Scottish Archaeological Internet Reports

3.11 The Zooarchaeology of Sand | Rachel Parks & James Barrett

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3.11.1 Introduction

This report is based on analysis of the mammal, bird and fish remains from Sand. Approximately one third of the material was analysed by Parks in fulfilment of an MSc in Zooarchaeology at the University of York. The data presented here combines results from that, and more recent analysis, and supersedes earlier unpublished work (Gamble 2002; Parks & Barrett 2004). The full bone catalogue is held as a database in the National Monuments Record for Scotland, and by the author, at the Department of Archaeology, University of York.

A narrow range of local taxa was exploited at Sand, including red deer, wild boar, razorbills and guillemots, and fish from the cod and wrasse families. The mammal remains are highly fragmentary and interpretation is tentative. The bird and fish assemblages, however, are large and it is suggested that two possible seasons of use are represented at the site. The zooarchaeological significance of Sand is not to be underestimated; it is a substantial assemblage from a period in Scottish prehistory with little faunal evidence.

3.11.1.1 The zooarchaeological record of Mesolithic Scotland

Comparative faunal assemblages are important to assess trends of animal use both at Sand and in the period as a whole, but the lack of faunal remains in the Scottish Mesolithic (McCormick & Buckland 1997; Kitchener *et al* 2004) means that few comparative assemblages are available. The unpublished or partly published nature of some sites further reduces this number. The largest comparative assemblage comes from the 5th millennium BC site of the Cnoc Coig shell midden on Oronsay, of which only the mammal bone has been comprehensively published (Grigson & Mellars 1987). The amount of mammal bone recovered here is small and by far the most common species was grey seal (360 specimens) followed by otter (123 specimens), red deer (70 specimens excluding antler) and wild boar (56 specimens). The existing published fish data deals explicitly with the otoliths from the dominant species, saithe (Mellars & Wilkinson 1980).

Much smaller, but published, faunal assemblages are available from the middens at Carding Mill Bay, near Oban, and Morton in Fife (Connock *et al* 1992, Coles 1971). At Carding Mill Bay, red deer, roe deer and wild boar were sparsely represented (two specimens each, Hamilton-Dyer & McCormick 1993:Table 6) and the remaining mammal, bird and fish specimens appear to be a mix of human refuse and natural deposits (McCormick & Buckland 1997:88; Hamilton-Dyer & McCormick 1993:34). From Morton site B, 23 identified mammal specimens are listed in the 1971 report, including deer (12 specimens), aurochs (six specimens), bank vole (two specimens) and single specimens of wild boar, hedgehog and roe deer (Coles 1971:349). The bird bones from the site have been interpreted as representing individual meals and were mostly from seabirds that prefer open water. Out of a total of 34 identified specimens the most abundant species were guillemot, represented by 14 specimens, and gannet, represented by six specimens (Cowles in Coles 1971:350). The fish remains (950 specimens) were overwhelmingly dominated by cod, and Wheeler (in Coles 1971:351) notes that many bones were from large fish, however, the method of recovery during excavation is unclear. Hand collection of material would bias towards large, intact specimens.

In addition to these sites reports on the faunal remains from Ulva cave, on the island of Ulva (Bonsall *et al* 1994:8–21), and An Corran, on Skye (Hardy *et al* forthcoming), await publication. This lack of comparative material, whilst frustrating, serves to highlight the importance of the faunal remains from Sand.

3.11.2 Recovery and methods at Sand

Recovery methods are crucial to understanding the faunal assemblage (Section 3.2; Hardy & Wickham-Jones 2000:48–55). Open area excavation on the terrace of the Sand rockshelter included both the midden deposits and the adjacent midden free area. Outside of the midden no *in situ* features were preserved, probably due to the steep slope, and the midden itself had begun to move down-slope. Approximately 90m² was excavated in two L-shaped trenches.

During excavation all material was wet sieved using a flotation machine: 1.0mm and 0.3mm sieves were used for the floating fraction and the heavy fraction was retained by a 1mm mesh. Some bone was also hand collected during excavation. During initial post-excavation the 1mm heavy fraction was sorted into basic categories: bird; mammal (burnt and unburnt); fish; teeth; and otoliths. The faunal material recovered from the floating fraction and hand collection was minimal and it was combined with the rest of the material prior to analysis.

Due to the rarity of Mesolithic faunal assemblages, no sub-sampling of excavated material was undertaken prior to analysis. However, material from the 1999 test pitting programme at Sand and a small amount of misclassified material extracted during recording was not included. The material was divided into greater than 4mm and greater than 2mm fractions. Fish, small mammal and amphibian bones recovered from both size fractions were analysed. For the bird and mammal bone only the greater than 4mm fraction was recorded.

Recording followed the York protocol (Harland *et al* 2003) which uses a system of quantification codes (QC) to distinguish between diagnostic and non-diagnostic elements. Under the York system, 17 diagnostic (QC1) mammal bone elements are routinely recorded in detail, including species, element zones present and maximum linear dimension. Preservation is assessed by two criteria; surface texture and element completeness. Elements with special interest such as antler are recorded as QC4 elements, all other elements are listed as QC0.

Recording for the bird bone follows that of mammals, with eight QC1 elements recorded in full. Eighteen diagnostic (QC1) fish bone elements are routinely recorded in detail as for bird and mammal, with the addition of an estimation of fish size. Special elements such as otoliths (QC4) are also recorded in detail. Vertebrae (QC2 elements) are identified to family or species level where possible, and all other (QC0) elements are recorded as unidentified. Gadidae vertebrae are further identified to eight groups according to their place along the vertebral column (as defined in Barrett 1997).

For all classes of material QC0 refers to bones that were truly unidentifiable and those not routinely recorded in the York System protocol. All bone fragments were counted and weighed. Measurements taken on mammal and bird specimens followed those defined in von den Driesch 1976, unless otherwise stated. Fish measurements followed those in Barrett 2001 (and references within) where possible; however, it was necessary to use alternative measurements for some Labridae specimens. Metric data for all classes of material are provided in Appendices 22, 23, 24. All alternative fish measurements used for labrids are defined in Appendix 21. The Latin names for taxa mentioned in the text are listed in Appendix 25.

Quantification is by number of identified specimens (NISP) and weight only. The number of identified specimens may be used as both a count of identified specimens and also as a relative measure of species abundance. Another commonly used method of assessing species abundance, the minimum number of individuals (MNI) is not used. MNI provides a conservative estimate of the least number of the individuals required to account for the specimens identified for a certain species by context or site. Both NISP and MNI are heavily affected by how easy it is to identify an element to species, and how fragmented the material is (Reitz & Wing 1999:191–194). In addition, NISP as 'raw data' is best suited for comparison with other sites. At Sand, given the above, the potentially large temporal range of deposition, the lack of distinct contexts within the main shell midden and the high fragmentation of the material, only NISP is used.

3.11.3 Results

In total, 113,998 bone fragments weighing 21,223.49g were examined from Sand (see Tables 135 & 136). This large number of fragments does, however, mask the much smaller subset of 16,589 diagnostic elements (QC1, QC4 and QC2 elements) that were subject to detailed analysis. The majority of bones were recovered from three contexts; the topsoil (Contexts 1, 2, 3), the main shell midden (mainly Contexts 11, 12, 13, 28), and organic rich silt layer (Context 22). The two most archaeologically significant contexts with sufficient remains, the main shell midden and organic rich silt layer are discussed in detail. Bone was also recovered in small quantity from the slumped stony deposit and the sandy soil with heat cracked stone in Area A (Contexts 17, 27, 29). Reference to the context concordance chart (Appendix 3) provides a full description of the way in which the contexts were divided.

To access a printable version of this table, please go to the separate page `table135.html` and set to LANDSCAPE mode.

Table 135

class	recovery	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	total
mammal											
diagnostic	4mm	66	137		2	72	3	9		3	292
	hc	1	2								3
unidentified	4mm	13601	13025	81	1473	6645	2521	5618	24	438	43426
	hc	59	1								60
	subtotal	13727	13165	81	1475	6717	2524	5627	24	441	43781
bird											
diagnostic	4mm	307	810		38	88	17	25	2	3	1290
unidentified	4mm	3608	7953	8	549	2375	206	325	9	18	15051
	subtotal	3915	8763	8	587	2463	223	350	11	21	16341
fish											
diagnostic	2–4mm	2817	6582	2	66	348	169	311	1	80	10376
	4mm	1015	3089		46	191	86	116	1	34	4578
unidentified	2–4mm	7992	21747	3	285	2669	694	1268	2	231	34891
	4mm	844	2609		29	244	44	63		19	3852
	subtotal	12668	34027	5	426	3452	993	1758	4	364	53697

small mammal and amphibian											
diagnostic	2–4mm	13	18				1	1			33
	4mm	5	10				1	1			17
unidentified	2–4mm	16	63		1	8	4	23			115
	4mm		13			1					14
	subtotal	34	104		1	9	6	25			179
	total diagnostic	4224	10648	2	152	699	277	463	4	120	16589
	total number of bones	30344	56059	94	2489	12641	3746	7760	39	826	113998

Table 135: SFS, Number of identified specimens from Sand by method of recovery
Key: hand collected (hc), wet sieved greater than 4mm fraction (4mm), wet sieved greater than 2mm fraction (2–4mm)

To access a printable version of this table, please go to the separate page table136.html and set to LANDSCAPE mode.

Table 136

class	recovery	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	total
mammal											
diagnostic	4mm	541.36	1437.72		72.50	764.56	48.50	52.54		39.50	2956.68
	hc	54.00	156.30								210.30
unidentified	4mm	4721.64	5103.45	10.00	465.04	2056.47	621.74	1413.43	8.50	275.57	14675.84
	hc	93.00	3.50								96.50
	subtotal	5410.00	6700.97	10.00	537.54	2821.03	670.24	1465.97	8.50	315.07	17939.32
bird											
diagnostic	4mm	121.50	360.94		12.97	38.64	6.99	10.71	0.50	3.94	556.19
unidentified	4mm	454.83	820.08	0.35	61.59	286.27	31.22	49.82	0.94	1.76	1706.86
	subtotal	576.33	1181.02	0.35	74.56	324.91	38.21	60.53	1.44	5.70	2263.05
fish											
diagnostic	2–4mm	50.99	114.22	0.03	0.72	5.31	2.98	4.34	0.03	1.56	180.18
	4mm	66.33	202.08		3.31	12.82	5.20	6.38	0.08	2.94	299.14
unidentified	2–4mm	91.88	221.59	0.03	2.71	29.12	8.42	12.34	0.02	2.77	368.88
	4mm	39.12	100.22		1.36	12.67	2.03	2.75		1.05	159.20

subtotal		248.32	638.11	0.06	8.10	59.92	18.63	25.81	0.13	8.32	1007.40
small mammal and amphibian											
diagnostic	2–4mm	0.15	12.25		0.03	0.02					12.45
	4mm		0.17		0.03	0.05					0.25
unidentified	2–4mm	0.02	0.55		0.01	0.07	0.02	0.22			0.89
	4mm		0.06			0.07					0.13
subtotal		0.17	13.03		0.07	0.21	0.02	0.22			13.72
total diagnostic		834.33	2283.68	0.03	89.56	821.40	63.67	73.97	0.61	47.94	4215.19
total number of bones		6234.82	8533.13	10.41	620.27	3206.07	727.10	1552.53	10.07	329.09	21223.49

Table 136: SFS, Weight of bones from Sand by method of recovery
Key: hand collected (hc); wet sieved greater than 4mm fraction (4mm), wet sieved greater than 2mm fraction (2–4mm)

From the main shell midden 139 mammal, 810 bird and 9,671 fish diagnostic elements were recorded. Fewer bones were recovered from the organic rich layer, including 72 mammal, 88 bird and 539 fish diagnostic elements. The majority of the fish remains were recovered from the >2mm fraction, highlighting the importance of fine-sieve recovery (in opposition to Vale & Gargett 2002). The greater number of fish bones is to some extent inflated by the large number of vertebrae (QC2 elements) recorded (see Section 3.11.3.4.3). But, taking into account the differing numbers of diagnostic elements recorded for each class (mammal 17 QC1, 4 QC4, bird 8 QC1 and fish 18 QC1, 4 QC4 and vertebrae), the number of mammal specimens, especially in the main shell midden, is relatively small. By weight, however, mammal bone was the dominant class for both the main shell midden and organic rich contexts. Unidentified mammal bone accounts for fewer than 60% of the total main shell midden bone assemblage. The high number of unidentified specimens suggests that much of the mammal bone was fragmented beyond identification and possible taphonomic and butchery patterns are explored below (Sections 3.11.3.1.4 and 3.11.3.1.6).

3.11.3.1 Mammal bone

3.11.3.1.1 Preservation

A total of 43,781 mammal bones weighing 17,939.31g was recovered from the site (see Tables 137 & 138, below). The small subset of 206 QC1 elements, the majority of which were recovered from the main shell midden and topsoil, makes comparison of preservation between contexts difficult. Based on the surface texture of QC1 elements, preservation of mammal bone in the main shell midden was generally fair to good (see Table 139). By the same criterion, preservation in the organic rich silt layer was fair to poor, although this assessment is based on only 20 specimens. The majority of elements in the main shell midden and organic rich contexts were –20% or 21–40% complete, indicating a high level of fragmentation (see Table 140).

To access a printable version of this table, please go to the separate page `table137.html` and set to LANDSCAPE mode.

Table 137

taxon	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
whale sp.		present								

dog or wolf		2								2
fox		1								1
dog family	1									1
badger					present					
otter		present								
seal sp.	1									1
wild boar	8	29			1		2			40
red deer	30	49		1	22	2	2		2	108
roe deer	1	5								6
deer family	3	2								5
Bos sp.	4	1			1		1			7
sheep	3						1			4
sheep or goat		1								1
large mammal	8	8			3	1	3			23
medium mammal	3	6			2					11
unidentified	13660	13026	81	1473	6645	2521	5618	24	438	43486
QC1 Subtotal	62	104	0	1	29	3	9	0	2	210
QC4 Subtotal	5	35	0	1	43	0	0	0	1	85
Total	13727	13165	81	1475	6717	2524	5627	24	441	43781

Table 137: Sand, Number of identified mammal specimens by context

To access a printable version of this table, please go to the separate page table138.html and set to LANDSCAPE mode.

Table 138

taxon	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
whale sp.		present								
dog or wolf		3.50								3.50
fox		0.50								0.50
dog family	0.50									0.50
badger					present					

otter		present								
seal sp.	2.00									2.00
wild boar	72.70	146.50			2.50		8.04			229.74
red deer	385.80	764.48		38.00	318.66	19.50	11.50		36.00	1573.94
roe deer	2.00	18.50								20.50
deer family	7.00	19.00								26.00
Bos sp.	26.86	11.87			27.00		20.00			85.73
sheep	15.50						1.50			17.00
sheep or goat		4.00								4.00
large mammal	61.50	210.86			21.50	29.00	11.50			334.36
medium mammal 1	10.50	18.00			21.00					49.50
unidentified	4814.64	5106.95	10.00	465.04	2056.47	621.74	1413.43	8.50	275.57	14772.34
QC1 Subtotal	584.36	1197.21	0	38.00	390.66	48.50	52.54	0	36.00	2347.27
QC4 Subtotal	11.01	390.37	0	34.50	373.90	0	0	0	3.50	813.28
Total	5410.01	6694.53	10.00	537.54	2821.03	670.24	1465.97	8.50	315.07	17932.89

Table 138: Sand, Weight of mammal specimens by context

To access a printable version of this table, please go to the separate page table139.html and set to LANDSCAPE mode.

Table 139

texture	topsoil	main shell midden	organic rich	shell midden	sandy soil	unprov	Total
excellent			1				1
good	21	57	3	1	2	1	85
fair	20	36	7	1	3	1	68
poor	4	3	9		1		17
Total	45	96	20	2	6	2	171

Table 139: Sand, Surface texture of mammal QC1 elements. Assessment of surface texture based on the following criteria (Harland *et al* 2003):
Excellent – majority of surface fresh or even slightly glossy; very localised flaky or powdery patches;
Good – lacks fresh appearance but solid; very localised flaky or powdery patches;
Fair – surface solid in places, but flaky or powdery on up to 49% of specimen;
Poor – surface flaky or powdery over >50% of specimen

To access a printable version of this table, please go to the separate page table140.html and set to LANDSCAPE mode.

Table 140

element completeness	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
0–20%	15	25		10		3		53
21–40%	13	35	1	7	1	2	1	60
41–60%	2	12		1	1		1	17
61–80%	1	4						5
81–100%	12	16		2		1		31
Total	43	92	1	20	2	6	2	166

Table 140: Sand, Completeness of mammal QC1 elements

Just over 30% of the mammal bone was burnt, mainly charred rather than calcined (see Table 141, below). A substantial number of charred fragments were recovered from the sandy soil and heat cracked stone context. Carnivore and rodent gnawing was minimal, and, excluding butchery and working evidence (discussed below), few specimens were otherwise modified. One antler specimen from the main shell midden is of interest as it shows signs of ungulate gnawing, probably by deer (see Illustration 482 lower, right). The same specimen also shows evidence of working, and could suggest the collection of shed antler for use at Sand (see Illustration 482 upper, right).

Illus 482 (right): Worked antler specimen (a, upper), the same specimen shows evidence of ungulate gnawing (b, lower). In both illustrations the bar scale represents 40mm

To access a printable version of this table, please go to the separate page table141.html and set to LANDSCAPE mode.

Table 141

modification	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
carnivore gnawing	6	9			6	1				22
rodent gnawing		2								2
root etching	4	5			3	1				13
root etching & carnivore gnawing		2								2
ungulate		1								1

gnawing										
calcined	1139	666	9	81	292	205	1086	1	29	3508
charred	3289	2869	10	218	644	522	1132	4	174	8862
burning Total	4428	3535	19	299	936	727	2218	5	203	12370

Table 141: Sand, Modification of mammal bone (all specimens) by context

3.11.3.1.2 Taxonomic abundance

The mammalian assemblage is dominated by wild terrestrial taxa (see Table 137, above), including species indicative of a woodland environment. The most abundant species recorded was red deer, followed by *Sus sp* assumed to be wild boar (based on a qualitative assessment of size and tooth cusp pattern) and referred to as such from hereafter. A wider diversity of species was recorded from the main shell midden, compared to the organic rich silt layer, including roe deer, fox, dog or wolf and otter. Apart from red deer and wild boar, the only other positively identified species from the organic rich silt was badger. Marine mammalian taxa are represented by one seal phalanx, unidentifiable to species, and one unidentified fragment of whale bone. There is no evidence at Sand, therefore, for the intensive exploitation of marine mammalia taxa as for grey seal at Cnoc Coig (Grigson & Mellars 1987).

A few, largely non-diagnostic, elements of probably domestic *Bos* sp. were recorded. These included isolated teeth, a navicular-cuboid and one axis and come from a variety of locations (see Table 142, below). The axis is clearly intrusive due to a cut mark apparently made with a metal blade, but it is not clear if the other elements are intrusive. Few measurable elements were recovered. Measurements were taken from a navicular-cuboid from the main shell midden and a mandibular first molar from the topsoil. Given the lack of measurements it is difficult to assess whether the Bos sp. specimens represent wild aurochs or domestic cattle, but the latter seems probable based on qualitative assessment (O'Connor *pers comm*). Whilst domestic animals are traditionally associated with the Neolithic, the early introduction of a few domesticates in otherwise Mesolithic contexts has recently been argued for Irish assemblages (Woodman & McCarthy 2003). Direct dating of the Sand specimens would be advantageous, but it may still be difficult to demonstrate domestic species on the basis of isolated specimens alone (Rowley-Conwy 1995).

This table can also be printed from the separate page table142.html in LANDSCAPE mode.

Table 142

taxon	element	topsoil	main shell midden	organic rich	shell midden	sandy soil	Total
Bos sp.	mandibular premolar	2					2
	mandibular molar	2	1	1		1	5
	axis		1				1
	navicular cuboid		1				1
	incisor	1	5				6
	isolated teeth		1				1
	maxillary molar		1	1			2
sheep	mandibular deciduous	2					2

	premolar						
	metatarsal	1					1
	pelvis					1	1
	maxillary molar		1				1
	isolated teeth					2	2
sheep or goat	calcaneum		1				1
	isolated teeth	5		1	1	1	8
	maxillary molar		1		1		2
	Total	13	13	3	2	5	36

Table 142: Sand, Possible domestic mammalian taxa recorded (all quantification codes)

In addition to *Bos* sp. specimens, one sheep pelvis was recovered from the sandy soil layer and one sheep metatarsal from the main shell midden. The colour and texture of the specimen from the main shell midden suggests that it was probably intrusive. A few other caprine specimens were also identified from various contexts, including a calcaneum, from the main shell midden (see Table 142, above). Whilst heeding the above, without direct dating it is assumed that these are also likely to be intrusive.

Following the York protocol, mammal elements not identifiable to genera were recorded as either 'large mammal', 'medium mammal 1' or 'medium mammal 2'. The first category was used to describe specimens which could have been red deer, cattle or large wild boar, medium mammal 1 was used for specimens the size of small cervids and wild boar, and medium mammal 2 for taxa such as otter, badger and canids.

3.11.3.1.3 Element representation

From the main shell midden, QC1 elements were recorded for red deer, wild boar, roe deer, dog or wolf, fox, *Bos* sp., sheep and either sheep or goat. From the organic rich silt layer, QC1 elements were recorded for red deer, wild boar and *Bos* sp. (see Table 143, below). Red deer was the most abundant species, followed by wild boar for both contexts. Apart from the relatively few diagnostic elements, as compared to the bird and fish assemblages (see below), the most striking observation regarding the mammal remains from Sand is the number of terminal appendicular elements as opposed to meat bearing bones.

To access a printable version of this table, please go to the separate page table143.html and set to LANDSCAPE mode.

Table 143

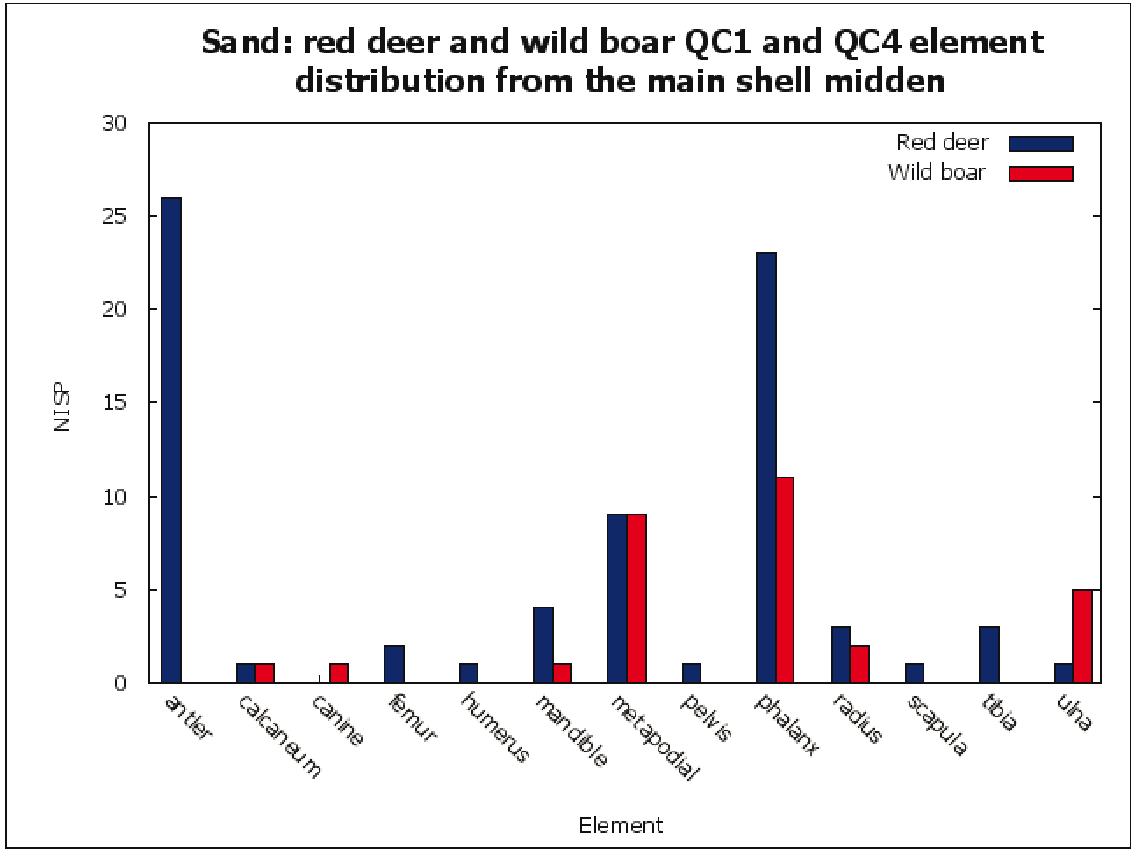
taxon	QC	element	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
dog or wolf	1	scapula		1						1
		ulna		1						1
fox	1	scapula		1						1
dog family	1	metacarpal	1							1

seal	1	phalanx1	1							1
wild boar	1	astragulus	1							1
		calcaneum	1	1						2
		metacarpal3		1						1
		metacarpal4		1						1
		metapodial	1	5						6
		metatarsal				1				1
		metatarsal3		1						1
		metatarsal4		1						1
		mandible	1	1				1		3
		phalanx1		3						3
		phalanx2	3	6				1		10
		phalanx3	1	2						3
		radius		2						2
		ulna		5						5
	4	canine		1					1	2
red deer	1	astragulus	4			1			1	6
		calcaneum	2	1		1				4
		femur		2						2
		humerus	2	1	1	3				7
		metapodial	2	7		5				14
		metatarsal		2						2
		mandible	6	4		5		1		16
		pelvis		1		1			1	3
		phalanx	2	2						4
		phalanx1	4	9		2	1			16
		phalanx2	2	5		1		1		9
		phalanx3	1	7		1				9
		radius	3	3						6
		radius/ulna	1							1
		scapula		1		1	1			3
		tibia	1	3						4
		ulna		1		1				2
	4	antler	3	26	1	41				71

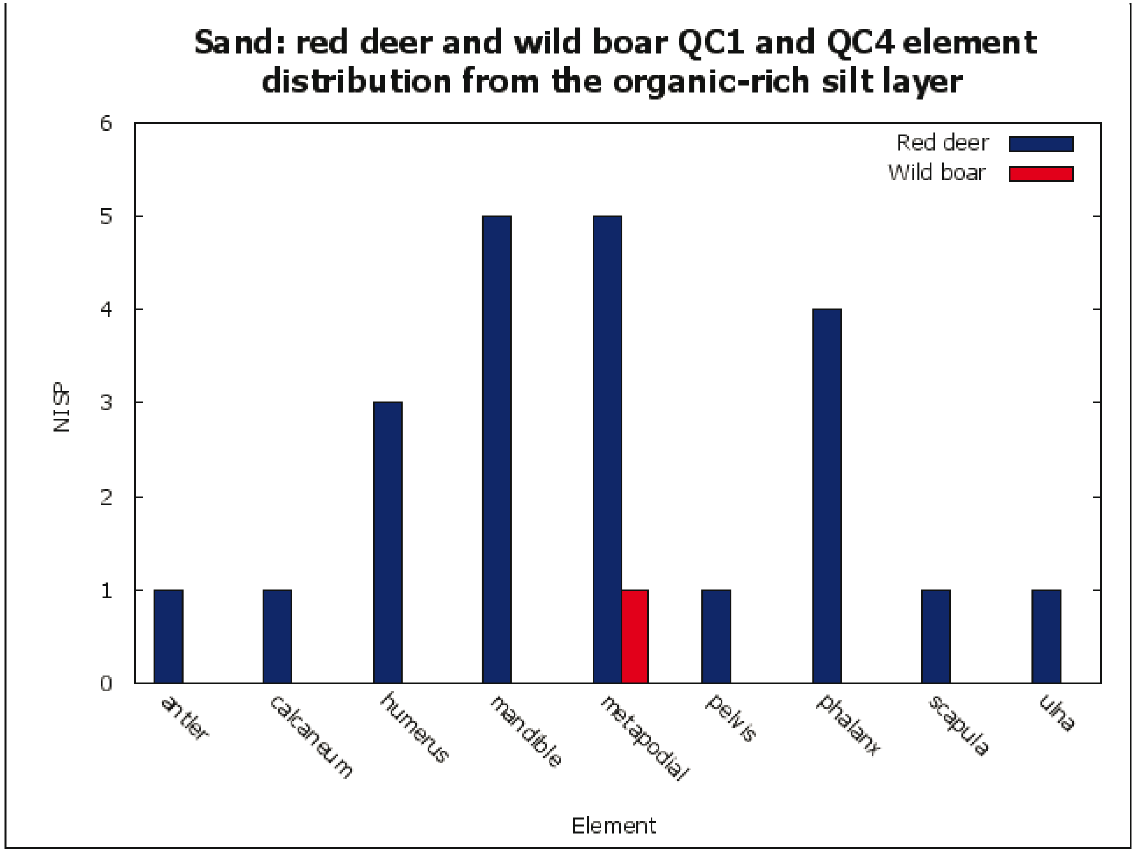
roe deer	1	mandible	1	1						2
		metapodial		2						2
		pelvis		1						1
		scapula		1						1
deer family	1	metacarpal		1						1
		metapodial	1	1						2
		phalanx1	1							1
		radius	1							1
	4	antler	2	8		2				12
Bos sp.	1	mandible	4	1		1		1		7
sheep		mandible	2							2
		metatarsal	1							1
		pelvis						1		1
sheep or goat	1	calcaneum		1						1
large mammal	1	humerus		2						2
		metapodial	5	1		3		1		10
		metatarsal		1						1
		mandible					1			1
		pelvis		1						1
		phalanx	1					2		3
		phalanx3	1							1
		scapula	1	3						4
medium mammal 1	1	astragulus	1							1
		humerus				2				2
		metapodial	2	1						3
		mandible		2						2
		phalanx		3						3
		Total	67	139	2	72	3	9	3	295

Table 143: Sand, Mammal QC1 and QC4 element representation

Illustration 483, (below) shows the QC1 element distribution for red deer and wild boar from the main shell midden context. Both species are best represented by metapodials and phalanges (excluding deer mandibles, where the count is inflated by a number of loose mandibular teeth). This pattern is replicated on a smaller scale in the organic rich silt layer for red deer (see Illustration 484, below). A similar element distribution pattern for red deer and wild boar was observed at the Cnoc Coig shell midden, Oronsay. Here the relative abundance of terminal elements, along with worked bone recovered from the site, was interpreted as possible evidence for hide processing (Grigson & Mellars 1987:252–253). At Sand, given the high degree of fragmentation of the mammal bone, it is unclear if the bias towards terminal elements is the result of this activity (see bone fragmentation below). The robustness and distinctive nature of these elements, even when incomplete, may have inflated their abundance. Skip Charts.



Illus 483: Sand, red deer and wild boar QC1 and QC4 element distribution from the main shell midden



Illus 484: Sand, red deer and wild boar QC1 and QC4 element distribution from the organic-rich silt layer

In addition, 83 antler specimens were recorded from these two contexts – 34 from the main shell midden and 43 from the organic rich silt layer (see Table 144, below). The majority of the antler specimens represent tine ends or small fragments. It is therefore difficult to assess whether the abundance of antler at the site is superficially inflated by fragmentation. Given the otherwise small number of red deer diagnostic elements, three individuals at most could be represented, if the main shell midden is interpreted as one period of deposition. Without antler bases as a means of quantification, it is difficult to speculate, (as Grigson and Mellars were able to argue at Cnoc Coig) whether the antler was removed from a whole carcass (or head) before being brought to the site or removed on site (Grigson & Mellars 1987:252). Shed antler may also have been collected and brought to the site, and in light of the specimen with working and gnawing (see Illustration 482, above), this may account for some of the antler at Sand.

Table 144

Sand context	NISP	unshed	worked?	worked
topsoil	5			
main shell midden	34		2	2
slopewash	1			
organic rich	43	2		1
Total	83	2	2	3

Table 144: Antler recovered from Sand

3.11.3.1.4 Butchery evidence

Fifty-six specimens were recorded as possibly or definitely worked, cut, or deliberately modified in some way (see Table 145, below). Over 60% of these specimens came from the main shell midden. The worked material is covered in the bone tool report (Hardy, Section 3.4). Skip Table.

This table can also be printed from the separate page `table145.html` in LANDSCAPE mode.

Table 145

bone id	taxon	element	modification	notes
mammal				
topsoil				
SFS4-148	unidentified	unidentified	cut	series fine parallel cut marks along length of frag
SFS4-147	unidentified	unidentified	cut & worked	fine irregular cut marks & striations visible at rounded end
SFS4-19	unidentified	unidentified	worked	bevel-ended
SFS4-2065	wild boar	calcaneum	cut?	possible small parallel cuts above distal end
SFS4-15726	unidentified	unidentified	worked?	possible flaking of end of fragment
SFS4-166	unidentified	unidentified	worked?	possible rounded end
SFS4-4	unidentified	unidentified	worked	bevel-ended
SFS4-3614	unidentified	unidentified	cut	three cut marks
SFS4-22	unidentified	unidentified	worked	bevel-ended
SFS4-3268	unidentified	shaft	cut	small medio-lateral cut mark across shaft
SFS4-3257	unidentified	unidentified	cut	
SFS4-203	unidentified	unidentified	worked?	possible striations & slight bevelling at one end of frag
				Total 12
main shell midden				
SFS4-6	unidentified	unidentified	cut & worked	rounded at both ends, shallow cut marks on one side
SFS4-393	large mammal	metapodial	worked	bevelling at one end, working to point at other

SFS4-149	unidentified	unidentified	worked?	slightly abraded at tip
SFS4-6993	Bos sp.	axis	cut	metal cut mark on condyle and chop
SFS4-3193	large mammal	shaft	worked	rounded at end
SFS4-13877	unidentified	shaft	cut	2 parallel cut marks
SFS4-574	unidentified	unidentified	worked?	possible working
SFS4-418	unidentified	unidentified	worked?	bevel-ended but striations ambiguous
SFS4-193	unidentified	unidentified	worked	rounded end
SFS4-16	red deer	antler	worked?	some abrasion but unclear if from human use
SFS4-394	unidentified	shaft	worked	bevel-ended
SFS4-3188	large mammal	shaft	worked	bevel-ended
SFS4-3172	red deer	antler	worked	evidence of use at end of tine – shine & abrasion
SFS4-25	unidentified	unidentified	worked	bevel-ended both ends
SFS4-3189	large mammal	shaft	worked	roughly bevel-ended, looks worked as for lithic
SFS4-3190	large mammal	shaft	worked?	possibly broken to point
SFS4-20	red deer	metatarsal	cut	series fine medio-lateral cut marks at proximal end
SFS4-379	red deer	phalanx 2	cut	small but clear dorsal-ventral cut mark at proximal end
SFS4-1884	red deer	antler	worked	tips of antler worked and also at base
SFS4-3179	unidentified	unidentified	cut	
SFS4-151	unidentified	unidentified	cut	cut across length of frag
SFS4-23	large mammal	scapula	cut	
SFS4-23	large mammal	scapula	cut	fine cut marks over curve of blade edge
SFS4-7	red deer	radius	chop?	chop/split towards proximal epiphysis on posterior side
SFS4-3185	large mammal	shaft	worked	bevel-ended
SFS4-	large mammal	shaft	worked	bevel-ended

3194				
SFS4-3186	large mammal	shaft	worked	bevel-ended
SFS4-400	unidentified	unidentified	worked	bevelled at both ends
SFS4-13879	unidentified	unidentified	cut	6 parallel cut marks
SFS4-15	unidentified	unidentified	worked	bevel-ended, striations visible
SFS4-14	red deer	antler	worked?	abrasion at tine tip possibly from use
SFS4-13	unidentified	unidentified	worked	rounded abraded end
SFS4-12	red deer	metapodial	chop?	
SFS4-3538	red deer	pelvis	cut	3 fine cut marks across ventral surface, zone 5
SFS4-573	unidentified	unidentified	worked	small frag worked to cylindrical shape and point
organic rich				
SFS4-401	red deer	antler	worked	bevel-ended
SFS4-399	unidentified	unidentified	worked	bevel-ended
SFS4-3250	red deer	phalanx 3	cut?	possible dorsal-ventral cut mark/carnivore gnaw on medial side, zone 1
shell midden				
SFS4-3763	unidentified	unidentified	worked	bevel-ended
sandy soil				
SFS4-3764	unidentified	unidentified	worked?	high degree of polish but unclear if worked
SFS4-3191	large mammal	metapodial	worked	roughly bevel-ended, looks worked as for lithic
SFS4-3221	unidentified	shaft	worked	bevel-ended
SFS4-3213	unidentified	shaft	worked	bevel-ended
unprov				
SFS4-6969	unidentified	rib	cut	deep cut mark towards articular end of rib
				Total 56
bird				

topsoil				
SFS4-4120	razorbill or guillemot	humerus	cut	medio-lateral cut mark below proximal head, fine scratches visible over entire shaft
main shell midden				
SFS4-5052	razorbill or guillemot	humerus	cut	medio-lateral cut mark c.2 mm on medial surface of shaft & 2 parallel cut marks on head
SFS4-4282	razorbill or guillemot	ulna	cut	4 very fine, sporadic cut marks, approx medio-laterally, along shaft
slopewash				
SFS4-4328	razorbill or guillemot	humerus	cut?	possible cut mark below crista lateralis of proximal head
				Total 4
fish				
main shell midden				
SFS4-6028	ballan wrasse	caudal vertebra	cut?	
				Total 1

Table 145: Sand, Butchery evidence (all classes of bone); Back to Section 3.11.3.3.3; Back to Section 3.11.3.4.3

Unambiguous cut marks were relatively rare. The identified specimens from the main shell midden produced clear, fine cut marks on a red deer pelvis, scapula, 2nd phalanx, and metatarsal. In the organic rich silt layer, a cut mark was noted on the 3rd phalanx of a red deer. Some of these cut marks are consistent with skinning (for example phalanges), whereas others are more likely to derive from dismembering carcases (for example pelvis, scapula). No cut marks were noted on the potential fur-bearing species (wolf or dog, fox, otter and badger) which are rare in the assemblage overall. There is thus no evidence for large-scale fur exploitation at Sand (Trolle-Lassen 1987).

With regard to the identification of the tools used in working bone, all cut marks, with one exception, show u-shaped profiles consistent with working with stone tools. On one example, an axis of *Bos* sp., the cut mark has a v-shaped profile indicating use of a metal blade.

3.11.3.1.5 Age at death and seasonality

The age at death and seasonality evidence based on the mammal remains is disappointing. Adult specimens were recorded from the main shell midden and organic rich silt layer. A small number of specimens were juvenile or immature specimens, based on juvenile cortex and unfused epiphyses. The majority of these were red deer and wild boar appendicular elements from the main shell midden (see Table 146, below). Unfortunately, the lack of complete mandibles prevents consideration of tooth eruption and wear. The antler specimens also provide little seasonality evidence. No shed antler bases were recovered from either context, and two unshed antler bases from the organic rich layer only exclude a spring death for these animal(s).

This table can also be printed from the separate page `table146.html` in LANDSCAPE mode.

Table 146					

context	taxon	element	juvenile cortex	proximal epiphysis	distal epiphysis
topsoil	dog family	metacarpal			unfused
	wild boar	astragulus			
		calcaneum	yes	unfused	unfused
		metapodial	yes		unfused
	red deer	astragulus	yes		
		humerus		unfused	
			yes		unfused
		radius			unfused
			yes		unfused
	deer family	metapodial			unfused
		radius	yes	unfused	
	sheep	metapodial			unfused
	large mammal	metapodial			unfused
			yes		unfused
		metapodial	yes		unfused
			Total 15		
main shell midden	wild boar	calcaneum	yes	unfused	unfused
		metapodial		unfused	
				unfused	
				unfused	
				unfused	
			yes		unfused
		phalanx 1		fusing	
		phalanx 2	yes	unfused	
					fusing
					unfused
		radius			unfused
			yes	unfused	
		ulna			unfused
					unfused
				unfused	
				unfused	
	red deer	metatarsal			unfused
		phalanx		unfused	
		tibia	yes		unfused

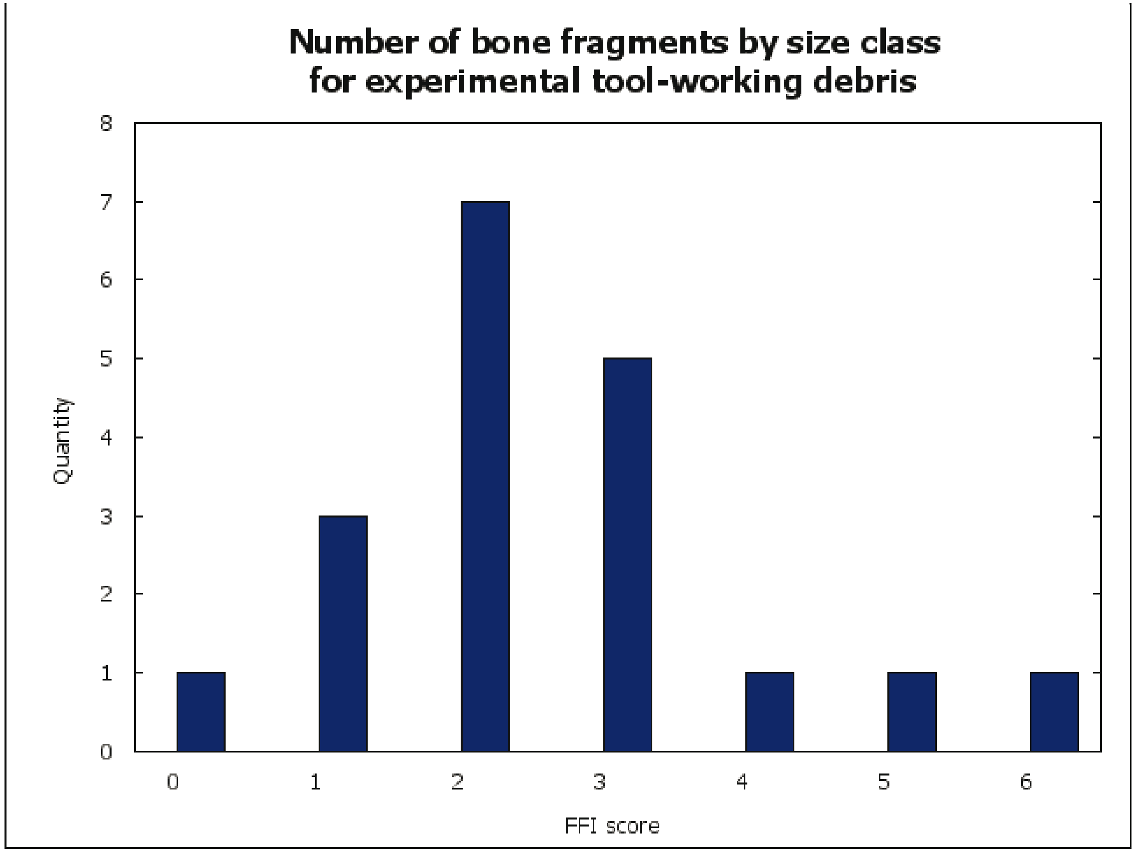
		ulna		unfused	
		femur	yes		
		radius	yes		unfused
	roe deer	metapodial			unfused
	medium mammal 2	phalanx	yes		
		Total 24			

Table 146: Sand, Juvenile mammal specimens

3.11.3.1.6 Bone fragmentation

At Sand it is unclear whether the high fragmentation of the mammal bone is the result of deliberate cultural activity or of post-depositional factors such as trampling. Several bone tools were recovered from the site (Hardy, Section 3.4) and the processing of bone for this purpose is considered below. Another possibility for the high degree of fragmentation is the exploitation of bone marrow and grease. Recently, Outram has advocated a new methodology for the assessment of bone marrow or grease extraction by applying a fracture freshness index (FFI) to shaft fragments and recording the number of cancellous and cortical bone fragments (Outram 2001, 2002, 2003). The FFI score is based on three criteria; fracture angle, fracture outline, and surface texture. When bone is fractured in a fresh state a characteristic helical fracture is produced. A shaft fragment can score between , indicating a smooth helical break on fresh bone, and 6 when the shaft has a rough surface texture and no helical break. If fragmentation for marrow extraction has taken place, a high proportion of shaft fragments with low FFI scores would be expected (Outram 2002).

As noted above, given the bone tools recovered from the site it is possible that some of the fragmentation at Sand is due to tool manufacture. Experimental tool manufacture by Birch (2003 and Section 3.4) found fresh bone was difficult to work with. Two year old bone was initially difficult to break into a uniform shape, but was easier to work when shaping a tool. Outram's FFI was applied to the debris from Birch's experimental tool manufacture on two year old red deer metapodia to assess the type of fracture produced. Illustration 485, (below) shows the FFI scores for the 19 tool manufacture shaft fragments, based on the waste from 12 tools. FFI scores of 2 and 3 were predominant and despite the bone not being fresh, helical fractures were present on many fragments.



Illus 485: Number of bone fragments by size class for experimental tool-working debris

As Outram's method is not standard zooarchaeological practice, it was not applied during initial analysis. However, the greater than 4mm mammal bone from the main shell midden context in B25A and B25B has now been re-assessed using the FFI. Outram's methodology to assess the degree of bone fragmentation relies on the survival of a reasonable number of shaft fragments over 30mm in length. Table 147, (below) not only demonstrates how fragmented the bone from Sand is, but also how few fragments (15%) were over 30mm. Over 70% of fragments were from cortical bone, very few whole or part bones (as defined in Outram 2001) were recorded, and no points of impact were observed. A bias towards cortical bone would be expected, as this is the predominant type of bone in the skeleton. Forty-nine shaft fragments were recorded, 19 of which had helical fractures (see Table 148, below). This paucity of shaft fragments makes meaningful analysis of the FFI scores problematic. Some helical fractures were recorded, and a range of scores was represented, suggesting that bone was broken in both a fresh and dry state.

To access a printable version of this table, please go to the separate page table147.html and set to LANDSCAPE mode.

Table 147

bone type	<20mm	20–29mm	30–39mm	40–49mm	50–59mm	60–69mm	70–79mm	80–89mm	90–99mm	100+mm	total
cortical bone											
shaft		23	12	25	10	2	2	2	3		79

other cortical	4286	427	85	24	12	2	2			1	4839
cortical subtotal											4918
cancellous bone											
appendicular cancellous	11	21	18	5	12	2	1	2	1		73
axial cancellous	2	9	12	5	5	1	1				35
rib	7	24	18	9	7	7	3	1	1		77
other cancellous	1326	99	30	1	1	2					1459
cancellous subtotal											1644
cranial fragments	3	3	7	3	1	3	1	1			22
unidentified & antler	4	10		1						1	16
Total	5639	616	182	73	48	19	10	6	5	2	6600

Table 147: Sand, Fracture freshness index fragments by size class and type

Table 148

FFI score	shaft with helical fracture	Total
0	1	1
1	7	10
2	3	8
3	5	5
4	3	7
5		10
6		7
Total	19	48

Table 148: Sand, Main shell midden fracture freshness index scores. Fracture freshness scores only given to fragments greater than 30mm (Outram 2002)

The cause of fractured bone from archaeological sites has long been debated, particularly with reference to the deliberate breaking by early hominids (as discussed in Lyman 1994:Chapter 8). As noted above, a helical break is typically formed when fresh bone is broken (although such breaks were also made during work on the two year old bone). However, a range of taphonomic processes can create such fractures, including trampling, carnivore gnawing and the dropping of a carcass from a distance (Lyman 1994:324). Due to the small number of shaft fragments from Sand it is difficult to assess whether the fragmentation is due to a specific cultural or post-depositional process based solely on the fracture fragmentation index. Bone marrow extraction remains a possibility, and, given the bone tools from the site, some fragmentation from tool manufacture is also plausible. Indeed, there is no reason why fragmentation for marrow extraction and tool manufacture could not have taken place together. However, in light of the small number of shaft fragments and large number of small fragments of bone it is impossible to favour cultural over taphonomic processes.

3.11.3.2 Small mammal and amphibian bone

A small number (179 diagnostic elements) of small mammal and amphibian remains were recorded, the majority from the topsoil and main shell midden (see Tables 149 & 150, below). These figures have not been included in the above discussion. Shrew, vole and mouse species were represented by mostly mandibles, a nominal amount of frog elements were also present (see Table 151, below). Bank vole, common shrew and wood or yellow-necked mouse were among the identified species. The bank vole is a woodland species (Corbet & Harris 1991) and is unlikely to post-date clearance and peat advancement in the area. Given the unconsolidated matrix of the midden and the burrowing activity or use of burrows by many of these species, it is highly likely that the small mammal and amphibian remains are intrusive, and they are, therefore, not discussed in greater detail. Skip Tables.

This table can also be printed from the separate page table149.html in LANDSCAPE mode.

Table 149

taxon	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	Total
common shrew	2	2					4
pygmy shrew	2						2
shrew sp.	2						2
bank vole	4	3				1	8
field vole	1						1
vole sp.		2				1	3
wood mouse		4					4
wood mouse?		2			1		3
wood or yellow-necked mouse	4	5					9
mouse sp.		1					1
vole or mouse	3	3					6
small mammal	1	4			1		6
common frog		2					2
unidentified	15	76	1	9	4	23	128
QC1 Subtotal	19	28			2	2	51
Grand Total	34	104	1	9	6	25	179

Table 149: Sand, Number of identified small mammal and amphibian specimens

This table can also be printed from the separate page table150.html in LANDSCAPE mode.

Table 150							
taxon	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	Total
common shrew	0.018	0.01					0.019
pygmy shrew	0.011						0.011
shrew sp.	0.012						0.012
bank vole	0.114	0.073				0.047	0.234
field vole	0.063						0.063
vole sp.		0.028				0.015	0.043
wood mouse		0.047					0.047
wood mouse?		0.038			0.026		0.064
wood or yellow-necked mouse	0.075	0.089					0.164
mouse sp.		0.006					0.006
vole or mouse	0.035	0.039					0.074
small mammal	0.015	12.041			0.025		12.081
common frog		0.047					0.047
unidentified	0.009	0.623	0.009	0.142	0.018	0.221	1.022
QC1 Subtotal	0.343	12.409			0.051	0.062	12.865
Grand Total	0.352	13.032	0.009	0.142	0.069	0.283	13.887

Table 150: Sand, Weight of identified small mammal and amphibian specimens

This table can also be printed from the separate page `table151.html` in LANDSCAPE mode.

Table 151						
taxon	element	topsoil	main shell midden	shell midden	sandy soil	Total
common shrew	mandible	2				2
	pelvis		1			1
	tibia		1			1
pygmy shrew	humerus	1				1
	mandible	1				1
shrew sp.	mandible	2				2
bank vole	mandible	3	3		1	7
	ulna	1				1
field vole	mandible	1				1

vole sp.	mandible		2		1	3
wood mouse	femur		2			2
	pelvis		1			1
	ulna		1			1
wood mouse?	femur		2			2
	mandible			1		1
wood or yellow-necked mouse	humerus	1				1
	mandible	1	4			5
	pelvis	1				1
	tibia	1	1			2
mouse sp.	mandible		1			1
vole/mouse	femur		1			1
	humerus	2				2
	pelvis		1			1
	tibia	1	1			2
small mammal	femur		2	1		3
	metapodial		1			1
	mandible	1				1
	tibia		1			1
common frog	radio/ulna		2			2
	Grand Total	19	28	2	2	51

Table 151: Sand, Small mammal and amphibian QC1 element representation

3.11.3.3 Bird bone

3.11.3.3.1 Preservation

A total of 16,341 bird bones weighing 2,263.05g was recovered from the site (see Tables 152 & 153, below). A subset of 1,290 diagnostic (QC1) elements, mainly from the topsoil, main shell midden and organic rich silt layer was analysed in detail. Based on the surface texture of the QC1 elements, the preservation of the bird bone from the main shell midden is predominantly good (see Table 154, below). From the organic rich layer the majority of the elements have a fair surface texture. Table 155, (below) shows that approximately half of the 806 specimens from the main shell midden were 21–40% complete. The remaining elements were mostly between −20% and 41–60% complete. The majority of specimens from the much smaller subset of 88 QC1 elements from the organic rich layer were also 21–40% complete. The bird element completeness is slightly more variable than the mammal bone, discussed above, but overall there seems to be a similar level of fragmentation of QC1 elements. Skip Tables.

To access a printable version of this table, please go to the separate page `table152.html` and set to LANDSCAPE mode.

Table 152

taxon	topsoil	main shell	palaeo	slopewash	organic	shell	sandy	natural	unprov	Total

		midden			rich	midden	soil			
shag or cormorant	1	6								7
razorbill	2	16			1					19
guillemot	18	58		1	2					79
razorbill or guillemot	241	645		35	69	10	19	2	3	1024
little auk		1								1
puffin?	2									2
great auk	4	5			1	1				11
auk family	39	76		2	15	6	6			144
thrush and chat family		3								3
unidentified	3608	7953	8	549	2375	206	325	9	18	15051
auk family Subtotal	306	801	0	38	88	17	25	2	3	1280
QC1 Subtotal	307	810	0	38	88	17	25	2	3	1290
Grand Total	3915	8763	8	587	2463	223	350	11	21	16341

Table 152: Sand, Number of identified bird specimens by context; Back to Section 3.11.3.3.2

To access a printable version of this table, please go to the separate page table153.html and set to LANDSCAPE mode.

Table 153

taxon	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
shag or cormorant	1.44	12.12								13.56
razorbill	2.56	10.35			1.04					13.95
guillemot	15.16	50.44		0.58	0.69					66.87
razorbill or guillemot	84.15	249.29		12.07	28.37	4.56	9.04	0.50	3.94	391.92
little auk		0.34								0.34
puffin?	0.28									0.28

great auk	5.65	10.23			2.30	1.08				19.26
auk family	12.26	27.83		0.32	6.24	1.35	1.67			49.67
thrush and chat family		0.34								0.34
unidentified	454.83	820.08	0.35	61.59	286.27	31.22	49.82	0.94	1.76	1706.86
auk family Subtotal	120.06	348.48	0	12.97	38.64	6.99	10.71	0.50	3.94	542.29
QC1 Subtotal	121.50	360.94	0	12.97	38.64	6.99	10.71	0.50	3.94	556.19
Grand Total	576.33	1181.60	0.35	74.56	324.91	38.21	60.53	1.44	5.70	2263.05

Table 153: Sand, Weight of identified bird specimens

To access a printable version of this table, please go to the separate page `table154.html` and set to LANDSCAPE mode.

Table 154

texture	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
excellent	1	8			1				10
good	207	596	4	21	2	4		3	837
fair	97	193	34	65	13	19	2		423
poor	1	7		2	1	2			13
Grand Total	306	804	38	88	17	25	2	3	1283

Table 154: Sand, Surface texture of bird QC1 elements. Assessment of surface texture based on the following criteria (Harland *et al* 2003):
Excellent – majority of surface fresh or even slightly glossy; very localised flaky or powdery patches;
Good – lacks fresh appearance but solid; very localised flaky or powdery patches;
Fair – surface solid in places, but flaky or powdery on up to 49% of specimen;
Poor – surface flaky or powdery over >50% of specimen

To access a printable version of this table, please go to the separate page `table155.html` and set to LANDSCAPE mode.

Table 155

element completeness	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
0–20%	64	112	10	10	1	4			201
21–40%	167	414	21	52	9	16	2	2	683

41–60%	56	189	7	21	5	2			280
61–80%	12	53		3		3			71
81–100%	7	38		2	2			1	50
Grand Total	306	806	38	88	17	25	2	3	1285

Table 155: Sand, Element completeness of bird QC1 elements

Fewer than 2% of the bird bones from the site were burnt, the majority of which were charred black rather than calcined white. Very few specimens were modified by gnawing or root etching (see Table 156, below).

This table can also be printed from the separate page `table156.html` in LANDSCAPE mode.

Table 156

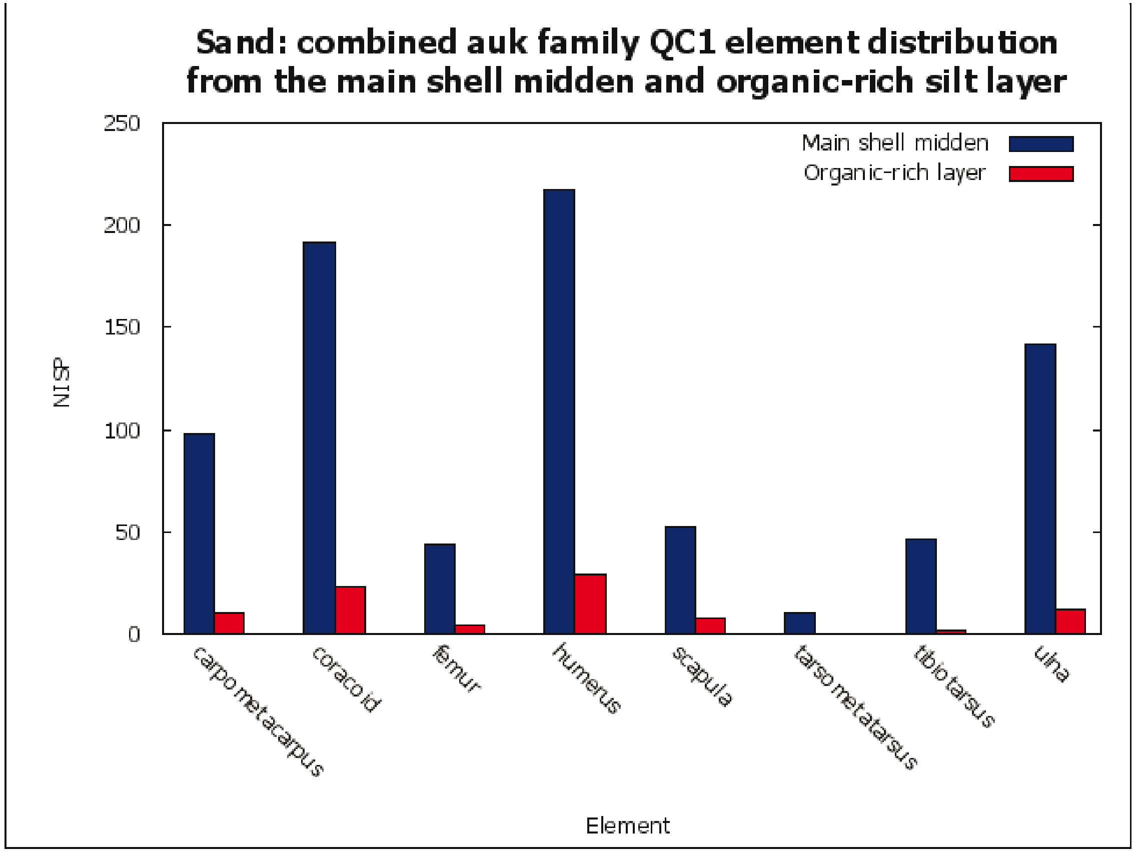
modification	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	Total
carnivore gnawing		1		1			2
rodent gnawing	1						1
root etching		10					10
calcined	1	3		1		1	6
charred	92	85	1	22	4	57	261
Burning Total	93	88	1	23	4	58	267

Table 156: Sand, Modified bird bone (all specimens) by context

3.11.3.3.2 Taxonomic abundance

The bird bone assemblage from all contexts at the site is made up almost exclusively of seabirds (see Table 152, above), in particular species belonging to the auk family (*Alcidae*). Guillemot and razorbill dominated the assemblage which also included rare specimens of other alcids, including the now extinct great auk. Guillemots and razorbills have a very similar skeletal morphology and for this reason distinction beyond the razorbill or guillemot identification was only possible on a limited range of elements. Guillemots are slightly bigger than razorbills but the two species do show some overlap in size, so this criterion alone is not reliable (Cramp 1985:170). Distinction was regularly possible between the two species on well-preserved distal humerii. Shag and cormorant present a similar identification problem. The cormorant is the larger of the two, but they are very similar osteologically. A small number of QC1 elements of either shag or cormorant were recorded from the main shell midden (six specimens) and topsoil (one specimen). Three thrush and chat family QC1 specimens from the main shell midden represent the only terrestrial species from the site.

3.11.3.3.3 Element representation and butchery evidence



Illus 486: Sand, combined auk family QC1 element distribution from the main shell midden and organic-rich silt

Table 157, (below) shows the element distribution of QC1 specimens. The assemblages from the main shell midden and organic rich silt are large enough to discuss in detail. Illustration 486, (above) shows the combined *alcid* (auk family) QC1 element distribution for these contexts. In the main shell midden all QC1 elements are represented, but there is a bias towards the pectoral region and wing elements. In the organic rich silt all QC1 elements apart from the tarsometatarsus are represented. The most abundant elements from this context are the coracoid and humerus, and the bias towards the pectoral and wing regions seems to be repeated. Given the robust and distinctive nature of both wing and leg elements in alcids, this does not seem to be a preservational bias. Skip Table.

To access a printable version of this table, please go to the separate page `table157.html` and set to LANDSCAPE mode.

Table 157

taxon	element	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
shag or	coracoid	1	3							4

cormorant	femur		2							2
	humerus		1							1
razorbill	coracoid		5							5
	humerus	2	11		1					14
guillemot	carpometacarpus	1	8							9
	coracoid	1	6							7
	femur		1							1
	humerus	15	39	1	2					57
	scapula		1							1
	tarsometatarsus		1							1
	ulna	1	2							3
razorbill or guillemot	carpometacarpus	33	88	5	10	3	4	1		144
	coracoid	71	159	15	17	3	3		1	269
	femur	20	34	1	4					59
	humerus	45	137	8	19	1	3			213
	scapula	16	46		7		5			74
	tarsometatarsus		6							6
	tibiotarsus	13	41		2	1	3		1	61
	ulna	43	134	6	10	2	1	1	1	198
little auk	tarsometatarsus		1							1
puffin?	coracoid	1								1
	humerus	1								1
great auk	carpometacarpus	1								1
	coracoid	2				1				3
	humerus	1	3		1					5
	scapula		1							1
	ulna		1							1
auk family	carpometacarpus	6	2	1			1			10
	coracoid	4	22	1	6	1	3			37
	femur	2	9							11
	humerus	17	27		6		1			51
	scapula	5	4		1	1	1			12
	tarsometatarsus	2	2			1				5
	tibiotarsus	2	5			3				10
	ulna	1	5		2					8
thrush and chat family	coracoid		1							1
	humerus		2							2

Grand Total	307	810	38	88	17	25	2	3	1290

Table 157: Sand, Bird QC1 element representation

Very few cut marks were recorded on the bird bone. There were four in total, two of which were on specimens from the main shell midden (see Table 145, above). All the cut marks are very similar – a series of short parallel cuts below or on the head of the proximal end of the humerus, consistent with wing removal. As highlighted by ethnographic evidence from Greenland and Scotland, auks provide many potential resources, including meat, marrow, skins and feathers (as discussed in Baldwin 1974:95–97; Gotfredson 1997:280; Serjeantson 1997:257).

3.11.3.3.4 Seasonality

A total of 15 juvenile QC1 elements, based on the surface texture consistent with immature bones, was recorded. Ten of these specimens, all alcids, came from the main shell midden context (see Table 158, below).

This table can also be printed from the separate page `table158.html` in LANDSCAPE mode.

Table 158

taxon	element	topsoil	main shell midden	organic rich	Total
razorbill or guillemot	carpometacarpus		1		1
	coracoid		2		2
	humerus		1		1
	ulna	1			1
auk family	coracoid		2		2
	femur		1		1
	humerus	2	3	1	6
	scapula	1			1
	Grand Total	4	10	1	15

Table 158: Sand, Juvenile bird specimens

Auks are diving seabirds and spend much of their time outside the breeding season at sea (Cramp 1985). As Serjeantson (1988:24), has highlighted this means that there is a restricted period of time when they and their young are on land and easily available for capture. Auks generally breed in May and June (Cramp 1985), and razorbills and guillemots brood for 34 days (Serjeantson 1988:24). The two species often form colonies together and prefer steep, rocky, sea-facing cliffs (Cramp 1985:171–178). If the birds were captured during the breeding season this suggests that the site was in use in late spring or early summer. There is, however, another period in the late summer and autumn, when the adult and young birds would be vulnerable to predation (Serjeantson 2001:44). Between late July and November adult auks have a complete moult at sea after breeding. The birds are flightless for 45–50 days from late July to September, until their primary feathers grow back (Cramp 1985:171–198). Rafts of flightless, moulting birds are seen in Loch Snizort and the Inner Sound during August and September (Yoxon & Yoxon 1990:27, Steven Birch *pers comm*). This represents a different type of hunting opportunity than the breeding season. Serjeantson (2001:44), (with specific reference to the great auk) suggests that birds could be taken from the water at that time using boats, possible methods of capture include the use of nets and hooks (Baldwin 1974:68).

If the assumption is made that the behaviour of razorbills and guillemots was similar when Sand was in use, both types and seasons of capture could have been exploited. The small number of juvenile bones recorded from the site may be more consistent with the late summer and autumn moult than with the breeding season in late spring and early summer. However, adult birds were also targeted at breeding sites in recent centuries (Serjeantson 2001).

3.11.3.4 Fish bone

3.11.3.4.1 Preservation

A total of 53,697 fish bones weighing 1,007.37g was recovered from the site (see Tables 159 & 160, below). As with the mammal and bird bones, this figure masks the much smaller number of 14, 954 identified specimens. Based on the surface texture of the QC1 elements, preservation of the fish remains from all contexts was generally good to fair (see Table 161, below). The completeness of these same elements was more variable, with completeness ranging from −20% to 81–100% complete in both contexts Table 162, below). Compared to the mammal and bird bone (see above), a greater proportion of the fish bone QC1 elements from the main shell midden were 81–100% complete. Less than 2% of the fish was burnt, most of which was charred black rather than calcined white (see Table 163, below). Six specimens, four from the topsoil and two from the main shell midden showed evidence of crushing whilst the bone was fresh. An additional specimen from the main shell midden was acid etched, both these modifications are consistent with mastication (Jones 1991). Crushed specimens are also found in otter spraint, but in light of the burnt material and lack of concretions on the bones, typically associated with otter spraint (Nicholson 2000) this can be discounted at Sand. Skip Tables.

To access a printable version of this table, please go to the separate page table159.html and set to LANDSCAPE mode.

Table 159

taxon	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
tope		1								1
dogfish families	1	12								13
ray family	4	1				1				6
elasmobranch	1	3								4
herring	73	87		1	11	9	8		10	199
eel	3	10					1			14
conger eel	1									1
salmon family	1						3			4
rockling sp.	2	1								3
saithe	186	275		6	2	9	23		8	509
pollack	39	101			1	3				144
saithe or pollack	710	1487	1	12	22	44	21		26	2323
cod	26	99		3	1	1	6			136
cod, saithe or pollack	397	1309		13	17	9	35		6	1786
haddock	4	3			1					8

whiting	4	3			1					8
poor cod		3								3
Norway pout, bib or poor cod	5	1		1		1				8
cod family	616	993	1	36	137	37	83		8	1911
gurnard family	2									2
sea scorpion family		3								3
Atlantic horse mackerel	2	15								17
seabream family		1								1
seabream family?							1			1
corkwing wrasse	29	48		1	2	1	1		3	85
goldsinny	1	1								2
corkwing wrasse or goldsinny	29	37				2	10			78
ballan wrasse	110	246		1	15	20	11		2	405
cuckoo wrasse	2	16								18
ballan or cuckoo wrasse	741	808		29	36	50	125	1	8	1798
wrasse family	817	3922		8	286	66	93	1	38	5231
eelpout									1	1
butterfish		17		1						18
sandeel family	1	4								5
Atlantic mackerel	23	159			7	1	5		4	199
perch order	1									1
plaice						1				1
plaice family	1	4					1			6
flatfish order		1								1
unidentified fish	8835	24356	3	314	2913	738	1331	2	250	38742
cod family Subtotal	1989	4275	2	71	182	104	168	48	0	6839
wrasse family Subtotal	1729	5157		39	339	139	240	2	51	7696
identified fish Subtotal	3832	9671	2	112	539	255	427	2	114	14954
Total Fish	12667	34027	5	426	3452	993	1758	4	364	53696

Table 159: Sand, Number of identified fish specimens by context

To access a printable version of this table, please go to the separate page `table160.html` and set to LANDSCAPE mode.

Table 160

taxon	topsoil	main shell midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	Total
blackmouthed dogfish		0.02								0.02
dogfish families	0.042	0.284								0.326
ray family	0.299	0.02				0.043				0.362
elasmobranch	0.119	0.116								0.235
eel	0.028	0.064					0.016			0.108
conger eel	0.023									0.023
herring	0.694	0.873		0.005	0.052	0.073	0.074		0.07	1.841
salmon family	0.04						0.079			0.119
rockling sp.	0.019	0.003								0.022
saithe	4.744	5.251		0.136	0.027	0.183	0.25		0.19	10.781
pollack	2.192	10.72			0.09	0.422				13.424
saithe or pollack	27.79	48.305	0.023	0.582	0.619	1.267	0.567		1.398	80.551
cod	1.872	4.251		0.37	0.02	0.088	0.187			6.788
cod, saithe or pollack	10.612	31.246		0.66	0.421	0.211	0.457		0.068	43.675
haddock	0.23	0.332			0.09					0.652
whiting	0.115	0.04			0.01					0.165
poor cod		0.349								0.349
Norway pout, bib or poor cod	0.11	0.024		0.016		0.122				0.272
cod family	14.511	32.78	0.01	0.923	5.069	0.638	1.182		0.663	55.776
gurnard family	0.157									0.157
sea scorpion family		0.026								0.026
Atlantic horse mackerel	0.412	1.283								1.695
seabream family		0.18								0.18
seabream family?							0.114			0.114
corkwing wrasse	0.775	1.94		0.024	0.167	0.04	0.011		0.384	3.341
goldsinny	0.03	0.017								0.047

corkwing wrasse or goldsinny	0.313	0.404				0.02	0.074			0.811
ballan wrasse	7.313	17.46		0.032	1.383	0.993	1.081		0.197	28.459
cuckoo wrasse	0.066	0.553								0.619
ballan or cuckoo wrasse	23.67	22.826		1.1	1.185	2.427	4.328	0.08	0.19	55.806
wrasse family	20.071	128.59		0.182	8.667	1.623	2.154	0.025	1.234	162.546
eelpout									0.006	0.006
butterfish		0.065		0.002						0.067
sandeel family	0.012	0.033								0.045
Atlantic mackerel	0.948	8.155			0.33	0.02	0.14		0.101	9.694
perch order	0.082									0.082
plaice						0.01				0.01
plaice family	0.023	0.08					0.01			0.113
flatfish order		0.01								0.01
unidentified fish	130.994	321.803	0.029	4.068	41.786	10.446	15.086	0.022	3.819	528.053
wrasse family Subtotal	52.238	174.28	0	1.338	11.402	5.103	7.648	0.105	2.005	254.119
cod family Subtotal	62.195	133.301	0.033	2.687	6.346	2.931	2.643	2.319	0	212.46
identified fish Subtotal	117.312	316.3	0.033	4.032	18.13	8.18	10.724	0.105	4.501	479.317
Grand Total	248.306	638.103	0.062	8.1	59.916	18.626	25.81	0.127	8.32	1007.37

Table 160: Sand, Weight of fish specimens by context

This table can also be printed from the separate page table161.html in LANDSCAPE mode.

Table 161

texture	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
excellent	22	20		1	1	5		49
good	141	535	1	20	9	17	2	725
fair	111	352	2	25	16	16	3	525
poor	21	49	2	10	3	1		86
Grand Total	295	956	5	56	29	39	5	1385

Table 161: Sand, Surface texture of fish QC1 elements. Assessment of surface texture based on the following criteria (Harland *et al* 2003):

Excellent – majority of surface fresh or even slightly glossy; very localised flaky or powdery patches
Good – lacks fresh appearance but solid; very localised flaky or powdery patches
Fair – surface solid in places, but flaky or powdery on up to 49% of specimen
Poor – surface flaky or powdery over >50% of specimen

To access a printable version of this table, please go to the separate page table162.html and set to LANDSCAPE mode.

Table 162

element completeness	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
0–21%	37	132		8	3	5		185
21–40%	94	281	4	24	12	11		426
41–60%	78	184		3	9	8		282
61–80%	40	189		8	2	9	3	251
81–100%	46	164	1	13	3	6	2	235
Grand Total	295	950	5	56	29	39	5	1379

Table 162: Sand, Element completeness of fish QC1 elements

To access a printable version of this table, please go to the separate page table163.html and set to LANDSCAPE mode.

Table 163

modification	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
acid etched		1						1
crushed	4	2						6
calcined	6	42		6	2	1		57
charred	172	475	1	59	11	16	3	737
Burning Total	178	517	1	65	13	17	3	794

Table 163: Sand, Modified fish bone (all specimens) by context; Back to Section 3.11.3.4.3

3.11.3.4.2 Taxonomic abundance

The fish assemblage from Sand is dominated by two families, the wrasse family (*Labridae*) and the cod family (*Gadidae*). From the wrasse family, the most abundant species was ballan wrasse. Cuckoo wrasse, corkwing wrasse and goldsinny were also identified. Saithe and pollack were the most common gadid species identified; less common gadids included cod, haddock and whiting. In order of abundance, mackerel, herring and horse mackerel were also identified in modest numbers, followed by trace amounts of other taxa (see Table 159, above). There was no great difference in species composition between contexts.

Due to the small size of the specimens and the similar anatomy of saithe and pollack it was often difficult to distinguish between the two. Ambiguous specimens were recorded as Pollachius. Distinction between saithe and pollack otoliths is especially problematic (Harkönen 1986:100), and no identification beyond Pollachius was attempted. Saithe and pollack vertebrae recorded in fulfilment of the MSc thesis were only identified to genus level. However, this should not affect the relative ratio of saithe to pollack based on the QC1 elements and subsequent identification of vertebrae to the species level. Specimens which had the characteristics of saithe, pollack or cod, but which could not be positively distinguished, were recorded as Gadus/Pollachius. Labrid elements were identified to species where possible. Specimens identified to either ballan wrasse or cuckoo wrasse were recorded as lbd1, those identified as either corkwing wrasse or goldsinny were recorded as lbd2. The habitat and behaviour of the most abundant taxa, and their implications for fishing practices, will be considered below.

3.11.3.4.3 Element representation

The main shell midden context produced 9671 of the identified elements from the site (960 QC1, 7910 QC2 and 801 QC4 elements). A sizeable amount of diagnostic material (3832 elements) was also recovered from the topsoil (see Table 164, below). A much smaller assemblage was recorded from the organic rich layer; 57 QC1, 466 QC2 and 416 QC4 elements. Nominal numbers of diagnostic specimens were recorded from other contexts.

To access a printable version of this table, please go to the separate page table164.html and set to LANDSCAPE mode.

Table 164

taxon	QC	element	topsoil	main midden	palaeo	slopewash	organic rich	shell midden	sandy soil	natural	unprov	total
black mouthed dogfish	2	vertebra		1								1
dogfish families	2	mvc	1	12								13
ray family	4	dermal denticle	4	1				1				6
elasmobranch	2	mvc	1	3								4
eel	1	basioccipital		1								1
		quadrate		1								1
		vomer		1								1
	2	abdominal vertebra	3									3
		caudal vertebra		7					1			8
conger eel	2	caudal vertebra	1									1
herring	2	abdominal vertebra	45	44			5	5	6		8	113
		abdominal vertebra 3		1								1

		caudal vertebra	25	29		1	6	4	2		2	69
		caudal vertebra 2		1								1
		first vertebra	2									2
		penultimate vertebra		1								1
		ultimate vertebra	1									1
		vertebra		11								11
salmon family	2	caudal vertebra	1						1			2
		vertebra							2			2
rockling sp.	2	abdominal vertebra	1									1
		abdominal vertebra1	1									1
		caudal vertebra1		1								1
saithe	1	basioccipital	4	4					1			9
		dentary	3	11								14
		hyomandibular	2	1								3
		infraphryngeal	1	1								2
		maxilla	6	7				2	1			16
		palatine	2	1				1				4
		parasphenoid		2								2
		posttemporal	1	1								2
		premaxilla	15	30					1			46
		quadrate	8	9								17
		supracleithrum	2									2
		vomer	5	3								8
	2	abdominal vertebra	2									2
		abdominal vertebra 1	25	45		2	1	3	6			82
		abdominal vertebra 2	21	30		2	1	1	5		1	61
		abdominal vertebra 3	35	50				1	5		1	92
		caudal	4	1								5

		vertebra										
		caudal vertebra 1	24	53		2			2		2	83
		caudal vertebra 2	23	21				1	1		3	49
		first vertebra	3	5					1		1	10
pollack	1	articular		1								1
		basioccipital		3								3
		dentary		6								6
		maxilla		3								3
		premaxilla		13								13
		quadrate		1								1
	2	abdominal vertebra		1								1
		abdominal vertebra 1	7	5								12
		abdominal vertebra 2	2	5				1				8
		abdominal vertebra 3	16	39			1	1				57
		caudal vertebra	2									2
		caudal vertebra 1	7	14				1				22
		caudal vertebra 2	5	10								15
saithe or pollack	1	articular					1					1
		basioccipital		2								2
		cleithrum		1								1
		dentary	3	12								15
		hyomandibular						1				1
		infraphryngeal		5								5
		maxilla	4	6		1		1				12
		palatine	1									1
		parasphenoid		2								2
		posttemporal	3									3
		premaxilla	10	24			1					35
		quadrate		1				1				2
		supracleithrum	2	1								3

		vomer	1	6								7
	2	abdominal vertebra	9	282				4				295
		abdominal vertebra 1	60	56		7	4	5	5		2	139
		abdominal vertebra 2	36	24		1	1	3	1		1	67
		abdominal vertebra 3	46	71		1	2	1	3		3	127
		caudal vertebra	15	298			2					315
		caudal vertebra 1	31	27							2	60
		caudal vertebra 2	39	29		2		2	2			74
		first vertebra	6	24								30
		penultimate vertebra		2								2
		vertebra		1								1
	4	otolith	444	613	1		11	26	10		18	1123
cod	1	basioccipital		1								1
		dentary		6								6
		hyomandibular	1									1
		maxilla		1								1
		parasphenoid				1						1
		posttemporal	1									1
		premaxilla		4					1			5
		quadrate	2	4								6
		vomer	2	1								3
	2	abdominal vertebra	1	13								14
		abdominal vertebra 1	3	5		1	1					10
		abdominal vertebra 2	1	2					1			4
		abdominal vertebra 3	5	3					2			10
		caudal vertebra		41								41
		caudal	1	1		1			1			4

		vertebra 1										
		caudal vertebra 2		5								5
		first vertebra	3	1					1			5
	4	otolith	6	11				1				18
cod, saithe or pollack	1	articular		2								2
		basioccipital		1								1
		dentary	6	8								14
		hyomandibular		1								1
		infraphryngeal	2	1								3
		maxilla	2	7								9
		posttemporal	1									1
		premaxilla	7	14					4			25
		quadrate	2	1								3
		vomer		6								6
	2	abdominal vertebra	22	412		3	7		1		1	446
		abdominal vertebra 1	87	49		1		2	11		1	151
		abdominal vertebra 2	26	33					4			63
		abdominal vertebra 3	51	114		6		1	1		2	175
		caudal vertebra	46	373		1	7	2	3			432
		caudal vertebra 1	89	133				2	8		2	234
		caudal vertebra 2	26	48		2	1	1	3			81
		first vertebra	3	15			2					20
		penultimate vertebra	1	1								2
		ultimate vertebra		1								1
		vertebra	1	67								68
	4	otolith	25	22				1				48
haddock	1	parasphenoid					1					1
		posttemporal		1								1
	2	abdominal vertebra1		1								1

		caudal vertebra	2									2
		caudal vertebra 1	1									1
		caudal vertebra 2	1									1
	4	otolith		1								1
whiting	1	premaxilla		1								1
	2	abdominal vertebra	3	2								5
		caudal vertebra	1				1					2
poor cod	4	otolith		3								3
Norway pout, bib or poor cod	2	abdominal vertebra	1			1						2
		abdominal vertebra1	1									1
		caudal vertebra1	1									1
	4	otolith	2	1				1				4
cod family	1	articular	3	5			1					9
		basioccipital	1	5					1			7
		dentary	6	15			1	1				23
		hyomandibular	1									1
		infraphryngeal		1								1
		maxilla	3	9					1			13
		palatine	2	1								3
		parasphenoid	1	1								2
		posttemporal	2	1			1					4
		premaxilla	20	28		1	7	3	2			61
		quadrate	2	6			1		1			10
		supracleithrum	1	1								2
		vomer	1	4					1			6
	2	abdominal vertebra	48	199	1	2	68	8	9			335
		abdominal vertebra 1	74	87		5	6	7	6			185
		abdominal vertebra 2	9	15		1			1			26
		abdominal	37	43			3		13		1	97

		vertebra 3										
		caudal vertebra	126	232		6	38	11	9		2	424
		caudal vertebra 1	37	59		1	1		8			106
		caudal vertebra 2	21	15		1	2		8		1	48
		first vertebra	18	22		1	2	1			1	45
		penultimate vertebra	1				1					2
		vertebra	64	98		15		1	12		2	192
	4	otolith	138	146		3	5	5	11		1	309
gurnard family	1	premaxilla	1									1
	2	abdominal vertebra	1									1
sea scorpion family	2	abdominal vertebra		1								1
		first vertebra		1								1
		ultimate vertebra		1								1
Atlantic horse mackerel	2	abdominal vertebra	1	6								7
		caudal vertebra	1	6								7
	4	otolith		3								3
sea bream family	2	caudal vertebra		1								1
		vertebra							1			1
corkwing wrasse	1	infraphryngeal	6	23			1	1			3	34
		premaxilla		1								1
		preopercular		4								4
		quadrate		2								3
		vomer	2						1			3
	2	abdominal vertebra	14	8			1					22
		caudal vertebra	7	8		1						16
		vertebra		2								2
goldsinny	1	infraphryngeal	1	1								2
corkwing	2	abdominal	23	15				1	2			41

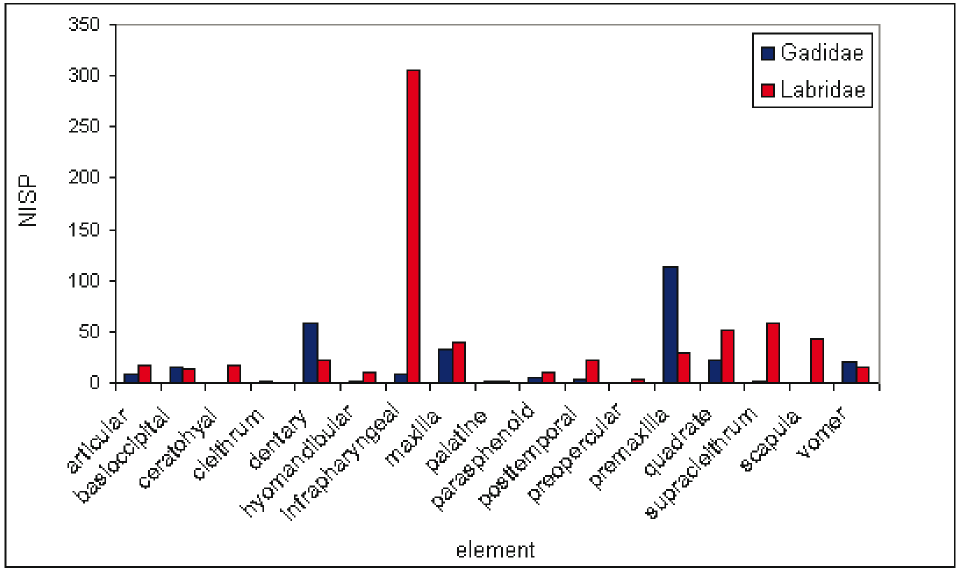
wrasse or goldsinny		vertebra										
		caudal vertebra	6	18				1	8			33
		caudal vertebra 2		4								4
ballan wrasse	1	articular	9	8			3	1			1	22
		basioccipital		2								2
		ceratohyal	1	7			1	1	1			11
		dentary	3	6							1	10
		infraphryngeal	13	46			1		1			61
		maxilla	2	8								10
		palatine	1						1			2
		parasphenoid	1	3								4
		posttemporal	1	6			2	1	1			11
		premaxilla		3				1	1			5
		quadrate	4	12			1	1				18
		supracleithrum	3	8				1	4			16
		scapula		1								1
		vomer		4								4
	2	abdominal vertebra	51	94		1	4	11	1			162
		caudal vertebra	18	26			3	1				48
		first vertebra	3	8				2	1			14
		penultimate vertebra		1								1
		ultimate vertebra		3								3
cuckoo wrasse	1	infraphryngeal		3								3
		posttemporal	1									1
		quadrate		1								1
		supracleithrum		2								2
		vomer		2								2
	2	abdominal vertebra	1	2								3
		caudal vertebra		5								5
		first vertebra		1								1
ballan or	1	basioccipital		1								1

cuckoo wrasse		infraphryngeal	2	8				2				12
		maxilla	1	2				1				4
		opercular	1									1
		palatine	1									1
		parasphenoid		1								1
		posttemporal	1									1
		quadrate		1								1
		supracleithrum	3									3
		scapula		3								3
		vomer		1								1
	2	abdominal vertebra	401	396		22	24	35	85	1	5	969
		abdominal vertebra1		1								1
		caudal vertebra	300	379		6	10	10	29		3	737
		first vertebra	22	13		1	2	2	9			49
		penultimate vertebra	9						2			11
		ultimate vertebra		2								2
wrasse family	1	articular	2	9			1					12
		basioccipital	6	11				2	1			20
		ceratohyal	2	11			3		2			18
		cleithrum	1									1
		dentary	7	16			5					28
		hyomandibular	6	11				1	1			19
		infraphryngeal	30	224		1	9	1				265
		maxilla	9	30			5	2	4			50
		palatine	4	1								5
		parasphenoid	1	7								8
		posttemporal	5	17			1	1				24
		premaxilla	3	25			1	1	2			32
		quadrate	4	35			5	1	3			48
		supracleithrum	7	48		1	2	1				59
		scapula	4	39			1		3			47
		vomer	5	9			1					15
	2	abdominal vertebra	361	1615		5	129	29	47	1	19	2206

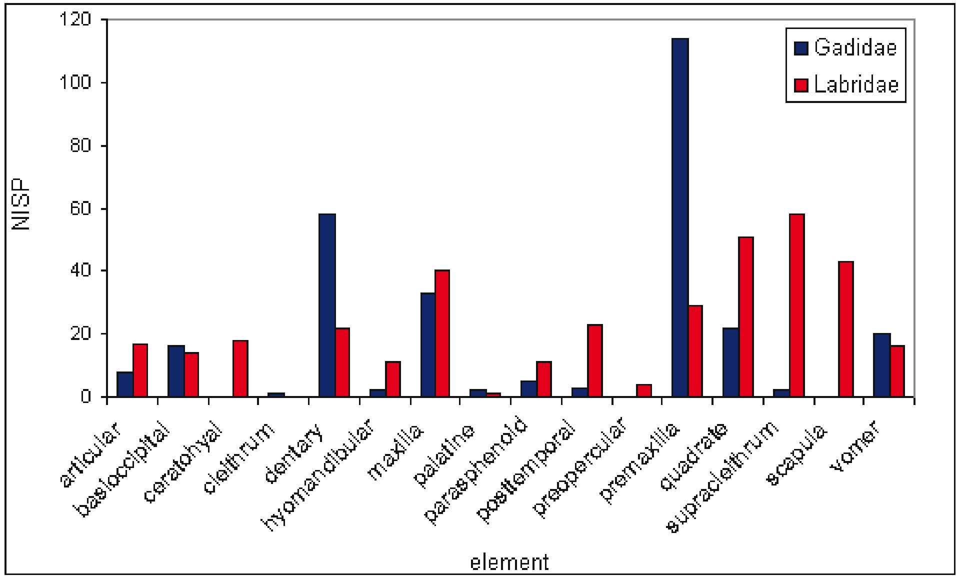
		caudal vertebra	295	1535			96	20	23		16	1985
		caudal vertebra 1									2	2
		first vertebra	41	122		1	22	5	5		1	197
		penultimate vertebra	23	42			4	1	2			72
		ultimate vertebra	1	20			1					22
		vertebra		95				1				96
eelpout	2	abdominal vertebra									1	1
butterfish	2	abdominal vertebra		13								13
		caudal vertebra		4		1						5
sandeel family	2	abdominal vertebra	1	4								5
Atlantic mackerel	2	abdominal vertebra	4	67			1		1		1	74
		abdominal vertebra 3	2									2
		caudal vertebra	16	85			6	1	4		3	115
		vertebra	1	7								8
perch order	1	parasphenoid	1									1
plaice	2	abdominal vertebra						1				1
plaice order	2	abdominal vertebra		2								2
		caudal vertebra	1	2					1			4
flatfish order	2	vertebra		1								1
		total	3832	9671	2	112	539	255	427	2	114	14954

Table 164: Sand, Fish QC1, QC2 and QC4 element representation
• ‘Mineralised vertebral centrum’ is abbreviated to mvc

Turning first to the main shell midden, Illustration 487 (below) shows the gadid and labrid QC1 element distributions for this context, combining all relevant data at the family level. Almost the full range of QC1 elements is present for both families, but the relative abundance of different elements is widely variable. The most abundant element by far is the wrasse infrapharyngeal. This is a very robust element with a distinctive morphology. Given these properties, it is likely that its abundance has been exaggerated by taphonomic and identification biases. Illustration 488 (below) shows the same QC1 element distribution without the infrapharyngeal. This implies that the element distribution of the gadids has also been influenced by preservation, as more robust elements such as the premaxilla and dentary are most common. A similar pattern of element distribution is seen in the organic rich silt layer. Although based on fewer QC1 elements, the labrid infrapharyngeal and gadid premaxilla are the most common elements.



Illus 487: Sand, combined gadid family and wrasse family QC1 element distribution for the main shell midden



Illus 488: Sand, combined gadid family and wrasse family QC1 element

distribution for the main shell midden without the infrphyrngeal

The paucity of gadid appendicular elements (for example cleithrum, supracleithrum and scapula) could be interpreted as the result of butchery, as these elements are sometimes left in dried fish after removal of the head and thus removed from the catch site (for example Barrett 1997). However, gadid abdominal and caudal vertebrae are both abundant (see Table 163, above) whereas in the case of dried fish some or all of these elements should also be underrepresented. In addition, only one possible cut mark was recorded, on a ballan wrasse caudal vertebrae from the main shell midden (see Table 145, above). Rather than the paucity or absence of certain elements being interpreted as the result of fish processing, it thus seems more plausible that it is due to preservation bias.

3.11.3.4.4 Fish size

Table 165, (below) shows that the majority of fish bones at Sand came from small (150–300mm) to medium (301–500mm) sized fish, based on comparison with reference specimens of known total length (TL). The size distribution for the collective wrasse family specimens and individual cod family species is shown in more detail in Table 166, (below).

To access a printable version of this table, please go to the separate page table165.html and set to LANDSCAPE mode.

Table 165

size	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
very large (801–1000mm)	1							1
large (501–800mm)	7	30	1	4	1			43
medium (301–500mm)	108	239		14	8	14	1	384
small (151–300mm)	167	606	3	33	20	20	4	853
tiny (<150mm)	8	56	1	2		4		71
Grand Total	291	931	5	53	29	38	5	1352

Table 165: Sand, Estimated size of fish from Sand

To access a printable version of this table, please go to the separate page table166.html and set to LANDSCAPE mode.

Table 166

taxon	size	topsoil	main shell midden	slopewash	organic rich	shell midden	sandy soil	unprov	Total
all wrasse family	large	1	2		1				4
	medium	50	142		10	3	11	1	217
	small	98	468	2	28	16	11	4	627
	tiny	4	38		2		3		47
saithe	large	1	2			1			4

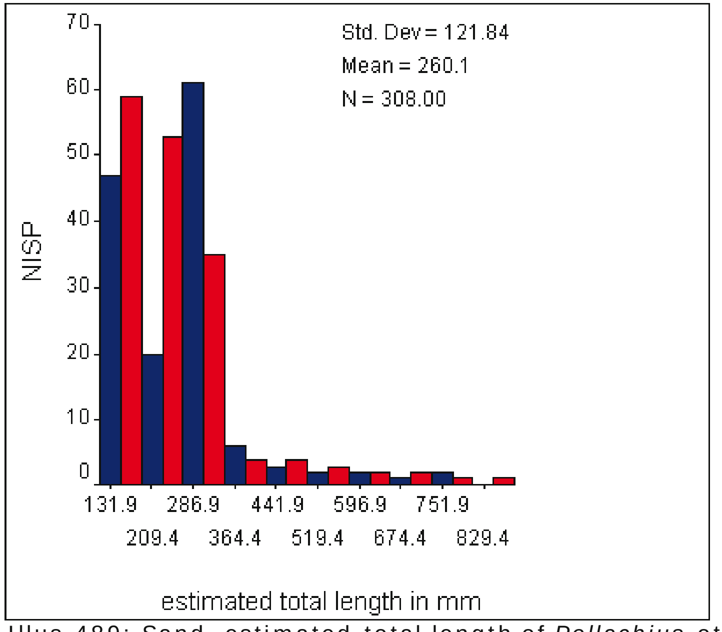
	medium	20	23			1	1		45
	small	27	39			1	2		69
	tiny	1	6						7
pollack	large		4						4
	medium		14						14
	small		8						8
	tiny		1						1
saithe or pollack	extra large	1							1
	large	1	4	1	1				7
	medium	11	20		1	2			34
	small	11	32			1			44
	tiny		1						1
cod	large	1	5						6
	medium	2	5				1		8
	small	3	6	1					10
	tiny		1						1
cod, saithe or pollack	large	1	1						2
	medium	6	15						21
	small	13	21				4		38
	tiny		3						3
haddock	medium		1		1				2
whiting	tiny		1						1
cod family	large	2	10		2				14
	medium	17	19		2	2	1		41
	small	15	32		5	2	3		57
	tiny	3	4	1			1		9

Table 166: Sand, Estimated size of gadid and labridae specimens

Less qualitative estimates of fish total length can be calculated using measurements of QC1 elements (given in Appendix 24) and regression equations relating them to total length (Desse & Desse-Berset 1996:172). Equations exist for selected measurements of the gadid species typically abundant on archaeological sites of all periods in Scotland (for example Jones 1991:161–162). Equations are also available for labrids of the Pacific Ocean, (Leach & Davidson 2001), but unfortunately the osteology of Atlantic labrids is not well researched. Research connected with the use of corkwing wrasse, rock cook and goldsinny as cleaner fish on salmon farms in Scotland (Treasurer 1996:74) does provide limited regression equations for the operculum and otolith (Treasurer 1994a). However, the wrasse otolith is too small for routine recovery and the operculum measurement requires complete preservation. Thus detailed analysis of the wrasse size distributions must await further research.

In the case of gadids, Jones' regression equations were applied to measurements taken on the otoliths of specimens identified as saithe, pollack, and Pollachius from the main shell midden (Appendix 24). A sample of over 300 measurements was obtained from the otoliths. Based on these measurements, a few large specimens are represented, but the majority (over 90%) are under

400mm, and the large specimens probably represent incidental catches. However, the most striking feature of the otolith total length estimates is the bimodal distribution (see Illustration 489, right).



Illus 489: Sand, estimated total length of *Pollachius* otoliths from the main shell midden

The Pollachius size distribution based on the otoliths from the main shell midden at Sand concords well with the bimodal distribution of saithe otolith measurements (as opposed to total length estimation) from the Cnoc Coig shell midden on Oronsay (Mellars & Wilkinson 1980:26). The evidence from Cnoc Coic (and other middens on Oronsay) has been interpreted as evidence for a seasonal fishery, in which age cohorts appear as modes in the measurement data. A similar interpretation of the otolith data from Sand seems reasonable and is discussed in more detail below.

3.11.3.4.5 Method of capture and seasonality

Wrasse are small to medium fish; ranging from the ballan wrasse at an average total length of 300–500mm TL to the goldsinny at around 100–140mm TL; that are found along the west coast today (Sayer & Treasurer 1996:3–7). All wrasse species are associated with rocky shores and they are generally shallow water fish. Treasurer has conducted several studies regarding the capture of wrasse, including the use of fyke nets (a series of joined hooped nets) and prawn creels (Treasurer 1994b, 1996, 2000). Baited and unbaited creels and traps were most successful, although larger species such as ballan and cuckoo wrasse were under-represented (probably due to the small apertures of the fishing gear). Perhaps of most relevance here are the by-catches found associated with these wrasse fishing techniques: saithe, pollack, cod, conger eel, scorpion fish, rockling, flatfish and dogfish species (Treasurer 1996:75). All of these taxa are represented at Sand, with saithe and pollack particularly abundant.

The adult size of saithe and pollack is much larger than that of wrasse and they can reach lengths of over 1m (Wheeler 1969:167–275). Their habitat varies with age (and therefore size), and as with all commercially important gadids, this has important implications regarding method of capture. Both saithe and pollack are found in the waters surrounding the west coast of Scotland and local fishermen attest to the abundance of pollack (lythe) around the coast of the Applecross Peninsula. The behaviour of saithe would make them more likely to be caught in greater abundance, as they form small shoals throughout the year. Only sexually mature, adult pollack shoal during the spawning period. However, the fish are often found in numbers on reefs, with young pollack found closer to the shore than adults, and today are a common catch of anglers (Wheeler 1969:272–273;

Whitehead *et al* 1986:690–691).

The young of both saithe and pollack are found close to the shore in their 1st and 2nd years (Wheeler 1969:272–275). Based on growth estimates for saithe given by Wheeler (1969:167), one year old fish reach *c*150mm TL, two year olds *c*300mm TL, and three year old fish 450mm TL. The otolith distribution from Sand has two modes, one centered around total lengths consistent with first year fish and the second with total lengths of second year fish (see Illustration 489, above right). Similar targeting of distinct size groups of saithe, comparative with those at Sand, was documented by Low in Orkney in the early 1800s (Low 1813:193–194). Here, small numbers of small (6–10 inches, *c*150mm) saithe began to be fished with rods from the shore from August to March with a peak in catch during the winter from large shoals. A second fishery in May, also with rods, targeted fish of *c*15 inches (300mm).

The catch of small sized saithe, pollack, wrasse, and indeed most other taxa from Sand, is broadly comparable with the Danish Mesolithic site of Maglemosegård, where most fish were less than 500mm in total length (Enghoff 1994:75). Although the principal species was cod, at this and other coastal sites, Enghoff found that the same cluster of small specimens was replicated for several coastal taxa (*ibid*:83–84). She thus proposed an indiscriminate 'catch all' method of fishing, probably using stationary traps or nets A similar interpretation may be appropriate for Sand especially when the by-catch evidence from the experimental wrasse capture methods (discussed above) is considered.

The lack of large fish at Sand suggests that deep sea fishing methods were not used and, based on the above, an inshore fishery can be proposed. The use of stationary traps or nets to target taxa with small maximum total lengths (the wrasses), and small specimens from species with large maximum lengths (saithe and pollack) seems plausible. If this were the case, the bimodal pattern seen in the main shell midden otolith TL estimates would reflect catches of first and second year fish. A single season of fishing, targeting two sizes of fish may be represented. Alternatively, this could indicate a strongly seasonal fishery, possibly with focused activity in spring and late autumn-winter, taking advantage of shoaling saithe, with pollack and wrasse also caught in abundance. All of the principal species can be taken by line, but the wrasse by-catch evidence suggests the use of stationary traps or nets as the primary fishing method at Sand.

3.11.4 Discussion

The faunal remains from Sand represent one of the largest assemblages from the Scottish Mesolithic, with over 16,000 identifiable specimens. Identifiable mammal remains make up only a small portion of this number, but the bird and fish assemblages are large. Two contexts were analysed in detail; the main shell midden and organic rich silt layer. As far as it is possible to compare the mammal and fish data from Sand with Cnoc Coig, Oronsay, a similar pattern of resource exploitation seems to have been practised. There is no evidence at Sand, however, for the intensive exploitation of marine mammalia taxa as for grey seal at Cnoc Coig. From both sites the mammal assemblages are small, yet similarities can be drawn between the element distribution of the most abundant terrestrial taxa at the site, red deer. At both sites metapodials and phalanges were the most common elements. Interpretation of the abundance of terminal appendicular elements of red deer at Sand remains inconclusive, however, hide processing, as suggested for Cnog Coig, remains one possibility. The bone fragmentation analysis does not permit a conclusive interpretation; marrow extraction and tool manufacture would both result in a high degree of fragmentation and may have occurred simultaneously. The high fragmentation may also be the result of taphonomic processes such as trampling.

With regard to the preservation of material it is worth noting the discrepancy between the quantity of mammal bones that is visibly burnt (30%) as compared with the amount of burnt bird bone (2%).

Turning now to the fish remains; at Sand either saithe or pollack along with species of the wrasse family were the most abundant taxa. Full comparison with Cnoc Coig is not possible due to the partly published nature of the data from Oronsay. However, the size distribution of *Pollachius* otoliths from the main shell midden at Sand compares well with the published saithe otoliths from Cnoc Coig, and may represent two seasons of fishing. From both sites the sizes of the most abundant taxa targeted were small and consistent with a littoral zone habitat. The capture of these fish with traps or nets, perhaps stationary, seems most plausible.

In terms of seasonal use of the site the mammal assemblage is disappointing. Whilst juvenile animals were present at the site, the paucity of evidence concerning age at death makes it difficult to determine seasonal use without tooth wear information. The bird and fish bone assemblages from the main shell midden, and to a lesser extent from the organic rich silt layer, however, give strong indications of seasonal use. Razorbills and guillemots are seabirds, only coming inland to breed. This results in two distinct periods for their possible capture. The first is in late spring or early summer during breeding, the second shortly after this when the birds have a complete moult in late summer and autumn. Given the large rafts of flightless, easily accessible birds that moult in the Inner Sound today, the latter period of capture appears to be the most readily available to the people at Sand. However, the capture of birds from colonies around Raasay and Skye remains a possibility. Similarly, two possible seasons of capture may be suggested by the fish remains. The bimodal distribution of the *Pollachius* otolith total length estimates from the main shell midden suggests that two populations of fish were consistently exploited. Two scenarios can be envisaged. The first is a single season of fishing, targeting two sizes of fish (as suggested by Mellars and Wilkinson 1980 for Cnoc Coig, Oronsay). The second is a seasonal fishery, with first year fishes being taken in late summer through to early spring, and second year fish in late spring, as described by Low (1813) for Orkney in the early 1800s. If the latter scenario is accepted, the combined fish and bird evidence is consistent with two possible periods of use at Sand; late spring and late summer.

The faunal remains from Sand make an important contribution to our understanding of the procurement of seasonal resources and food consumption in the Mesolithic. Much of the recent discourse in the literature concerning diet in the early prehistory of Scotland and beyond has centred around the stable isotope analysis of human bone (for example Schulting & Richards 2002, but see also Bailey & Milner 2002). The assemblage from Sand is not without bias, (it is unclear, for example, what purpose the mammal remains at the site served) but provides important zooarchaeological evidence for a period that is lacking in faunal remains.

3.11.5 Summary

Excavation at Sand has produced one of the largest Mesolithic faunal assemblages in Britain. Substantial quantities of mammal, bird and fish bone have been analysed. This analysis has revealed a focus on a narrow suite of local resources, including wild terrestrial mammals, seabirds and littoral zone fish. The highly fragmentary nature of the mammal assemblage makes interpretation difficult. If the fragmentation is not the result of post-depositional processes, tentative suggestions are the possible skinning of red deer and wild boar, the extraction of bone fat and tool manufacture. The bird remains are dominated almost exclusively by razorbills and guillemots, and their behavioural and breeding patterns place the time of their capture in late spring and early summer, or late summer and autumn. The fish assemblage is dominated by fish from the cod family and wrasse family. The total length estimate distributions for the main gadid taxa, saithe and pollack, point towards one or more seasons of fishing, targeting different sizes of fish. If this does represent two seasons of fishing, late summer and autumn (possibly into winter), and late spring are the most likely. Based on the size and species of fish it is likely that stationary traps and nets were the primary method of fishing at Sand.

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