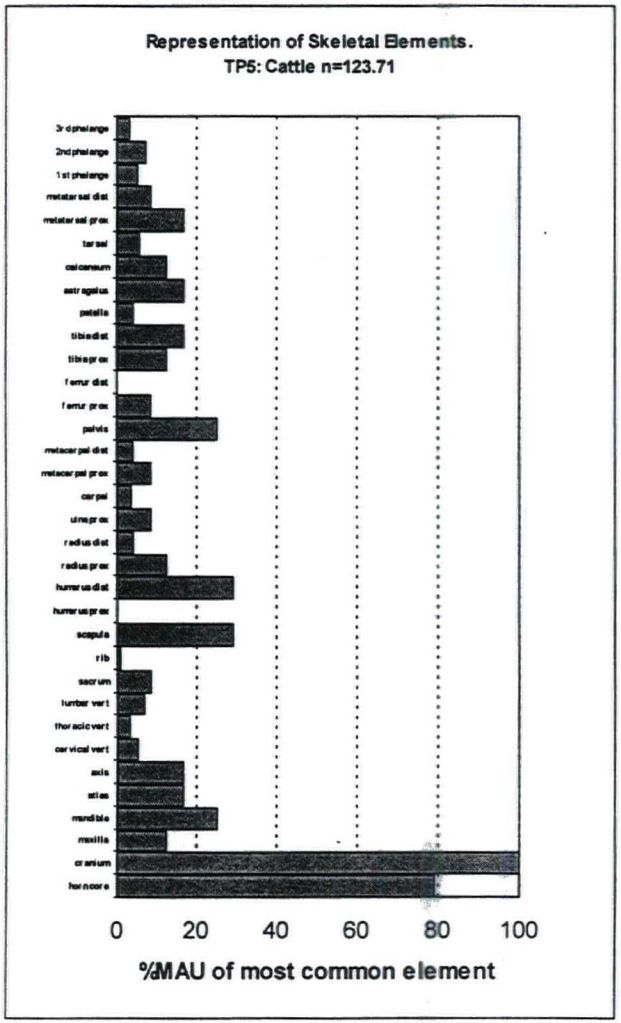

Representation of Skeletal Elements.
TP3: Sheep n=89.11
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

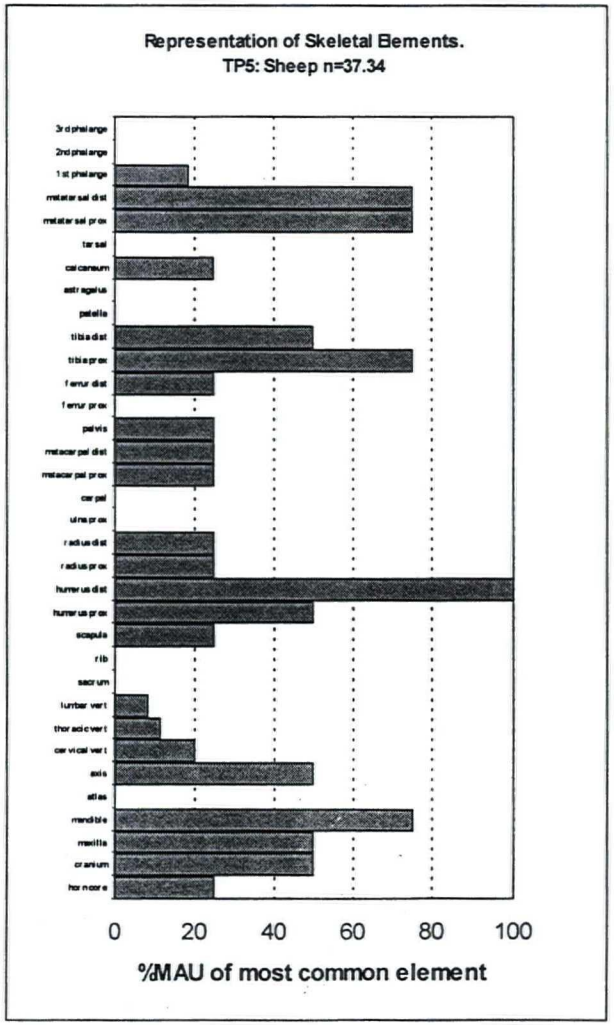

Representation of Skeletal Elements.
TP3: Pig n=37.54
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

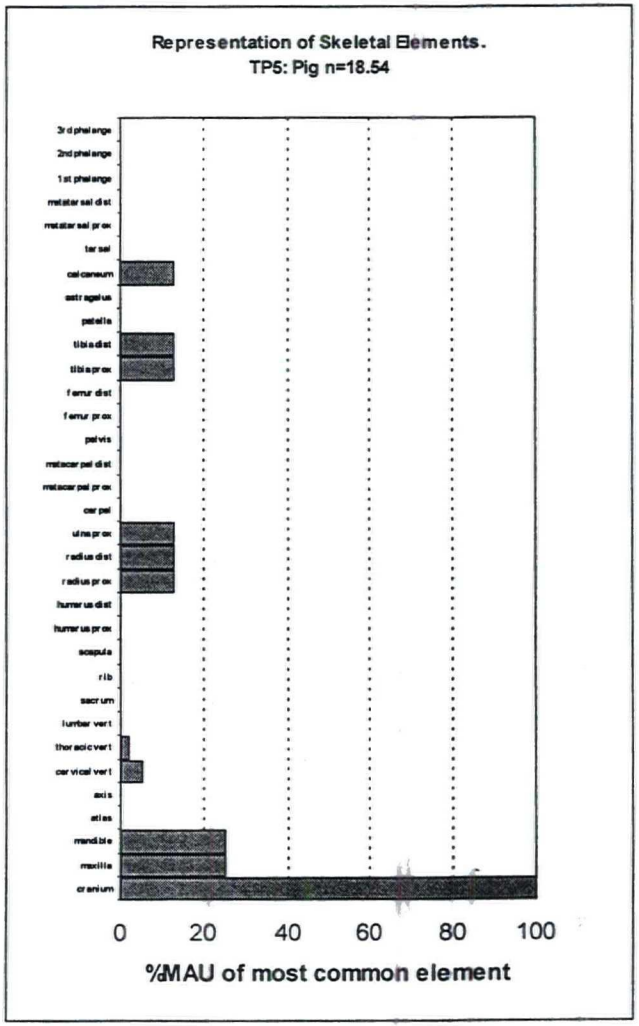

Representation of Skeletal Elements.
TP4: Cattle n=100.71
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

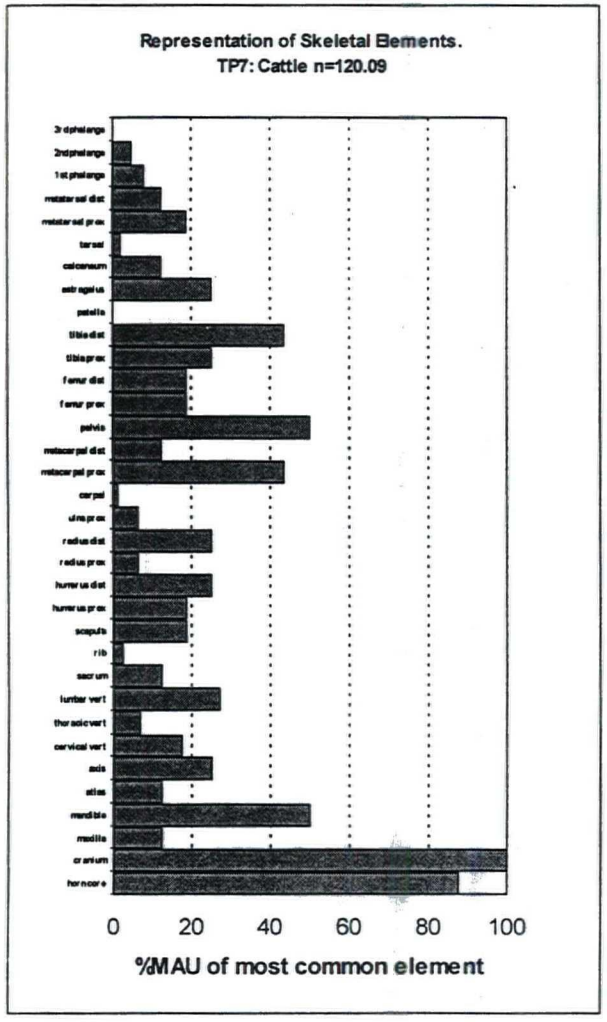

Representation of Skeletal Elements.
TP4: Sheep n=64.17
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

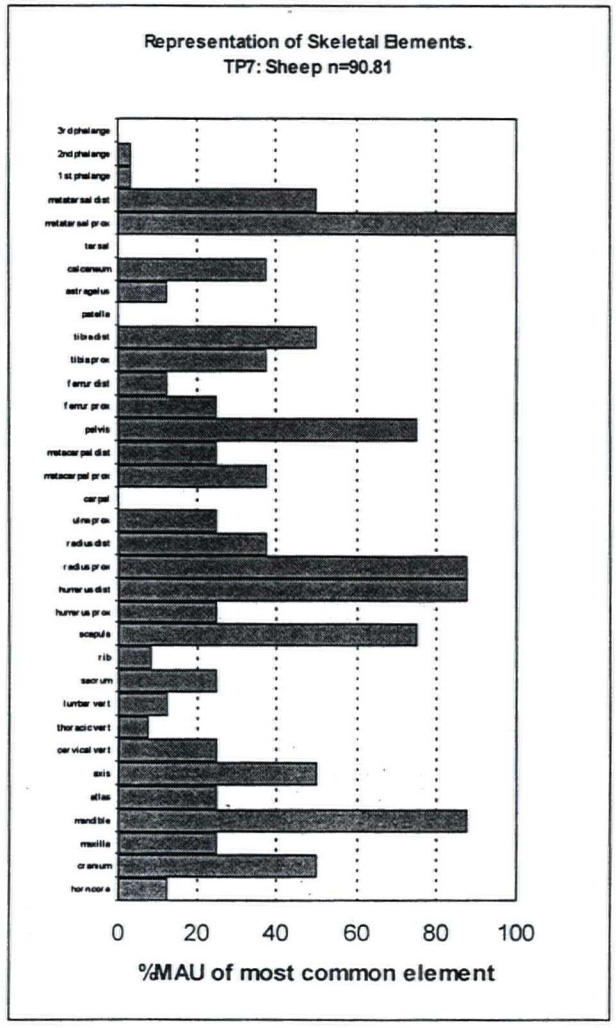

Representation of Skeletal Elements.
TP4: Pig n=19.53
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

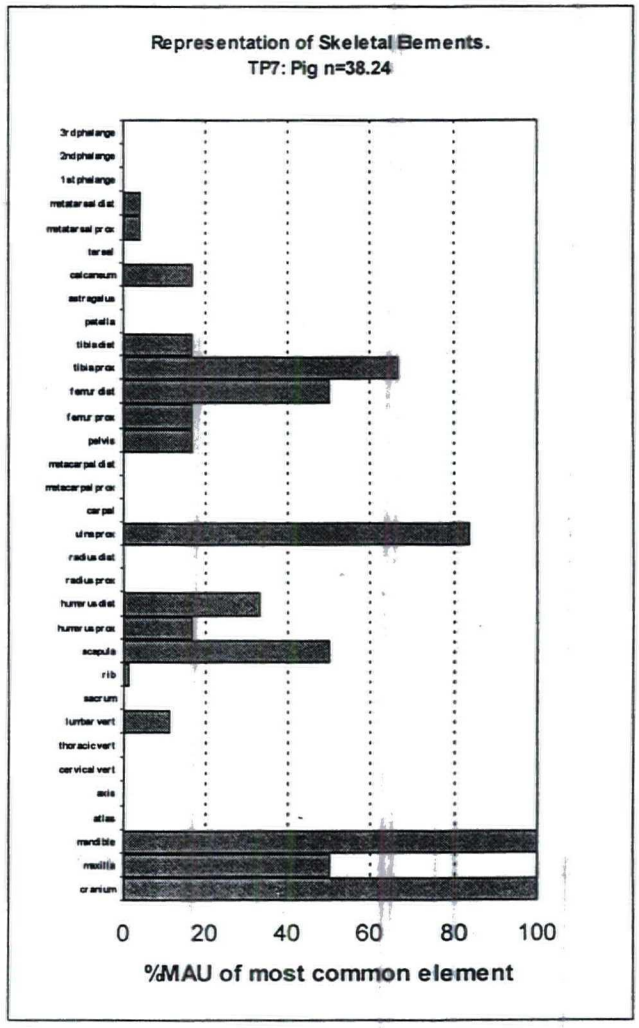

Representation of Skeletal Elements.
TP5: Cattle n=123.71
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

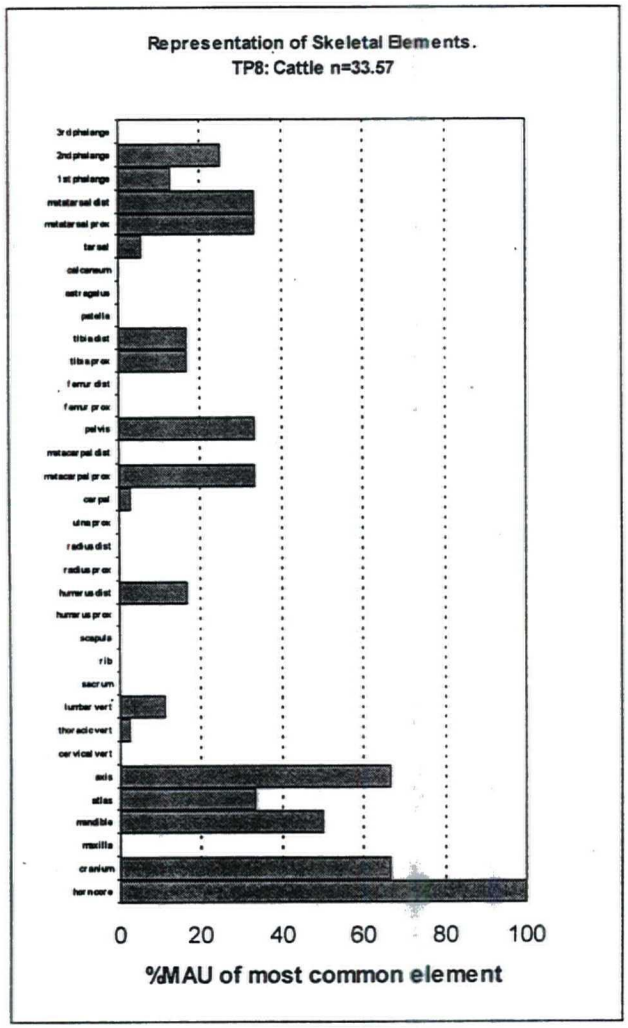

Representation of Skeletal Elements.
TP5: Sheep n=37.34
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

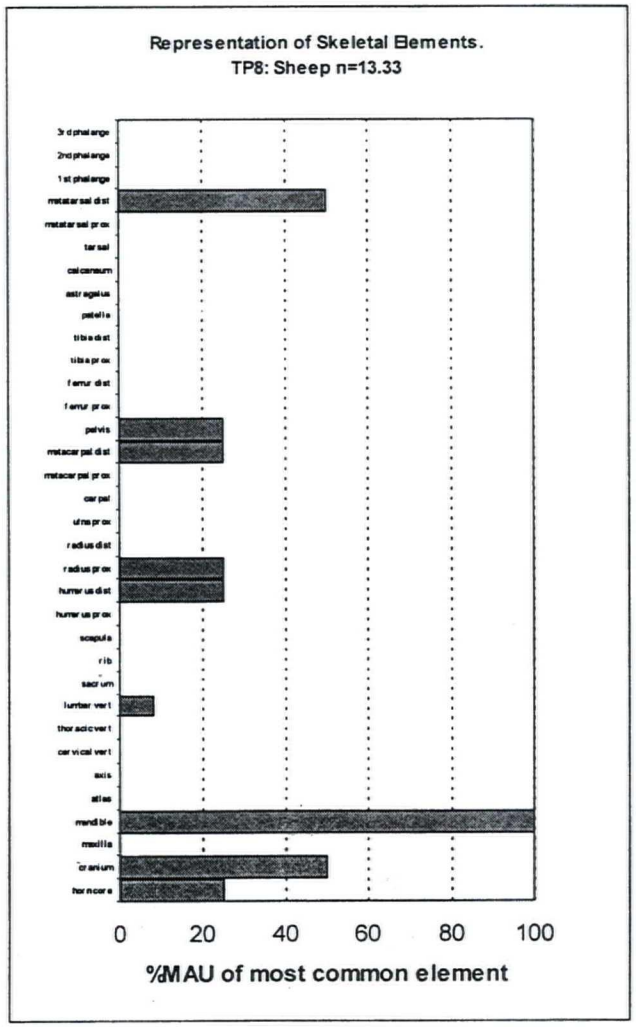

Representation of Skeletal Elements.
TP5: Pig n=18.54
3rd phelange
2nd phelange
1st phelange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

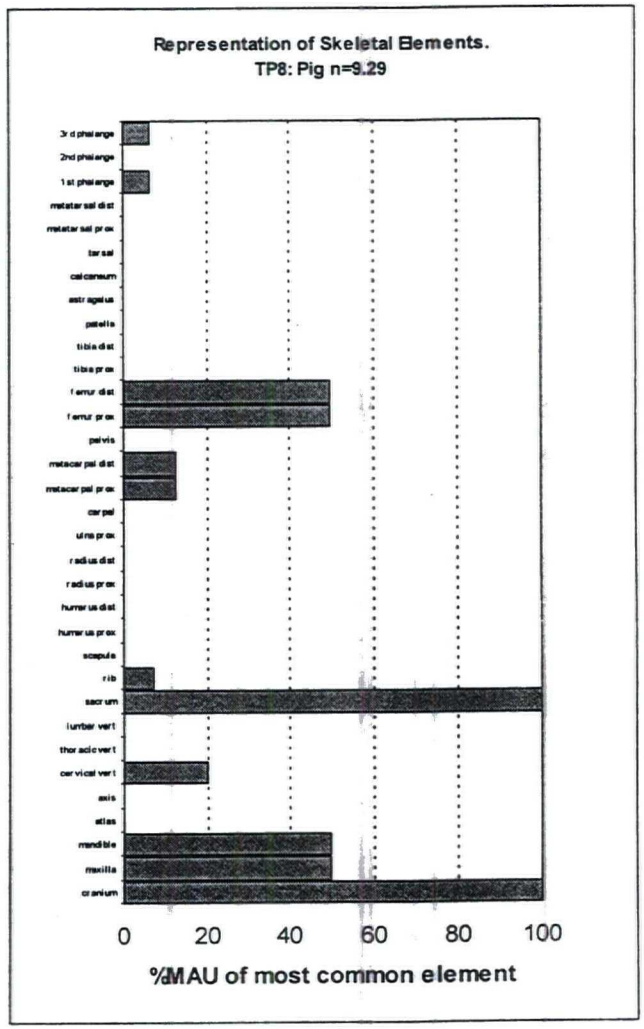

Representation of Skeletal Elements.
TP7: Cattle n=120.09
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

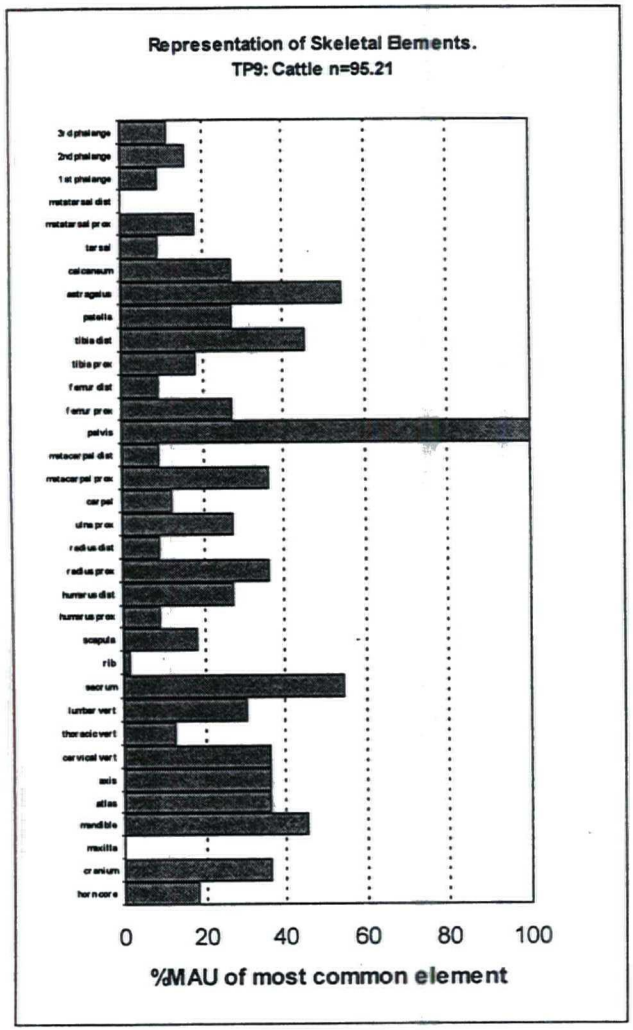

Representation of Skeletal Elements.
TP7: Sheep n=90.81
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

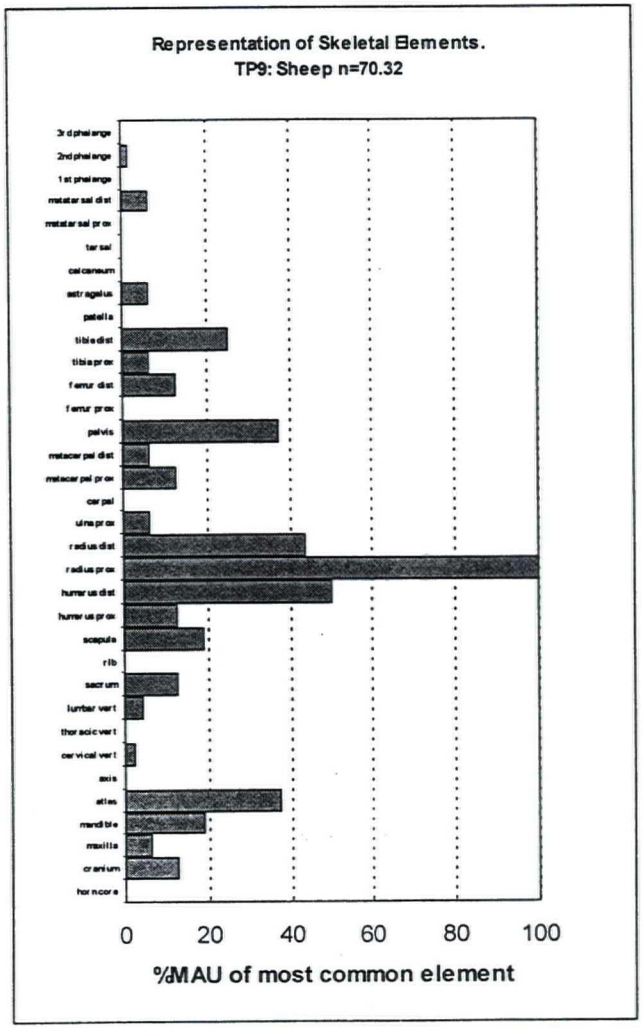

Representation of Skeletal Elements.
TP7: Pig n=38.24
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

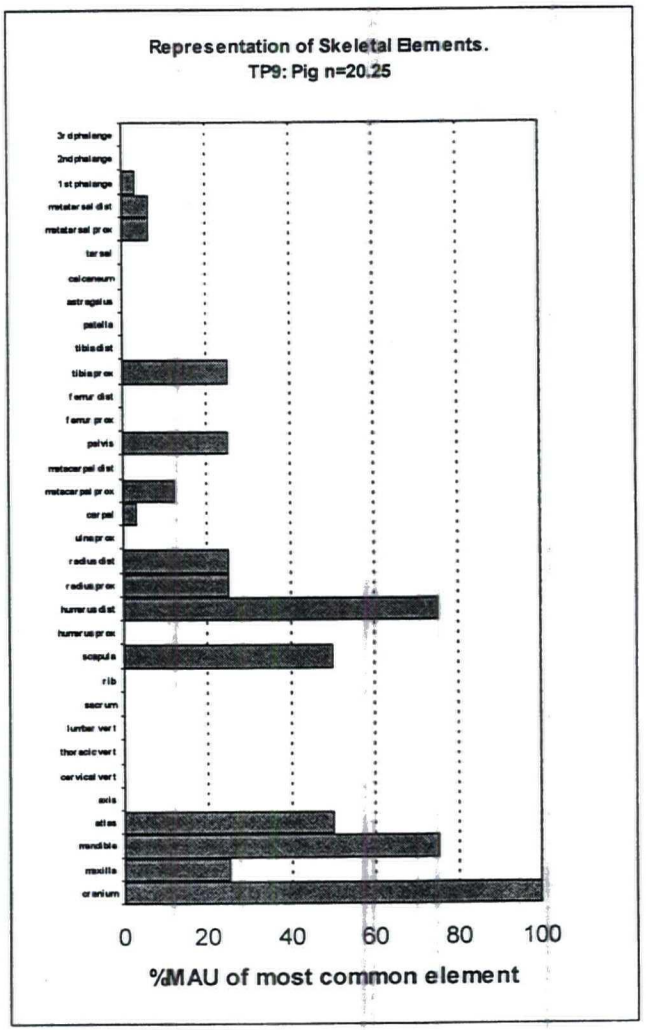

Representation of Skeletal Elements.
TP8: Cattle n=33.57
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
TP8: Sheep n=13.33
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

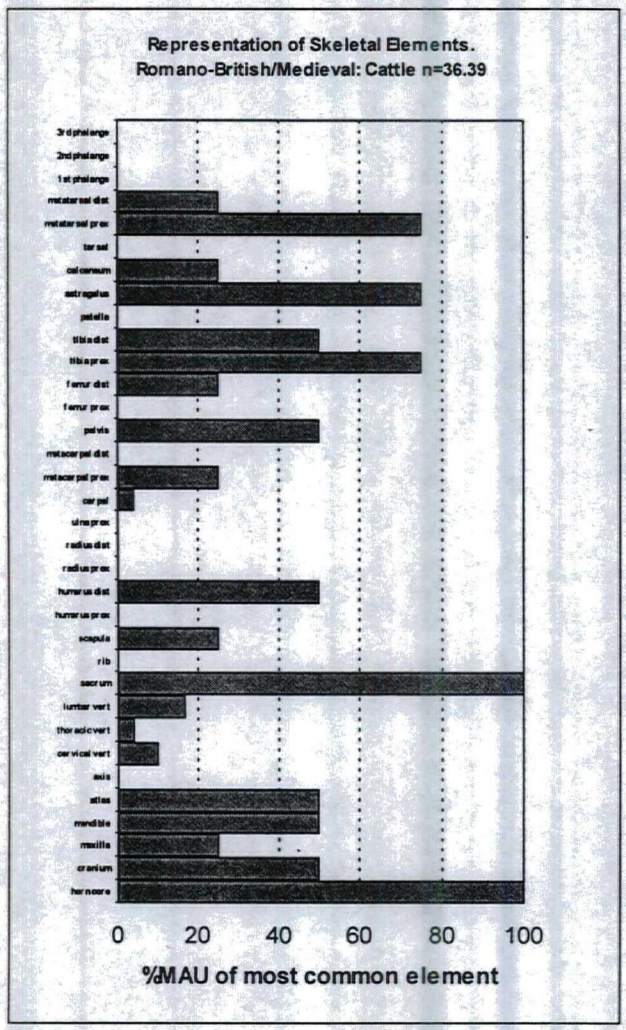

Representation of Skeletal Elements.
TP8: Pig n=9.29
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

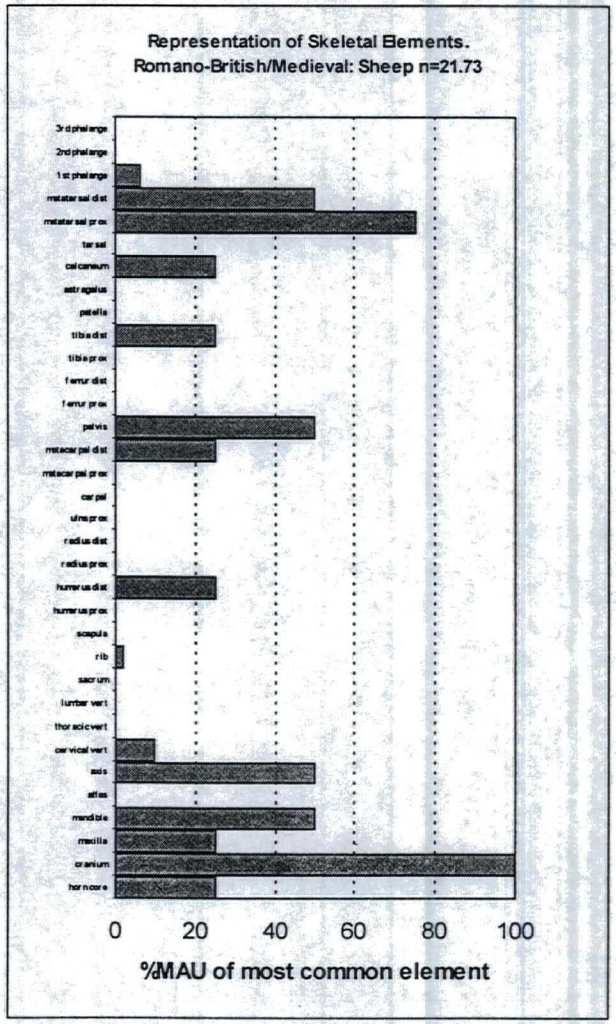

Representation of Skeletal Elements.
TP9: Cattle n=95.21
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horn core
0
20
40
60
80
100
%MAU of most common element

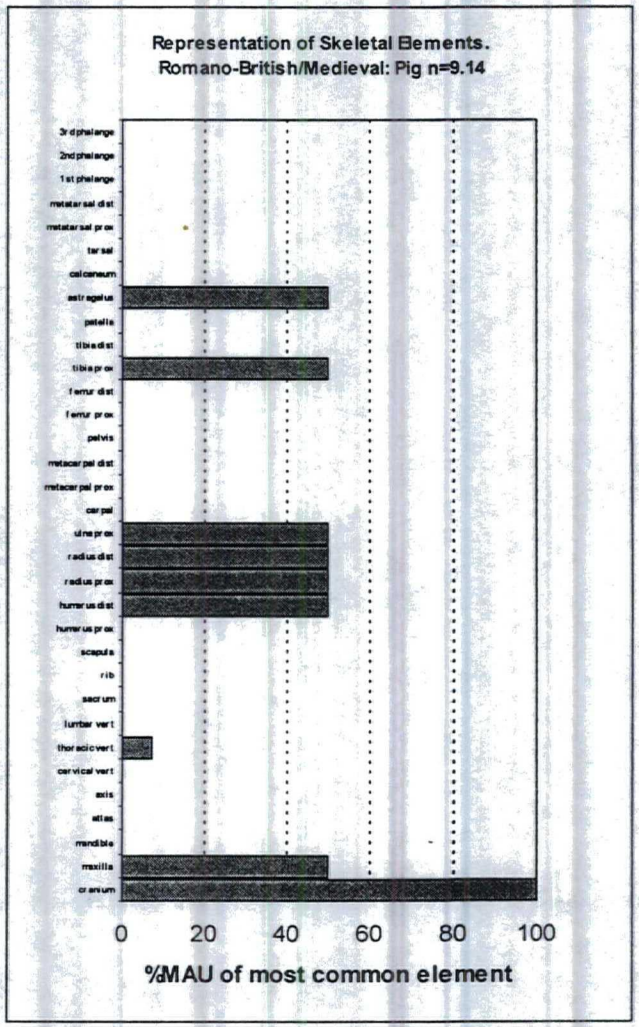

Representation of Skeletal Elements.
TP9: Sheep n=70.32
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horn core
0
20
40
60
80
100
%MAU of most common element

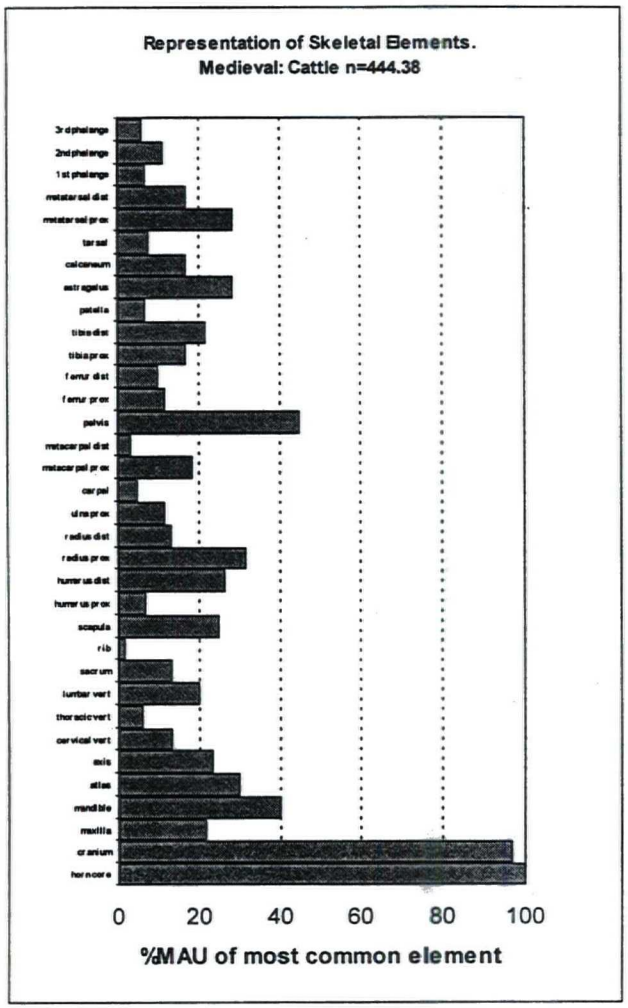

Representation of Skeletal Elements.
TP9: Pig n=20.25
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

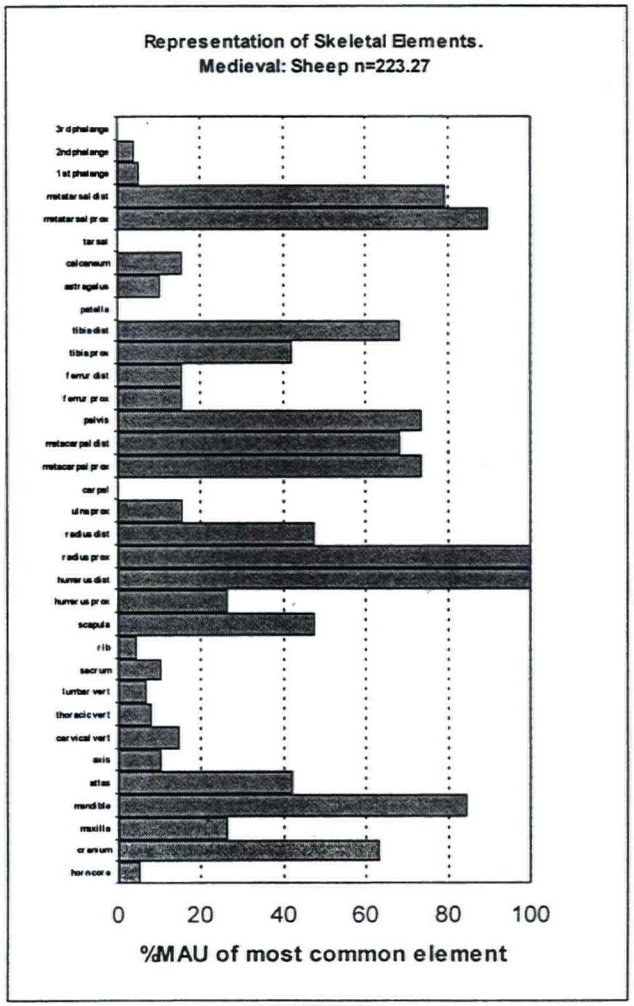
APPENDIX 4:
REPRESENTATION OF SKELETAL ELEMENTS IN CATTLE AND SHEEP FROM DIFFERENT PERIODS

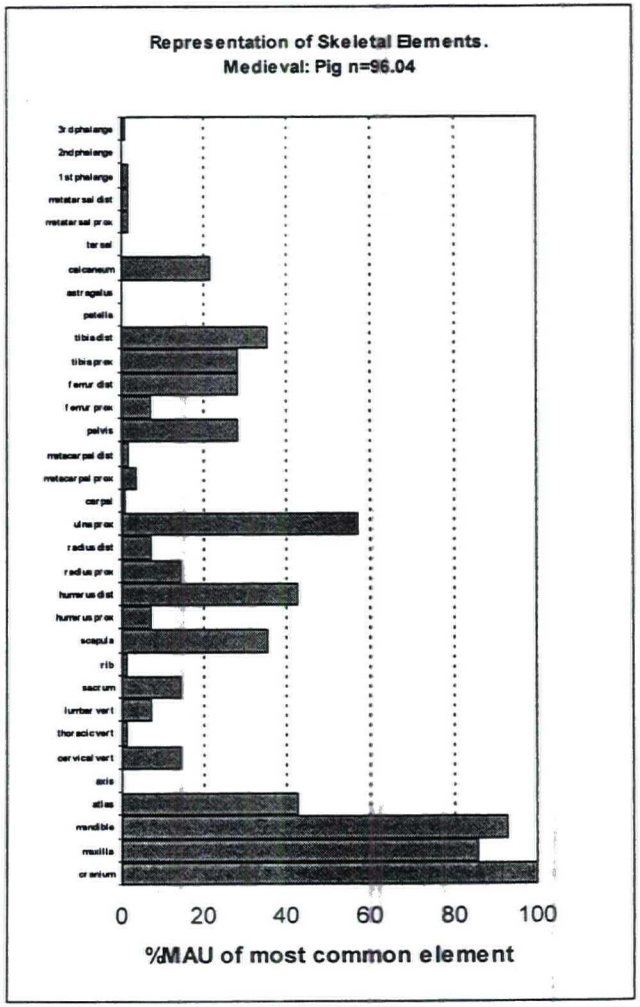

Representation of Skeletal Elements.
Romano-British/Medieval: Cattle n=36.39
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horn core
0
20
40
60
80
100
%MAU of most common element

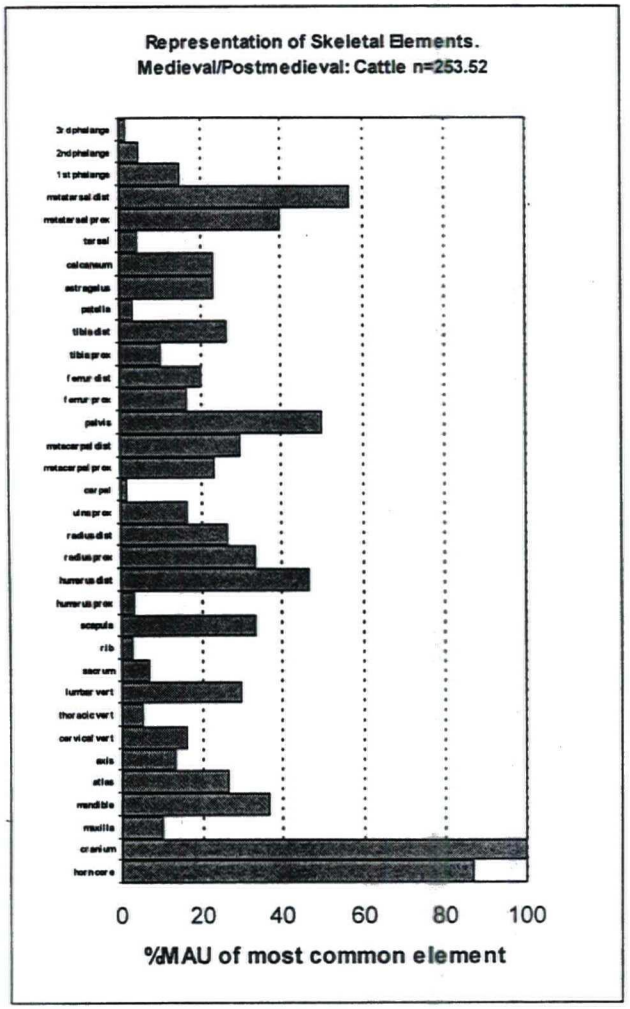

Representation of Skeletal Elements.
Romano-British/Medieval: Sheep n=21.73
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horn core
0
20
40
60
80
100
%MAU of most common element

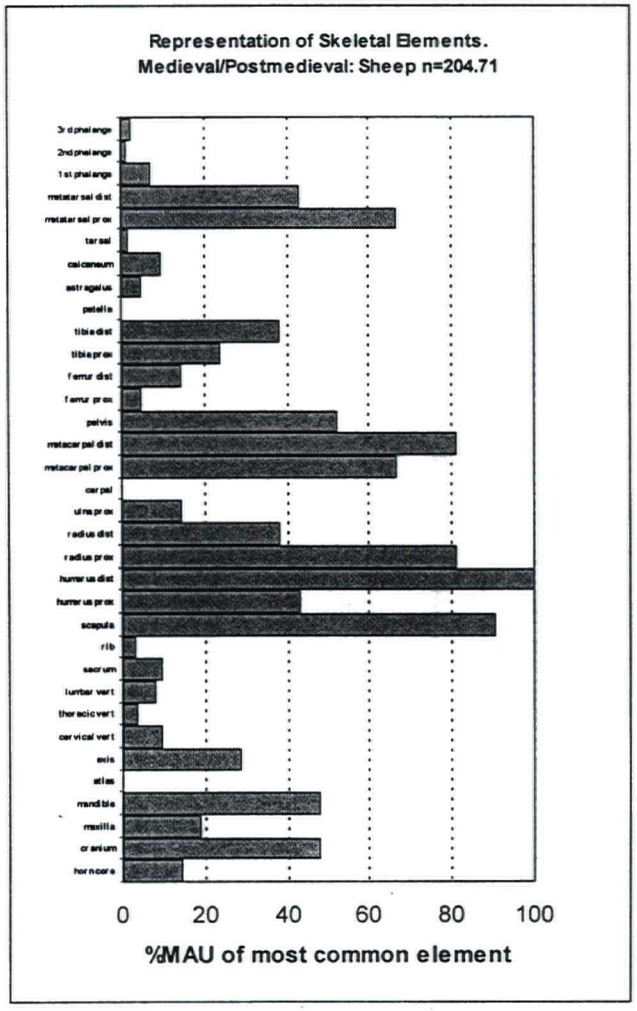

Representation of Skeletal Elements.
Romano-British/Medieval: Pig n=9.14
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

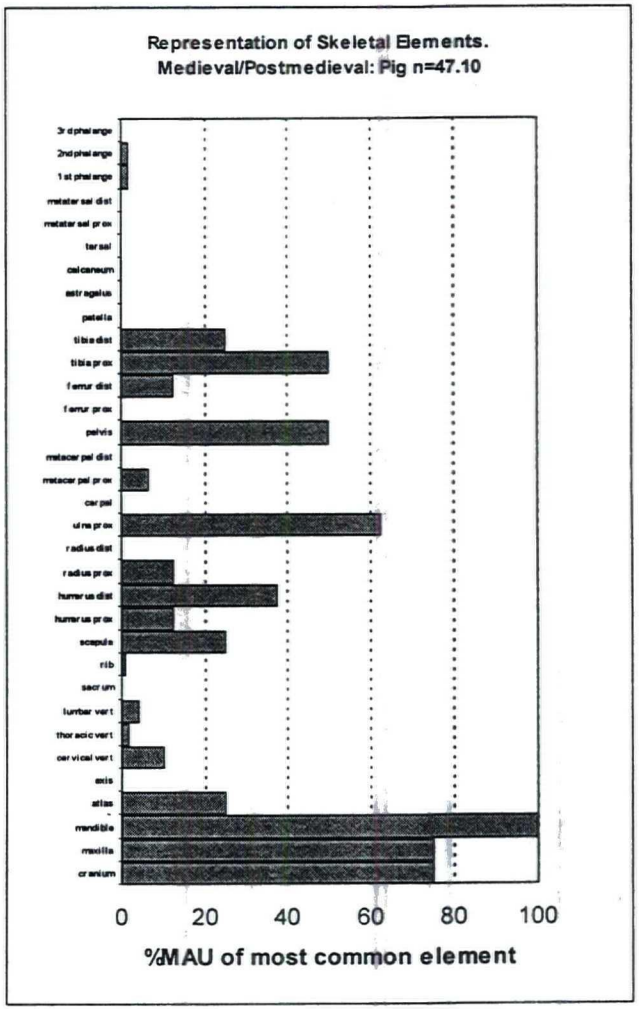

Representation of Skeletal Elements.
Medieval: Cattle n=444.38
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

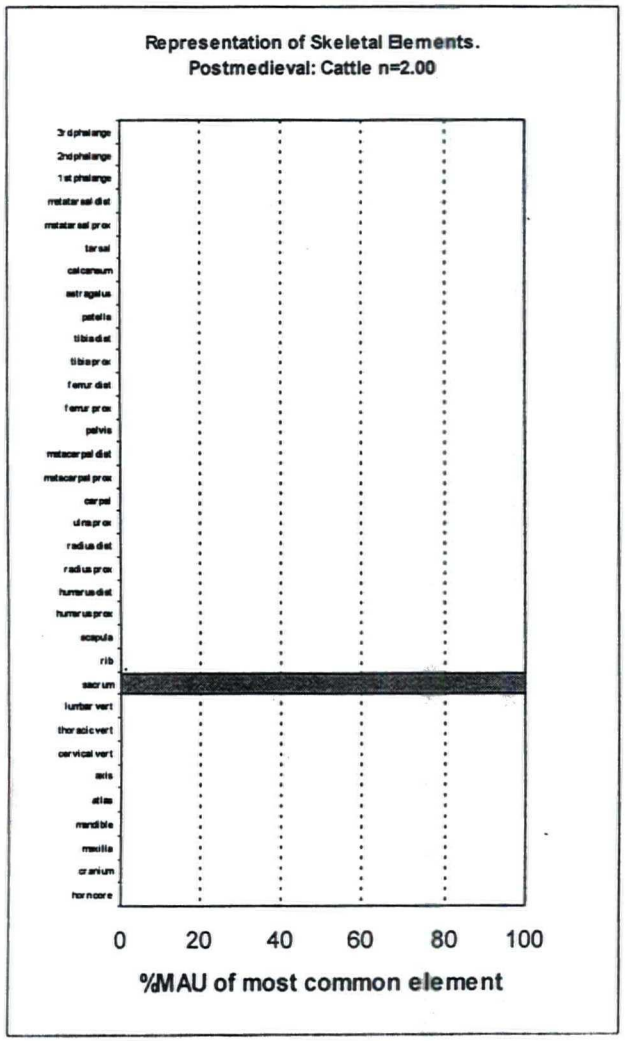

Representation of Skeletal Elements.
Medieval: Sheep n=223.27
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element

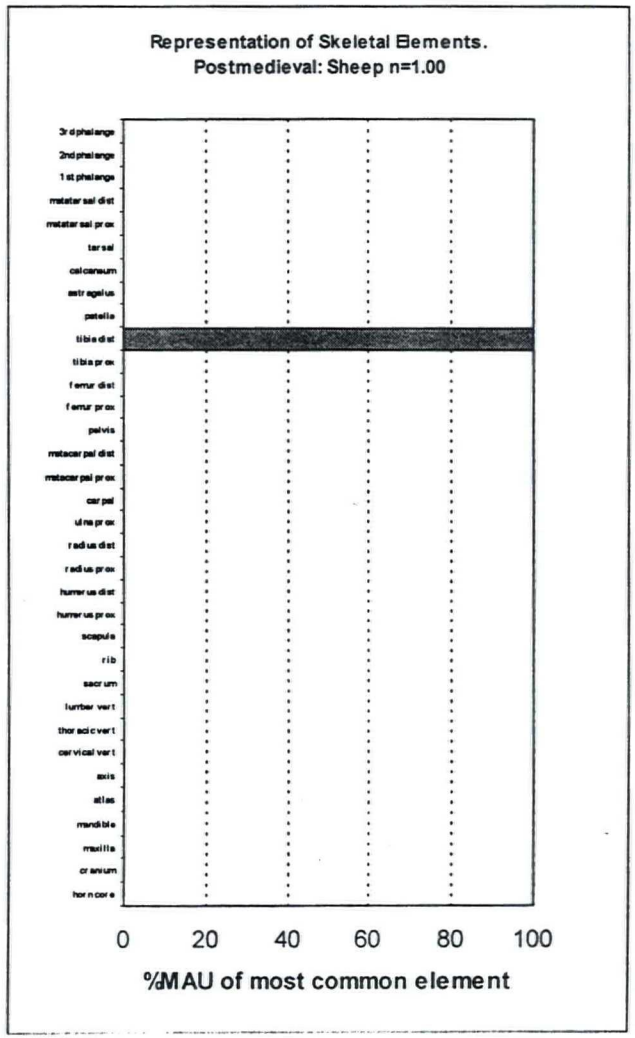

Representation of Skeletal Elements.
Medieval: Pig n=96.04
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

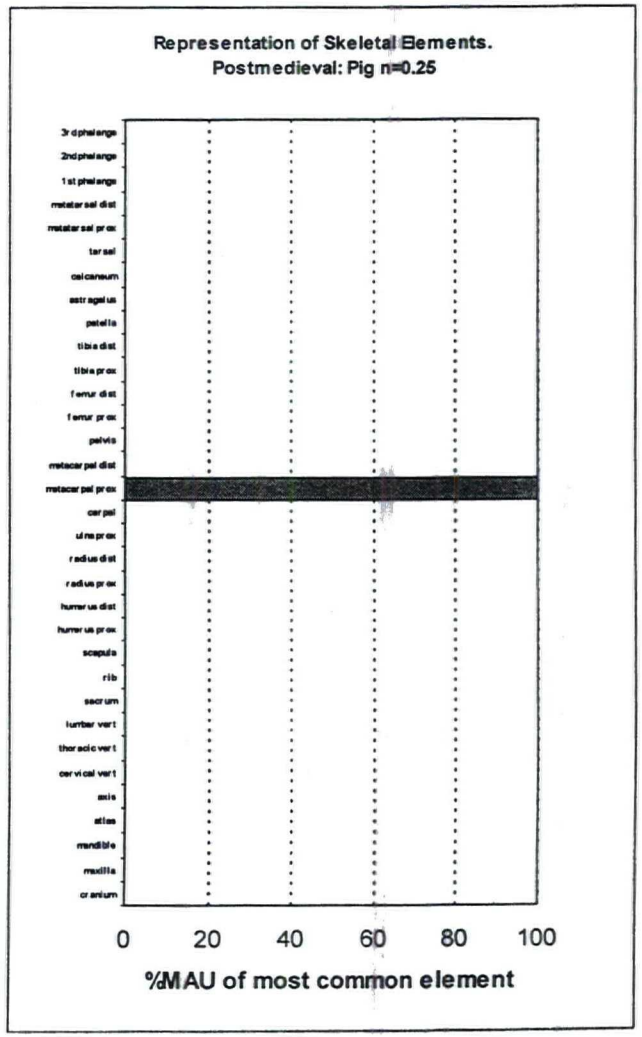

Representation of Skeletal Elements.
Medieval/Postmedieval: Cattle n=253.52
3r d phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
Medieval/Postmedieval: Sheep n=204.71
3r d phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
Medieval/Postmedieval: Pig n=47.10
3r d phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumbar vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
Postmedieval: Cattle n=2.00
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
Postmedieval: Sheep n=1.00
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
horncore
0
20
40
60
80
100
%MAU of most common element


Representation of Skeletal Elements.
Postmedieval: Pig n=0.25
3rd phalange
2nd phalange
1st phalange
metatarsal dist
metatarsal prox
tarsal
calcaneum
astragalus
patella
tibia dist
tibia prox
femur dist
femur prox
pelvis
metacarpal dist
metacarpal prox
carpal
ulna prox
radius dist
radius prox
humerus dist
humerus prox
scapula
rib
sacrum
lumber vert
thoracic vert
cervical vert
axis
atlas
mandible
maxilla
cranium
0
20
40
60
80
100
%MAU of most common element

APPENDIX 5: MANDIBULAR TOOTH WEAR DATA

Grant tooth wear stages for mandibular cheeck teeth of cattle sheep and pig.

MAN = Teeth *in situ* in mandible
MN TO = Loose mandibular cheek tooth
MN GP = Mandibular cheek tooth row re-fitted from loose teeth

Species	Element	Period	Dp4	P4	M1	M2	M3	Comments
COW	MAN	M					g	
COW	MAN	M				/	c	
COW	MAN	?M				/	g	wear suggests partial attached 3rd cusp M3
COW	MAN	M			/	-	l	
COW	MAN	M			/	f	b	
COW	MAN	M			/	k	j	
COW	MAN	?M			/	l	k	chopped in front of M2
COW	MAN	M			j	g	/	
COW	MAN	M/PM		-	k	-	/	
COW	MAN	M		/	j	h	/	
COW	MAN	M/PM		b	j	g	/	
COW	MAN	M		c	/			
COW	MAN	M		c	k	g	/	chopped behind M2
COW	MAN	M		E	k	g	b	
COW	MAN	M		g	-	-	/	broken/chopped behind M2
COW	MAN	?M		g	l	k	/	chopped behind M2
COW	MAN	M		h	j	g	g	
COW	MAN	M		h	m	/		
COW	MAN	M		j	o	m	m	
COW	MAN	M	b		V			
COW	MAN	M/PM	c		/			
COW	MAN	M	c		V			
COW	MAN	M	c	-	/			
COW	MAN	M	k		h	d	E	
COW	MAN	M	l		j	f	/	
COW	MAN	RB/M	m		-	e/f	/	M2 broken
COW	MN GP	M/PM			j	g		
COW	MN GP	M	b					
COW	MN TO	M					b	
COW	MN TO	M					c	
COW	MN TO	M/PM					g	
COW	MN TO	M					g	
COW	MN TO	M					h	
COW	MN TO	M					k	
COW	MN TO	M		f				
COW	MN TO	?M	b					
COW	MN TO	M/PM	b					
COW	MN TO	M	c					
COW	MN TO	M	c					
COW	MN TO	M	c					
COW	MN TO	M	c					
COW	MN TO	RB/M	d					

Species	Element	Period	Dp4	P4	M1	M2	M3	Comments
SHP	MAN	M/PM			/	g	d	
SHP	MAN	RB/M		-	-	g	g	
SHP	MAN	M		-	-	g	g	
SHP	MAN	M		-	g	-	/	
SHP	MAN	M		-	g	g	e	
SHP	MAN	M		-	h	g	g	
SHP	MAN	M/PM		-	m	h	g	
SHP	MAN	M/PM		/	g	f	/	
SHP	MAN	RB/M		e	g	f	c	
SHP	MAN	M		e	g	f	c	
SHP	MAN	M		f	h	g	f	
SHP	MAN	?M		g	-	/		
SHP	MAN	M		g	-	f	e	
SHP	MAN	M/PM		g	g	f	e	
SHP	MAN	M/PM		g	g	g	d	
SHP	MAN	M		g	g	g	f	
SHP	MAN	M/PM		g	g	g	g	misaligned P4 poss due to over crowding.
SHP	MAN	M		g	h	g	b	
SHP	MAN	?M		g	h	g	e	
SHP	MAN	M/PM		g	h	g	g	
SHP	MAN	M/PM		h	I	g	/	
SHP	MAN	M/PM		h	m	g	g	congenital absence P2
SHP	MAN	M		j	I	h	g	
SHP	MAN	M/PM		k	m	h	g	chopped in front of P3
SHP	MAN	M		I	m	j	g	
SHP	MAN	M	-		g	-	V	
SHP	MAN	M	-		g	e	V?/	
SHP	MAN	M	f		E			
SHP	MAN	M	h		e	b		
SHP	MN GP	M				g	f	
SHP	MN GP	M		g	g			
SHP	MN TO	M					b	
SHP	MN TO	M					c	
SHP	MN TO	?M					c	
SHP	MN TO	M/PM					e	
SHP	MN TO	M					e	
SHP	MN TO	M					f	
SHP	MN TO	M/PM					g	
SHP	MN TO	M/PM					g	
SHP	MN TO	M/PM					g	

Species	Element	Period	Dp4	P4	M1	M2	M3	Comments
PIG	MAN	M/PM				/	1/2	chopped in front of M3
PIG	MAN	M			/	k	c	
PIG	MAN	M/PM		-	d	-	/	
PIG	MAN	M		-	e	b	/	
PIG	MAN	M		/	l	f	b	
PIG	MAN	M		a	e	b	/	
PIG	MAN	M/PM		a	e	b	C	chopped in front P2
PIG	MAN	M		a	f	d	/	
PIG	MAN	M		a	g	b	V	
PIG	MAN	M/PM		b	g	d	E	
PIG	MAN	M		b	h	d	/	
PIG	MAN	M/PM		d	h	e	b+	M3 broken
PIG	MAN	M		e	/			
PIG	MAN	M		e	/			
PIG	MAN	M		U	f	a	-	
PIG	MAN	M/PM	-		e	b	C	
PIG	MN TO	M/PM					b	
PIG	MN TO	M				d		
PIG	MN TO	M			/	j	/	
PIG	MN TO	M			d			
PIG	MN TO	M/PM			g			
PIG	MN TO	M	m					

APPENDIX 6: DEFINITIONS OF MANDIBULAR WEAR STAGES AND SUGGESTED AGES

Sheep Tooth Wear Stages

Payne Age Stage	Suggested Age	Halstead Definition	Grant Definition
A	0-2 mth	m3/p4 unworn	m3/p4 ≤a
B	2-6 mth	m3/p4 in wear, M1 unworn	m3/p4 ≥b, M1 ≤a
C	6-12 mth	M1 in wear, M2 unworn	M1 ≥b, M2 ≤a
D	1-2 yr	M2 in wear, M3 unworn	M2 ≥b, M3 ≤a
E	2-3 yr	M3 in wear, post cusp unworn	M3 b - d
F	3-4 yr	M3 post cusp in wear, M3 pre	M3 e - f
G	4-6 yr	M3 , M2	M3 = g, M2 = g
H	6-8 yr	M3 , M2 post	M3= g. M2 ≥h
I	8-10 yr	M3 post	M3 ≥h

Cattle Tooth Wear Stages

Halstead Age Stage	Suggested Age	Halstead Definition	Grant Definition
A	0-1 mth	m3/p4 unworn	m3/p4 ≤a
B	1-8 mth	m3/p4 in wear, M1 unworn	m3/p4 ≥b, M1 ≤a
C	8-18 mth	M1 in wear, M2 unworn	M1 ≥b, M2 ≤a
D	18-30 mth	M2 in wear, M3 unworn	M2 ≥b, M3 ≤a
E	30-36 mth	M3 in wear, post cusp unworn	M3 b - d
F	young adult	M3 post cusp in wear, M3 < g	M3 e - f
G	adult	M3 = g	M3 = g
H	old adult	M3 = h or j	M3 h - j
I	senile	M3 = k or above	M3 ≥k

Pig Tooth Wear Stages

Age Stage	Suggested Age	Definition	Grant Definition
A	0-2 mth	m3/p4 unworn	m3/p4 ≤a
B	2-7 mth	m3/p4 in wear, M1 unworn	m3/p4 ≥b, M1 ≤a
C	7-14 mth	M1 in wear, M2 unworn	M1 ≥b, M2 ≤a
D	14-21 mth	M2 in wear, M3 unworn	M2 ≥b, M3 ≤a
E	21-27 mth	M3 in wear, post cusp unworn	M3 b - d
F	27-36 mth	M3 post cusp in wear, M3 < g	M3 e - f
G	adult	M3 = g	M3 = g
H	old adult	M3 = h or j	M3 h - j
I	senile	M3 = k or above	M3 ≥k

after Hambleton (forthcoming)

APPENDIX 7: MEASUREMENTS

The measurements taken for cattle, sheep and pig bones are listed below.
All measurements are after von den Driesch (1976) unless otherwise indicated.

Mandible
1) Length cheek tooth row
2) Greatest length M3
3) Greatest width M3

Skull

(Horncore)
1) Basal maximum diameter
2) Basal minimum diameter
3) Basal circumference
4) Outer curvature length

(Maxilla)
5) Length cheek tooth row
6) Greatest length M3
7) Greatest width M3

Scapula
1) Greatest length glenoid process
2) Length glenoid cavity
3) Breadth glenoid cavity
4) Minimum neck width

Humerus
1) Maximum breadth distal end
2) Maximum height trochlea (after Legge & Rowley-Conwy 1988)
3) Minimum height trochlea at constriction (after Legge & Rowley-Conwy 1988)
4) Greatest length from condyles
5) Greatest length

Radius
1) Maximum breadth proximal end
2) Maximum breadth distal end
3) Greatest length

Metapodials
1) Maximum breadth proximal end
2) Maximum depth proximal end
3) Maximum breadth distal end
4) Maximum depth distal end
5) Diameter external medial condyle - sheep only (after Boessneck 1969)
6) Diameter internal medial condyle - sheep only (after Boessneck 1969)
7) Greatest length

Tibia
1) Maximum breadth proximal end
2) Maximum depth proximal end
3) Maximum breadth distal end
4) Maximum depth distal end
5) Greatest length

Astragalus
1) Greatest length lateral side

Pelvis
1) Shortest distance between ilio-pubic ridge and acetabular border (after Grigson 1982)

Species	Period	Element	Fusion	Meas 1	Meas 2	Meas 3	Meas 4	Meas 5	Meas 6	Meas 7
COW	M	AST		48.5						
COW	RB/M	AST		51.85						
COW	M	AST		52.8						
COW	M	AST		53.5						
COW	RB/M	AST		54.3						
COW	M	AST		56.8						
COW	M	AST		57						
COW	M	AST		57.35						
COW	RB/M	AST		57.4						
COW	M	AST		61.4						
COW	M	AST		62.5						
COW	M/PM	AST		64.75						
COW	M	AST		68.05						
COW	M/PM	AST		71.45						
COW	M/PM	AST		72.15						
COW	M/PM	HUM	DF			30.7				
COW	M	HUM	DF		38.25	30.45				
COW	M	HUM	DF		39.85	31.2				
COW	M/PM	HUM	DF		45.6	31.8				
COW	M	HUM	DF	69.85		30.05				
COW	M/PM	HUM	DF	71.05	37.7	28.35				
COW	M	HUM	DF	72	40.2	31				
COW	M/PM	HUM	DF	74.7	48.95	35.9				
COW	M	HUM	DF	89.25	44.3	35.65				
COW	M	MAN		70.85						
COW	M/PM	MC	F			52.4	29.15			
COW	M/PM	MC	F			52.6	28.5			
COW	M	MC	F			53.35	28.95			
COW	M/PM	MC	F			53.7				
COW	M/PM	MC	F			56.35	30.75			
COW	M/PM	MC	F			63.45	32.4			
COW	M/PM	MC	F			66.75	34.55			
COW	M	MC		44.95						
COW	M	MC		46.35	30.8					
COW	M	MC		49.3						
COW	M/PM	MC		49.65	31.6					
COW	M	MC		50	38.75					
COW	M/PM	MC		50.45						
COW	RB/M	MC		52.4	31.6					
COW	M/PM	MC		52.55	31.9					
COW	M	MC		53.75	32.7					
COW	M/PM	MC	F	55	35.15	55.8				
COW	M/PM	MC	F	55.5	29.75					
COW	M	MC		62.5	39.7					
COW	M	MC		62.8	30.6					
COW	M/PM	MC		63.4	40.8					
COW	M	MN TO							32.65	13.8
COW	M	MP	U			50.25	27.2			
COW	M/PM	MP	U			53	29.95			
COW	M/PM	MP	U			56.1	31.7			
COW	M	MT	F			47.3	27.8			
COW	M/PM	MT	F			47.9	29.15			
COW	M/PM	MT	F			48.2	28.4			
COW	M/PM	MT	F			48.25	28.65			
COW	M/PM	MT	F			48.5				
COW	M	MT	F			48.6	27.55			
COW	M/PM	MT	F			49.2				
COW	M/PM	MT	F			49.75	28.65			
COW	M/PM	MT	F			51.05	29.3			
COW	M/PM	MT	F			51.05	29.35			
COW	M/PM	MT	F			53.9	32.1			

COW	M	MT	U			54.8	32.15			
COW	M/PM	MT	F			55.2	31.1			
COW	M	MT	F			56.35	32.15			
COW	M/PM	MT	F			58.55	32.2			
COW	M/PM	MT	F			58.75	33.25			
COW	M	MT	F			61.35	34.65			
COW	M/PM	MT	F			62.6	33.05			
COW	M/PM	MT	DF			66.5				
COW	M	MT		37.75	36.9					
COW	M	MT		41.2	39.4					
COW	M	MT		41.25	39.15					
COW	M	MT		41.65	35.15					
COW	M	MT		42.3	38.05					
COW	RB/M	MT		43	40.65					
COW	RB/M	MT		43.4	40.25					
COW	M	MT	U	43.4	40.5					
COW	?M	MT		43.9	38.2					
COW	M	MT		44.05	41.5					
COW	M	MT		44.25	42.5					
COW	M/PM	MT		44.9	40.7					
COW	M/PM	MT		46	46.65					
COW	M	MT		46.15	45.45					
COW	M	MT	F	47.95						
COW	M/PM	MT		48.1	48.9					
COW	M	MT		48.25	45.2					
COW	M/PM	MT		48.55	45.5					
COW	M	MT	F	49.7	48.55					
COW	M/PM	MT	F	65.85						
COW	M	MX TO							30.1	21.5
COW	M/PM	PELV	F	10.15						
COW	M	PELV	F	10.4						
COW	M	PELV	F	11.5						
COW	M	PELV	F	11.75						
COW	M	PELV	F	5.95						
COW	M/PM	PELV	F	6.3						
COW	M	PELV	F	7.1						
COW	M	PELV	F	9.1						
COW	M/PM	RAD	DF		63.55					
COW	?M	RAD	DF		67.35					
COW	M	RAD	DF		73					
COW	M/PM	RAD	DU		74.7					
COW	M/PM	RAD	PF	67.3						
COW	M/PM	RAD	PF	69.1						
COW	M	RAD	PF	70.55						
COW	M	RAD	PF	72.9						
COW	M/PM	RAD	PF	73.95						
COW	M/PM	RAD	PF	77.5						
COW	M	RAD	PF	79.15						
COW	M	RAD	PF	81.8						
COW	M	RAD	PF	83						
COW	M	RAD	PF	83.4						
COW	M/PM	RAD	PF	85.4						
COW	M	SCAP	F				38.75			
COW	M/PM	SCAP	F			42.95	47.4			
COW	M/PM	SCAP	F			45.3				
COW	M/PM	SCAP	F		49.4	40.25				
COW	M	SCAP	F		63.85	55.1				
COW	M	SCAP	F	62.6	55.15	52.55				
COW	M	SCAP	F	64	44.3	43.2				
COW	M	SCAP	F	65.35	54.35	43.55				
COW	M	SCAP	F	78.2	51.1					
COW	M	SKULL						104.7		
COW	M	SKULL	F	13.95	36.4	127				

COW	M	SKULL	F	14.25						
COW	M/PM	SKULL	F	32.95	27.05	95	96			
COW	M/PM	SKULL	F	35.1	54.2	188				
COW	M/PM	SKULL	U	35.8	28.55	103	103			
COW	M	SKULL	F	36.3	31.75	110	119			
COW	M/PM	SKULL		36.4	33.9					
COW	M	SKULL	F	36.65	30.95	105	97			
COW	M	SKULL	F	36.95	27.7	104	113			
COW	M	SKULL		37.15	30.75	105	149			
COW	M/PM	SKULL		38	31.8	112				
COW	M	SKULL	F	38.3	29.5	109	132			
COW	RB/M	SKULL		39.25	28	108				
COW	M/PM	SKULL	F	39.95		112	98			
COW	M	SKULL	F	39.95	32.55	112	133			
COW	M	SKULL	F	40		112	111			
COW	M/PM	SKULL		40	31.35	115	107			
COW	M	SKULL	F	40.2	36.1	128	138			
COW	M	SKULL	F	40.35	30.9	113	123			
COW	M	SKULL		41.35	31.4					
COW	M	SKULL	F	41.5	32.8	122	121			
COW	M/PM	SKULL	F	41.6	33.5	119	125			
COW	M	SKULL	U	41.7	33.55					
COW	RB/M	SKULL	F	41.95	27.95	111	131			
COW	M	SKULL	F	42.05	32.9					
COW	M/PM	SKULL	F	42.3	30.85	113	133			
COW	M	SKULL	F	42.85	33.7	125	144			
COW	M	SKULL		42.85	33.8	123				
COW	M/PM	SKULL		43.45	35.45	126				
COW	M	SKULL	F	44.1	34	125				
COW	M	SKULL		44.3						
COW	M/PM	SKULL		46.65	37.2	130	128			
COW	M	SKULL	F	46.9	36.05	131	142			
COW	RB/M	SKULL	F	46.9	36.5	129				
COW	M/PM	SKULL		47.2	35.15	129	149			
COW	M/PM	SKULL	F	47.75	35.25	132	153			
COW	M	SKULL	F	47.95	37	136	119			
COW	M	SKULL		48.9	35.55	131	125			
COW	M/PM	SKULL		48.95	37.05	137				
COW	M	SKULL	F	49.35	38.55	138				
COW	M	SKULL	F	49.5	39.05	137	156			
COW	?PM	SKULL	F	49.65	40	142				
COW	M	SKULL		49.7						
COW	M/PM	SKULL	F	50.85	41.25	146	158			
COW	M	SKULL	F	50.9	39.2	144	153			
COW	M	SKULL	F	50.95	41.8	146				
COW	?PM	SKULL	F	51	41.35	146				
COW	M	SKULL	F	51.5	38.05	142	191			
COW	M	SKULL	F	52.2	35.45	138	145			
COW	M	SKULL	F	52.5	41.5					
COW	M/PM	SKULL		53.35	39.2	143				
COW	M	SKULL	F	53.55	41.3					
COW	M	SKULL		53.85	48.6	162				
COW	M	SKULL		54.9	47.8					
COW	M	SKULL	F	55.15	47.65					
COW	M/PM	SKULL	F	56.55	47.85					
COW	M/PM	SKULL	F	57.2	47.7	165				
COW	M	SKULL		57.45	44.95					
COW	M	SKULL	F	57.55	45.8	159				
COW	M	SKULL	F	57.55	46.7	165	173			
COW	M/PM	SKULL		58.3	40.05					
COW	M	SKULL	F	58.3	49.2	170	175			
COW	M	SKULL		58.35	49.65	173				
COW	M	SKULL	F	58.55	51.6	185				

COW	M/PM	SKULL	F	60.1	47.95	173				
COW	M	SKULL		61.05	51.85	175				
COW	M/PM	SKULL		61.2	47.3	174				
COW	M	SKULL	F	61.4	47.35	172				
COW	M/PM	SKULL	F	62.2	49.8	179				
COW	M	SKULL	F	62.4	51.9	183				
COW	M	SKULL	F	62.45	44.3	168				
COW	M	SKULL	F	65.3	48	182				
COW	M	SKULL		68.05	48.1	188				
COW	M	SKULL	F	70	55.55	202				
COW	M	SKULL	F	76.9						
COW	M/PM	TIB	DF				46.85			
COW	M/PM	TIB	DF			53.2	36.9			
COW	M/PM	TIB	DF			54.4				
COW	M/PM	TIB	DI			56.2	41.2			
COW	M/PM	TIB	DF			60.25	40.3			
COW	M	TIB	DF			62.45	46.4			
COW	M	TIB	DF			62.5				
COW	M	TIB	DF			64	51.7			
COW	M	TIB	DF			64.05				

Species	Period	Element	Fusion	Meas 1	Meas 2	Meas 3	Meas 4	Meas 5	Meas 6	Meas 7
GOAT	M	MC	F	23.25	16.3	27.35	15.9	9.55	16	116
SHP	M	AST		24.7						
SHP	M	AST		28.05						
SHP	M/PM	AST		28.3						
SHP	M	HUM	DF			13.8				
SHP	M	HUM	DF			14.65				
SHP	M	HUM	DF		16.6	13.9				
SHP	M	HUM	DF		17.05	13.2				
SHP	M	HUM	DF		17.2	14.55				
SHP	M/PM	HUM	DF		18	13.2				
SHP	M/PM	HUM	DF		19.55	14.05				
SHP	M/PM	HUM	DF	26.1	15.8	13.2				
SHP	M	HUM	DF	27.55	18.25	13.5				
SHP	M	HUM	DF	27.6	16.4	13.45				
SHP	M/PM	HUM	DF	28.7	18.4	13.8				
SHP	M/PM	HUM	DF	28.75	18.05	14.6				
SHP	M	HUM	DF	28.85	16.15	12.55				
SHP	M/PM	HUM	DF	29.15	16.85	13.6				
SHP	M/PM	HUM	DF	29.15	17.7	13.75				
SHP	M/PM	HUM	DF	29.35	17.4	13.95				
SHP	M	HUM	DF	30.15	17.55	14.2				
SHP	M/PM	HUM	DF	30.35	16.55	14.4				
SHP	M	HUM	DF	30.5	18.35	14.5				
SHP	M/PM	HUM	DF	30.5	18.6	14.7				
SHP	M/PM	HUM	DF	31	13.05	14.6				
SHP	M	HUM	DF	31.05	17.75	14.75				
SHP	M/PM	HUM	PIDF	31.45	18.8	15.25	127	140		
SHP	M/PM	HUM	DF	31.5	17.8	14.8				
SHP	M/PM	HUM	DF	32.35	18.35	14.4				
SHP	M/PM	HUM	DF	33.2	17.85	14.7				
SHP	M/PM	HUM	PFDF	34.15	19.85	15.5	126	142		
SHP	M/PM	MAN							21.65	8.35
SHP	M/PM	MAN							21.8	7.9
SHP	M	MAN							22.1	8.25
SHP	RB/M	MAN							22.45	8.1
SHP	M/PM	MAN						60.5		
SHP	M	MAN						64.45		
SHP	M	MAN						67.05		
SHP	M	MAN						69.15		
SHP	?M	MAN						69.95		
SHP	M	MAN						70.1	21.25	
SHP	M/PM	MAN						70.6		
SHP	M/PM	MAN						71.9		
SHP	M/PM	MAN						71.95	20.05	7.7
SHP	RB/M	MAN						72.7		
SHP	M	MAN						73		
SHP	RB/M	MC	F			22.8				
SHP	M/PM	MC	F			23.25				
SHP	M/PM	MC	F			23.8	15	10.75	15	115
SHP	M	MC	F			24.1	15.9	10.65	15.9	
SHP	M	MC	F			25.05				
SHP	M/PM	MC		19.65	14.2					
SHP	M	MC	F	20.25	15.85	23.8	14.1	9.75	14.15	106
SHP	M	MC		20.5	13.65					
SHP	M	MC		20.6	15.85					
SHP	M/PM	MC	U	20.75	15					
SHP	M/PM	MC		20.9	15.5					
SHP	M/PM	MC		21.7	15.5					
SHP	M	MC		21.75	16.85					
SHP	M	MC		21.85	11.5					
SHP	M/PM	MC	F	22	17	26.1	16.5	11.4	16.5	118

SHP	M	MC	F	22.05	15.65	22.85	15.05	10.45	15.05	111
SHP	M/PM	MC	U	22.05	16.55					
SHP	M/PM	MC	F	22.15	16.2	24.5				117
SHP	M	MC		22.35	16.85					
SHP	M/PM	MC		22.65	16.5					
SHP	M	MC		23	16.8					
SHP	M/PM	MC		23.1	17					
SHP	M	MC		23.2						
SHP	M/PM	MC	F	23.25	16.8	25.35	16.65	11.2	15.65	124
SHP	M/PM	MC	F	23.3	16.9	25.45				114
SHP	M	MC	F	23.5	16.7	25.25	15.6	10.9	15.6	119
SHP	?M/PM	MC	F	23.6	17.75	26.1	16.6	11.45	16.55	115
SHP	M	MC		23.85	16.85					
SHP	M/PM	MC		24.15	17.1					
SHP	M	MN GP							20.95	8.1
SHP	M/PM	MN TO							21.15	7.7
SHP	M	MN TO							21.2	7.95
SHP	M/PM	MN TO							21.2	8.4
SHP	M	MN TO							21.25	7.8
SHP	?M	MN TO							21.35	8.05
SHP	M	MN TO							21.4	8.2
SHP	M	MN TO							22.35	8.45
SHP	M/PM	MN TO							22.45	8.4
SHP	M/PM	MN TO							22.9	8.5
SHP	M	MN TO							31.5	8.35
SHP	M/PM	MP	U			23.55	15	10.5	15	
SHP	M	MT	F			22.05	13.95	9.15	13.95	
SHP	M	MT	F			22.1	15.05	9.5	15.1	
SHP	M	MT	F			23.3				
SHP	M/PM	MT	F			23.5	15.75	10.45	15.75	
SHP	M	MT	F			23.55	14.95	10.25	15.05	
SHP	RB/M	MT	F			23.65				
SHP	M/PM	MT	F			23.95	14.8	9.8	14.7	
SHP	M	MT	F			24.15	15.01	9.8	15.1	
SHP	M	MT	F			24.55				
SHP	M/PM	MT		18.2	18.85					
SHP	M/PM	MT		18.7	19.5					
SHP	M/PM	MT	F	19.2	18.85	21.75	14.65	9.55	14.65	121
SHP	M	MT		19.3	19.85					
SHP	M/PM	MT	U	19.6	19.6					
SHP	M	MT		19.65	20.15					
SHP	M	MT		19.7	20.15					
SHP	M/PM	MT		19.75	20.85					
SHP	M	MT		19.8	20					
SHP	M	MT		19.9	20.65					
SHP	M	MT	F	20.05	20.2	23.6	15.45	10.15	15.5	131
SHP	RB/M	MT		20.05	21.5					
SHP	M/PM	MT	F	20.15	19.4	23.3	15.5	10	15.5	119
SHP	M	MT		20.15	20.9					
SHP	M	MT		20.15	21.4					
SHP	M	MT		20.35	19.95					
SHP	M/PM	MT		20.6	20.5					
SHP	RB/M	MT	F	20.9	19.8	24.65	15.75	9.65	15.75	135
SHP	M	MT	F	20.9	21.35	24.45	16.1	10.35	16.1	124
SHP	M	MT		21.05	21					
SHP	M	MT	F	21.25		24.85	16.7	11	16.65	128
SHP	M/PM	MT		21.55	20.9					
SHP	M/PM	MT	F	24.5	20.95					
SHP	M	MX TO							16.6	10.8
SHP	M/PM	MX TO							18.45	10.8
SHP	M	MX TO							18.45	11.2
SHP	M	MX TO							19.1	11.4
SHP	RB/M	PELV	F	1.9						

SHP	M/PM	PELV	F	3.2						
SHP	M	PELV	F	3.95						
SHP	M	PELV	F	4.2						
SHP	M/PM	PELV	F	4.5						
SHP	M/PM	PELV	F	5.2						
SHP	RB/M	PELV	F	5.45						
SHP	M	PELV	F	5.5						
SHP	M	PELV	F	5.85						
SHP	M/PM	PELV	F	6.4						
SHP	M	PELV	F	8.1						
SHP	M	RAD	DF		26.85					
SHP	M	RAD	DF		29.8					
SHP	M	RAD	PFDU	27						
SHP	M	RAD	PF	27.3						
SHP	M/PM	RAD	PF	28.15	14.3					
SHP	M/PM	RAD	PF	29.5						
SHP	M/PM	RAD	PF	29.5						
SHP	M/PM	RAD	PF	29.6						
SHP	M	RAD	PF	30.05						
SHP	M	RAD	PF	30.4						
SHP	M	RAD	PF	30.5						
SHP	M/PM	RAD	PF	30.7						
SHP	M/PM	RAD	PF	30.8						
SHP	M/PM	RAD	PF	31						
SHP	M	RAD	PF	31.4						
SHP	M	RAD	PF	31.9						
SHP	M	RAD	PF	32						
SHP	M/PM	RAD	PF	32.6						
SHP	M	SCAP	F				17.45			
SHP	M/PM	SCAP	F				18.45			
SHP	M/PM	SCAP	F				18.8			
SHP	M/PM	SCAP	F				18.9			
SHP	M/PM	SCAP	F				19.05			
SHP	M/PM	SCAP					19.3			
SHP	M/PM	SCAP	F				21.7			
SHP	M/PM	SCAP	F				22.7			
SHP	M	SCAP	F			18.4				
SHP	M/PM	SCAP	F			18.95	18.6			
SHP	M	SCAP	F		25.35					
SHP	M	SCAP	F	27.6	23	18.4				
SHP	M/PM	SCAP	F	29.15	23.9		18.05			
SHP	M	SCAP	PF	29.45						
SHP	M/PM	SCAP	F	29.95	22.2	17.2	16.45			
SHP	?PM	SCAP	F	30.3	24.15	20.85	18.85			
SHP	M/PM	SCAP	F	31.85	25		18.3			
SHP	M/PM	SCAP	F	32.15			20.85			
SHP	M	SCAP	F	32.55	24.75	22.2	19.9			
SHP	M/PM	SKULL		30.6	23.2					
SHP	M	TIB	DF			22.25	19.8			
SHP	M	TIB	DF			23.7	17.55			
SHP	M	TIB	DF			24.75	18.6			
SHP	M/PM	TIB	DF			25.1	18.65			
SHP	M	TIB	DF			25.4	20.15			
SHP	M/PM	TIB	DF			25.6	18.9			
SHP	M/PM	TIB	DF			26				
SHP	M/PM	TIB	DF			26.15	21			
SHP	M	TIB	DF			26.6	19.7			
SHP	PM	TIB	DF			26.85	19.6			
SHP	M	TIB	DF			27.75				
SHP	M/PM	TIB	DF			28.55	21.3			
SHP	M/PM	TIB	DF			29.05	22.55			
SHP	M	TIB	PF	38.4	35.95					
SHP	M	TIB	PF	40.9	38.35					

Species	Period	Element	Fusion	Meas 1	Meas 2	Meas 3	Meas 4	Meas 5	Meas 6	Meas 7
PIG	M	HUM	DF	36.15	24.05	17.55				
PIG	RB/M	HUM	DF	39.7						
PIG	M/PM	MN TO							32.1	14.25
PIG	M	RAD	PF	30.1						
PIG	M	RAD	PF	30.45						
PIG	M/PM	SCAP					24.65			
PIG	M	SCAP	F			26.25	24.75			
PIG	M	SCAP	F	31.95		20.2	19.4			
PIG	M/PM	SCAP	F	40.95	31.3	29.9	27.85			
PIG	M	TIB	PUDF			24.35	21.45			
PIG	M	TIB	DF			28.7	24.1			
PIG	M	TIB	DF			30.7	25.35			