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**Methods and measurement**

The mammal and bird bones from Culzean Cave were identified by direct comparison with modern comparative material and allocated to particular bone and species where possible. Where it was not possible to identify mammalian bones as far as species, the terms *large ungulate*, *small ungulate* and *indeterminate mammal* were used: thus all large vertebrae other than the atlas and axis were described as large ungulate, while small vertebrae were described as small ungulate. Ribs were similarly allocated depending on their size. Large ungulate bones were most likely to have come from cattle, but could also have come from horse or, less likely in this case, red deer. Similarly, small ungulate bones were most likely to have come from sheep, but could possibly have originated from goat, pig or roe deer. All other mammalian fragments for which neither species nor bone could be ascertained were described as indeterminate mammal.

Measurements were made in accordance with the scheme of von den Driesch (1976) and are expressed in millimetres. Additional measurements on the humerus follow Legge & Rowley-Conwy (1988).

**Species present**

The bones were moderately well preserved. There was however a high degree of fragmentation due to butchery, particularly noticeable in Trench 1, Context 001, where more than half of the fragments were classified as indeterminate mammal. In total, 453 fragments were recorded from all four trenches.

Bones of cattle, sheep/goat, pig, horse, dog/fox, hare, hare/rabbit, domestic fowl (*Gallus gallus*), shag (*Phalacrocorax aristotelis*), curlew (*Numenius arquata*), probable wader species, rock dove (feral pigeon; *Columba palumbus*) and fish were found. Several human bones were recovered from Trench 1, Context 001. The numbers of bones from each species is summarised for each trench in **Table 1** (human and fish bones are excluded).

**Age of animals at death**

Since no mandibular parts survived, the age at death of the livestock was estimated using epiphysal fusion evidence (see **Table 2**). The available sample was however, very small, and although juvenile or immature cattle, sheep/goats and pigs were present, these figures should be treated with caution and the relative proportions of young to old animals cannot be stated with any great certainty.

## **Size of animals**

Few measurements were available due to butchery, but those which could be taken indicate that the bones are from fairly small livestock, probably of pre-modern date (see **Table 3**). The bones are probably within the size ranges for medieval and post-medieval cattle, sheep/goats and pigs.

## **Butchery: evidence of human activity with respect to the animal bones**

Evidence of butchery marks on a number of the larger bones of domestic livestock indicate that the animals were indeed butchered. These marks consisted mainly of chop or hack marks, probably caused by the use of axes or cleavers (such as those noted along the edge of a rib from Trench 1, Context 001) and small knife cuts (as seen on the shaft of a sheep/goat metacarpal in Trench 2, Context 202). There was no evidence that saws had been used, indicating a pre-modern origin for the assemblage.

A high proportion of the fragments from Trench 1, Context 001 came from mammalian long bones, probably cattle. These slivers of bone were small and fairly sharp edged and probably represent the end-result of dismembering and carcass dressing in the near vicinity.

There was also some evidence of animal activity in the cave. A small number of the bones had apparently been gnawed by a carnivore, such as a dog; gnawed bones were found in Trench 1, Context 001 and Trench 3, Context 302. Three bones from a fox or small dog were indeed recovered from Trench 1, Context 001. Thus although people were probably the main agents responsible for the presence of bones in the cave, it is possible that carnivores may have brought in at least some of the material. Alternatively, foxes may merely have scavenged from an existing rubbish heap and at least one carnivore probably perished there.

The site was probably also home to roosting rock doves (feral pigeons), which are equally at home in caves as they are in old buildings. The shag, curlew and wader species may either represent birds eaten as food, or bones washed into the cave by natural means.

## **Bone artefact**

An artefact made from a pig fibula was recovered from Trench 1, Context 001. The method by which this pin was made is typical of the medieval and earlier periods. The distal end of the bone (which was from an immature, unfused specimen) was left unmodified, the proximal end was removed and the shaft of the bone was trimmed to a point, probably using a sharp knife. In this case, the distal end was unpierced, but in other examples, there is often a bored hole.

## Discussion

The animal bones from Culzean Cave represent domestic waste, assumed to have been brought there by human agency, and may result from butchery of livestock on site. Predatory carnivores did however gnaw some of the bones. Other cave complexes in Scotland have also seen this type of activity, for example, excavations by GUARD at the Geodh Smoo (Smith forthcoming) recovered bone and antler fragments of Norse date resulting from bone and antler working and butchery. Excavations at Wemyss Caves in Fife also recovered faunal assemblages, some of which could be attributed to activity within the caves themselves (Guttman 2002). Since caves form a natural shelter, yet allow fresh air to circulate, and may be scoured clean on a regular basis by tides, it is not unsurprising that they should be chosen for activities such as butchery.

The bones at Culzean are probably of pre-modern date: the butchery tools used and the style of butchery are reminiscent of medieval techniques, and the animals themselves are mainly of small build, typical of the period before the agricultural improvements of the late 18th and early 19th centuries.

## References

von den Driesch, A 1976 *The Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Bulletin 1, Harvard University, USA.

Guttman, E B 2002 'Time and tide at East Wemyss: excavations on the foreshore 1980-1995', *Tayside & Fife Archaeological Journal*, 8, 110-24.

Legge, A J & Rowley-Conwy, P A 1988 *Star Carr Revisited*. Birkbeck College, University of London.

Smith C forthcoming *in* Pollard, T 'The animal bone from the Geodh Smoo'.

**Table 1** Numbers of animal bones recovered from Culzean Cave, by trench and species

Species	Trench 1	Trench 2	Trench 3	Trench 4	Total
Cattle	24	4	15		43
Sheep/goat	12	3	1		16
Pig	8	3	2		13
Horse	1		2		3
Dog/Fox	3				3
Hare	2				2
Hare/Rabbit		1			1
Large Ungulate	53		2		55
Small Ungulate	33	3			36
Indeterminate Mammal	248	6	12	1	267
Domestic Fowl	3				3
Shag	1				1
Curlew	1				1
?Wader sp	1				1
Rock Dove	2				2
Indeterminate Bird	6				6
Total	398	20	34	1	453

**Table 2** Age categories of long bones of cattle, sheep/goat and pig, based on epiphysal fusion evidence

Age Category	Cattle		Sheep/goat		Pig	
	n	%	n	%	n	%
J	2	15.4	1	12.5		
J/I	5	38.5	3	37.5	3	33.3
I					1	11.1
I/A	5	38.5	1	12.5	4	44.4
A	1	7.7	3	37.5	1	11.1
Total	13	100.1	8	100.0	9	99.9

Key

- J juvenile
- J/I juvenile or immature
- I immature
- I/A immature or adult

**Table 3** Bone size range summary

Note Measurements follow the systems of von den Driesch (1976) and Legge & Rowley-Conwy (1988) and are expressed in millimetres

### 3.1 Cattle

Bone	Measurement	Range	n
Astragalus	GLl	62.7	1
	Bd	37.8	1
1st Phalange	GLpe	54.2	1
	Bp	27.3	1
	SD	23.6	1
2nd Phalange	GL	33.2-36.8	3
	Bp	24.4-24.6	2
	SD	19.0-19.9	2
3rd Phalange	DLS	57.3-58.2	2
	Ld	43.8-46.2	2

### 3.2 Sheep/Goat

Bone	Measurement	Range	n
Humerus	Bd	31.5	1
	BT	30.4	1
	HT	19.8	1
	HTC	15.2	1
1st Phalange	GLpe	31.9	1
	SD	10.4	1

### 3.3 Pig

Bone	Measurement	Range	n
Scapula	SLC	21.6-23.8	2
	GLP	31.8-34.6	2
Metacarpal III	GL	61.2	1
	Bp	13.6	1
	Bd	14.0	1
	SD	11.2	1
Tibia	Bd	27.7-31.1	2
	Dd	25.2-26.1	2
Astragalus	GLl	40.2	1
	GLm	37.0	1
1st Phalange	Bd	13.0	1
	SD	11.0	1