CNOC COIG: THE SPATIAL ANALYSIS OF A LATE MESOLITHIC SHELL MIDDEN IN WESTERN SCOTLAND

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CHAPTER 6

SPATIAL ANALYSIS: MAMMAL BONES

It was noted above in Chapter 2 that a major objective of intra-site spatial analysis in archaeology is the identification of clusters in the distributions of single classes of items; any spatially delimited clusters are then often used as the analytical units for subsequent analyses. Indeed, the general expectation is that any non-random patterning will consist of clustered, as opposed to uniformly spaced, distributions. Although this expectation is perhaps not always warranted in the case of some artifactual remains, it is still generally valid for the patterning that we would usually anticipate encountering in the distribution of mammal bone remains within archaeological sites.

While some researchers have shunned the use of the traditional method of visually inspecting distribution plots in this search for clusters, it was pointed out above (pp. 52-54) that quantitative methods of spatial analysis such as the Clark and Evans (1954) nearest-neighbour statistic detect tendencies towards clustering but that they do <u>not</u> actually delimit spatial clusters on the ground. Fortunately, the identification of clusters of items within archaeological sites is visually obvious in many cases and does not require the use of some statistical technique. In general, the mammal bones from Cnoc Coig provide a good example of such visually detectable patterning. By the visual inspection of a wide variety of computer-generated distribution plots, some very clear patterning in the distribution of mammal bones in Cnoc Coig has been revealed, and in particular, it has been possible with most species to define groupings of spatially associated bones which may be presumed to represent depositionally contemporaneous subunits of the total assemblage on the site.

Seal

Introduction

As an initial step, we may look at the overall distribution of seal remains in Cnoc Coig by the use of depth-compressed horizontal plots. Figures 41 to 43 show the overall distribution of adult, young and foetal seal bones respectively[1]. It should be pointed out that the term "adult" refers to sexually matured individuals, while "foetal" refers to newborn infant seals. The age category of "young" seals is less well defined; while it may include some bones of infant seal (those which are osteologically not obviously foetal), most probably represent older but subadult individuals (C. Grigson, personal communication). Remembering that the fish bone evidence points to Cnoc Coig having been occupied primarily during the autumn (Mellars 1978: 380-384; Mellars & Wilkinson 1980: 34, 36-39; Wilkinson 1981: 113-115, 126), which is when seals would have been hauled out onto land to breed, the presence of foetal seal bone in this site is perfectly consistent with its seasonal dating based on the fish remains.

At any rate, Figures 41 to 43 clearly demonstrate a strong clustering tendency for seal bones of all age categories, and a number of distinct groups can be readily defined. However, because these are depth-compressed plots, it is not necessarily the case that all the bones in any apparent cluster belong together as one discrete group, since it is possible that at least some of these groups consist of more than one cluster which, though superimposed on these plots as if they do constitute a single entity, are in fact stratigraphically separate. In order to investigate the stratigraphic and depositional integrity of these clusters, the other two types of distribution plots can be employed. Firstly, by examining a sequential

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[1] These and all subsequent computer-generated distribution plots used in the spatial analysis of Cnoc Coig, which commence with Figure 41, appear after the main body of the thesis (following the list of references cited) and are contained in Volume 2.

series of depth-selective horizontal plots (each of which spans one 5 cm level), with which one can follow individual clusters down through the midden deposits, one can get a good idea of the depth range of clusters which are apparent on the depth-compressed plots and, of particular importance, one can determine if there are any stratigraphic lacunae within what seems to be a single horizontal group. These plots show that these apparent clusters are typically quite concentrated stratigraphically, occurring mainly in two to four levels (10-20 cm of deposit), although the overall depth distribution of the larger or more scattered groups is sometimes greater than this due to the fact that they occur on sloping surfaces and not on level planes. In any case, this sequence of depth-selective horizontal plots would seem to indicate that the majority of the clusters visible on the depth-compressed plots do have depositional integrity and do not involve several stratigraphically separate groups.

This is even more apparent when clusters are viewed in section by the vertical distribution plots, since these reveal stratigraphic relationships far more clearly than either of the two kinds of horizontal plots. Figures 44 to 52 show the distribution in section of seal bones in the following east-west lanes: Lanes 4, 5, 6, 11, 12, 13 and 18. Figures 53 to 59 show the occurrence of seal bones in the following south-north lanes: Lanes F/G, H, I, J, M and N. Note that most of these plots do not run the full length of the areas of the site which have been excavated in their respective lanes; rather, they cover only those portions of the lanes which contain a reasonably large number of seal bones and which show the most important features of the distributions. Also, it should be recalled from Chapter 5 that on these sectional plots the depth dimension is distorted by three and one-third times relative to the other dimension so that differences in depth are somewhat exaggerated. One can see on these sectional plots the depth spread of groups of bones and also how they occur along slopes within the midden -- and by examining the other lanes at right angles to them, one can also see how they slope in the other direction.

Seal Bone Groupings

Using all the relevant horizontal and sectional distribution plots, the most informative of which are reproduced here as Figures 41 to 59, it has been possible to define eleven major groups of seal bones in the midden. Within some of these major localized groups, particularly the larger ones, two or more subgroups have been defined for one of two reasons. Firstly, a subgroup distinction is made between bones of each of the three age categories within a major group, regardless of whether these subgroups based on age are intermixed or stratigraphically separate. However, such subgroup status is not assigned to one or two isolated bones of one age category within or near a group of another age category, which particularly applies to a few scattered young seal bones -- such bones are either considered as isolated or they are placed together with the nearby group of bones of the other age category, depending on their stratigraphic relationships to this nearby group. Secondly, for the larger and more horizontally diffuse groups only, the major groups represent bones which broadly speaking are spatially related, although it is not always clear if all the bones in the group are equally and unequivocally stratigraphically associated with all the other bones in the group. Hence, separate subgroups have been defined for bones within a group which can be unambiguously considered to be stratigraphically related to each other but which are somewhat horizontally and/or vertically separated from other similarly defined subgroups within the major group. In effect, for the larger and more widely scattered groups of bones, this two-tier hierarchical system of defining groups reflects differing degrees of certainty about stratigraphic/depositional relationships within the midden -- the subgroups represent bones which may reasonably be considered to be related both stratigraphically and depositionally, while the major groups represent larger entities which are stratigraphically related such that they are probably also related depositionally though this is less certain.

The groups and subgroups of in situ seal bones from Cnoc Coig which have been defined are delimited in Figures 41 to 43, while Table 18 lists all the bones belonging to each grouping. It should be recalled from Chapter 4 (pp. 82, 84) that Grigson (1981: 174) initially only recognized grey seal in the Cnoc Coig mammal bone assemblage, as a result of which even those seal bones which could not be precisely identified to the species level were regarded as being grey seal (C. Grigson, personal communication). The spatial analysis proceeded on this basis, treating all seal remains from the site as a single taxonomic entity. Subsequent to the completion of the analysis, Grigson (1985) has recognized the presence of two bones of common seal in the assemblage. The effect of this change is that the less specifically identified bones may represent either grey seal or common seal, even though the bones of the former vastly outnumber those of the latter. To take some account of the fact that two seal species are included in the assemblage, Table 18 shows the taxonomic identification for each bone. Aside from the taxa of grey seal and common seal, which include both definite and probable identifications for each species, two other taxa are indicated: "seal" indicates bones which are identified as being definitely seal but of indeterminate species, while "seal?" is used for bones which are identified as only being probably seal. From this table, the relative proportions of these four seal taxa can be determined for the in situ bones: of the 211 adult bones, 102 (48.3%) are grey seal, only two (0.9%) are common seal, 85 (40.3%) are seal spp., and 22 (10.4%) are seal?; of the 23 bones of young seal, 14 (60.9%) are grey seal, eight (34.8%) are seal spp., one (4.3%) is seal?, and none are common seal; and of the 38 foetal bones, 13 (34.2%) are grey seal, 22 (57.9%) are seal spp., three (7.9%) are seal?, and none are common seal. As can be seen from Table 18, only groups 1C and 8C contain a bone of common seal. However, even with the other

Table 18. List of the *In Situ* Seal Bones Belonging to the Spatially Defined Groups and Subgroups. All bones are fragmentary unless otherwise stated. The bone identifications are by C. Grigson (personal communication).

Group	Finds Number	Age	Seal Taxon	Bone Element
1A	2,075	foetal	grey	R. petrous
	7,039	"	seal	L. petrous
	7,020	"	seal	proximal phalange
1B	7,037	young	grey	skull fragments
	7,037	"	grey	L. lower teeth (P1 to M1)
	7,014	"	grey	L. lower teeth (I to P3)
	7,024	"	grey	R. lower teeth (I to P4)
	7,171	"	grey	R. scapula
1C	7,132	adult	grey	R. petrous ⎤ a pair?
	7,124	"	grey	L. petrous ⎦
	7,149	"	grey	L. petrous
	7,184	"	grey	palate
	7,030	"	grey	maxilla & teeth (C, P2 and 3 cheek teeth)
	7,119	"	grey	L. maxilla & teeth (C, P1, P2 and 3 others)
	4,128	"	seal?	tooth (lower P1?)
	7,187	"	grey	4 very old root stumps
	7,213	"	grey	cervical vertebra V
	7,186	"	grey	cervical vertebra VI
	15,226	"	seal	cervical vertebra
	7,152	"	grey	dorsal vertebra III
	7,164	"	grey	dorsal vertebra
	7,131	"	grey	dorsal vertebra
	7,117	"	seal	dorsal vertebra
	7,033	"	seal	thoracic vertebra
	7,191	"	seal	caudal vertebra III, complete
	7,025	"	seal	caudal vertebra VI?
	7,138	"	seal?	vertebra
	7,013	"	seal	vertebra
	4,164	"	seal?	vertebra
	7,161	"	seal	rib
	7,013	"	seal	sternebra
	7,146	"	seal	sternebra
	4,144	"	seal?	sternebra?
	7,168	"	grey	L. scapula
	7,165	"	grey	R. pelvis
	4,124	"	grey	L. pelvis
	7,126	"	grey	R. humerus, complete
	7,125	"	grey	L. humerus, complete
	7,141	"	grey	R. radius, complete
	7,034	"	grey	R. radius, complete
	15,225	"	grey	R. scapho-lunate
	7,113	"	grey	R. metacarpal II?, complete

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
1C	7,133	adult	grey	L. metacarpal I, complete
	7,035	"	grey	L. tibia
	7,032A	"	grey	R. fibula
	7,185	"	seal	R. ant. cuneiform, complete
	7,143	"	grey	L. posterior lateral cuneiform, complete
	7,172	"	grey	L. navicular
	7,153	"	grey	L. cuboid
	7,190	"	grey	L. astragulus, complete
	7,151	"	seal	L. cuboid ┐
	7,151	"	seal	L. navicular ├ same ankle
	7,151	"	seal	L. cuneiforms ┘
	7,158	"	grey	R. metatarsal I
	7,031	"	common	R. post. proximal phalange V
	7,027	"	grey	post. proximal phalange I?
	4,158	"	seal?	ant. proximal phalange (I?)
	8,119	"	grey	ant. proximal phalange IV?
	7,127	"	grey	L. anterior proximal phalange IV, complete
	7,162	"	seal	posterior middle phalange
	7,009	"	grey	anterior middle phalange II?, complete
	7,154	"	seal	anterior terminal phalange
	7,181	"	grey	terminal phalange
1D	4,130	adult	grey	R. mandible
	7,083	"	grey	atlas
	7,089	"	grey	rib
	7,079	"	seal?	rib?
	7,029	"	grey	L. femur
	4,116	"	seal	L. metatarsal I
	7,080	"	grey	L. metacarpal V
1E	7,093	adult	grey	R. trapezium, complete
	7,095	"	grey	R. metacarpal I, complete
	7,094	"	grey	R. metacarpal II, complete
1F	2,050	adult	seal	occipital
	2,052	"	seal	vertebra
	2,053	"	seal?	vertebra?
	4,047	"	seal?	rib
	2,092	"	seal	anterior proximal phalange
Two isolated bones in Lanes 6 & 7, south of Group 1:				
	3,575	adult	seal?	fibula?
	10,930B	"	seal?	2 phalanges

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
One isolated bone in Lane 4, east of Group 1:				
	15,208	adult	seal?	mandible?
2A	15,534	adult	grey	cervical vertebra VII
	15,611	"	seal?	vertebra ⎤ same bone?
	15,613	"	seal	vertebra ⎦
	15,650	"	seal	L. humerus
	15,617	"	grey	R. metacarpal II
	21,064	"	grey	metatarsal (probably III)
	15,658	"	seal	sesamoid?
2B	15,614	young	seal	rib
	15,584	adult	seal	rib
	21,201	"	seal	rib
	21,281	"	seal	rib
3	15,427	adult	grey	R. trapezoid, complete
	18,269	"	grey	R. metatarsal III, complete
	18,267	"	grey	R. metatarsal V
	18,268	"	grey	R. metatarsal IV
	18,290	"	grey	R. posterior proximal phalange II, complete
	18,289	"	grey	R. post. prox. phalange III
	18,308	"	grey	R. posterior proximal phalange IV, complete
	18,295A	"	seal	post. proximal phalange I
	18,309	"	grey	R. posterior proximal phalange V, complete
	18,303	"	grey	R. posterior middle phalange III, complete
	18,312	"	grey	R. post. middle phalange V
	18,318	"	seal	?posterior middle phalange
	18,257	"	seal	post. middle phalange III?
	18,199	"	seal	anterior middle phalange
	18,302	"	seal	posterior terminal phalange I, complete
	18,265	"	seal	terminal phalange
	18,273	"	seal	terminal phalange
	15,305	"	seal	terminal phalange, burnt
4	15,412	adult	seal?	R. occipital?
	15,317	"	seal	rib
	15,370	"	seal?	L. lateral cuneiform?
	15,439	"	grey	L. metatarsal II
	15,408	"	grey	L. metatarsal IV
	15,310	"	grey	post. proximal phalange I

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
4	15,407	adult	grey	post. proximal phalange I
	15,775	"	grey	posterior proximal phalange
	15,314	"	grey	anterior middle phalange
	15,406	"	seal	terminal phalange
5A	21,130	adult	seal?	rib
	21,136	"	seal?	vertebral centrum
5B	21,009	adult	grey	R. tibia ┐ same bone ┐ same leg
	21,010	"	grey	R. tibia ┘
	21,011	"	grey	R. fibula ┐ same bone ┘
	21,025	"	seal	R. fibula ┘
	21,008	"	seal	anterior proximal phalange
Six isolated bones scattered about in the vicinity of Groups 3, 4 and 5A in the eastern end of Lanes 4 & 5 and in the northern end of Lanes H to J:				
	18,235	foetal	seal	petrous
	18,193	adult	grey	tooth (L. upper P2)
	21,174	young	grey	dorsal vertebra (c. VII)
	21,173	adult	seal?	vertebral centrum epiphysis
	18,207	"	seal	rib
	21,116	"	grey	R. metatarsal II
6	15,867	foetal	seal	thoracic vertebra
	15,892	"	grey	R. humerus
	15,831	adult	grey	R. rib I, complete
	15,830	"	grey	L. rib
	15,833	"	grey	rib
	15,834	"	grey	rib
	15,835	"	grey	rib
	15,872	"	grey	L. post. proximal phalange I
	15,860	"	seal?	middle phalange
7	15,870	adult	grey	thoracic vertebra III?
	15,885	"	seal	rib head
	15,876	"	grey	L. metacarpal III, complete
	15,890	young	grey	L. occipital
	15,881	foetal	seal?	braincase fragments
	15,886	"	grey	mandible & teeth
	15,883	"	grey	R. scapula
	15,882	"	grey	vertebra & fragments
	15,884	"	grey	vertebra & fragments
	15,884	"	seal	2 vertebral centra
	15,885	"	seal	3 vertebrae & fragments
	15,885	"	grey	vertebral fragments

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
7	15,885	foetal	grey	rib fragments
	15,885	"	grey	rib fragments
	15,880	"	grey	pelvis & fragments
	15,879	"	grey	R. femur
	15,885	"	seal	tibia
	15,139	"	grey	R. astragulus
8A	17,180	foetal	seal	vertebra
	3,380	"	seal	rib
	17,107	"	grey	L. fibula
	3,166	"	seal	R. metacarpal I
	3,330	"	seal	metacarpal
	3,356	"	seal?	carpal/tarsal?
	3,367	"	seal	metatarsal
	3,492	"	seal	metatarsal V
	3,479	"	seal	R. post. proximal phalange I
	3,480	"	seal	posterior proximal phalange
	3,361	"	seal	posterior proximal phalange
	3,490	"	seal	R. ant. proximal phalange I
	3,366	"	seal	L. ant. proximal phalange I
	3,358	"	seal	ant. middle phalange (same bone)
	3,363	"	seal	ant. middle phalange (same bone)
	3,362	"	seal	anterior middle phalange
	3,506	"	seal	anterior middle phalange
8B	3,483	young	seal	rib
	15,106	"	seal?	caudal vertebra
	15,099	"	grey	R. humerus
	15,056	"	grey	femur
	17,136	"	grey	L. magnum
	3,467	"	grey	L. metatarsal I
	3,484	"	seal	L. proximal phalange
	17,110	"	grey	anterior middle phalange V, complete
	3,325	"	seal	anterior middle phalange
	3,341	"	seal	terminal phalange
	3,342	"	seal	terminal phalange
8C	17,195	adult	seal	petrous
	15,136	"	seal?	sternebra
	17,163	"	seal	sternebra
	17,164	"	seal	sternebra
	17,223	"	seal	sternebra
	17,224	"	seal	sternebra
	17,160	"	seal	sternebra
	17,101	"	seal	rib

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
8C	17,122	adult	seal	rib?
	17,156	"	seal	rib
	17,158	"	seal	rib & fragment
	17,222	"	seal	rib
	17,170	"	seal	2 ribs & 2 fragments
	17,162	"	seal	rib
	17,161	"	seal	rib
	17,092	"	grey	dorsal vertebra (XII?)
	17,215	"	seal	sacral vertebra I
	17,226	"	grey	caudal vertebra
	17,227	"	seal	caudal vertebra III
	17,230	"	seal	vertebra
	17,189	"	seal	lumbar vertebra
	17,225	"	common	R. pelvis
	3,486	"	grey	L. ulna
	15,105	"	seal	R. ulna
	17,235	"	grey	?post. proximal phalange I?
	17,213	"	grey	R. ant. proximal phalange I
	3,455	"	grey	proximal phalange
	15,070	"	grey	R. post. middle phalange III?
	17,191	"	seal	anterior middle phalange
	17,216	"	seal	anterior middle phalange
	17,237	"	seal	anterior middle phalange
	3,189	"	seal	terminal phalange
8D	17,192	adult	grey	R. maxilla & teeth (C to P4)
	22,019	"	grey	L. mandible
	22,161	"	grey	cervical vertebra IV
	22,511	"	seal	dorsal vertebra
	22,514	"	seal	lumbar? vertebra
	22,515	"	seal?	vertebral centrum epiphysis
	8,049	"	grey	L. femur, complete
8E	17,090	adult	seal?	R. mandible & fragments
	17,120	"	seal	rib
	17,209	"	seal	rib

Three isolated bones in Lane F/G in the vicinity of Groups 8A-8C, but much too shallow to relate to them:

	Finds Number	Age	Seal Taxon	Bone Element
	3,251	young	seal	terminal phalange, burnt
	3,399	adult	seal	rib
	3,032	"	seal	L. ant. proximal phalange I

Two isolated bones in Lanes 13 & 14 near Groups 8C & 8D:

	Finds Number	Age	Seal Taxon	Bone Element
	17,017	young	grey	R. tibia shaft
	18,019	"	seal	L. scapho-lunate

Table 18. Continued.

Group	Finds Number	Age	Seal Taxon	Bone Element
9	15,485	adult	seal	vertebra
	15,517	"	grey	L. femur, complete
10	7,283	adult	grey	tooth (R. lower P2)
	22,523	"	seal	sternebra
	22,038	"	grey	R. trapezium, complete
	22,114	"	seal	phalange
	22,078	"	grey	R. ant. proximal phalange I
	15,072	"	grey	anterior middle phalange
	7,294	"	grey	anterior middle phalange IV?, complete
11A	15,843	adult	seal	rib
	15,846	"	seal	rib
	15,849	"	seal	rib
	15,853	"	seal	rib
	15,858	"	seal	rib
	15,844	"	seal	thoracic vertebra
	15,857	"	seal	thoracic vertebra
	15,850	"	grey	thoracic vertebra IV
	15,855	"	grey	thoracic vertebra V
	15,852	"	grey	thoracic vertebra (VI?)
	15,848	"	seal	thoracic vertebra VIII
11B	18,085	foetal	seal?	ischium?
	16,097	adult	seal	R. petrous } a pair (with 16,097 L. petrous)
	16,097	"	seal	L. petrous } a pair (with 16,097 R. petrous)
	18,098	"	seal	R. petrous } same bone (with 18,130)
	18,130	"	grey	R. petrous } same bone (with 18,098); a pair (with 18,136)
	18,136	"	grey	L. petrous } a pair (with 18,098/18,130)
	16,077	"	grey	L. petrous
	18,087	"	grey	tooth (?R. upper P4)
11C	18,113	adult	seal?	rib
	18,116	"	seal	rib
	18,051	"	seal	thoracic vertebra
	18,039	"	grey	R. metacarpal III, complete
	18,099	"	grey	L. ant. proximal phalange III
11D	15,474	adult	seal	rib
	15,495	"	grey	L. calcaneum, complete
11E	15,496	young	grey	tooth (R. lower P2)
	16,058	adult	grey	tooth (R. lower P1)

groupings, some of the less specifically identified seal bones might derive from common seal, even though grey seal accounts for nearly half of the total assemblage compared to less than one percent for common seal.

At any rate, it can be seen from Figures 41 to 43 that these groups of seal bones vary somewhat in terms of the density or compactness of the grouping. A distinction, albeit a rather arbitrary one, may be made between highly compact "clusters" and relatively diffuse "scatters". Some of the groupings (such as 1C, 6, 7 and 11A) consist of very dense and compact clusters of bones, while others (such as 4, 8D, 10 and 11C) are altogether more diffuse scatters with no obvious centre or focal point; other groupings (such as 2A and 3) lie somewhere between these two extremes. The largest groups of seal bones at Cnoc Coig (groups 1, 8 and 11) consist of a relatively dense cluster with some outlying scatters around them. There can be little doubt that the central subgroup clusters represent depositionally related bones and, although the subgroup scatters nearby are less clearly related to them, they do appear to be extensions of the main subgroup clusters.

The best example of this is group 1 (see Lanes 4 & 5 = Figs. 45 & 47). Firstly, the two small subgroups of foetal and young bones (1A and 1B) can be seen to be completely intermixed with the main group of adult bones (1C) and thus, these subgroup distinctions based on age have no spatial, stratigraphic or depositional significance. Subgroup 1D is clearly a westward extension of the main cluster, while 1E is a further westward extension on the down-sloping edge of the midden (see Fig. 47). Subgroup 1F is somewhat less clearly related to this major grouping, although it may reasonably be considered a southwestward extension of subgroups 1C-1E.

Subgroup 2A is a small, diffuse scatter of reasonably well-associated bones which slopes rather steeply westwards and northwards (see Lanes 6 & M = Figs. 48 & 58). To the immediate north-northwest of subgroup 2A is a small, linear scatter (2B) composed of four bones, one of which is identified as young. These bones are very close to subgroup 2A and they could be related to it as a north-northwestward, up-slope extension. If so, then group 2 as a whole would be a scatter occurring in a U-shaped trough which, rather suggestively, parallels the slope of the surface of the midden in this area -- see Lane M (Fig. 58). However, this spatial association is not so convincing that these two subgroups can unequivocally be considered to be depositionally related.

Group 3 is a loose cluster of well-associated bones which lie in a slightly concave trough which slopes downwards towards the southwest -- see Lanes 4 and 5 (Figs. 44 & 46) and Lanes H and I (Figs. 54 & 55). Group 4 is a small, diffuse scatter immediately south of group 3 -- see Lanes 5 and 6 (Figs. 46 & 48) and Lanes H and I (Figs. 54 & 55). Because of its greater depth, it is clearly stratigraphically separate from group 3 and therefore not an extension of it. To the west of groups 3 and 4 are two small clusters, subgroups 5A and 5B -- see Lanes 5 and 6 (Figs. 46 & 48) and Lane J (Fig. 56). Because they are much shallower, lying close to the surface of the midden, they cannot be stratigraphically associated with either group 3 or group 4, although they could be depositionally related to each other.

Groups 6 and 7 are two compact clusters which are stratigraphically separated one above the other in the north-central area of Lane H (Fig. 54). The smaller, uppermost cluster (group 6) is made up primarily of adult bones, while the lowermost cluster (group 7) consists of 14 foetal bones plus one young and three adult bones. Group 7 might well be depositionally related to group 4 which lies slightly down-slope just to the north of it. The bones of these two groups, being the deepest and therefore depositionally earliest in this area of the site, would thus occur on a low dome-shaped mound with group 7 sloping slightly southwards and group 4 being a down-slope extension to the north. In any event, groups 6 and 7 appear to be stratigraphically separated, and therefore to represent successive depositional events, even though the bones comprising them might suggest depositional association or perhaps even some post-depositional intermixing of the two clusters.

In any event, depositionally later than groups 6 and 7 is group 8 in Lanes F/G to K (see Figs. 53-56; also Lanes 11-13 = Figs. 49-51). Group 8 consists of three main clusters, one each of foetal, young and adult bones (8A, 8B and 8C respectively), plus a small scatter to the west (8D) and a small cluster to the south (8E). Although the three main clusters are sufficiently intermixed to be regarded as depositionally contemporaneous, there is some horizontal separation of them. Subgroup 8A occurs mainly in Lane F/G with a west-southwest extension into Lanes H and I, whereas the adult cluster (8C) is the opposite with its main concentration in Lanes H and I and a few bones scattered east-northeastwards into Lane F/G; the cluster of young bones (8B) is intermediate with a roughly equal spread from Lane F/G to Lane I. Subgroup 8D is a small scatter of adult bones which lies immediately west-southwest of subgroup 8C and appears to be a small westward extension of this large cluster -- see especially Lane 13 (Fig. 51). Subgroup 8E is a small cluster of three adult bones immediately south of 8C in Lane H (Fig. 54) near the southern edge of the midden. Overall, group 8 occurs on a surface which slopes fairly gently towards the south and west.

Nearby group 8 are several other bones which are clearly depositionally unrelated to it. In Lane F/G (Fig. 53) are two adult bones and one young bone which are too shallow to relate to group 8 and are clearly depositionally later. Although possibly related to each other, these three bones are not well associated with any other grouping of seal bones. There are also two young seal bones in the vicinity of subgroup 8D (cf. Figs. 41 & 42), one in Lane I (Fig. 55; see also Lane 13 = Fig. 51) near the interface between 8C and 8D, and the other in Lane L at the western end of subgroup 8D -- both of these bones occur near the surface of the midden and appear to be unrelated to group 8. Just north of group 8 is an isolated pair of bones, group 9 (see Lanes H & 11 = Figs. 54 & 49). Because of their depth, and because of the fact that seal bones occur in south-sloping lenses successively from north to south in this area of the site, group 9 is clearly depositionally earlier than group 8. It might be a down-slope southward extension of either group 6 or group 7, but it is not possible to determine on spatial grounds which of these two possible associations is more likely. Group 10 is a small scatter of adult bones in Lanes I to K (see Figs. 55 & 56; also Lanes 11 & 12 = Figs. 49 & 50). This loose scatter occurs on a surface which slopes from Lane I downwards to the west and from Lane 10 downwards to the south. Group 10 is not associated in an obvious way with any other grouping of seal bones, although it might possibly be interpreted as a southwestwards down-slope extension of group 6. In any case, even though it is close to subgroup 8D, because of its greater depth, it would appear to be depositionally earlier than 8D and therefore not associated with it.

Group 11 comprises a number of subgroups located in the south-central area of the site near the southern edge of the midden -- see Lanes M and N (Figs. 57 & 59) and Lane 18 (Fig. 52). The deepest is subgroup 11A which consists of a very compact cluster of adult seal bones. Subgroup 11B is a loose scatter of seven adult bones plus one foetal bone which lies directly above 11A and is slightly stratigraphically separated from it (see Lanes 18 & M = Figs. 52 & 57). It is difficult to say whether this stratigraphic separation (of about 12-20 cm) implies separate depositional events. Because subgroup 11A is made up of the upper torso and 11B consists of head bones, it might be tempting to regard these two subgroups as representing different body parts from one seal processing event, and therefore as being depositionally contemporaneous, despite the stratigraphic separation between them. However, following a more conservative view, it is best to regard these two subgroups as representing separate depositional events.

Subgroup 11C is a small scatter of adult bones in Lanes L and M (see Fig. 57) which occurs on a surface sloping steeply down to the west and south. It lies up-slope to the north of subgroups 11A and 11B and it may reasonably be considered depositionally related to one of them, as an up-slope extension. On stratigraphic grounds alone, it is not possible to determine to which of these two subgroups it relates; however, on the basis of the bones which comprise these subgroups, it seems more likely to relate to 11A.

To the west of subgroup 11C are three adult bones and one young seal bone. These four bones occur on the very steeply sloping western edge of the midden so that their stratigraphic/depositional relationships are difficult to ascertain. Nevertheless, they do not appear to constitute a single grouping of depositionally related bones. Rather, the deepest two adult bones seem to constitute a pair (subgroup 11D) which depositionally precedes the shallower third adult bone. Although the young seal bone is more problematically associated, it appears to relate to the upper, isolated adult bone -- thus, this pair has been designated as subgroup 11E. The stratigraphic relationships of these two subgroups to the other subgroups are even more problematical. Either pair of bones might be considered a westward down-slope extension of subgroup 11C but, on the basis of stratigraphic relationships alone, any such association must be considered uncertain. In any case, because of the depositional sequence in which 11A precedes 11B, and 11D apparently precedes 11E, it is tempting to relate 11D to 11A and 11E to 11B, and therefore to associate 11D with 11C (if 11C is viewed to be more likely related to 11A than to 11B). In terms of the composition of these subgroups of bones (see Table 18), this set of stratigraphic/depositional relationships makes the most sense, although it must be reiterated that the associations of the four bones of subgroups 11D and 11E suggested here must be regarded as tenuous.

Spatial Association with Hearths

A few observations may be made regarding the spatial association of these groupings of seal bones with the many hearths within the midden. The largest concentration of seal bones (group 1) occurs in the upper part of the midden deposits well above the many hearths in this northwestern area of the site. It is clear that these bones were deposited after these hearths would have been in active use, and there are no other nearby hearths which stratigraphically might be contemporaneous with this group; the nearest such hearths are several metres to the east.

In marked contrast are the bones of groups 2 to 5 in the north-central and northeastern areas of the site. Group 2 lies in close proximity to two stratigraphically related hearths, with all but the two westernmost bones of subgroup 2B being within 1.0 m of the edge of a hearth. Similarly, group 3 is spatially well associated with one of the very few hearths in the northeastern area of the site. The closest bones of group 3 lie around this hearth on its western edge, while the rest are scattered away to the southwest. If anything, group 4 is even better associated with one of the few hearths in this northeastern area. Seven of the ten bones of this group occur right on the periphery of a hearth, three on one side and four on the other, with the remaining three bones lying scattered around nearby. And again, the compact cluster of 5A lies right on the edge of a hearth, while subgroup 5B occurs about 1.0 m away on the other side of this same hearth, or it might relate to another hearth nearby at a somewhat slightly greater distance (ca. 1.5 m).

The foetal bone cluster comprising group 7 is moderately well associated with its nearest stratigraphically related hearth which is about 1.0 to 1.5 m away, while group 6 above it is more distantly removed from its nearest hearth (ca. 2.5 m away). With only a few exceptions, the bones of group 8, including the main concentrations in 8A-8C and most of the outlying scatter of bones, are quite far removed from the nearest stratigraphically associated hearth (at distances of 2.5 to 3.5 m or more). The pair of bones comprising group 9 occur about 1.0 m away from their nearest hearth, while the bones of group 10 are loosely scattered around one of the few hearths in the central area of the site, lying within a distance of about 1.5 m from the hearth. Finally, subgroups 11A and 11B occur in close proximity (within ca. 1.0 m) to one or the other of the few hearths in the south-central extreme of the site, while the scatter of subgroup 11C is somewhat further away from the closest stratigraphically related hearth (at ca. 1.5 m away), and the two pairs of bones comprising 11D and 11E are even more distantly removed at about 2.0 m.

Thus, in terms of their stratigraphical association with hearths, the seal bone groupings within Cnoc Coig would appear to be referrable to one of two patterns of association. The largest two groups (1 and 8), as well as group 6, do not occur in close proximity to their nearest stratigraphically related hearths, lying about 2.5 m or more away. In contrast, the other groupings lie in much closer proximity to hearths. Indeed, some of them (such as 3, 4, 5A and portions of others) lie very close to the edge of a hearth, while the remainder are generally all within 1.0 to 1.5 m of a hearth. Except for group 7 and subgroup 11A, the larger of these groupings (i.e. 2A, 3, 4, 10, 11B and 11C) are much looser, lower density scatters than groups 1, 6 and 8. These observations might suggest that the various seal bone groupings might be referrable to different disposal modes. Specifically, the clusters and associated scatter of groups 1, 6 and 8 might be best interpreted as refuse which had been dumped away from any contemporaneously active hearths, whereas the more scattered and generally smaller groups found in the vicinity of hearths might represent refuse which had been dropped within hearth-centred activity loci or perhaps also tossed a short distance away from such loci. If this dichotomous pattern of discard is a valid interpretation, then the seal bones in Cnoc Coig which had been discarded as dumped refuse would represent the largest groupings and most of the bones, but only a small number of depositional events; on the other hand, the other bones which had been dropped or tossed as "primary refuse" would represent fewer bones but a greater number of depositional events.

Depositional Events

Using the defined groups and subgroups of seal bones, it is possible to determine a minimum number of depositional events which these groupings represent and, in some cases, to suggest the depositional sequence of these events. In the northwestern area of the site lies the largest grouping of seal bones, group 1. Although a number of subgroups have been defined on the basis of the horizontal spread of the grouping, group 1 would seem to represent a single depositional episode because it is not possible to define any clear stratigraphically separate occurrences in this large cluster and its associated scatter. In the south-central area of the site is group 11. Once again, several subgroups have been defined, but in this case, not all of these subgroups can reliably be regarded as depositionally contemporaneous. In this grouping, two depositional events were proposed: subgroups 11A, 11C and possibly 11D constituting the first event, and subgroups 11B and possibly 11E comprising the second event in this area. In the north-central part of the site occur two relatively small groupings, subgroups 2A and 2B, which may or may not be depositionally related episodes.

On the eastern side of the site are several groups of bones which represent several successive depositional events. The earliest two are groups 7 and 4 which may or may not be associated as a single event. To the north, group 3 constitutes a later episode and to the north-northwest, still later are the two small subgroups 5A and 5B. Moving south again, the next events following group 7 are group 6 directly above it and group 10 to the southwest which might possibly be contemporaneous with group 6. The next grouping to the south is group 9 but, since this pair of bones could easily relate to either group 6 or group 7, it should perhaps not be regarded as a separate depositional episode. In any case, next in the sequence after both groups 6 and 10 are the five subgroups of group 8.

Therefore, depending on what group and subgroup associations one is willing to accept, with the exception of a handful of isolated bones, virtually all of the _in situ_ seal bones from Cnoc Coig can be assigned to a specified number of depositional events. Accepting all but the more tenuous subgroup associations, 16 depositional events can be identified: group 1; subgroups 11A and 11C; subgroup 11B; subgroup 11D; subgroup 11E; subgroup 2A; subgroup 2B; subgroup 5A; subgroup 5B; group 3; group 4; group 7; group 6; group 10; group 9; and group 8. However, this number of depositional events is somewhat inflated by the fact that six of these events are represented by groupings with a mere five bones or less, as a result of which some of these small groupings probably relate to larger groups and do not therefore constitute separate depositional episodes in a temporal sense. If we accept a few of the slightly more tenuous subgroup associations, the number of depositional events is reduced to 12: group 1; subgroups 11A, 11C and 11D; subgroups 11B and 11E; group 2; group 5; group 3; group 4; group 7; group 6; group 10; group 9; and group 8. And if we accept a few of the more tenuous group associations -- group 7 with 4; group 6 with 10; and group 9 with either 6 or 7 -- then the number of depositional episodes is even less.

However, regardless of whether one tends to be conservative or liberal in terms of accepting certain associations, one important observation about the seal bone assemblage from Cnoc Coig should be emphasized. Many of the seal bone groupings comprise only a small number of bones and in fact, there are only two large groups (1 and 8) which contain more than 60 _in situ_ seal bones and which therefore represent major depositional events in economic terms. In addition to these, there are four moderately sized groupings with more than ten but less than 20 seal bones -- groups 2, 3, 7 and 11A/C/D. The other groupings --

groups 4, 5, 6, 9, 10 and 11 B/E -- consist of ten or less *in situ* seal bones and must be seen as representing only minor depositional episodes which in economic terms are not very significant. Indeed, these six groupings are so small that it is questionable whether they should be seen as representing distinct depositional events in an economic sense -- that is, they probably are depositionally contemporaneous with some of the larger groups of seal bones, although such depositional contemporaneity cannot at present be demonstrated because it is not presently possible to relate stratigraphically midden deposits across the whole site or even over wide areas of it. Of course, in some cases, particularly those on the eastern (seaward) side of the site, these small groupings might also relate to a larger group in an unexcavated area. In any case, however they may relate to more major groupings, six of the 12 depositional events of seal bones cannot be viewed as being of much economic significance.

The Exploitation of Seal

It is not within the scope of the present study to attempt to quantify how much meat is represented by the seal bone assemblage from Cnoc Coig, but one general observation is unavoidable: despite the fact that seal is by far the most abundantly represented mammal in Cnoc Coig, the overall amount of food represented by these remains is not very great. Even envisaging a small number of inhabitants at the site, relatively short occupations and only a moderately important dietary contribution from seal, the amount of seal remains found at Cnoc Coig could be readily accounted for by a handful of occupational episodes. For example, assuming that each occupational event would be represented by at least one large or moderately large (greater than 10 *in situ* bones) depositional event of seal bones, which is not an unreasonable assumption since Cnoc Coig was occupied at a time of year when seal would have been most readily exploitable, then the vast bulk of the seal bones at Cnoc Coig could be accounted for by six occupations. Of course, we might reasonably consider this to be an underestimation because some major seal bone groupings might well exist in unexcavated parts of the site. However, even if we double this figure to 12 for example, this number of implied occupations would appear to be at odds with the radiocarbon dates for Cnoc Coig (see p. 59) which suggest that the midden deposits accumulated over one or even two centuries. This apparent discrepancy could be taken to indicate either that Cnoc Coig was not occupied regularly as part of an annual round, or that seals were not intensively or regularly exploited even though they were a locally abundant and readily exploitable resource. Since both of these alternatives seem unlikely for a number of reasons, the possibility must be entertained that exploited seals were most often butchered and processed "off-midden" at some other localities.

In any event, this general observation about the relatively small absolute amount of food represented by the seal bones from the site is strengthened even further when the composition of the spatially defined bone groupings is taken into account. Of course, one could calculate the minimum number of individuals (M.N.I.) for each seal bone grouping and, on this basis, estimate the amount of meat represented by each. However, this would ignore the fact that most groups do not even come close to representing substantially complete seals and, except perhaps for the two large groups, this procedure would result in highly inflated values. A much more accurate picture would be obtained by calculating the amount of meat represented by each bone or body part included in the various groupings. A full examination of this matter is not within the scope of the present study but once again, a few general comments may be made.

Firstly, nearly a quarter of the *in situ* seal bone is from young or even infant seals, and the amount of meat represented by these bones is substantially less than that represented by the equivalent adult bones. The five sub-groups which are comprised totally or substantially of foetal (1A, 7 and 8A) or young (1B and 8B) bones do not therefore represent a large amount of meat, and this is particularly so when one looks at the composition of these groupings. Subgroups 1A and 1B consist almost entirely of skull bones and teeth, while subgroup 8A and, to a lesser extent, 8B are mostly composed of flipper bones. Only group 7 seems to represent more or less the whole body of an infant seal. Similarly, several of the moderately large subgroups of adult bones consist of low meat-bearing bones which means that these subgroups, despite their size in terms of the number of bones, represent very little food. Group 3, for example, is composed entirely of flipper bones and indeed, most of the bones of this group could belong to a single, right hind flipper. Likewise, the small scatters of bones in groups 4 and 10 consist mostly of flipper bones, while subgroup 11B is composed almost entirely of the skull bones of two adults. Other groupings, even though they consist of more prime meat-bearing bones, still only represent moderate quantities of food. For example, subgroup 5B represents the lower part of one right leg of an adult seal. Similarly, group 6 mainly contains several rib fragments, while subgroup 11A is composed entirely of ribs and the adjoining thoracic vertebrae -- and in both cases, the bones are apparently referrable to a single adult animal (C. Grigson, personal communication).

Thus, most of the seal bone groupings indicate only moderate or small amounts of meat and fat, and only groups 1 and 8 represent large quantities of food. In summary, despite the relatively large numbers of seal bones in Cnoc Coig, these remains do not appear to indicate a large-scale, regular (annual) exploitation of seal over a period of many years. The defined seal bone groupings at Cnoc Coig could all be accounted for by a small number of occupations.

Otter

The same procedures used in the analysis of the seal bones from Cnoc Coig have also been applied to the bones of the other mammal species represented in the midden -- namely, otter, red deer, pig, human and cetacean. The occurrence of bones of these other mammal species in the various lanes across the site are shown together on the same vertical distribution plots. Figures 66 to 74 show respectively their occurrence in the following lanes: Lanes 4, 5, 6, 7, 13, 14, H, I and M. In addition, Figure 75 plots the distribution of otter bones in Lane P, and Figures 76 and 77 plot the red deer, pig and human bones in Lanes T and U. Using these and other section plots, as well as a variety of horizontal distribution plots, groups of bones have been defined which represent particular depositional events for these mammal species.

Turning first to otter remains, Figure 60 is a depth-compressed horizontal plot showing the overall distribution of young and adult otter bones in the site. As with seal remains, it is readily apparent by visual inspection that there is a marked tendency for otter bones to cluster, and a number of groups and subgroups have therefore been defined. On Figure 60, these groupings of _in situ_ otter bones are delimited, and Table 19 lists all the bones belonging to each.

Group 1 in the central and western areas of Lanes 3 to 7 (see Figs. 66-69) is by far the largest group of otter bones and in fact, it accounts for over two-thirds of the _in situ_ otter bones from the site. Subgroup 1A is a very compact cluster in Lane 5 (Fig. 67; see also Lane P = Fig. 75) which represents the main concentration of the grouping. Subgroups 1B and 1C are linear scatters which lie respectively to the northwest of 1A in Lanes 3 and 4, and to the southwest in Lanes 6 and 7. Subgroup 1D is a small cluster in Lanes 6 and 7 southwest of 1A between it and 1C, while subgroup 1E is a pair of bones in Lane 7 located south-southeast of the main cluster. These four subgroups (1B-1E) are all reasonably well associated stratigraphically with

Table 19. List of the In Situ Otter Bones Belonging to the Spatially Defined Groups and Subgroups. All bones are fragmentary unless otherwise stated. The bone identifications are by C. Grigson (personal communication).

Group	Finds Number	Age	Bone Element
1A	21,279	adult	L. periotic
	22,188	"	tooth (upper canine), burnt
	22,186	"	vertebra, burnt
	22,188	"	vertebrae, 8 fragments, burnt
	22,188	"	rib, burnt
	22,185	"	ulna, burnt
	22,188	"	ulna, 3 fragments, burnt
	22,188	"	radius, burnt, complete
	22,182	"	femur, burnt
	22,187	"	femur, burnt
	22,188	"	tibia, 3 fragments, burnt
	22,188	"	metapodial, burnt
	22,188	"	proximal phalange, burnt
	22,188	"	7 unidentifiable fragments, burnt
1B	15,256	adult	cranial vault
	15,250	"	L. & R. mandibles
	15,232	"	R. mandible
	15,235	"	teeth (R. upper C, I3 & fragments)
	7,206	"	teeth (L. lower C & P3)
	15,207	"	radius
	15,244	"	fibula
1C	8,113	adult	R. mandible } a pair
	8,115	"	L. mandible } a pair
	4,063	"	R. ulna, burnt
	2,082	"	radius
	2,081	"	metapodial
	10,931	"	metapodial, burnt
	3,550	"	L. astragulus
1D	8,094	adult	radius
	8,094	"	ulna
	8,064	"	metapodial
1E	22,189	young?	radius
	15,801	adult	R. humerus shaft
1F	8,055	adult	tooth (canine?)
	21,312	"	R. mandible, burnt
	21,263	"	metapodial, burnt
	21,191	"	humerus
2	21,344	adult	ulna
	21,345	"	humerus

Table 19. Continued.

Group	Finds Number	Age	Bone Element
3A	15,353	adult	radius, burnt
	15,324	young	femur
3B	18,219	adult	R. femur, burnt
	21,127	"	R. calcaneum, complete
3C	21,055	adult	middle phalange, complete
	21,038	"	phalange
4	15,453	adult	skull fragments
	17,199	"	mandible
	3,292	"	tooth (R. lower canine)
	7,318	young	tooth (L.? lower canine)
	15,064	adult	tooth (R. upper P4)
	15,453	"	vertebral fragments
	22,520	"	metatarsal?
5	3,354	adult	rib
	3,168	"	proximal phalange

subgroup 1A as bones scattered around it in various directions. Subgroup 1F consists of four bones in Lanes 4 to 6 (Figs. 66-68) which are also in close proximity to subgroup 1A. Yet, because these four bones occur right at (or even just above) the surface of the midden, they are sufficiently stratigraphically separated from the rest of the bones of group 1 that they might be considered to be depositionally later. However, these bones occur in, or very near to, a large disturbed pit in the midden's surface (see especially Lane P = Fig. 75) and consequently, it seems likely that they have been disturbed from a stratigraphic position in which they would be more clearly associated with the other bones of group 1. Thus, subgroup 1F, despite its stratigraphic position, probably does not represent a separate and later depositional event.

Subgroup 1A is composed of bones which represent most parts of the body and, apparently, they derive from one individual (C. Grigson, personal communication). Subgroups 1B-1F around this main cluster mostly contain skull bones, teeth and fragments of various long bones, and many of these could well be attributed to the single adult otter represented by the bones of subgroup 1A. However, on the basis of the mandible fragments, more than one individual is clearly represented in the bones of group 1, and this is true whether or not subgroup 1F is included. Regardless of the number of individuals, there is stratigraphically no reason to think that the bones of group 1 involve more than one depositional event, except for the possibility that subgroup 1F represents a second and later depositional episode in this area of the site.

Group 3 is made up of three subgroups, each of which is composed of a pair of bones, located towards the eastern end of Lanes 5 to 7 (Figs. 67-69). Although these three pairs of bones are not unambiguously related to each other, their stratigraphic positions are such that they might well be considered to be depositionally contemporaneous, and hence, they have been defined as three subgroups of the same group. Group 2 is a pair of well-associated bones consisting of two fragments of long bones from the forelimb; these have been attributed to the same animal (C. Grigson, personal communication). They occur in Lane 3 near the surface of the midden on the northern edge of the site. On the basis of their stratigraphic position, they could be depositionally contemporaneous with either group 1 or group 3; but because they are not clearly more related to one of these groups than to the other, they have been defined as a separate group rather than a subgroup of either group 1 or group 3. Nevertheless, it is doubtful that they should be regarded as representing a separate depositional event.

Group 4 consists of a small, very diffuse scatter of bones in Lanes 11 to 13. Because of its dispersed nature, the depositional integrity of this group must be viewed with some scepticism. Nevertheless, these bones do appear to be reasonably well associated, occurring on a surface which slopes downwards from east to west and from north to south, so that their inclusion together as a separate group is not totally unwarranted. Group 5 comprises two bones in Lane F/G which underlie, and are therefore depositionally earlier than, the bones in group 4.

In terms of their association with hearths, the otter bones are generally in fairly close proximity to their nearest stratigraphically related hearths. Although subgroup 1A occurs above most of the hearths in this area of the site and below a couple of others, it lies reasonably close to three hearths, about 1.0 m away from one and 1.5 m from two others. Similarly, the linear scatter of subgroup 1B occurs above most of the hearths in the northwestern area of the site, but nevertheless, some of the bones are quite close to the nearest hearth (well within ca. 1.0 m) while a few are more distantly removed (at ca. 1.5 m or more). The bones of subgroup 1C are scattered around three hearths, well within 1.0 m, whereas subgroups 1D and 1E are less well associated spatially with their nearest hearths, being between 1.0 and 2.0 m away. Of course, because it occurs at the surface of the midden, subgroup 1F is not close to any hearth. The pair of bones of group 2 are about 1.5 m away from a hearth, and the bones of group 3 generally occur about 1.0 m from their nearest hearths. Because of its dispersed nature, group 4 is a mixed grouping -- four bones lie within 1.0 m of one stratigraphically related hearth, one is a similar distance to another hearth, and the remaining two are distantly removed from any hearth (more than 2.0 m). Finally, the two bones of group 5 lie a long way from any of the hearths in the site.

Overall then, most of the otter bones in Cnoc Coig lie in quite close proximity (within 1.5 m away) to their nearest hearths, although a few are more distantly removed. This is in contrast to seal bones where the largest groups are not spatially well associated with hearths. Given this pattern of association with hearths, and the fact that the otter bone groupings tend to be small and are rather scattered around the site, it is doubtful if they can be regarded as dumped refuse, except perhaps for subgroup 1A. Most of the groupings, therefore, would appear to be better interpreted as remains which were discarded by dropping or tossing. The only caution to this interpretation is that, since a relatively large proportion of the otter bones from Cnoc Coig were not recovered as _in situ_ data, then some of these apparently small groupings may in fact derive from a cluster of bones which had been discarded by dumping.

In any event, the _in situ_ otter bones from Cnoc Coig could conservatively be attributed to six depositional events: subgroups 1A-1E, subgroup 1F, group 2, group 3, group 4, and group 5. And this number could be reduced to four if subgroup 1F is included with the rest of group 1 and if group 2 is related either to group 1 or group 3. Except for the fact that group 5 is clearly earlier than group 4, it is not possible to establish a depositional sequence for these otter bone groupings. Indeed, it is even possible that some of these otter bone groups are contemporaneous -- for example, groups 1 and 3 or groups 3 and 4 -- but such associations across relatively large areas of the site cannot be established at present with any degree of certainty. In any case, even if we accept that there are six separate depositional episodes of otter bones represented at Cnoc Coig, these could easily be accounted for by a very small number of occupations. However, regardless of how many depositional events are defined, as is analogous with the seal remains, it is certain that most of the groups of otter bones are so small that they represent only negligible amounts of food (and/or skins), and only one of the five groupings (group 1) is large enough to be worth mentioning in economic terms. The amount of otter remains at the site and the number of defined groups do not suggest any sort of large-scale or regular exploitation of otters over a long period of time; rather, regardless of how many occupational episodes are represented at Cnoc Coig, otters would appear to have been captured only on a few occasions.

Red Deer

The distribution of in situ red deer bones in Cnoc Coig is shown in Figure 61 -- note that this does not include antler remains which are considerably more numerous and are dealt with in Chapter 10. It can be seen that the bones of red deer reveal a less pronounced tendency towards clustering than do seal or even otter bones. Nevertheless, several groups and subgroups have been defined, and these are delimited on Figure 61 and the contents of each listed in Table 20.

Group 1 in the western end of Lanes 3 to 6 is the largest group of red deer bones and is composed of three subgroups. Subgroup 1A in Lane 6 (Fig. 68; see also Lane U = Fig. 77) is a small, tight cluster of skull bones from an immature deer. Nearby to the immediate northeast, subgroups 1B and 1C in Lanes 3 to 5 (see Figs. 66 & 67; also Lane T = Fig. 76) are two small, loose clusters of adult bones. Although they are horizontally intermixed, there is some indication of vertical separation among these bones, so that they might possibly represent two successive depositional episodes; for this reason, two subgroups rather than one have been defined. On the other hand, because they might well be depositionally contemporaneous, they have been treated as subgroups within one group rather than as two separate groups. In any case, subgroup 1A is almost certainly depositionally contemporaneous with at least one of these subgroups of adult bones. South-southwest of group 1, group 2 is a linear scatter of well-associated bones in Lane 7 (Fig. 69) which, on stratigraphic grounds, might well be depositionally related to group 1. If so, then all the bones in the northwestern area of the site could be referrable to a single depositional episode.

Group 3 is a small, linear scatter of bones in Lanes 5 to 7 which lie diagonally across a V-shaped trough running east-west. Group 4 consists of a pair of bones in the eastern end of Lanes 5 and 6 (Figs. 67 & 68), while group 5 is a pair of bones in Lane H (Fig. 72). Group 6 is comprised of three bones in the central areas of Lanes 12

Table 20. List of the In Situ Red Deer Bones Belonging to the Spatially Defined Groups and Subgroups. All bones are fragmentary unless otherwise stated. The bone identifications are by C. Grigson (personal communication).

Group	Finds Number	Age	Bone Element
1A	4,086	young	part of face
	4,086A	"	skull fragments
	4,086B	"	basioccipital
	4,086C	"	part of frontal bone
1B	4,148	adult	L. scaphoid
	7,188	"	L. anterior cuneiform (same foot)
	7,195	"	L. hamatum (same foot)
	7,201	"	L. magnum (same foot)
	15,227	"	L. metatarsal
1C	7,129	adult	sternal rib
	7,142	"	R. ischium & fragment
	4,096	"	R. metacarpal IV
	7,179	"	metatarsal
Three isolated bones in Lanes 4 to 6 which are close to group 1 but probably too deep to relate to it:			
	4,108	adult	R. scapula
	7,057	"	metapodial
	15,245	"	metatarsal
2	2,093	adult	lumbar vertebra
	2,069	"	vertebra
	2,053B	"	long bone fragment
	2,059	"	long bone fragment
	2,062	"	long bone fragment
	4,052	"	long bone fragment
	3,526	"	metapodial
	4,049	"	metatarsal
3	15,670	adult	teeth (R. lower I2 & I3?)
	15,734	"	radius? shaft
	15,626	"	R. patella
	15,671	"	metatarsal?
Two isolated bones in the central area of Lanes 3 & 5, between groups 1 & 3:			
	21,383	adult	metapodial & 4 fragments
	22,218	"	metapodial? splinter

Table 20. Continued.

Group	Finds Number	Age	Bone Element
Two isolated bones in the eastern portion of Lane 7:			
	15,751	adult	metatarsal
	15,339	"	navicular
4	15,316	young	femur
	21,034	adult	metacarpal, burnt
5	15,113	adult	R. radius
	15,891	"	proximal phalange
6	22,031	adult	L. metatarsal
	22,027	"	proximal phalange
	22,506	"	terminal phalange, complete
Three isolated bones in Lanes 11 to 13 scattered around group 6 which might possibly be related to it:			
	15,061	adult	metatarsal
	16,037	"	metapodial shaft
	17,070	"	tooth (R. lower I3)
Two isolated bones in Lanes 11 & 13 near group 6 but clearly not related to it:			
	7,298	adult	R. tibia
	17,108	"	lumbar vertebra?
Two isolated bones in Lane F/G:			
	3,407	adult	R. metacarpal
	4,017	"	metacarpal
One isolated bone in the central area of Lane N:			
	16,020	adult	L. fibula
7	18,057	adult	R.? femur?
	18,070	"	R. tibia
	18,078	"	R. magnum
	16,093	"	L. navicular
	18,093	"	L. metacarpal
One isolated bone in the southern end of Lane M, possibly related to group 7 nearby:			
	4,066	adult	sesamoid, burnt, complete

and 13 (see Fig. 70) around which are scattered five other bones, three of which might be related to it but are not sufficiently associated to be included in the group. Group 7 in Lanes L to N (see Fig. 74) is a small scatter near the southern edge of the midden. In addition to these groupings, there are 16 isolated bones scattered around the site which cannot be reliably related to any of the groups, and these bones comprise a relatively large proportion (30.2%) of the total *in situ* red deer bone assemblage.

Because these groupings are scattered widely across the site, it is not possible to define any depositional relationships among the seven groups and, in particular, to suggest a depositional sequence of any of the groups. Clearly, many bones might be depositionally contemporaneous with others elsewhere in the site, but this cannot be established on stratigraphic grounds. If we accept the depositional contemporaneity of red deer groups 1 and 2, then the distribution of red deer bones is somewhat similar to that of otter, in that there is one large grouping representing one depositional event which accounts for a substantial amount of the *in situ* bone assemblage, with the remainder being more scattered as either isolated bones or small groups. The differences between otter and red deer are, however, that the large red deer group accounts for a smaller proportion of the total assemblage than is the case with otter, and that the remaining bones are even more diffusely scattered with the proportion of isolated bones being much higher. Indeed, excluding groups 1 and 2, the red deer bones at Cnoc Coig reveal only a very slight clustering tendency, by far the least of all the mammals represented at the site.

The deer bones in Cnoc Coig reveal a dichotomous pattern of association with hearths. As with seal group 1, the bones of groups 1 and 2 lie above most of the many hearths in the northwestern area of the site. Although subgroup 1A *may* be stratigraphically related to one hearth about 1.0 m away, it is probably best related to another hearth further away (at ca. 3.0 m). Subgroups 1B and 1C occur 2.0 to 3.0 m from their nearest hearth, while the bones of group 2 lie beyond 3.0 m from any hearth which might be stratigraphically related. In marked contrast, groups 3 to 7 occur in much closer proximity to their nearest hearths. The bones of group 3 lie within 1.0 m of two hearths, and the pair of bones in group 4 are about 1.0 m away from a hearth, while groups 5, 6 and 7 occur within 1.0 to 1.5 m of one or two nearby hearths. Also reflecting this dichotomous pattern of association, some of the isolated bones (such as the three bones below group 1) are in close proximity to a hearth, whereas others (such as the two in Lane F/G) are much more distantly removed. In terms of discard processes, groups 1 and 2 would seem to have been dumped away from high-use activity areas in the northwestern part of the site after it had ceased being intensively used as a living area. In contrast, most of the remaining red deer bones are probably best interpreted as refuse dropped within hearth-centred activity loci.

All of these observations are interesting in that they suggest that different cultural formation processes might be involved in creating the observed pattern of distribution of red deer bones compared to those of other mammals. The bone elements making up the red deer bone assemblage at Cnoc Coig suggest what these processes might be. Grigson (1981: 169) has put forward four hypotheses regarding the utilization of red deer at the Oronsay sites which may be tested by bone element analysis. On the basis of the <u>in situ</u> bones (see Table 5),[1] it is clear that Grigson's hypothesis "d" is not substantiated since the relative frequency of different bone elements does not imply butchering of whole animals on the site. Likewise, hypothesis "c" is not borne out since skull bones are not over-represented. However, there are some prime meat-bearing bones (notably, three fragments of vertebrae, one

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[1] Of course, they do not represent the entire red deer bone assemblage from Cnoc Coig, but, as Table 4 illustrates, the majority of red deer bones (76.8%) were found <u>in situ</u> and so these data are a substantial and representative sample of the total assemblage.

of scapula, one of pelvis and some long bones), so that hypothesis "b" is partially substantiated -- that is, bone element analysis does indicate that some meat was being brought to the site in the form of joints from animals which had been butchered elsewhere. Nevertheless, the amount of meat which was brought to the site is not very great -- indeed, much of it is represented by the bones of groups 1 and 2, while the remaining groups and isolated bones represent almost nothing in terms of meat, except perhaps for group 7. Finally, Grigson's hypothesis "a" is also substantiated. In addition to massive quantities of antler plus bone and antler tools (see Tables 9 and 12), metapodials, which are the bones used primarily in tool manufacture, are the most common bone element among the red deer bones from the site -- 18 of the 48 (37.5%) adult bones are fragments of metapodials, while ten others are various carpals, tarsals and phalanges which might well have been brought onto the site while still articulating with the metapodials.

In summary, analysis of the bone elements represented at Cnoc Coig clearly seems to indicate that red deer were killed and butchered away from Oronsay and that small portions of the animals were brought to the island in the form of feet, to use metapodials for manufacturing tools, and occasionally also as joints of meat. However, the amount of deer meat indicated by the bones at Cnoc Coig is quite small, so that this use of deer seems clearly to have been secondary to the use of metapodials for tool making. This dual use of red deer is mirrored by the dichotomous pattern of distribution of deer bones. On the one hand, groups 3 to 7 and the isolated bones are highly dispersed around the site, generally occurring in close proximity to stratigraphically associated hearths, and these remains consist mostly of metapodials and adjoining bones (20 of 32 or 62.5%), all of which is consistent with the view that these remains represent tool manufacturing waste material which had been dropped in hearth-centred loci where these activities had been conducted. On the other hand, groups 1 and 2 are relatively large and more clustered groupings which occur further away from hearths and which include relatively less metapodials and more in the way of prime meat-bearing bones, all of which is consistent with their being dumped (largely food) refuse which had been discarded away from hearth-centred activity areas.

Because of the dispersed nature of the deer bones at Cnoc Coig, it is not possible to suggest how many separate events of bringing in deer feet for tool manufacture are indicated. If each group containing a metapodial and each isolated metapodial were taken to represent a distinct episode, then 16 events would be indicated. However, since whenever a deer was killed four metapodials would be obtained, one might expect that more than one discarded metapodial fragment would result from one episode. Thus, far fewer than 16 events might be indicated, and as few as four or five episodes would certainly be sufficient to account also for the number of joints of deer meat which appear to have been brought to the site. Consequently, unless most occupations of the midden did not involve importing any deer bone remains to the site, then the number of occupations which are indicated by the amount of red deer bones at Cnoc Coig is not very great.

Pig

Figure 62 shows the distribution of all *in situ* pig bones in Cnoc Coig, and it is readily apparent from this plot that once again there is a clear tendency for these bone remains to cluster. The groupings of pig bones which have been defined are indicated on Figure 62 and Table 21 lists the bones belonging to each.

Group 1 is a small cluster with some outlying scatter in the western end of Lanes 4 and 5 (Figs. 66 & 67; see also Lane T = Fig. 76). Group 2 is composed of four relatively small subgroups which are stratigraphically located such that they could all be depositionally related, although, owing to their rather dispersed nature, this association is not entirely certain. Subgroup 2A is a

Table 21. List of the *In Situ* Pig Bones Belonging to the Spatially Defined Groups and Subgroups. All bones are fragmentary unless otherwise stated. The bone identifications are by C. Grigson (personal communication).

Group	Finds Number	Age	Bone Element
1	7,135	young	R. ulna
	7,123	adult	L. ulna
	7,044	"	L. ilium & 5 fragments
	7,167	"	L. femur
	7,177	"	L. tibia (same bone as 7,174)
	7,174	"	L. tibia (same bone as 7,177)
	7,010	"	tibia
	15,201	"	fibula?
	15,206	"	R. astragulus, complete
	7,178	young	middle phalange
2A	17,071	adult	L. ulna
	22,093	"	navicular, complete
	17,197	"	middle phalange
	17,084	"	proximal phalange
	17,062	"	proximal phalange
2B	22,004	adult	tooth (L. lower canine)
	7,257	"	R. astragulus
	7,258	"	distal phalange
2C	15,821	adult	L. tibia
	15,838	"	astragulus
	15,331	"	proximal phalange
2D	3,081	adult	tooth (canine fragment)
	3,420	"	piece of dentine
One isolated bone in Lane 13 near subgroup 2A but too deep to relate to it:			
	17,251	adult	sesamoid
One isolated bone in Lane 14 near subgroup 2A but too shallow to relate to it:			
	17,005	young	tooth (L. upper M3, unerupted)
3A	15,498	adult	tibia, burnt?
	16,057	"	L. lunate, complete
3B	18,103	young	middle phalange
	16,071	adult	distal phalange, nearly complete
One isolated bone in Lane L possibly related to subgroup 3B:			
	18,060	adult	R. radius

scatter of bones in Lanes 13 and 14 (Figs. 70 & 71; see also Lanes H & I = Figs. 72 & 73), and subgroup 2B is a small, loose scatter northwest of it in Lanes J and K. Subgroup 2C is a small, linear scatter in Lane H (Fig. 72) northeast of 2A, while subgroup 2D is a pair of bones east of 2A in Lane F/G. Overall, group 2 occurs on a surface sloping downwards from Lane F/G to the west and from Lane 10 downwards to the south. Finally, subgroup 3A is a pair of bones towards the southern end of Lane O occurring on the steeply sloping southwestern edge of the midden. To the southeast of 3A is subgroup 3B which consists of a pair of bones in the southern end of Lanes M and N that are probably depositionally contemporaneous with subgroup 3A.

Thus, the pig bones in Cnoc Coig represent a limited number of depositional events. If groups 2 and 3 are regarded as constituting one depositional episode each, then there are only three episodes represented in the entire midden; but if we do not accept these associations, then the number may be as many as seven (one for each grouping). In either case, the quantity of pig bones in Cnoc Coig and the number of defined groupings do not suggest any sort of large-scale or regular exploitation of pigs, and the entire pig bone assemblage could easily be accounted for by a handful of occupational episodes.

Like seal group 1 and red deer groups 1 and 2 in the same part of the midden, pig group 1 lies above the many hearths in the northwestern area of the site, so that the nearest stratigraphically related hearth is 2.0 to 4.0 m to the east (although the outlying, easternmost bone of this group is only about 1.0 m away). Similarly, subgroup 2A occurs right above a large hearth complex and so is between 1.5 and 3.0 m away from two possibly stratigraphically associated hearths. The pair of bones in subgroup 2D are about 2.0 to 2.5 m from a hearth, whereas subgroups 2B and 2C are much closer at distances of between 1.0 and 2.0 m. Subgroup 3A lies about 2.0 m from its nearest hearth, while the two bones of subgroup 3B are close to two or three hearths in the south-central area of the site at a distance of about 1.0 m. Overall then, the two largest groupings (1 and 2A) are quite distantly removed from their nearest stratigraphically associated hearths, as are subgroups 2D and 3A. On the other hand, the small, dispersed groupings of 2B, 2C and 3B are in closer proximity to hearths. As with the other mammals represented in the site, these differences might be interpreted as reflecting different disposal modes. Specifically, group 1 is probably best interpreted as dumped refuse, whereas the smaller size and more dispersed nature of groupings 2A, 2D and 3A might suggest tossing in these instances. On the other hand, subgroups 2B, 2C and 3B might be interpreted as either dropped or lightly tossed refuse.

Analysis of the bone elements represented by the *in situ* pig bones from Cnoc Coig reveals a somewhat curious pattern of body part representation. As can be seen from Table 21 (see also Table 5), except for a few scattered single teeth, virtually all of the pig bones represent legs and feet, and there are no bones whatsoever from the torso; and it should be noted that this pattern also occurs in the non-*in situ* pig bones from the site (C. Grigson, personal communication) which represent a relatively large proportion (22 of 52 or 42.3%) of the total assemblage. Clearly then, whole pigs were not being butchered at Cnoc Coig, but rather, like red deer, they were killed and butchered elsewhere with portions of the animal imported to the site. In the case of pigs, these portions were restricted almost entirely to limbs, although the presence of several teeth is somewhat of an anomaly. The groupings of pig bones are not entirely consistent in terms of which limbs are represented in each one. Group 1 can be interpreted as consisting mostly of a left leg including some of the pelvis, but it also contains fragments of a left and a right ulna and at least two individuals would appear to be represented in the group. Subgroup 3A contains a tibia fragment in association with a carpal bone, while subgroup 2A is the opposite with a left ulna being associated with a tarsal bone (plus phalanges). The total absence of metapodials is also curious, although a couple of fragments are included in the non-in situ bones. However, despite these internal inconsistencies, the fact remains that pigs are represented almost entirely by limbs and, except for the femur in group 1, entirely by the distal portions of limbs. Thus, the amount of meat which these bones represent is very limited, which is perhaps curious if we regard that these portions of pigs were brought to the site as joints of meat -- if this were the pattern of utilization of pigs, then, as Grigson (1981: 169) has suggested regarding the exploitation of red deer, one might expect more in the way of prime meat-bearing bones. Consequently, the pig bones from Cnoc Coig do not appear to be referrable to this pattern of exploitation. Like red deer, pigs seem to represent a different pattern from that of seal and otter for which all parts of the body are reasonably well represented in the assemblage. In light of this, it might be concluded that the lower legs of pigs were introduced into the site to use the metapodials for tool manufacturing.

Human

In terms of formation processes, even more curious than the pig bones in Cnoc Coig is the human bone assemblage from the site. Figure 63 shows the distribution of in situ human bones in Cnoc Coig. It can be seen that, as with all the other mammals, these bone remains reveal a definite clustering tendency. Several groups of human bones have been defined and these are shown in Figure 63, while Table 22 lists the bones belonging to each group.

Group 1 is a small scatter in the east-central area of Lane 6 (Fig. 68) which lies in a slight depression near the base of the midden. Immediately east of it, group 2 is a loose cluster with some outlying scatter in Lanes I to K (see Fig. 73; also Lanes 5-7 = Figs. 67-69) which is centred in a shallow depression in the midden deposits. Subgroup 3A is a compact cluster in Lanes 13 and 14 (Figs. 70 & 71; see also Lanes H & I = Figs. 72 & 73), while subgroup 3B is a pair of bones just south of 3A in Lane H.

Table 22. List of the *In Situ* Human Bones Belonging to the Spatially Defined Groups and Subgroups. All bones are fragmentary unless otherwise stated. The bone identifications are by Meiklejohn and Denston (1985).

Group	Finds Number	Age	Bone Element
Three apparently unrelated bones in the western end of Lanes 4 to 6:			
	4,094	adult	cranial vault fragment (squamous area of the parietal)
	7,032	"	L. clavicle, nearly complete but badly crushed
	4,069	"	shaft fragment (fibula?)
One isolated bone in the central area of Lane 5:			
	8,135	adult	tooth (R.? maxillary M3)
1	21,089	adult	R. metacarpal III, nearly complete
	15,647	"	hand proximal phalange I
	15,742	"	hand distal phalange V, complete
	21,091	"	R. metatarsal V
2	18,287	adult	axis vertebra (2 fragments)
	18,282	"	body of cervical vertebra (4th?), badly deteriorated
	18,284	"	R. metacarpal I, complete
	25,574	"	R. hand proximal phalange (IV or V)
	21,142	"	R. hand proximal phalange V, complete
	18,238	"	R. hand middle phalange V, complete
	21,024	"	R. hand distal phalange (II or V), complete
	18,279	"	L. hand middle phalange V
	15,382	"	L. hand middle phalange V, complete except for slight damage to proximal extremity
	15,294	"	hand distal phalange V, complete
	21,039	"	R. middle (2nd) cuneiform
Two isolated bones in Lanes H & I between groups 2 and 3A:			
	15,057	adult	hand proximal phalange
	15,112	child	epiphysis for the dens of an axis vertebra & 12 other fragments

Table 22. Continued.

Group	Finds Number	Age	Bone Element
3A	17,124	adult	tooth (R. maxillary M3)
	17,109	"	vertebra or sacral segment
	22,560	"	R. clavicle (2 fragments)
	17,157	"	L. clavicle, complete
	17,187	"	R. metacarpal
	17,201	"	R. hand middle phalange II
	17,193	"	R. hand middle phalange II, complete
	17,142	"	L. metacarpal II
	17,203	"	L. metacarpal III, complete
	17,194	"	L. hand middle phalange II, complete
	17,168	"	R. tibia (2 fragments)
	17,234	"	R. talus & 2 smaller fragments (of an associated calcaneum?)
	17,145	"	R. foot proximal phalange II, complete
	17,137	"	R. foot proximal phalange (II/III)
	17,204	"	L. cuboid, nearly complete
3B	17,119	adult	L. lateral (3rd) cuneiform
	17,173	"	foot middle phalange
One isolated bone in Lane I lying above subgroup 3A:			
	17,047	adult	patella? (human?)
One isolated bone in Lane M lying above group 4:			
	18,089	adult	cranial vault fragment (frontal?)
4	18,143	adult	R. temporal (3 quite deteriorated fragments)
	18,104	"	L. clavicle
	18,147	"	R. foot proximal phalange I, complete
5	16,103	adult	rib (6 fragments)
	16,091	"	L. pelvis including most of the ilium, the acetabulum and the superior portion of the ischium

Group 4 is a small scatter in the southern end of Lane M (Fig. 74), and group 5 is an isolated pair of bones in the central area of Lane N.

In terms of depositional relationships, aside from the fact that subgroups 3A and 3B are almost certainly related, groups 1 and 2 might possibly be depositionally contemporaneous despite the fact that the former is considerably deeper than the latter. If so, group 1 would be a westward down-slope extension of 2 occurring in a hollow at the base of a fairly steep slope at the western margin of group 2. Nevertheless, because such an association is far from certain, these two groups most likely represent separate depositional events. Because the rest of the groupings are widely dispersed across the site, no other depositional associations can be established, although of course it is always possible that some of these groups are contemporaneous. At any rate, the human bones at Cnoc Coig clearly represent a very limited number of depositional events; if each group is taken to represent one event, then the number of indicated events would be four. Interestingly, this is the same as the M.N.I. estimate of four adults which is based on the four clavicles (Meiklejohn & Denston 1985).

Regarding their spatial proximity to hearths, the bones of group 1 lie scattered around three stratigraphically related hearths, well within 1.0 m. Similarly, group 2 is quite well associated with one of the few hearths in the northeastern area of the site, with six bones occurring within 1.0 m of the western edge of the hearth and the rest being scattered slightly down-slope to the west and south. Subgroup 3A appears to underlie the large hearth complex in this area of the site, but the difference in depth is so slight that it might be tempting to relate them depositionally; if so, then most of these human bones would actually lie within this large hearth. However, since none of them are charred, it would appear that they are depositionally earlier than the hearth and sufficiently separated by shell deposits from it to have remained unburnt. Therefore, the nearest stratigraphically associated hearths are two hearths, one to the north and one to the south, at distances of 1.5 to 3.5 m away from these bones. Subgroup 3B occurs close to its nearest hearth (at ca. 1.0 m), while group 4 lies somewhat further away from a couple of hearths nearby (at distances of ca. 1.0 to 1.5 m). Finally, the pair of bones of group 5 lie a long way from their nearest hearth at about 3.0 m away. Overall, the human bones in Cnoc Coig vary in terms of their proximity to hearths -- groups 1, 2, 3B and 4 are quite close to their nearest hearths, while groups 3A and 5 are more distantly removed. As with the other mammals, these differences might be referrable to the use of different disposal modes in the discarding of these remains.

Group 2 is noteworthy for its spatial association with a hearth for a particular reason. Intriguingly, seal group 3 occurs near the same hearth as human group 2 in the same pattern of association (see p. 228). In fact, the main concentration of human group 2 is virtually horizontally coterminous with that of seal group 3, although the human group lies just above the seal group (cf. Figs. 46 & 67). However, this vertical separation is so slight that they must represent successive depositional events which were very closely spaced temporally. Indeed, if the bones of the two groups were assigned to one species, they would almost certainly be judged to be depositionally contemporaneous. The bone element composition of these two groups is even more intriguing. As can be seen from a comparison of Tables 18 and 22, seal group 3 consists of flipper bones, while human group 2 similarly contains mostly hand bones. It would appear, therefore, that on the western side of this hearth there were two closely spaced depositional events, the first involving the depositing of seal flipper bones and the second the depositing of human hand bones. In terms of formation processes, this apparently identical treatment of human and seal bones is curious.

Indeed, consideration of the bone element composition of all the human bone groups, and of the *in situ* human bone assemblage as a whole, presents some intriguing curiosities. As Table 4 illustrates, it should be noted that the vast majority of human bones from the site (95.7%) were recorded *in situ*, so that these data are very representative of the total assemblage. As can be seen from Table 22 (see also Table 5), there are at least one or two bone fragments representing virtually all parts of the body -- head, torso, limbs and extremities. Nevertheless, there is a clear bias towards bones of the extremities with 60% (27 of 45) of the *in situ* bones being from wrists, hands, ankles and feet. Most of the bone groupings reflect this bias and are made up primarily, or even entirely, of these bones, the two largest groupings (group 2 and subgroup 3A) being the prime examples. This bias is somewhat reminiscent of the red deer and pig bones and is in contrast to seal and otter where most body parts are reasonably well represented. The specific content of these groups of bones of the extremities is also puzzling, in that left and right hands and feet are intermixed along with a few bones from other parts of the body (i.e. the groups are far from being internally consistent). In any case, these groups of human bones clearly do *not* represent primary burials and it is scarcely tenable to argue that the observed patterns are simply a result of differential preservation.

In short, the human bone assemblage from Cnoc Coig is an anomaly which cannot be readily explained at present. Indeed, were these bones identified as belonging to some other mammal, one would almost certainly conclude that they indicate an exploitation pattern similar to that of red deer and pig in which animals were killed and butchered elsewhere and selected portions of them brought to the site! Such a conclusion can scarcely be accepted unless one is willing to indulge in speculation about cannibalism in the late Mesolithic of western Scotland; and Meiklejohn and Denston (1985) point out that the total absence of cut marks on the human bones from all the Oronsay shell middens (which total 58 bones) argues against such an interpretation. It should also be noted that the occurrence in habitation sites of loose human bones which are not clearly associated with intentional burials is not uncommon in the European Mesolithic. Meiklejohn and Denston (1985) have recently reviewed these data and have discerned three different patterns in terms of body part representation. Although Cnoc Coig and the other Obanian shell middens on Oronsay are not unique in containing loose human bones, they are the sole examples of one of these patterns -- that is, no other European Mesolithic sites contain such a broad range of body parts found as loose human bones, nor are any others dominated by hand and foot bones. Moreover, Cnoc Coig stands almost alone in quantitative terms, with nearly all other European Mesolithic sites containing only a few loose human bones. Meiklejohn and Denston (1985) simply conclude that at present some burial practice would seem to be indicated in which bodies were interred elsewhere with certain body parts being intentionally removed and brought onto the shell middens where they were ultimately deposited.

Other Mammal Bones

The remaining mammal bones from Cnoc Coig represent general taxa which could refer to several different species. The order Cetacea is represented by nine *in situ* bone fragments of which six are ribs and three are vertebrae. Although Grigson (1981: 168) specifically refers to the common rorqual (*Balaenoptera physalus*) and the blue whale (*B. musculus*) when discussing the fauna of Colonsay and Oronsay, the cetacean remains probably derive from either the common porpoise (*Phocaena phocaena*) or the common dolphin (*Delphinus delphis*) (Grigson 1985). Thus, the nine cetacean bones in Cnoc Coig may represent more than one species, but, even if they could all be referred to only one, these remains would still not necessarily represent the same animal and therefore one depositional event.

In any case, Figure 64 shows the distribution of cetacean bones in the site. The three vertebrae lie at the very base of the midden deposits on the pre-midden sands (see Lane H = Fig. 72; also Lane 5 = Fig. 67). It is possible, therefore, that these three bones are not present as a result of human agency, but rather, that they are remains which lay on the pre-midden surface and were preserved only because of the accumulation of shell midden deposits on top of them. It should also be noted that the two vertebrae which occur close together have been attributed to the same animal (C. Grigson, personal communication). In any case, the ribs do occur within the midden deposits (see Lanes 5, 6 & H = Figs. 67, 68 & 72) and so presumably are present because of human activity, but this does not necessarily imply, therefore, that cetaceans were actively hunted. For one, the paucity of cetacean remains could be seen to argue against this, and there is certainly much evidence for the utilization of stranded whales in historic and prehistoric times in northwestern Europe (see Clark 1947: 88-98). It is of course possible either that these cetacean remains represent freshly stranded whales whose flesh and blubber were occasionally exploited as a fortuitous source of food, or that the bones from previously stranded animals were collected off beaches since whale bones have been used as a suitable raw material for a variety of purposes (see Clark 1947: 99-100). In either event, it may be noted that dolphin bones were recovered from Cnoc Sligeach (Bishop 1914: 105), while the remains of rorqual were found at C.N.G. I (Grieve 1885: 55) and Risga (Lacaille 1951: 116). In the former case, as at Cnoc Coig, active hunting <u>may</u> be involved since the remains derive from small whales (i.e. dolphins or porpoises), but the cetacean bones from C.N.G. I and Risga almost certainly represent exploited stranded whales given that such large whales are involved.

Aside from cetacean remains, there are also four <u>in situ</u> bones identified as ungulate spp. which include three long bone fragments and one phalange (see Table 5). These bones probably derive from either red deer or pig --

indeed, the femur fragment has been identified as possibly being that of red deer and the tibia that of pig (C. Grigson, personal communication), but specific identification is sufficiently uncertain to warrant their inclusion in the general category of ungulate spp. It should not be surprising to note that these few bones represent the same body parts (i.e. limbs and extremities) as do the bones which have been specifically identified to red deer and pig. The occurrence of these ungulate spp. bones in the site is shown in Figure 65.

Finally, there are a large number of mammal bone fragments which can only be identified to the class level. The distribution of these unidentifiable mammal bones is also shown in Figure 65. Because these remains could be derived from several mammal species, little can be said about their distribution except to note that, like the specifically identified bones of the several mammals found in the site, these bones also reveal such a marked tendency to cluster that groups of them could be easily defined. However, this would not be a particularly informative exercise, and it is sufficient to note here that the distribution of these remains mirrors very precisely the distribution of the various mammal species, especially those of seal. For example, there are clusters of these unidentifiable mammal bones which correspond almost exactly with the locations of seal bone groups 1, 2A, 3, 4, 8A-8C and 11A/B. Of course, this is hardly surprising since seal is by far the most abundantly represented mammal in the midden, so that it is probable that the majority of these mammal bones are in fact derived from seal. Nevertheless, several groupings of other mammal species also correspond to the location of the clusters of unidentifiable mammal bones and undoubtedly, many of them are also derived from these other mammals.

Summary

Observed Distribution Patterns

It has been seen that the mammal bones at Cnoc Coig reveal a marked clustering tendency which is readily apparent from the visual inspection of a wide variety of distribution plots. This clustering tendency is sufficiently great to enable for the most part groups of spatially associated bones to be defined. These groups vary in terms of the degree of compactness and a subjective, but nonetheless useful, distinction may be made between very compact "clusters" on the one extreme and diffuse "scatters" on the other. Except for the cetacean bones which are not very numerous, all mammal species include both clusters and scatters. Generally, all mammals show a similarly marked clustering tendency, with the exception of red deer whose remains are overall more dispersed throughout the midden, although this difference is only one of degree. Like the other species, red deer bones do include some relatively compact clusters, while the other species do include loose scatters of bones. The feature which most clearly distinguishes the distribution of red deer bones is the relatively high proportion of single, isolated bones -- it is these particularly which make the distribution of red deer bones overall more scattered than those of other mammals in the site.

Using the defined groupings of bones for each mammal species, the spatial associations with the nearest stratigraphically related hearths were noted. With all species, it was seen that some groupings occur in close proximity to a hearth, while others are more distantly removed. Indeed, most of the mammal bone groups are close to their nearest stratigraphically associated hearth (i.e. within 1.5 m). However, these tend to be smaller groups which are more diffuse scatters. Except for otter, the largest groupings for seal (groups 1 and 8), red deer (groups 1 and 2), pig (group 1) and human (subgroup 3A) are quite distantly removed from their nearest hearths, generally at distances of 2.5 m or more. It is perhaps ironical that all of these larger groups, except for seal group 8 and human subgroup 3A, are located in the northwestern area of the site where the greatest concentration of hearths occurs -- it is clear that these groups were deposited above the many hearths in this area of the site and therefore after they had ceased being in active use. Similarly, in the southeastern area of the midden, seal group 8 and human subgroup 3A lie respectively above and below a large hearth complex in this area and, since there are very few other hearths nearby, they are not in close proximity to any stratigraphically related hearths.

In general therefore, a dichotomous pattern of association with hearths has been noted. The groupings which are less well associated with hearths include most of the larger groups which tend to be the more compact clusters of each species -- the otter is the only exception to this, with otter group 1 lying in quite close proximity to a number of hearths in the north-central area of the site. The remaining groupings, which are much more closely associated with hearths, are more numerous, but they include nearly all of the smaller groups and the larger ones of them tend to be scatters or loose clusters rather than more compact clusters. It was suggested that this dichotomous pattern might be referrable to the use of different modes of disposal in the discard of these mammal bone remains.

Disposal Modes

This reference to disposal modes leads to a consideration of what these observed patterns in the distribution of mammal bones might represent in behavioural terms. First of all, it should be emphasized that the locations of these mammal bone groupings do not necessarily indicate activity loci where various mammals were butchered and/or consumed; rather, they represent the locations of discard which may or may not correspond to such loci. Employing Schiffer's (1972a: 161; 1976: 30) terminology, the problem is to distinguish between "primary refuse" discarded within a locus of activity and "secondary refuse" discarded away from such a locus in refuse disposal zones. Binford (1978a: 344-348) has defined five categories of "disposal modes", the identification of which in the archaeological record may prove to be critical for dealing with this problem. Two of these modes of disposal, dropping and dumping, result in aggregated or clustered distributions, whereas tossing results in a more dispersed pattern; in the present context, the other disposal modes mentioned by Binford (i.e. resting and positioning) are not particularly germane. Although dropping and tossing clearly result in what Schiffer would call primary refuse, Binford (1978a: 347-348) points out that dumping, which Schiffer equates with secondary refuse, also results in primary refuse in some contexts (such as at the Mask Site). This is because items may be dumped immediately adjacent to the locus of use and they may, therefore, be deposited no further away from it than are tossed items. At the Mask Site and in many other contexts, the situation is clearly different from those in which dumped items are discarded in specific refuse disposal zones which occur a considerable distance away from the locations of use, which is presumably the kind of situation Schiffer has in mind when he refers to secondary refuse. In any event, even though Schiffer's distinction between primary and secondary refuse may be of little or no relevance, at least not in the context of many hunter-gatherer settlements (see also Binford 1983: 189-190), the recognition of various disposal modes in archaeological distributions remains an important goal of intra-site spatial analysis.

The disposal modes which Binford observed on the Mask Site do not necessarily provide an exhaustive list of all possible disposal modes. Although Binford refers to dumping, this was an infrequently observed behaviour at the Mask Site, and so he does not describe precisely what is involved in the action of dumping. This may seem trivial but, in fact, two forms of dumping may be recognized which can be expected to result in somewhat different patterns of distribution for the discarded items. Whereas dumping would normally involve the aggregated items in a container being removed simply by turning the container upside down and letting the contents fall out, "toss-dumping" may be recognized in which the contents are tossed out of the container by a sudden and jerky thrust. In effect, toss-dumping is a mixture of tossing and dumping as the name implies -- the actual motion is more like tossing, but instead of single items being tossed from the hand, numerous items are accumulated in a container, as in dumping, and then tossed out of the container (presumably after having been removed at least a short distance from the location where the items were collected). Binford (1978a: 347) notes that dumping results in a high density clustered distribution, but toss-dumping may be expected to result in a rather more scattered distribution, although the nature of the items being discarded and the force with which they are tossed may be presumed to have some effect on this. In general, toss-dumping involves the initial few items out of the container travelling furthest and the majority which follow going a shorter distance falling in a loose bunch, while the last few travel the least distance, perhaps even just dropping out of the container; and because of the force with which the items may be propelled, many may bounce after falling to the ground and so become somewhat more scattered. The final result of toss-dumping is a less compact cluster with some associated scatter fore and aft which has, overall, an extended or linear appearance. Some simple experiments readily demonstrate this pattern.

Suggestively, several of the groupings of mammal bones at Cnoc Coig are linear in shape, particularly those in the northwestern and north-central areas of the site -- seal subgroups 1C-1E and 1F, otter subgroups 1B and 1C, red deer group 2, and pig group 1 (see Figs. 41, 60, 61 & 62). It is possible, therefore, that these groups of mammal bones were discarded by toss-dumping rather than by dumping in the more conventional sense. In either case, it should be recalled that, except for the two otter subgroups, all of these groupings are not in close proximity to any stratigraphically associated hearths. Other groupings which also occur further away from hearths but consist of more compact clusters might be best interpreted as straightforwardly dumped refuse -- most notable are seal groupings 6, 8A and at least the main concentration of 8C, and human subgroup 3A. Compact clusters found near hearths might be referrable to dropping, although, since these nearby stratigraphically associated hearths might no longer have been active when they were deposited, these groups might alternatively be referrable to dumping -- examples would include otter subgroup 1A and seal groupings 7 and 11A. The remaining groupings consist of either an isolated pair of bones or more diffuse scatters of a relatively small number of bones. These groupings, and the isolated bones in the site, might be seen to represent either tossed or dropped refuse; distinguishing between the two in these cases might be difficult unless their relative proximities to hearths can be used as a guide to differentiate low density groups and isolated bones discarded by tossing versus those discarded by dropping.

At any rate, until more relevant middle-range research has been conducted on the matter of disposal modes, it must be stated that no firm conclusions can at present be made about how the observed distribution patterns of mammal bones at Cnoc Coig can be best interpreted in terms of the disposal modes which are likely to have been used in the discard of the different mammal bone groupings. Nevertheless, it may be tentatively concluded that dumping and toss-dumping would appear to account for the largest groups of mammal bones, and therefore for a large proportion of the mammal bone assemblage, but a considerable amount of this material, involving many of the smaller groupings, would seem not to be referrable to some form of dumping but rather to tossing and/or dropping. In short, it would appear that a combination of disposal modes is required to account for the observed patterns of distribution of mammal bones at Cnoc Coig.

Depositional Relationships and Episodes

It can be seen from the various depth-compressed horizontal plots (Figs. 41-43 & 60-65) that mammal bones are distributed in virtually all parts of the midden. Nevertheless, some differences in distribution across the site may be noted and, on the basis of the locations of the various mammal bone groupings, some statements can be made regarding depositional relationships and episodes both within particular areas and among different areas of the site.

The northwestern area of the midden has by far the greatest concentration of mammal bones since it contains the largest groups of seal, red deer and pig. Viewed horizontally, all these groups overlap considerably. When viewed in section, although pig group 1 lies just above deer group 1, both are completely intermixed with seal group 1, and deer group 2 is similarly intermixed with seal subgroup 1F. Overall, this massive concentration of bones spans at most 20 cm of deposit in any particular part of it. Consequently, on stratigraphic grounds, it may be concluded that all of these groups in this northwestern area are depositionally contemporaneous, so that this concentration of bones may reasonably be assigned to one or a few closely spaced occupational episodes. To the immediate east, the north-central area of the site is virtually devoid of mammal bones, except for otter group 1. It cannot be established unequivocally whether or not this otter group is contemporaneous with the bones in the northwestern area, since these groups overlap so little. However, otter subgroup 1C provides an overlap with the bones in the northwestern area and these otter bones do appear to underlie red deer group 2. If these few bones are truly indicative of the stratigraphic relationships between otter group 1 and the concentration of bones west of it, then the otter bones in the north-central part of the midden may be taken to represent an earlier depositional event dating to an earlier occupation.

The northeastern area of the site contains several smaller scatters and loose clusters of all mammals except pig. Because most of the 14 groupings in this area are relatively small, the stratigraphic relationships among the various mammal bone groups are very complex. Consequently, because only a few of the many possible relationships which could be proposed are relatively unambiguous, it is not possible to state with any degree of certainty how many depositional episodes are indicated overall by these 14 groupings of mammal bones. However, looking only at the largest groups, it may be noted that seal group 4 is clearly deeper than, and not associated with, any other mammal bone group in the area -- it therefore represents a separate and the first depositional event. Human group 2, which is clearly contemporaneous with a number of smaller groups, lies directly above seal group 3 and they would thus represent successive depositional events which were closely spaced temporally and which might well belong to the same occupational episode. In any case, both groupings are clearly later than seal group 4. There appears to be a third comparatively major depositional event represented by the smaller groupings to the west (seal subgroup 2A, deer group 3 and human group 1). The several other small groups in the northeastern area complicate this picture considerably, and the total number of separate depositional events which are indicated is very difficult to ascertain. Nevertheless, there appear to be three major episodes and perhaps three or even four others which, however, would be represented by a very small number of bones indeed. Finally, due to the lack of overlap, it is not possible to determine whether otter group 1 in the north-central area is later or earlier than, or contemporary with, any of the groupings in the northeastern part of the site.

The southeastern portion of the midden includes both large and small clusters and scatters of all five major mammals represented at the site. As in the northeastern area, the stratigraphic relationships among these various groupings are very complex. As was discussed above (pp. 230-231), there is a clear depositional sequence of seal bones in this area; some of the other mammal bone groups relate well to this, although others complicate the picture somewhat. Following seal group 4 to the north, the three successive depositional episodes in this sequence from north to south are represented by: seal group 7 with red deer group 5; seal group 6 which may be contemporaneous with seal group 10; and lastly, seal group 8 with human group 3, pig subgroup 2A and probably also otter group 4. Regarding the remaining several other small groupings and the isolated bones (especially those of red deer), it is difficult to determine how these relate to this sequence of depositional episodes, and it is not clear whether any of these should be taken to indicate any additional depositional events. In any case, the bone groupings in the southeastern area of the site certainly only indicate three major, distinct depositional episodes.

To the immediate west, the central area of Cnoc Coig is virtually devoid of mammal bones; all it contains is a pair of human bones, three cetacean rib fragments and two isolated deer bones, plus a few others on the fringes adjacent to the "richer" areas to the east and south. Thus, this area contains no major depositional episodes of mammal bones, which is not so surprising since it is a rather peripheral part of the midden where the deposits are very shallow. Finally, the south-central area contains a number of subgroups of seal plus small groups of red deer, pig and human bones. On the basis of the seal bones, it was suggested that two depositional episodes are indicated, represented primarily by subgroups 11A and 11B. The human bones would also suggest two events, since there is an isolated human bone lying above group 4. The latter group is depositionally related to seal subgroup 11A and so is part of the first event. On the other hand, the isolated human bone as well as the deer and pig groups seem to be depositionally contemporaneous with the later episode which is represented by seal subgroup 11B. Seal subgroups 11C-11E complicate the picture somewhat, but they do not negate the idea that two major depositional episodes are indicated in the south-central area of the site.

Implications for the Number of Occupations

In the preceding discussions on each mammal species, the defined bone groupings were used to suggest a likely number of depositional events which are indicated by the bones of each species. These were as follows: for seal, two events represented by large groups, four by moderately large groups and six by small groups; four events for otter; for red deer, one event represented by two relatively large groups and perhaps five others by very small groups; for pigs, perhaps as few as three events; and four or five events for humans. Therefore, there are in total as many as 30 depositional episodes of mammal bones represented at Cnoc Coig. However, by looking at the different mammal groups in various areas of the site, we have just seen that many of these events based on individual mammal species are certainly contemporaneous. Due to the stratigraphic complexities of the midden, it is of course not possible to reduce this to an exact number of specified major depositional episodes, each of which might represent a separate occupation of the site. Nevertheless, it has been seen that the northwestern and north-central areas could well represent a single depositional episode each, while the northeastern area might represent only three major events, the southeastern area perhaps as few as three, and the south-central area only two. Thus, as few as ten major depositional episodes of mammal bones might be indicated, and not all of these would necessarily represent a separate occupation since several of these major events could refer to the same occupations. In short, on the basis of the mammal bone distributions alone, the total number of episodes of occupation at Cnoc Coig could be reduced to as few as ten and possibly even less.

Also in the preceding discussions, it was noted that the amount of food which is indicated by the various mammal bone groupings is not very great. This is partly because many of the groups are quite small and the quantity of meat which the specific bones represent is not very much, and partly because the body parts which are represented at the site do not include much in the way of prime meat-bearing bones in the case of red deer and pig, so that even less food is indicated. In fact, except for seal group 8 and the concentration of bones in the north-western area of the site (especially seal group 1), only small amounts of food are indicated by the various mammal bone groups or even by combinations of several groupings of different species in particular areas.

Therefore, taking the mammal bone assemblage from Cnoc Coig as a whole, it is difficult to interpret these data as indicating any sort of large-scale or regular (such as annual) exploitation of any of the mammals over a comparatively long time such as a century or more. In the case of all species, the quantity of bone and the number of defined groupings of bones, and the amount of food that these represent, are sufficiently small to be accommodated by a small number of occupations. Unless the majority of occupations at Cnoc Coig involved no consumption of any mammal resources whatsoever, then the number of occupations which are indicated by the mammal bones is low, perhaps as many as ten or twelve and possibly less.

CHAPTER 7

SPATIAL ANALYSIS: BIRD BONES

In Chapter 4, it was noted that the bird bone assemblage from Cnoc Coig contains 57 taxa of which 21 include no *in situ* bones and 11 others are represented by only one *in situ* bone each (see Table 6). Obviously therefore, except noting their presence in the midden, nothing can be said regarding the spatial distribution of the bones of these 32 taxa. This is not, however, a major deficiency because very little could be said about these distributions anyway, since all of these birds are represented by less than ten bones in total, and in all cases but two by less than five bones in total. Each of the remaining 25 taxa contain at least two *in situ* bones, the horizontal distributions of which are shown as depth-compressed plots in Figures 78 to 87. On the basis of these distributions, these 25 taxa can be divided into three categories.

Birds with Dispersed Distributions

The first category of birds are those species which are represented by a small number of *in situ* bones which are widely scattered throughout the midden. There are eight such species: raven (Fig. 78), woodcock (Fig. 78), whooper swan (Fig. 79), long-tailed duck (Fig. 82), Manx shearwater (Fig. 84), herring/lesser black-backed gull (Fig. 84), puffin (Fig. 84), and black guillemot (Fig. 85). The dispersed nature of these distributions means that it is not possible to define any groups of horizontally and stratigraphically associated bones.

As can be seen from Table 8, the 24 *in situ* bones of these eight birds consist of one scapula, one coracoid, 13 humeri, two radii, three ulnae, one wing phalange and three tibiotarsi -- in short, they are predominately wing bones. These few *in situ* bones for these birds indicate a

M.N.I. of one for all species except for puffin and raven, for which the M.N.I. is two and three respectively. Consequently, except for the puffin and raven, the bones of each species could refer to the same individual and thus to a single depositional event, despite the fact that they are so widely dispersed throughout the midden. The 24 in situ bones of these eight species reveal a somewhat variable pattern of association with stratigraphically related hearths. On the one hand, two Manx shearwater bones and all three woodcock bones occur very distantly removed from the nearest hearth (i.e. beyond 3.0 m). At the other extreme, about a quarter of these bones lie in close proximity to hearths (i.e. within 1.0 m); most particularly, these include the three left humeri shafts of raven, two of which are charred. Most of the remaining dozen or so bones of these birds are moderately well associated with hearths (ca. 1.0-1.5 m away).

On the basis of these observations, it would seem that the likely disposal modes employed in the discard of these remains are either dropping or tossing of individual bones, the former for those bones found in relatively close proximity to hearths and the latter for those few bones located further away from hearths. Of course, some of these scattered bird bones might be present in the midden as a result of natural rather than human agency, but there are no clear criteria by which such bones could be distinguished if this were the case for some of the bones of these eight species of category I birds.

Birds with Clustered Distributions

The second category consists of nine species which also have bones scattered around the site but which have a less dispersed distribution because many, or even most, of their in situ bones occur in clusters or scatters of at least two or three well-associated bones. Overall then, the bones of these birds reveal a definite tendency towards clustering, although the definable groups are usually fairly small and the groups themselves may be widely scattered around the midden. Most of these nine birds are represented by a moderately large number of in situ bones (ten or more), and it is these species which generally are the most abundantly represented birds in the avian assemblage from the site. Partly because of their comparatively large sample sizes, and partly because of their pattern of distribution which is essentially like those of mammals (albeit on a smaller scale), there can be little doubt that these nine birds are present in the midden as a result of human agency.

Greylag Goose and Goose spp.

There are only four in situ bones of greylag goose in the midden, the distribution of which is shown in Figure 80. In addition, there are seven bones identified as goose spp. which also probably represent the greylag since no other goose species has been positively identified in the avian assemblage from Cnoc Coig (see Table 6). Most of these goose bones have been identified as being from a large goose, which is consistent with their being bones of the greylag, except for one which is identified as a "small goose, e.g. lesser white front or similar" (D. Bramwell, personal communication) and which is not spatially well associated with any other goose bone. Therefore, excluding this one small goose bone, there are ten in situ bones of greylag goose or probable greylag goose.

These bones, listed in Table 23, anatomically indicate a M.N.I. estimate of one. However, on the basis of the rather tentative sexing of three bones, it would appear that one male and one female goose is represented, thereby indicating a M.N.I. of two. Consistent with this latter M.N.I. estimate, the spatial distribution of these goose bones suggests that more than one separate depositional episode is represented. As is shown in Figure 80 and Table 23, two small groups can be defined -- group 1 is a small cluster in Lane H (Fig. 91; see also Lanes 5 & 6 = Figs. 88 & 89), while group 2 is a pair of bones in

Table 23. List of the *In Situ* Bones of Greylag Goose and Large Goose Belonging to the Spatially Defined Groups. The bone identifications are by D. Bramwell (personal communication).

Group No./ Isolated	Finds Number	Taxon	Bone Element
1	18,204	greylag	R. mandibular ramus
	18,206	goose	L. distal humerus
	18,220	goose	L. distal ulna
	18,214	goose	L. distal tibiotarsus
isol.	18,295	goose	foot phalange fragment
2	3,088	greylag	R. distal tibiotarsus (probably gander)
	4,015	goose	phalange (2nd), proximal fragment
isol.	3,382	goose	L. distal tarsometatarsus (size of female greylag)
isol.	21,163	greylag	sternum, anterior end (cf. male)
isol.	22,077	greylag	foot phalange

Lane F/G (Fig. 92). Although it cannot be stratigraphically demonstrated due to the distance separating them, these two groups could be depositionally contemporaneous; similarly, the two isolated greylag goose bones could be contemporaneous with either or both of these groups. However, the two isolated bones of large goose cannot be regarded as being contemporaneous with the two groups. Very close to group 1 is one goose bone which is clearly stratigraphically below it and so depositionally earlier (see Lane 6 = Fig. 89); and near group 2 in Lane F/G (Fig. 92), there is another large goose bone which appears to be unassociated with, and depositionally earlier than, this group. These two isolated bones, therefore, indicate that there are at least two depositional events represented by the greylag/large goose bones; and if groups 1 and 2 are not contemporaneous, then there could be as many as four, although this number is undoubtedly inflated since two of these events would be indicated by single bones and a third one by only a pair of bones. In any case, unless post-depositional disturbance is evoked to account for the single isolated bones near groups 1 and 2, there would appear to be a minimum of two depositional episodes of greylag/large goose represented at the site, which is consistent with the M.N.I. estimate of two.

In terms of their association with possibly stratigraphically related hearths, only two of the isolated bones (the two foot phalanges) lie in relatively close proximity to a hearth. The remaining goose bones are either only moderately closely associated with a hearth (e.g. group 1) or quite distantly removed (e.g. group 2). Given these observations and the somewhat dispersed distribution of these bones, tossing is probably the most likely disposal mode employed in the discard of most of the greylag goose and large goose bones in Cnoc Coig.

Eider Duck and Duck spp.

The eider duck is represented by nine in situ bones in the midden, which are shown in Figure 81. In addition, there are four bones of duck spp., three of which occur near bones of the eider and may be taken to represent this duck; hence, they are included in this discussion on the eider duck bones. Only one of these three duck bones, the one in Lane H in the main concentration of eider bones, is near a bone belonging to another species of duck, namely, one of the bones of the long-tailed duck (cf. Figs. 81 & 82). However, although herein classified as duck spp. so that it might relate to either the eider or the long-tailed duck, it is identified as being from a "large duck, e.g. eider" (D. Bramwell, personal communication). Consequently, it seems reasonable to regard this bone to be more likely that of an eider and so, along with two of the other duck spp. bones, it is included in the following discussion with the eider duck bones.

There are thus twelve in situ bones of eider or probable eider, which are listed in Table 24. On the basis

Table 24. List of the In Situ Bones of Eider Duck and Duck spp. Belonging to the Spatially Defined Groups. The bone identifications are by D. Bramwell (personal communication).

Group No./ Isolated	Finds Number	Taxon	Bone Element
1	2,107	eider	L. humerus shaft
	2,112	duck	metacarpal
isol.	21,293	duck	cervical vertebra
2	21,227	eider	R. coracoid fragment
	15,858B	eider	L. distal tibiotarsus (male)
3	15,356	eider	R. scapula
	18,215	eider	R. humerus
	15,360	eider	R. distal humerus
	15,359	eider	R. ulna shaft fragment
	15,351	duck	ulna shaft fragment
4	15,313A	eider	R. scapula
	15,415	eider	R. coracoid fragment (cf. male)

of the two right scapulae and the two right coracoid fragments, these bones indicate a M.N.I. of two. As shown in Figure 81 and Table 24, four groups have been defined. Group 1 is a pair of bones in Lane 7 near the western edge of the midden, while group 2 consists of two associated bones in the central area of Lane 4 near the northern edge of the midden; just west of group 2 is an isolated duck bone which could stratigraphically be related to this grouping. Groups 3 and 4 lie further to the east, towards the eastern end of Lanes 5 to 7 (Figs. 88-90; see also Lane H = Fig. 91). Despite their proximity to each other, groups 3 and 4 have been defined as separate groups rather than as possibly related subgroups because group 4 lies too deep to be considered a likely down-slope extension of group 3.

In terms of depositional relationships, groups 1 and 2 could be contemporaneous with each other or with either groups 3 or 4, although any such possible relationships cannot be stratigraphically demonstrated due to the dispersed nature of these groups. However, because group 4 appears to be depositionally earlier than group 3, the assemblage of eider duck bones in Cnoc Coig indicates a minimum of two distinct depositional episodes. This number is consistent with the indicated M.N.I. of two adult eider ducks. If this correspondence is to be maintained, then, on the basis of the bone element composition of these groupings, group 2 would be precluded from being associated with group 4 due to the presence of a right coracoid fragment in each. Thus, the first depositional event would be represented by group 4, and the second event by groups 2 and 3, while group 1 might refer to either.

Regarding their associations with possibly related hearths, groups 2 and 4 lie in very close proximity to hearths (less than 1.0 m away from the centre of the nearest stratigraphically associated hearth). In contrast, groups 1 and 3 are quite distantly removed from their nearest hearths (2.0-3.5 m away). Given this marked dichotomy, it might be suggested that the bones of groups 2 and 4 were discarded by dropping in locations where eider ducks were consumed, while groups 1 and 3 represent bones tossed away from such locations. Interestingly, this inference that groups 2 and 4 represent two eider consumption loci would accord with the M.N.I. estimate of two eider ducks in the site and with the suggestion that groups 2 and 4 represent separate depositional events each involving one duck.

Gannet

The gannet is represented by ten *in situ* bones which are listed in Table 25. From this list, it can be seen that these bones indicate a M.N.I. of two, on the basis of two left distal coracoid fragments. Although these ten bones have a rather dispersed distribution throughout the midden (see Fig. 83), two small groups of associated bones can be defined. Group 1 is a pair of bones in Lane U in the western area of the site near the northwestern edge of the midden, while group 2 comprises three bones (including one of the left coracoids) in Lane M near the southern edge of the midden.

There are no other groupings of stratigraphically associated gannet bones -- in particular, the two bones in Lane H which appear associated when viewed horizontally (Fig. 83) can be seen to be stratigraphically separated when viewed in section. Thus, this pair of bones demonstrates that there are at least two depositional events represented by the gannet bones in Cnoc Coig, which is consistent with the M.N.I. estimate of two. The lowermost of these two bones (a sternal fragment) would represent the first depositional episode, while the upper one (a left tibiotarsus) would represent the second event. The isolated bone to the north in Lane H (the other left coracoid fragment) is stratigraphically situated such that it would only be depositionally related to the second event. If the correspondence between the M.N.I. estimate and the minimum number of depositional episodes is to be maintained, then the bones of group 2 would have to relate to the first event, since this grouping includes a left distal coracoid which would preclude its contemporaneity with the bones of the second depositional episode. In any case, group 1 and the remaining two isolated bones cannot be tied into these two suggested depositional events, although they could all easily be accommodated into two events each of which represents a single adult gannet.

In terms of their association with possibly related hearths, the gannet bones generally occur in moderately close proximity to hearths. Group 1 lies quite close to its nearest stratigraphically associated hearth (within 1.0 m), which might indicate that these bones were dropped within a hearth-centred locus. The remaining gannet bones are moderately close to a hearth (1.0-1.7 m), except for the one isolated bone in Lane F/G which is distantly removed from its nearest hearth (ca. 3.0 m away). Dropping and some tossing would thus seem to be the most likely disposal modes employed in the discard of these bones.

Table 25. List of the *In Situ* Bones of Gannet, Shag, Cormorant and Fulmar Belonging to the Spatially Defined Groups. The bone identifications are by D. Bramwell (personal communication).

Species	Group No./ Isolated	Finds Number	Bone Element
Gannet	1	7,072	R. proximal coracoid
		7,063	R. distal humerus
	isol.	15,413	anterior sternum
	isol.	15,293	L. distal coracoid
	isol.	15,364	L. distal tibiotarsus
	isol.	3,273	L. ulnare
	isol.	16,045	quadrate
	2	18,157	L. distal coracoid
		18,165	R. proximal ulna & shaft
		18,178	R. distal ulna
Shag	1	17,188	proximal radius
		17,218	R. proximal ulna (shag/ cormorant?)
		17,179	L. distal tarsometatarsus
	isol.	15,344	L. distal tarsometatarsus
	isol.	21,132	L. distal ulna
Cormorant	1	4,020	rib fragments
		4,020D	thoracic vertebra
		3,346	L. proximal radius
		3,482	L. femur
		4,020B	L. tibiotarsus
		4,020E	L. tarsometatarsus
		4,020C	R. distal tibiotarsus
		4,020A	R. tarsometatarsus
		4,020	wing phalange
	2	22,098	L. proximal humerus
		15,091	R. humerus shaft
		7,344	wing phalange (1st)
	isol.	18,224	proximal radius
	isol.	4,059	wing phalange
Fulmar	1	18,259	R. coracoid
		21,138	R. distal ulna
	2	15,636A	L. coracoid
		15,636B	proximal humerus
		15,633	R. distal humerus

Shag

The four *in situ* bones of shag in the midden are shown in Figure 83 and listed in Table 25. As can be seen from this list, a M.N.I. of two is indicated, on the basis of two left distal tarsometatarsus fragments. The only group which can be defined consists of the two shag bones in the south-central area of Lane H; and the only *in situ* pelicaniform bone, identified as being "shag/cormorant?" (D. Bramwell, personal communication), is well associated with this group and so is included in it. The other two shag bones are clearly stratigraphically separated, despite being horizontally fairly close to each other. Therefore, these bones indicate that a minimum of two depositional events are represented by the shag remains in the site, which is consistent with the indicated M.N.I. of two adult shags. Thus, the isolated left ulna fragment could be considered contemporaneous with the bones in group 1 which would represent one depositional episode, while an earlier event would be indicated by the isolated left distal tarsometatarsus in the northern end of Lane H. All of these shag bones are only moderately closely associated with their nearest stratigraphically related hearths (1.0-1.8 m) and can probably be attributed to tossing, although the bones of group 1 could alternatively perhaps be attributed to dropping.

Cormorant

The cormorant is represented by 14 *in situ* bones which are listed in Table 25 and whose distribution is shown in Figure 83. It can be seen from Table 25 that these bones indicate a M.N.I. of one. Two groupings have been defined. Group 1 consists of seven cormorant bones which occur as a very compact cluster in Lane F/G (Fig. 92) plus two other associated bones nearby. To the northwest is group 2 which is a very loose scatter of three bones in Lanes I to K; despite their scattered distribution, this group has been defined because these bones are stratigraphically situated such that they could be depositionally contemporaneous. Similarly, on stratigraphic grounds, group 2 could be depositionally contemporaneous with the main cluster of group 1, since it lies on a surface which slopes slightly downwards from group 1 towards the west. Thus, the 12 bones of groups 1 and 2 could constitute one depositional event representing much of the body of one adult cormorant. The other two isolated cormorant bones cannot be related to groups 1 and 2 because they are horizontally so far removed from them. Nevertheless, they do not stratigraphically demonstrate the existence of a second depositional episode of cormorant bones, and they could therefore belong to the same individual that is represented by the bones of groups 1 and 2. In terms of their association with stratigraphically related hearths, except for the isolated wing phalange, all of the cormorant bones are distantly removed from their nearest hearths (1.6-3.0 m away). The compact cluster of group 1 is probably best interpreted as dumped refuse, while the remaining few bones scattered around the site may be attributed to tossing.

Fulmar

The fulmar is represented by five *in situ* bones in the eastern and central areas of Lanes 4 and 5 near the northern margin of the midden (Fig. 84). These bones, listed in Table 25, indicate a M.N.I. of one. Two groups of clearly associated bones may be defined. Group 1 consists of the easternmost pair of bones and group 2 of the three bones to the west. These two groups are stratigraphically well associated with each other, with group 2 occurring slightly down-slope to the west of group 1. Thus, all of these bones could well be referrable to a single depositional episode, which is consistent with the fact that these remains could all be derived from a single individual. Group 2 lies in the immediate proximity of its stratigraphically nearest hearth, while the bones of group 1 are more distantly removed. In terms of disposal modes, therefore, group 1 may represent bones dropped in a hearth-centred locus and the bones of group 2 may be attributed to tossing further away from this location.

Guillemot

The guillemot is represented by 14 in situ bones (Fig. 85) which, unfortunately, comprise only a relatively small proportion (35.9%) of the total number of guillemot bones found at the site (see Table 6). In any case, these bones, listed in Table 26, indicate a M.N.I. of three, on the basis of three left humeri. As can be seen from Figure 85, all of these bones occur in the southeastern and south-central areas of the midden, and in particular, most are concentrated in the south-central part of Lanes H to J. Within this concentration, there are two definable groups in addition to a number of isolated bones. Group 1 is a small, very compact cluster plus one associated bone in Lane H (Fig. 95). The two isolated bones, one about 2.0 m to the east and the other about 3.0 m to the west, are situated such that they might also be included in this grouping. Located west-southwest of group 1 in Lanes I and J is another small, compact cluster of bones which comprise group 2. Directly below this group is one isolated bone located near the base of the midden. Finally, to the west-southwest of this main concentration of guillemot bones, group 3 is a small, very compact cluster in Lane N (Fig. 98).

In terms of depositional relationships, the bones comprising the main concentration indicate that a minimum of three depositional episodes are represented by the in situ assemblage of guillemot bones in the site. The earliest event is represented by the isolated bone which lies towards the base of the midden below group 2, while the second episode is represented by group 1 and the final depositional episode by the bones of group 2 which lie near the surface of the midden. On stratigraphic grounds, group 3 could relate to, and be contemporaneous with, any of these depositional events. In any case, this minimum number of depositional episodes corresponds with the M.N.I. estimate of three birds. However, it should be noted that a discrepancy exists because the final event involves two individuals, as indicated by the two left proximal humerus shaft fragments in group 2. In other words, a M.N.I.

Table 26. List of the In Situ Bones of Guillemot and Razorbill Belonging to the Spatially Defined Groups. The bone identifications are by D. Bramwell (personal communication).

Species	Group No./ Isolated	Finds Number	Bone Element
Guillemot	1	17,061C	upper beak fragment
		17,061B	furcula
		17,061B	sternal fragments
		17,074	L. humerus
	isol.	3,087	R. distal radius
	isol.	22,507	L. proximal scapula
	2	22,162	L. proximal scapula
		22,162	L. proximal humerus shaft
		17,021	L. proximal humerus shaft
	isol.	17,127	R. humerus
	3	15,493C	3 cervical vertebrae
		15,493C	R. proximal scapula
		15,493B	R. coracoid
		15,493A	R. humerus shaft
Guillemot/ Razorbill	isol.	3,257	L. humerus
Razorbill	1	21,243	L. femur (less prox. end)
		21,244	R. tarsometatarsus (less proximal end)
	isol.	21,147	R. distal humerus
	isol.	21,059	L. humerus shaft
	2	17,061A	furcula fragment
		17,061A	anterior sternum
		4,012	R. proximal humerus (same bone as 4,013)
		4,013	R. distal humerus (same bone as 4,012)
		17,094	R. ulna
		17,085	L. femur
	isol.	7,343	furcula fragment
	isol.	18,151	R. humerus (less prox. end)

estimate of four would be required to be consistent with three depositional episodes, since one of these includes two individuals.

Regarding their association with hearths, it may be noted that group 1 lies in quite close proximity (ca. 1.0 m) to its stratigraphically related nearest hearth, as does the one isolated bone representing the earliest depositional event. On the other hand, all the remaining bones, including those of groups 2 and 3, are quite distantly removed from hearths (ca. 2.0-3.0 m away). Thus, although group 1 might be attributed to dropping in a hearth-centred locus, the majority of in situ guillemot bones are probably best interpreted as refuse which was discarded by tossing.

Razorbill

Like the guillemot unfortunately, the 12 in situ bones of razorbill represent a relatively small proportion (33.3%) of the complete assemblage of razorbill bones from the site. These 12 bones are listed in Table 26 and their distribution is shown in Figure 85. As can be seen from Table 26, on the basis of three right humeri, these 12 in situ bones indicate a M.N.I. of three. Two groupings of razorbill bones may be defined -- group 1 is a pair of bones in the central area of Lane 4 (Fig. 93) near the northern edge of the midden, while group 2 is a small scatter of bones in Lanes F/G to I (see Fig. 95). Since none of the in situ razorbill bones are stratigraphically separated from any others nearby, all of these bones could be depositionally contemporaneous and thus be referrable to a single depositional episode. This minimum of one depositional event contrasts with the M.N.I. estimate of three. Of course, it is possible that more than one depositional episode is involved even though this cannot be stratigraphically demonstrated. In this context, it should be pointed out that, if more razorbill bones were recovered as in situ finds, additional depositional events might indeed be indicated. As it is however, the existing data do not demonstrate that more than one depositional event must be represented by the assemblage of in situ razorbill bones at Cnoc Coig.

In terms of their association with hearths, the razorbill bones are similar to those of guillemot. The two bones of group 1, as well as two of the isolated bones, lie in close proximity (within 1.0 m) to their stratigraphically related nearest hearth. In contrast, the remaining bones are much less well associated, particularly those of group 2 which are quite distantly removed from their nearest hearth (ca. 3.0 m). Once again, although four bones (including group 1) might be attributed to dropping in hearth-centred loci, most of the in situ razorbill bones are probably best attributed to tossing.

Great Auk

The great auk is the most abundantly represented bird at Cnoc Coig, with 46 in situ bones which are plotted in Figure 86 and listed in Table 27. These show that 11 groupings of great auk bones have been defined. All of these groupings are quite small, containing four bones or less in all instances but two (group 1 and subgroup 2A).

Group 1 is a very compact cluster in Lanes 4 and 5 (see Fig. 93) in the northwestern area of the site. Subgroup 2A is a loose cluster near the surface of the midden occurring on the southern slope of a shallow trough running east-west in Lane 6 (Fig. 94; see especially Lanes L & M = 96 & 97), while lying to the immediate west where this trough levels off is subgroup 2B in Lane 5. Two subgroups rather than two separate groups have been defined because these two groupings are stratigraphically associated such that it seems likely that subgroup 2B is a depositionally contemporaneous westwards extension of subgroup 2A. Nearby on the northern edge of the midden are groups 3 and 4 which are two stratigraphically superimposed small groups in Lane 4 (Fig. 93; see also Lane M = Fig. 97), with group 3 lying directly below group 4. Groups 5 to 7 are three small groups in Lane H (two of which are shown

Table 27. List of the In Situ Bones of Great Auk Belonging to the Spatially Defined Groups and Subgroups. The bone identifications are by D. Bramwell (personal communication).

Group No./ Isolated	Finds Number	Bone Element	
1	10,929D	L. proximal scapula	
	10,929B	L. coracoid (in 2 pieces)	
	10,929A	L. proximal humerus & shaft	same bone
	7,128	L. distal humerus	same bone
	10,929C	L. distal ulna	
	10,929F	L. distal radius	
	7,136	R. humerus (in 9 pieces)	
	10,929E	R. distal carpometacarpus	
isol.	15,266	R. tarsometatarsus	
isol.	8,063	R. distal tibiotarsus	
2A	21,030	R. quadrate	
	21,026	dorsal vertebra	
	21,003	L. humerus shaft	
	15,560	R. proximal humerus	
	21,019	R. distal tibiotarsus	
	15,577	R. tarsometatarsus	
2B	22,063	L. quadrate	
	21,205	cervical vertebra	
	21,203	L. proximal ulna	
isol.	21,077	R. tarsometatarsus	
3	15,601	axis vertebra	
	15,606	L. coracoid	
	15,607	mid-furcula (in 6 pieces)	
	15,602	R. proximal tarsometatarsus	
4	15,596	large sternal fragment (in 2 pieces)	
	15,592	R. proximal scapula	
	15,594	R. distal radius	
5	15,295	R. proximal scapula	
	15,312	L. femur shaft (slightly charred)	
6	15,140B	2 dorsal vertebrae	
	15,140A	synsacrum	articulate
	15,140C	R. ilium & ischium	articulate
	15,140B	3 caudal vertebrae	
isol.	3,214	L. distal femur	

Table 27. Continued.

Group No./ Isolated	Finds Number	Bone Element
7	17,159A	mid-furcula
	17,159B	sternal fragment?
isol.	17,056	proximal? tibiotarsus
isol.	17,063	R. mandibular ramus
8	7,299	quadrate
	7,314	L. ulna shaft
9A	18,037	R. proximal mandibular ramus
	16,075B	R. proximal scapula
	16,075A	R. proximal coracoid
9B	18,097	2 cervical vertebrae
	18,177	dorsal vertebra
	18,177	ca. 4 ribs (proximal ends)

in Fig. 95), while group 8 is a pair of bones in Lane K in the central area of the site. Group 9 consists of two small subgroups in the south-central part of the midden; subgroup 9A is a small cluster in Lanes M and N (see Fig. 98), and south-southeast is subgroup 9B in Lane L near the southern edge of the midden.

Because all of them are quite small, some of these 11 groupings are undoubtedly depositionally contemporaneous with others located either nearby or elsewhere in the site. As outlined above, the two subgroups of group 2 are quite likely to be contemporaneous, and the same holds for subgroups 9A and 9B. Also, it seems probable that either group 3 or group 4 is contemporaneous with group 2 nearby; on stratigraphic grounds, group 4 seems the more likely of the two to be depositionally associated with group 2, although this is far from certain. In any case, despite such possible associations, it is clear that more than one major depositional episode is represented by the assemblage of _in situ_ great auk bones in Cnoc Coig. The stratigraphic superimposition of group 4 over group 3 indicates the existence of at least two separate depositional events, but more important are the bones lying in Lane H. Recalling the depositional sequence established for seal bones in this area of the midden (cf. Figs. 54 & 95), it can be seen that at least three successive depositional episodes are indicated -- although group 5 could well be contemporaneous with group 6, groups 6 and 7 and the isolated bone lying above group 7 clearly represent three stratigraphically separate events. Thus, the minimum number of depositional episodes which is indicated is three.

The M.N.I. estimate is only slightly more than this. As can be seen from Table 27, a M.N.I. of four great auks is indicated by the right tarsometatarsi. One each occurs in groups 2 and 3, while a third one is an isolated bone in Lane 3 to the east of group 1, and the fourth one is another isolated bone very close to subgroup 2A. This discrepancy between the M.N.I. estimate and the established minimum number of depositional events might simply mean that one depositional episode involved the disposal of two birds. Alternatively of course, the actual number of depositional events might well be more than the minimum number which can be stratigraphically demonstrated, and perhaps an additional event might be indicated if some of the dozen "other" great auk bones had been recovered as _in situ_ finds. In any case, the existing data demonstrate that a _minimum_ of three depositional episodes is represented by the assemblage of _in situ_ great auk bones.

As with most other category II birds, the bones of great auk mostly do not occur in close proximity to their nearest stratigraphically related hearths. Only group 6 lies in the immediate vicinity of a hearth (less than 1.0 m away), while groups 2A, 2B, 3, 4 and 7 lie only moderately close (1.0-1.5 m) to their nearest hearths. In contrast, groups 1, 5, 8, 9A and 9B are quite distantly removed from a hearth (at distances of 2.0-3.0 m away). In terms of disposal modes, group 6 and perhaps some of the groupings which are moderately well associated with hearths might be attributed to dropping within hearth-centred loci. On the other hand, given the smallness of most groups and the fact that many consist of articulating bone elements, the groups which are distantly removed from hearths, and probably also some of those which are moderately well associated with hearths, can be interpreted as refuse discarded by tossing rather than by dumping or dropping.

Birds with Highly Clustered Distributions

The third category consists of those species which are represented by a single, very compact cluster, with no other *in situ* bones located elsewhere in the midden. There are four such species: curlew (Fig. 78), quail (Fig. 78), Bewick's swan (Fig. 79), and teal (Fig. 82). When viewed in section (Fig. 99), it can be seen that all of these clusters are very deep, lying at the very base of the midden on the basal sand. The pattern of distribution of the bones of these four species, in which all of the *in situ* bones occur within a single compact cluster, is completely different from that of birds whose remains are actually found within the body of the midden -- in these latter cases, as we have seen, the bones are either widely dispersed or occur in several small clusters or scatters. Given their stratigraphic location and pattern of distribution, it seems highly likely that the presence of these bird bone clusters in the site is not the result of human activity.

Moreover, the composition of these four clusters, shown in Table 28, strongly supports the notion that these remains are the result of natural depositional processes and have nothing to do with human activity on the site. It can be seen from Table 28 that these clusters are internally very coherent, representing particular body parts of a single individual. The teal cluster comprises much of the body of one adult bird -- the proximal halves of the wings, breast and shoulder bones, neck, pelvis and part of the right leg. The other clusters represent more

Table 28. List of the *In Situ* Bones of Bewick's Swan, Teal, Curlew and Quail Belonging to the Single Cluster of Each Species. The bone identifications are by D. Bramwell (personal communication).

Species	Finds Number	Bone Element
Bewick's Swan	21,177-25	furcula, very fragmentary
	21,177-26	L. coracoid, complete
	21,177-21	L. humerus, complete (in 3 pieces)
	21,177-18	L.? proximal radius
	21,177-29	L. proximal ulna (in 2 pieces)
	21,177-24	R. proximal scapula
	21,177-27	R. humerus, complete (in 3 pieces)
	21,177- 1 21,177-10	R. radius, complete (in 8 pieces)
	21,177- 3	R. distal ulna & shaft (in 3 pieces)
	21,177-30 21,177- 5	R. proximal ulna (4 pieces)
	21,177- 2	R. radiale, complete
	21,177- 3	R. ulnare, complete
	21,177-10	R. prox. carpometacarpus (3 pieces)
	21,177-11	R. wing phalange (1st)
	21,177- 7	wing phalange
	21,177	plus 14 other finds of unidentifiable fragments
Teal	15,762B	several cervical vertebrae, complete
	15,752E	sternum
	15,752B	furcula, complete
	15,752D	L. scapula, complete
	15,752C	L. coracoid, complete
	15,752A	L. humerus, complete
	15,760A	R. coracoid, complete
	15,759	R. humerus, complete
	15,762A	pelvic bones
	15,756	R. femur, complete
	15,757	tarsometatarsus
	15,757	some phalange fragments
Curlew	22,400	12 vertebrae
	22,400	synsacrum
	22,400	L. femur, complete
	22,400	L. tibiotarsus, complete
	22,400	L. tarsometatarsus, complete
Quail	15,760C	R. scapula, complete
	15,760B	L. coracoid, complete
	15,758	L. proximal humerus

restricted parts of the body: the wings and adjoining shoulder girdle in the case of the Bewick's swan; the left leg and some of the spinal column of the curlew; and part of the shoulder girdle and left wing of the quail. In addition, it should be noted that many of these bones were found with articulating bones lying adjacent to one another in situ. In this context, it is worth recalling Binford's (1981a: 15-16) comments about the potential accumulations of bones from natural processes given conditions favourable to their preservation. In the present case, the accumulation of the shell midden deposits by humans provided conditions favourable to the preservation of carcasses (or portions thereof) which had been deposited by natural agents.

In summary, this interpretation of the bone remains of these four birds rests on three observations: (1) for each species, the presence of only a single compact cluster which includes all of the in situ bones of that species; (2) the stratigraphic location of these clusters; (3) their bone element composition. Thus, the nature of the spatial distribution of these in situ bones is of fundamental importance to this interpretation. However, three of these bird species are also represented by some non-in situ (or "other") bones (see Table 6), so that the bones listed in Table 28 and plotted on the various figures do not comprise the complete bone assemblage for three of these four birds. For the preceding interpretation to be accepted, therefore, it must be considered whether these "other" bones can be attributed to the same individuals represented by the single cluster of in situ bones, or whether they indicate that the pattern of distribution observed for the in situ bones is not fully representative of the total assemblages.

As can be seen from Table 6, the Bewick's swan is the one category III bird for which there is not even a single "other" bone, while there are three and two respectively for the curlew and the teal duck. The three "other" curlew bones do not anatomically indicate the presence of a second individual, and indeed, on the basis of their square/unit provenance, it is abundantly clear that they are spatially related to, and can be considered an integral part of, the cluster of five in situ bones. The same applies to the two "other" teal bones. Therefore, the interpretation that the remains of these three birds are present on the site due to non-human agents may stand.

However, the eight "other" quail bones are rather scattered around the site and do not occur in close proximity to the three in situ quail bones. Moreover, they contain a second left humerus and two right coracoids, thereby indicating a M.N.I. of two for the total quail bone assemblage from the site. Five of these "other" bones, including the second left humerus and one of the right coracoids, occur as a compact cluster which is clearly not associated with the in situ cluster; the remaining three "other" bones occur as isolated bones scattered around the midden. In short, the pattern of distribution of quail bones as a whole is not characteristic of category III birds, but rather, it is typical of the category II birds with which it more properly belongs. This suggests that the quail remains in the site are perhaps the result of human agency after all. That the in situ bones suggested otherwise can undoubtedly be seen as a product of the fact that they represent such a small proportion (27.3%) of the total quail bone assemblage. In light of the consideration of the non-in situ bones, it may therefore be concluded that the quail bones are in fact present on the site due to human activity, and that two depositional episodes involving one quail each are represented.

Summary

The 57 taxa of birds represented at Cnoc Coig include 32 which have either no in situ bones or only one, and which, therefore, cannot meaningfully be included in a discussion on the spatial patterning of bird remains in the site. Nevertheless, the location of the single in situ bone for four of these taxa was noted in the instances where this information was relevant to the discussion of some related and more abundantly represented bird (see Figs. 82, 83 & 85). Two of the other taxa (family Alcidae and bird spp.) are very general categories, the bones of which could refer to several species, so that no meaningful information can be derived from the spatial distribution of their in situ bones. The remaining 23 taxa, which contain at least two in situ bones each, were divided into three categories on the basis of the pattern of distribution of their bones.

Observed Distribution Patterns

The first category includes eight species -- raven, woodcock, whooper swan, long-tailed duck, Manx shearwater, herring/lesser black-backed gull, puffin and black guillemot. All of these birds are represented by a small number of in situ bones (five or less) which are so widely dispersed throughout the midden that it is not possible to define any groupings of spatially associated bones. The second category includes 11 taxa representing nine bird species -- greylag goose/goose spp., eider duck/duck spp., gannet, shag, cormorant, fulmar, guillemot, razorbill and great auk. These birds are represented by a moderately large number of in situ bones (at least ten), except for the shag and fulmar. More importantly, these remains reveal a less dispersed distribution than those of the birds of category I because many, or even most, of their in situ bones occur in small clusters or scatters; in other words, the bones of these birds reveal a definite clustering tendency, even though the definable groups are small and the groups themselves are rather widely scattered around the midden.

The third category of birds includes four species -- curlew, quail, Bewick's swan and teal. Each of these birds is represented by a single, very compact cluster, with no other in situ bones located anywhere else in the midden deposits. In terms of bone element composition, all of these clusters are internally very coherent, representing particular body parts of a single individual often with articulating bones lying adjacent to one another *in situ*. Also, all of these clusters occur at the very base of the midden lying on the basal sands. In light of these observations, the remains of these birds were interpreted to be present on the site as a result of non-human agents. However, when the non-*in situ* (or "other") bones were also taken into account, it was shown that the distribution pattern of quail bones as a whole does not conform to the characteristic pattern of category III birds, but rather, that they are typical of the distribution of category II birds where, therefore, the quail should more properly be assigned.

Thus, excluding the three birds of category III which are interpreted to be present on the site as a result of non-human agents, a basic distinction has been made between birds with dispersed distributions and birds with clustered distributions. The bones of the species assigned to category I are so widely scattered that not even two of them occur in close proximity to one another; hence, these distributions have been characterized as dispersed. The bones of birds assigned to category II have been characterized as clustered rather than dispersed because their bones overall tend to be found together in groups. However, the vast majority of these groups are quite small, consisting of four bones or less, and these groups are rather widely scattered around the site. Consequently, it is important to realize that the difference between those birds characterized by a dispersed distribution and those by a clustered one is not very great. Indeed, this dichotomy tends to obscure the fact that the bones of all these birds have a rather similar pattern of distribution; the only difference is simply that for some the bones are scattered in very small groups plus as isolated bones, and not *solely* as isolated bones as is the case with others. In fact, this difference in the pattern of distribution is probably no more than a function of sample size -- all the birds of category I have five or less *in situ* bones, while those of category II have more than ten except for the shag and fulmar. In other words, there is no reason to think that the birds assigned to categories I and II represent different consumable elements in terms of the patterns of consumption and disposal of these various bird remains.

Disposal Modes

The bones of the various birds of categories I and II reveal a broadly similar pattern of spatial association with their nearest stratigraphically related hearths. Although relatively few bones lie in very close proximity (less than 1.0 m away), most of them are moderately well associated with hearths -- despite some obvious variation from species to species, in general about two-thirds of these bird bones, including both isolated bones and small clusters, lie within 2.0 m of a hearth. In contrast, most of the remaining one-third lie beyond 2.5 m.

In terms of disposal modes, three observations might suggest that tossing was the primary disposal mode employed in the discard of these remains: (1) the rather scattered nature of these bird bones; (2) the small size of the definable groupings; (3) the fact that these groupings quite often consist of adjacent bones which could have still been articulating when discarded. However, the pattern of association with hearths would at least partly seem to indicate that other disposal modes are involved. The bones which occur relatively far away from hearths could indeed be attributed to over-the-shoulder tossing, although a few of the relatively larger groups (e.g. great auk group 1 and cormorant group 1) which are quite distantly removed from their nearest hearth might alternatively be attributed to dumping. On the other hand, the few bones which lie in close proximity to a hearth would probably be best interpreted as refuse dropped within hearth-centred loci, and the same might apply to some of the many bones which are moderately close to a hearth, while the rest of them would probably represent items discarded by over-the-shoulder tossing or perhaps by forward tossing (i.e. across a hearth to its other side) which resulted in their being nearer hearths than would be the case with over-the-shoulder tossing. Overall then, it would seem that the bird bones in Cnoc Coig are probably best attributed to a combination of disposal modes -- that is, to both tossing and dropping with little (if any) dumping.

Depositional Episodes

In the preceding discussion on the eight category I birds and the nine category II birds, values for the M.N.I. based on the in situ bones and the minimum number of depositional episodes (M.N.D.E.) established on the basis of their distributions in the midden were derived for each species. Table 29 summarizes these derived values. However, as was the case with the category III birds, we should also take into account the non-in situ ("other") bones, since in some cases these represent sufficiently substantial proportions of the total number of bones of these birds (see Table 6) that they might have an effect on the M.N.I. estimates. Consequently, Table 29 also shows the M.N.I. values based on the total bone assemblage for each species.

As this table illustrates, for six of the eight category I birds and five of the nine category II birds, the M.N.I. indicated by their in situ bones corresponds with the established M.N.D.E. This table also shows that the M.N.I. for these 11 birds based on their in situ bones remains unchanged when the total bone assemblage is used. This is hardly surprising since all of these birds are represented by relatively few "other" bones (at most 50% of the total number of bones -- see Table 6). There is thus complete correspondence between both of the M.N.I. values and the established M.N.D.E. for these 11 species.

For four of the remaining six birds, the M.N.I. counts are increased when based on the total number of bones rather than on the assemblage of in situ bones. For three of these birds (the puffin, razorbill and guillemot), this is of course not too surprising since the "other" bones represent the majority of bones for these birds (see

Table 29. Comparison of the Minimum Number of Individuals, Based on Both the *In Situ* Bones and the Total Number of Bones, with the Minimum Number of Depositional Episodes Indicated by the *In Situ* Bones for the 17 Category I and II Birds.

Species	In Situ M.N.I.	Total M.N.I.	M.N.D.E.
Category I:			
Raven	3	3	1
Woodcock	1	1	1
Whooper Swan	1	1	1
Long-tailed Duck	1	1	1
Manx Shearwater	1	1	1
Herring/Lesser Black-backed Gull	1	1	1
Puffin	2	3	1
Black Guillemot	1	1	1
Category II:			
Greylag Goose/ Goose spp.	2	2	2
Eider Duck/Duck spp.	2	2	2
Gannet	2	2	2
Shag	2	2	2
Cormorant	1	2	1
Fulmar	1	1	1
Guillemot	3	5	3
Razorbill	3	4	1
Great Auk	4	4	3
Totals:	31	36	25

Table 6) -- indeed, it would be surprising if such large proportions of "other" bones did not increase the M.N.I. estimates. In any case, regardless of whether or not their M.N.I. values are increased when the whole assemblage is used, for all of these six remaining birds, the established M.N.D.E. value is less than the M.N.I. estimate based on their total number of bones. In the case of the puffin, razorbill and guillemot, the discrepancies between the M.N.I. and M.N.D.E. values may largely be a function of the fact that their in situ bone counts represent only relatively small proportions of their total bone counts -- if all or at least more of the bones of these three birds had been recovered as in situ data, and so could be used in the derivation of the M.N.D.E., it is quite possible that the M.N.D.E. values would be increased, thereby reducing or even eliminating the discrepancies between the M.N.I. and M.N.D.E. values. In any case, this argument would be less applicable to the cormorant and great auk, and completely inapplicable to the raven. In other words, regardless of the possibility of this explanation for some birds, the fact remains that in some cases there is a discrepancy between the M.N.I. estimate and the established M.N.D.E., even though there is overall a close correspondence between these two values.

However, such discrepancies are not in themselves a problem since, for two reasons, one need not expect that the M.N.I. and M.N.D.E. values will always correspond precisely. First of all, there will undoubtedly be instances when more than one individual was discarded during one depositional episode, even though this may not be indicated by the spatial distribution of the remains (and especially by the bone element composition of stratigraphically associated groupings); in fact, this does occur in one instance with the avian assemblage from Cnoc Coig, namely, with guillemot group 2. Secondly, we should not expect that separate depositional events involving different individuals will always and necessarily be demonstrated stratigraphically by the distribution of remains. In short, we should anticipate that in some instances the M.N.I. value will be greater than the M.N.D.E. What would be perhaps difficult to explain would be if the M.N.I. was less than the M.N.D.E., and this does not occur with any of the birds at Cnoc Coig.

The Exploitation of Birds

In general then, it may be said that the minimum number of depositional episodes which can be stratigraphically demonstrated on the basis of the distribution of the in situ bones in the midden corresponds quite closely to the minimum number of individuals which is indicated for the birds of categories I and II. The clear implication of this correspondence is that, in the vast majority of cases, single birds were being consumed and disposed of at a time. Stated differently, the distribution of bird remains at Cnoc Coig does not indicate that birds were being procured, eaten and discarded in large quantities at any one time. If this were the case, one would clearly expect that at least some of the bird bone groupings would contain bones from more than one individual and perhaps even that there would be some quite large concentrations of bird bones. As it is however, there are no large concentrations and only one of the defined bird bone groupings indicates the presence of more than one bird (or selected parts thereof to be more precise). This is in contrast with mammals, most particularly with seals, where some of the groupings are quite large and several do contain bones from more than one animal.

This suggests, therefore, that the exploitation of birds was neither intensive nor large scale, as would be the case if large breeding colonies of sea birds were being exploited. If this latter pattern of exploitation were the case, then the total number of sea birds observed at Cnoc Coig could easily have been procured in only one or two hunting episodes! Thus, the distribution of bird remains in the midden clearly does not point in any way to this sort of mass procurement of sea birds. Of course, this observation is not surprising when it is recalled that the analysis of fish remains indicates that Cnoc Coig was primarily occupied in autumn with only some indications of occasional spring/early summer occupation during which time breeding colonies of sea birds would have been available (see Mellars 1978: 380-384; Mellars & Wilkinson 1980: 34, 36-39; Wilkinson 1981: 113-115, 126). If these sea birds were not caught on land while nesting when they would have been most accessible and most readily exploitable, one must wonder how such elusive birds were procured in their normal habitats out to sea and in coastal waters. The difficulty and effort required to capture these birds in these usual habitats would seem to preclude their exploitation from being worthwhile. In this context, the suggestion (P. Mellars, personal communication) must be seriously entertained that sea birds, which comprise most of the species of the birds of categories I and II, were not actively hunted, except perhaps when nesting, and that at other times of the year, such as when Cnoc Coig was most frequently occupied, sea birds which died from natural causes were simply collected when washed up on the beaches. The infrequency of such events would of course accord well with the small numbers of individuals and numbers of depositional episodes indicated for the birds of categories I and II.

Finally, we may turn to the matter of the quantity of food represented by the bird remains. Regarding mammals, it was pointed out above that the remains of most mammals did not indicate large quantities of food, and this was particularly so with red deer and pigs where most bones represent only low meat-bearing body parts. An examination of the body parts represented by the bird bones at the site (see Table 8) certainly shows a definite bias towards bones of the wing and shoulder and secondarily the lower leg. Nonetheless, despite such biases and whatever may be the reasons for them, it is reasonable to assume in the case of birds that the consumption of whole animals is indicated by these remains.

Yet, the amount of food represented by any _one_ species of bird is not particularly great, even in the case of the larger birds. Of the numerous species which are represented by either one or no _in situ_ bones, the small number of bones in all cases indicates a M.N.I. of only one bird. Similarly, seven of the 17 category I and II birds represent a single individual, and five others just a pair of birds. Thus, there are only five species, four of them auks, which indicate the presence of more than two individuals -- three in the case of puffin and raven, four in the case of razorbill and great auk, and five for the guillemot. Yet even in these instances, none of these represent particularly impressive quantities of food. Nevertheless, because of the large number of species, the total amount of food represented by _all_ of the birds in the site is not inconsiderable. The 17 category I and II species alone indicate a total of 36 birds, some of which are quite large, and this total quantity of food must surely rival, if not surpass, the amount of food available from most of the individual mammal species. Therefore, birds must have been a significant, though not major, resource in the overall diet of the Mesolithic occupants of Cnoc Coig.

Because of the relatively low number of bones of any one species of bird, and because there is no reason to think that every occupation would have necessarily entailed the capture of at least one individual of any particular species, it is not possible to suggest how many occupations might have been responsible for the accumulation of these remains. It was suggested above in Chapter 6 that the mammal bones need not indicate more than a dozen occupations of the site. Considering only the birds of categories I and II, this number would mean that on average about three birds were consumed and discarded in each occupational episode. If the species which are not represented by more than one _in situ_ bone are also included, then there would be about five birds per occupation, although many of these other birds are quite small and would not represent much additional food. In either case, this number of birds does not sound unreasonable and would represent a moderate quantity of food per occupation. Of course, the number of occupations represented by the Cnoc Coig shell midden might be considerably more than a dozen, in which case the number of birds consumed per occupation would be correspondingly less.

CHAPTER 8

SPATIAL ANALYSIS: LIMPET SCOOPS AND RELATED STONE ARTIFACTS

Limpet Scoops

As was noted above in Chapter 4, the most abundant class of artifacts from Cnoc Coig which were recorded *in situ* are limpet scoops, made of either antler, bone or stone. These artifacts occur abundantly in all Obanian sites and indeed, they are one of the major diagnostic items of the Obanian. Cnoc Coig is no exception to this -- the excavated areas of the site, excluding Peacock's (1978) sampling squares, yielded a total of 795 limpet scoops. Because the vast majority of these artifacts were recorded *in situ*, for purposes of spatial analysis, they provide a wealth of data which may be subjected to statistical manipulation.

The Nature of Their Distribution

The 795 limpet scoops from Cnoc Coig can be divided into a number of types and subtypes, as was discussed above in Chapter 4 (pp. 109-117) and summarized in Tables 9 and 10. It should be noted that the *in situ* counts in Table 10 include 20 large S.L.S. (i.e. ones greater than 99 mm in length) -- 13 of these are single-ended on whole pebbles, five are single-ended on truncated pebbles, and two are double-ended. One question that might be asked of these data concerns the nature of the distribution of particular limpet scoop types or of the entire assemblage of scoops -- that is, are these distributions random or non-random, and if the latter, clustered or regularly spaced? This question is the one which is statistically addressed by "univariate" distance methods of spatial analysis such as the Clark and Evans (1954) nearest-neighbour statistic. However, the small numbers of A./B.L.S., B.L.S. and large S.L.S. would prohibit the use of such techniques for these three types of limpet scoops, although it may be parenthetically noted that small sample sizes have not always inhibited archaeologists and human geographers from utilizing these statistical methods (see pp. 42-44). Furthermore, regardless of the problem of sample size, the irregular nature of the excavated areas of Cnoc Coig would effectively preclude the use of such statistical techniques of spatial analysis due to the problem of boundary effects (see pp. 45-48). More importantly, this question concerning the nature of the distribution of limpet scoops is not one which is particularly relevant in the present context. Thus, even if a univariate distance method of spatial analysis could be legitimately applied to the limpet scoop data from Cnoc Coig, aside from providing a statistical description of the pattern of distribution, the results would be of little value because they would not be directed at solving a major problem of interest.

Having said this however, it may be noted that limpet scoops clearly do not reveal a marked clustering tendency as, for example, do mammal bones. Figures 100 to 103 are depth-compressed horizontal plots showing respectively the distribution of all A.L.S., A./B.L.S. and B.L.S., S.L.S., and large S.L.S. in the site; and Figures 104 to 109 are six depth-selective horizontal plots which show the distribution of all A.L.S. and S.L.S. (excluding the 20 large S.L.S.) in a series of specific levels down through the midden deposits. As an illustrative sample of vertical distributions, Figures 110 to 113 show the occurrence in section of all limpet scoops in Lanes 6, 7, H and I. An examination of these plots reveals that the pattern of distribution of limpet scoops in the site is very complex, and, while it is clear enough that limpet scoops are not <u>highly</u> clustered, it is not visually obvious whether their distribution is random or clustered or uniformly spaced. Looking at Figures 105 to 108 in particular, it can be seen that in some areas -- such as the western part of the site in Levels 9 and 10 (Fig. 105) -- the distribution appears to be regularly spaced, while in other areas limpet scoops tend to occur in small clusters; some of these small clusters contain both A.L.S. and S.L.S., whereas others are composed predominately, or even exclusively, of only one type. Thus, it is difficult to determine with certainty whether the overall distribution of limpet scoops is most accurately characterized as random, clustered or uniformly spaced -- but even if this were possible, it is doubtful whether such a characterization would be of much value given the fact that in different parts of the site the distribution seems to vary.

In any case, one feature of the distribution of the entire assemblage of limpet scoops which is important is their ubiquity throughout the midden. As Figures 100 to 113 illustrate, limpet scoops occur in all parts of the site, and wherever there is midden deposit, there are limpet scoops. Indeed, limpet scoops are so consistently ubiquitous that their distribution in particular levels reflects with considerable accuracy the occurrence of midden deposit in those levels.

Perhaps even more remarkable is the overall consistent occurrence of limpet scoops per unit volume of midden. Using the unit plans and other site records, it is possible to determine with a reasonable degree of accuracy the depth of midden deposit (and thereby the volume) in every excavated trench and square in the site. Since the total number of limpet scoops is known for each trench and square, the number of limpet scoops per cubic metre of midden can be readily calculated for the entire site or for particular subareas. The excavated areas of the site used in the present study yielded 761 limpet scoops[1] and have a total volume of ca. 42 m^3 of midden -- thus, the site overall contains about 18 limpet scoops/m^3. In addition, the site was divided into four subareas of varying sizes and the resulting densities of limpet scoops calculated for each subarea; this was done several times using a different

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[1] Thirty four of the limpet scoops included in the category of "other" finds listed in Tables 9 and 10 are from excavated areas excluded herein for the purpose of spatial analysis (as shown in Fig. 4) and so, they are not included in this total.

configuration of subareas each time. Perhaps surprisingly, regardless of the configuration used and the consequent size and location of particular subareas, the resulting densities of limpet scoops were generally very similar. Although densities ranged overall from as low as 16 to as high as 24, most subareas contained between 19 and 21 limpet scoops/m^3. The one exception to this is the subarea comprising the western half of Lanes 4 to 7 where there are only about 11 limpet scoops/m^3.

In fact, there is a good reason why this area should reveal a lower density of limpet scoops than the rest of the site, and this reason would also probably account for the less extreme variability in limpet scoop densities in other areas of the site. It may be recalled that Mellars (1978: 389) has distinguished two kinds of deposit within the midden -- "shell heaps" which comprise loose accumulations of shells with little intervening soil, and "occupation surfaces" which contain very comminuted shells and a much higher ratio of soil to shell in the deposit. The occupation surfaces predominately occur on the landward (northwestern) side of the site, and this is precisely the area with the lowest limpet scoop densities; indeed, the lower density of limpet scoops can clearly be seen in the western half of Lanes 6 and 7 when viewed in section (Figs. 110 & 111). Consequently, it would seem that the observed variations in limpet scoop densities are simply reflecting variations in the ratio of shell to soil matrix in the midden deposit -- lower densities reflect a higher proportion of soil, and higher densities reflect relatively "pure" shell heaps with a minimum of intervening soil in the deposit. Of course, in order to overcome the fact that the midden deposit varies in terms of the relative proportions of shell to soil matrix, a better way to express the occurrence of limpet scoops would be in relation to the volume or weight of the shell fraction of the deposit, rather than the entire midden deposit as was done above. Unfortunately, the data required to do this are not available, but if they were, it seems highly likely that the occurrence of limpet scoops throughout the midden would be even more consistent than the figures mentioned here suggest. In other words, it would seem that the occurrence of limpet scoops in the midden is remarkably constant in relation to the amount of shell, and limpet shells in particular since limpets are by far the dominant shellfish contained in the site.

This feature of the occurrence of limpet scoops in Cnoc Coig is of greater interest than simply characterizing the distribution of particular limpet scoop types or the entire assemblage as either random, clustered or uniformly spaced. This is because the consistent ubiquity of limpet scoops in the site relates to the functional interpretation of these artifacts as discussed in Appendix A. The fact that limpet scoops occur with such consistency in relation to shell refuse is a strong argument in favour of the limpet scooping function attributed to these artifacts originally by Bishop (1914: 95). And on the other hand, it may be noted that the nature of the distribution of limpet scoops in the site would be difficult to reconcile with other functional interpretations of these objects, such as that of skin working. As mentioned in the discussion in Appendix A, the sheer number of limpet scoops, particularly in relation to the relatively small numbers of mammals (especially seals) which are represented in the site, seems to argue strongly against a skin working interpretation. But even if this objection is ignored, it is difficult to envisage the cultural formation processes responsible for the observed pattern of distribution of limpet scoops if these were indeed skin working tools -- if this were so, one would expect a more localized distribution, perhaps even with scoops tending to be associated with seal or other mammalian remains.

At any rate, Bishop's proposed life history of a limpet scoop implies that limpet scoops were essentially non-curated tools which underwent little or even no maintenance between manufacture and discard. Of course, the sheer number of limpet scoops in all the middens on Oronsay strongly suggests that they were non-curated artifacts with a relatively short uselife. But why should this be so? After it had been used to the point that it had lost its sharp edge and had acquired the classic blunt bevelled end, why not simply reflake a limpet scoop instead of making a new one? The reason would seem to relate to the length of these tools -- that is, beyond a certain minimal length, the resharpening of a worn-out limpet scoop would not be feasible because reworking of the tool would reduce it to an unusable length. Of course, it is possible that limpet scoops, or at least the longer ones, were in fact resharpened once or twice before being finally discarded. However, solely on the basis of the tools themselves, it is not possible to determine if such maintenance was indeed practised -- experimental data should be able to provide an answer to this question, but such experimental work remains to be done. In either case, whether or not limpet scoops underwent some maintenance, the fact remains that they could at most only be resharpened a very limited number of times and consequently that they had a relatively short uselife.

Moreover, it seems reasonable that this uselife would be fairly constant since the number of limpets scooped in order to wear out a scoop to the point that it is discarded may be presumed to be reasonably regular, although the required number of limpets would presumably be different for the three different material types. And of course, a relatively constant uselife in terms of the number of limpets scooped would account for the observation that limpet scoops occur with such consistent frequency in relation to shell refuse in the midden. Since there are about 20 limpet scoops/m^3 of midden in areas where there is comparatively little intervening soil, and since a cubic metre contains around 240,000 limpet shells when there is no intervening soil (which is based on two sample counts of midden limpets from ¼" sorted deposits from C.N.G. I), there is thus a maximum of approximately 12,000 limpet shells in the midden per limpet scoop. Whether this number of limpets is sufficient to wear out a limpet scoop beyond further use (including one or two possible resharpenings of the tool) can only be determined by experimental research which has yet to be conducted. Nevertheless, on the basis of the limited experimental evidence reported in Appendix B, this number of limpets does indeed seem to be quite adequate.

One final point pertaining to the ubiquitous distribution of limpet scoops in Cnoc Coig concerns activity areas. Since limpet scoops are so ubiquitous throughout the midden deposit and in a relatively constant proportion to limpet shells, it seems clear that worn-out limpet scoops were dumped together with limpet shells. Consequently, because they were not discarded as "primary" refuse, their locations can in no way be taken to indicate limpet processing loci any more than could the locations of limpet shells! Thus, nothing can be said about the location of specific limpet processing loci within the midden, although it seems reasonable enough to suppose that limpet processing was conducted around hearths and that the limpet shells, and any worn-out limpet scoops, were removed at least a short distance away and dumped.

The Segregation of A.L.S. and S.L.S.

In Chapter 4 (pp. 123-126), an explanation was put forward to account for the presence of three different material types of limpet scoops and for the varying relative frequencies of these three types observed in different Obanian sites. This explanation assumes that, for whatever reasons, there is a ranked preference of these three material types in which bone is preferred over antler and antler over stone. Given this ranked preference, the relative proportions of the three material types of limpet scoops would be a function of how adequately these preferences could be satisfied by the differential availability of the three raw materials. At Cnoc Coig and the other sites on Oronsay, antler and bone were not locally available and could only have been obtained on other islands, the result of which would be that supplies of these raw materials would have been sporadic and perhaps also unreliable; it should also be remembered that antler and bone were also required for other manufacturing needs which would contribute further to limiting their supply. On the other hand, stone in the form of elongated beach pebbles was a raw material which was locally available in abundance, and which presumably was resorted to whenever supplies of the preferred material types were (temporarily) exhausted.

It should be noted that B.L.S. are so rare in the sites on Oronsay that there would have been no point in time when only B.L.S. were being used. Since antler and bone were undoubtedly acquired from the same source(s), we may presume that whenever bone was obtained so usually was antler, although the reverse may well not be true however. Hence, because of this and because bone was in such limited supply compared to antler, the occasional use of B.L.S. would have occurred at the same time that A.L.S. were predominately being used. Furthermore, we may presume that supplies of bone ran out before those of antler. In short, B.L.S. may be effectively eliminated as a separate major entity and instead be considered together with A.L.S.

Therefore, according to this explanation, whenever antler and bone were available, limpet scoops would be made from these materials for as long as supplies lasted, after which stone would be utilized. At the point in time when antler supplies were running out and stone was beginning to be resorted to, we may expect a short transition period when both A.L.S. and S.L.S. were being manufactured, used and discarded. Thus, except for this short transition period when both types of scoop were simultaneously being discarded, most of the time either <u>only</u> A.L.S. (along with B.L.S. on some occasions) or <u>only</u> S.L.S. were being used and discarded. This hypothesized pattern of use of the three material types of limpet scoops has clear test implications regarding the spatial distribution of the different types of limpet scoops in the Oronsay middens, namely: (1) there should be observable and significant segregation overall between the distributions of A.L.S. on the one hand and S.L.S. on the other; (2) similarly, B.L.S.

and S.L.S. should be significantly segregated; (3) A.L.S. and B.L.S. should not be significantly segregated but rather randomly intermingled.

The coefficient of segregation which was described above (pp. 55-58, 206-210) may be used to determine whether these test implications concerning the segregation or non-segregation of the different material types of limpet scoop are statistically verified. Unfortunately however, because of the small number of B.L.S. in the site and the consequent large disparity in sample sizes between B.L.S. on the one hand and A.L.S. and S.L.S. on the other, the index of segregation cannot be used to test the latter two implications listed above -- when sample sizes are so widely disparate, the results obtained from this statistic are not a reliable indication of the presence or absence of segregation between the distribution of two types of points (N. Fieller, personal communication). Nevertheless, since the number of in situ A.L.S. and S.L.S. in the site are very similar (see Tables 9 and 10), there are no such problems in applying the coefficient of segregation to determine if these two types of limpet scoops are indeed segregated as the proposed model predicts.

Using the entire assemblage of A.L.S. and S.L.S., the results obtained from the coefficient of segregation are shown in Table 30. These results are based on three-dimensional nearest-neighbour distances and weighted nearest-neighbour values. Two sets of statistics are shown. One is based on the entire assemblage of 293 A.L.S. and 316 S.L.S., while the other excludes the 20 large S.L.S. The reason for including one set of statistics which excludes the large S.L.S. is that, as discussed in Chapter 4, there is some reason for regarding S.L.S. as being a non-homogeneous population with most S.L.S. comprising one group and the few large S.L.S. constituting a second group. Hence, if these two groups do relate to some (unknown) functional difference, then the pattern of discard of large S.L.S. may be different from that of the smaller S.L.S. with the result that their distribution may

Table 30. Results of the Test of Segregation between Antler and Stone Limpet Scoops for the Entire Midden in Three Dimensions Using Weighted Nearest-Neighbour Values.

I. 293 A.L.S. and 316 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	157.0	123.1	280.1	139.7	134.1	273.8
S.L.S.	132.2	171.7	303.9	135.0	162.9	297.9
Total	289.2	294.8	584.0	274.7	297.0	571.7

$S = 0.125426$ $S_2 = 0.056885$

Sign. level = .006 Sign. level = .100

II. 293 A.L.S. and 296 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	159.0	121.1	280.1	143.6	130.1	273.7
S.L.S.	127.1	156.6	283.7	130.1	148.0	278.1
Total	286.1	277.7	563.8	273.7	278.1	551.8

$S = 0.119740$ $S_2 = 0.056944$

Sign. level = .008 Sign. level = .124

not be entirely typical. Despite this possibility, given that the large S.L.S. comprise only about 6% of the total number of in situ S.L.S., it is not too surprising to note that the inclusion of the large S.L.S. has no difference on the overall results. As can be seen from Table 30, both S values are highly significant, at the 1% level, indicating significant segregation between A.L.S. and S.L.S. as the model predicts. The S_2 values indicate much less significant segregation, at about the 10 to 12% level, which is what one might expect from the model outlined above since there is an increased likelihood of having mixed pairs with second nearest neighbours. That is, while the model of limpet scoop discard suggests that there is a high probability of having a limpet scoop of the same type as the first nearest neighbour, there is a decreasing probability of this occurring with second, third and subsequent nearest neighbours. In other words, as one looks at increasingly larger-scale patterns of distribution between the two types of limpet scoops, one would expect decreasing evidence of segregation. In summary therefore, the coefficient of segregation confirms the model's prediction that A.L.S. and S.L.S. are overall significantly segregated.

If we divide the site into a number of arbitrary levels and look individually at the pattern of segregation between A.L.S. and S.L.S. in these levels, we might expect that these levels would generally reveal a similar pattern of segregation to that observed for the site as a whole. In order to maintain moderately large sample sizes, six arbitrary levels were defined -- four are the 10.0 cm levels between 60.0 and 99.9 cm below datum, while the additional two are for all scoops shallower than 60.0 cm and for all scoops deeper than 99.9 cm below datum. These six levels are the depth-selective subdivisions of the site used to plot the distribution of A.L.S. and S.L.S. in Figures 104 to 109. Note that these six levels do not include the 20 large S.L.S.

The coefficient of segregation was determined for these six levels, once again using three-dimensional nearest-neighbour distances and weighted nearest-neighbour values. The results are shown in Table 31. The first observation to make about this set of statistics is that, except for level VI, the results based on first and second nearest neighbours are in agreement as to whether or not there is significant segregation between the two types of limpet scoop. However, the individual levels vary considerably in terms of whether or not significant segregation is indicated. In three levels (II, III and VI), A.L.S. and S.L.S. are highly significantly segregated, thus reflecting the pattern of segregation observed for the site as a whole, which is what one would expect. Yet, the other three levels (I, IV and V) somewhat surprisingly yielded results which indicate that the two types of scoop are randomly intermingled and not segregated! How can this apparent discrepancy be explained since these results intuitively seem to contradict, and cast doubt upon, the conclusion based on the entire assemblage of scoops?

Firstly, the matter of reduced sample sizes must be considered. It is perhaps possible that total sample sizes in the order of 76 to 127 scoops might simply be too small to provide a reliable indication of the "true" pattern of segregation. Moreover, whereas in the site as a whole the two types of scoop are nearly equal in number, the relative proportions of A.L.S. and S.L.S. in these levels vary considerably, and this might also have some effect on the results. Nevertheless, it is difficult to accept that these two factors alone could so affect S values as to "obscure" the presence of segregation in three of the six levels.

A more likely reason for these levels being so variable in terms of revealing segregation or non-segregation relates to the arbitrary manner in which these levels are defined. The boundaries between the levels are horizontal planes which arbitrarily cut across the sloping midden deposits, and undoubtedly, they move into a different level the nearest neighbours of some or even many points, thereby severing actual nearest-neighbour relationships and

Table 31. Results of the Test of Segregation between Antler and Stone Limpet Scoops for Six Arbitrarily Defined Levels within the Midden Using Weighted Nearest-Neighbour Values.

I. 20.0-59.9 cm B.D. (Levels 1-8); 57 A.L.S. and 39 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	26.6	25.9	52.5	27.0	21.0	48.0
S.L.S.	23.9	13.1	37.0	18.8	15.3	34.1
Total	50.5	39.0	89.5	45.8	36.3	82.1
	S = -0.139348			S_2 = 0.011483		
	Sign. level = .816			Sign. level = .420		

II. 60.0-69.9 cm B.D. (Levels 9 & 10); 38 A.L.S. and 46 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	21.9	14.0	35.9	20.5	13.6	34.1
S.L.S.	13.4	28.1	41.5	14.5	23.9	38.4
Total	35.3	42.1	77.4	35.0	37.5	72.5
	S = 0.286889			S_2 = 0.223085		
	Sign. level = .024			Sign. level = .026		

III. 70.0-79.9 cm B.D. (Levels 11 & 12); 70 A.L.S. and 57 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	42.8	21.3	64.1	37.5	24.0	61.5
S.L.S.	22.1	31.5	53.6	22.6	28.9	51.5
Total	64.9	52.8	117.7	60.1	52.9	113.0
	S = 0.255154			S_2 = 0.169502		
	Sign. level = .016			Sign. level = .028		

Table 31. Continued.

IV. 80.0-89.9 cm B.D. (Levels 13 & 14); 64 A.L.S. and 51 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	30.6	28.3	58.9	33.1	24.5	57.6
S.L.S.	29.7	17.8	47.5	26.4	19.2	45.6
Total	60.3	46.1	106.4	59.5	43.7	103.2
	S = -0.105742			S_2 = -0.003827		
	Sign. level = .806			Sign. level = .486		

V. 90.0-99.9 cm B.D. (Levels 15 & 16); 39 A.L.S. and 52 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	15.2	22.0	37.2	20.0	15.8	35.8
S.L.S.	20.2	28.7	48.9	22.3	24.7	47.0
Total	35.4	50.7	86.1	42.3	40.5	82.8
	S = -0.004471			S_2 = 0.082263		
	Sign. level = .498			Sign. level = .236		

VI. 100.0-159.9 cm B.D. (Levels 17-28); 25 A.L.S. and 51 S.L.S.:

	1st Nearest Neighbour			2nd Nearest Neighbour		
	A.L.S.	S.L.S.	Total	A.L.S.	S.L.S.	Total
A.L.S.	13.2	9.3	22.5	5.7	15.9	21.6
S.L.S.	14.8	31.8	46.6	9.7	34.3	44.0
Total	28.0	41.1	69.1	15.4	50.2	65.6
	S = 0.254356			S_2 = 0.047793		
	Sign. level = .032			Sign. level = .266		

causing other points to become the nearest neighbours. In actual fact, these new nearest neighbours may be only the second or third (or even more distant) nearest neighbours. Recalling that the likelihood of obtaining mixed pairs increases with increasingly distant nearest neighbours, then one can envisage how segregation may be "lost" when these arbitrary levels are used. Viewed another way, the use of arbitrary levels massively compounds the problem of boundary effects because, in addition to the boundaries of the excavated areas of the site, there are (arbitrarily induced) vertical boundaries beyond which, for many points, there may be nearest neighbours which effectively are not known; and the system of weighting nearest-neighbour values to deal with the possible horizontal boundary effects was not designed to take into account vertical boundaries in the case of such arbitrary levels which are likely to be an even greater problem than are the horizontal boundaries of the excavated areas of the site.

Admittedly, for the points within any given level, the number of severed nearest-neighbour relationships may not be very great, and not all of these will necessarily involve a change in the type of point which is the nearest neighbour. Nevertheless, for some levels, there may well be several points which experience such a change and, in particular, which change from pairs of the same type to mixed pairs. The effect of having an increased number of mixed pairs is to reduce the value of S and possibly therefore to eliminate the presence of significant segregation. In very large samples, a few additional mixed pairs should not affect the results very much, but, with the much smaller sample sizes of these levels (compared to the site as a whole), the effect of having a few mixed pairs which are "artificially" created as a result of the arbitrarily defined nature of these levels could be sufficient to account for the "loss" of significant segregation in three of the six levels. In short, the combination of reduced sample sizes and the effect on the number of mixed pairs which result from the use of arbitrarily defined levels may well explain why three of the six levels did not reflect the pattern of significant segregation which is observed when the site is treated as a whole.

Therefore, it may be concluded that the coefficient of segregation does indeed confirm that A.L.S. and S.L.S. in the midden are significantly segregated overall, as the model of limpet scoop discard predicts. However, does this indicated segregation in itself actually support the proposed model or could such segregation arise from different formation processes? We may envisage that segregation could arise from three possible situations regarding the distribution of two types of points: (1) from horizontal separation in which A.L.S. and S.L.S. generally are found in different areas of the site; (2) from vertical separation in which A.L.S. and S.L.S. are generally found in separate levels, with one type being depositionally earlier and therefore primarily occurring towards the base of the midden, and the other type being later and occurring near the top; (3) from patchiness of distribution in which each type tends to be found in small clumps or patches of points of its own type. The first of these alternative situations is certainly not the case with limpet scoops -- as Figures 104 to 109 clearly show, both types occur in all areas of the site. Likewise, the second alternative is not applicable to limpet scoop distributions since the sectional plots (see Figs. 110-113) amply demonstrate that both A.L.S. and S.L.S. are found throughout the midden deposit, and therefore that there is no discernible tendency for the two types to be vertically separated. By elimination, this leaves the third situation, and of course, it is this latter alternative which is embodied in the model of limpet scoop discard. In fact, when viewed in section, there are places where patches of one type or the other can be detected -- Lane H (Fig. 112) contains several discernible clumps of either A.L.S. or S.L.S.

Thus, it may be concluded that the indicated segregation of A.L.S. and S.L.S. in the midden does indeed support the proposed model of limpet scoop discard. And as a final comment, it may be noted that we should expect that Cnoc Coig is not unique in this regard -- if other Obanian shell middens on Oronsay were also subjected to large-scale areal excavation, analysis of the distribution of A.L.S. and S.L.S. in them should also reveal significant segregation for the same reasons that pertain to Cnoc Coig.

Related Stone Artifacts

As was discussed in detail in Chapter 4, in addition to S.L.S., a number of other types of elongated beach pebble artifacts were found in Cnoc Coig. Firstly, there are six S.L.H. which are large elongated pebbles that have one end flaked and roughly bevelled in the characteristic manner. Secondly, there are nine pebbles which had been flaked on their ends for use as limpet scoops but which were discarded or lost before they had been sufficiently used to cause any noticeable signs of wear. In short, these are unused stone limpet scoops (U.S.L.S.). Finally, there are 157 elongated beach pebbles which are not modified in any way nor show any signs of having been used. Because of the similarity in form and size to S.L.S., these artifacts are interpreted to represent excess raw material which had been collected from storm beaches for use as S.L.S. Having said this however, included in this total of 157 P.S.L.S. are 18 large pebbles (i.e. greater than 99 mm in length) which may have been collected either for use as limpet scoops or as limpet hammers and which, therefore, are more properly regarded as P.S.L.S./H.

Expected Distributions

Aside from all being elongated beach pebbles, these four types of artifacts have one feature in common which pertains to our expectations regarding their distributions in the midden -- that is, all of these artifacts were still potentially usable. Whereas limpet scoops were discarded (being dumped along with limpet shells) because they were worn out beyond further possible use, these other elongated pebble artifacts may be thought to have entered the archaeological record by different cultural formation processes because they were still usable -- rather than being discarded as such (by dumping, dropping or tossing), these items may be presumed to have been either abandoned, in which case they would constitute "de facto refuse" in Schiffer's (1972a: 160; 1976: 33) terms, or perhaps lost in some instances. If they can generally be regarded as de facto refuse, then the most likely disposal modes (Binford 1978a: 344-348) employed for these objects would be either resting or positioning.

Positioning, or placing, is defined by Binford as follows:

> An item was identified as positioned if there was some attempt to (a) aggregate several, (b) unobtrusively place them so they would not interfere with ongoing activities at the location, and (c) insure their easy retrieval at some future date. Formally this is a difficult category because there is an assumed motive -- the temporary placement of an item or items in anticipation of future use. This is what the archaeologist would call caching, although some of these "caches" may be very short term (1978a: 346).

Because of their relatively large numbers, this mode of disposal would be most appropriate for P.S.L.S. and perhaps also for P.S.L.S./H. We may suggest that, during an occupation when S.L.S. were being used and so P.S.L.S. were being collected, several P.S.L.S. would be cached together in a convenient place to be retrieved whenever a new S.L.S. was needed. Thus, since the P.S.L.S. found in the midden may be regarded as the unused remnants of such caches, we might expect that these artifacts would mostly occur in groups rather than individually scattered around the site, and that these groups would be very compact clusters. Furthermore, we might suggest that a likely location for P.S.L.S. caches, and hence for any archaeologically observable clusters of P.S.L.S., would be on the edge of hearths, if we assume that limpet processing was normally carried out around hearths. Such a location would certainly facilitate easy retrieval of P.S.L.S. whenever one was required, and, because of their relatively small size, small caches of P.S.L.S. at such locations would presumably be unobtrusive and would not interfere with other activities being conducted around hearths. Of course, it is entirely possible that other locations somewhat more peripheral to hearth-centred activity areas might also be anticipated places where P.S.L.S. were cached. However, in either case, we would not expect to find groups of P.S.L.S. distantly removed from hearths in shell dumps since such locations would not be particularly convenient for their easy retrieval.

Because of the relatively small number of U.S.L.S. and S.L.H., resting rather than positioning would be the more appropriate suggested disposal mode for these objects. Of course, like positioning, resting is a manipulative act that, despite occurring very frequently, only rarely results in an item becoming part of the archaeological record because it intrinsically involves the temporary placement of an object with the expected intention of its future use (Binford 1978a: 347). Presumably, before wearing out and being discarded, S.L.S. were frequently rested in a convenient spot and later retrieved. Similarly, S.L.H. were presumably often returned to the midden after a limpet collecting episode and rested in a convenient spot before they eventually broke in use and were discarded at a limpet collecting locality. The paucity of these two types of artifacts in the site thus reflects the fact that rested S.L.S. and S.L.H. were only very infrequently not later retrieved. Because of this, we should expect that U.S.L.S. and S.L.H. would not be found as small clusters, but rather as isolated specimens scattered throughout the midden. As with P.S.L.S., we might also expect that the locations of these artifacts would be in the vicinity of hearths and not distantly removed from them in shell dumping areas.

In summary, this model of the cultural formation processes which are responsible for the archaeological occurrence of these four types of elongated beach pebble artifacts involves the following expectations regarding their spatial distribution in the midden:

(A) P.S.L.S., together with P.S.L.S./H., should generally be found in compact clusters, although these clusters may only contain as few as two or three specimens;
(B) U.S.L.S. should be found as isolated specimens scattered around the midden;
(C) S.L.H. should also be found as isolated and scattered specimens;
(D) the clusters of P.S.L.S. should not be located in shell dump areas distantly removed from any hearths, but rather, they should occur in the vicinity of hearths, perhaps even right at their edges, which may be judged to be prime locations for the convenient retrieval of cached P.S.L.S.;
(E) for the same reason, U.S.L.S. should also be located in the vicinity of hearths;
(F) and likewise for S.L.H.

Observed Distributions

We may test whether these six expectations are confirmed by examining a variety of horizontal and vertical plots which show the distribution of these four artifact types within the midden, particularly in relation to the locations of hearths. To begin with, Figure 114 is a depth-compressed horizontal plot showing the distribution of all P.S.L.S. and P.S.L.S./H. in the site, while the distribution of all U.S.L.S. and S.L.H. are plotted in Figure 115. Figures 116 to 121 are a series of depth-selective horizontal plots which show the distribution of all four types of elongated pebble artifacts in units of 10 cm each; the locations of hearths are also shown. These plots range from Levels 7 and 8 (Fig. 116) through to Levels 17 and 18 (Fig. 121) -- only these levels are shown because all U.S.L.S., all but one S.L.H., and the vast majority (89.8%) of P.S.L.S. and P.S.L.S./H. occur in Levels 7 to 18. Finally, Figures 122 to 127 show the occurrence of S.L.H., U.S.L.S., P.S.L.S. and P.S.L.S./H. in Lanes 4, 5, 6, 7, H and I respectively; once again, the locations of hearths are also shown on these plots.

P.S.L.S. and P.S.L.S./H. Turning our attention first of all to expectation A, it can be seen from Figure 114 that the distribution of P.S.L.S. does overall appear clustered. Nevertheless, although there are some very compact clusters which may represent caches, the majority of these artifacts occur either as loose clusters or as isolated specimens. Thus, solely on the basis of Figure 114, expectation A does not appear to be very well substantiated. Moreover, because such depth-compressed horizontal plots do not necessarily provide an accurate indication of the presence of clusters, the few compact clusters and loose scatters of P.S.L.S. apparent in Figure 114 could simply be a product of the compressed nature of such a plot.

In order to deal with this, depth-selective horizontal plots (Figs. 116-121) and vertical plots (Figs. 122-127) may be used to determine if apparent groupings do in fact have depositional integrity. It can be seen from these various plots that some of the apparent groupings in Figure 114 are actually spread throughout several levels of midden deposit and thus do not have depositional integrity. Indeed, a majority of these artifacts occur as isolated specimens scattered throughout the site. Nonetheless, some depositionally meaningful groupings of P.S.L.S. can be identified. Most of these groups are quite small but, more importantly, most are loose clusters or scatters rather than compact clusters. In fact, there are only four compact clusters which might be interpreted as the remnants of caches left as de facto refuse: a very compact group of five P.S.L.S. in Levels 11 and 12 (Fig. 118); a group of three in Level 14 (Fig. 119; see also Lane 4 = Fig. 122); a pair of P.S.L.S. in Level 19 (see Lane 4 = Fig. 122); and a group of three in Level 24. The other depositionally meaningful groupings of P.S.L.S. are much looser clusters or scatters which could not be said to have resulted from positioning; rather, they appear to be groups which were generated as a result of dumping or perhaps dropping. The most notable example of these loose clusters is a group consisting of six P.S.L.S. (plus two U.S.L.S. and a S.L.H.)

in the southern end of Lanes H and I (Figs. 126 & 127); when viewed horizontally, this group occurs from Levels 8 through 11 (Figs. 116-118). Another notable loose cluster comprises eight P.S.L.S. in the western area of Lanes 6 and 7 (Figs. 124 & 125; see also Levels 12 to 14 = Figs. 118 & 119). On balance then, the distribution of P.S.L.S. in Cnoc Coig cannot be characterized as clustered overall and, of the groupings that can be defined, only four are compact clusters. Thus, expectation A has essentially not been substantiated.

Regarding the spatial relationships between P.S.L.S. and hearths (expectation D), it may be noted that, although none of the four compact clusters occur right at the edge of a hearth, all are relatively close to one, being at most 1.75 m from the centre of the nearest stratigraphically associated hearth. Likewise, the loose clusters also tend to be scattered in the general vicinity of hearths, including the two most notable ones mentioned above. In addition, the distribution plots show that many of the isolated specimens scattered around the site also occur close to hearths. As described above (pp. 204-206), we may characterize the spatial relationship between P.S.L.S. and hearths by determining the distance to the centre of the stratigraphically associated hearth nearest to each P.S.L.S. Figure 23 (top histogram) shows the distribution of these distances. We may note that 51 P.S.L.S. (36.7%) occur within 1.0 m of hearth, 94 (67.6%) within 1.5 m, and fully 119 (85.6%) within 2.0 m. Therefore, although very few of these artifacts lie right on the edge of a hearth, the majority of them are quite near a hearth (within 1.5 or 2.0 m) and only a small minority are more distantly removed (beyond 2.0 m). In comparison with other classes of artifacts which will be discussed later, these data do indeed suggest that generally P.S.L.S. are relatively well associated with hearths. Thus, expectation D appears to be quite well substantiated.

The large P.S.L.S./H. reveal a very similar pattern of distribution to P.S.L.S. The majority of them occur as

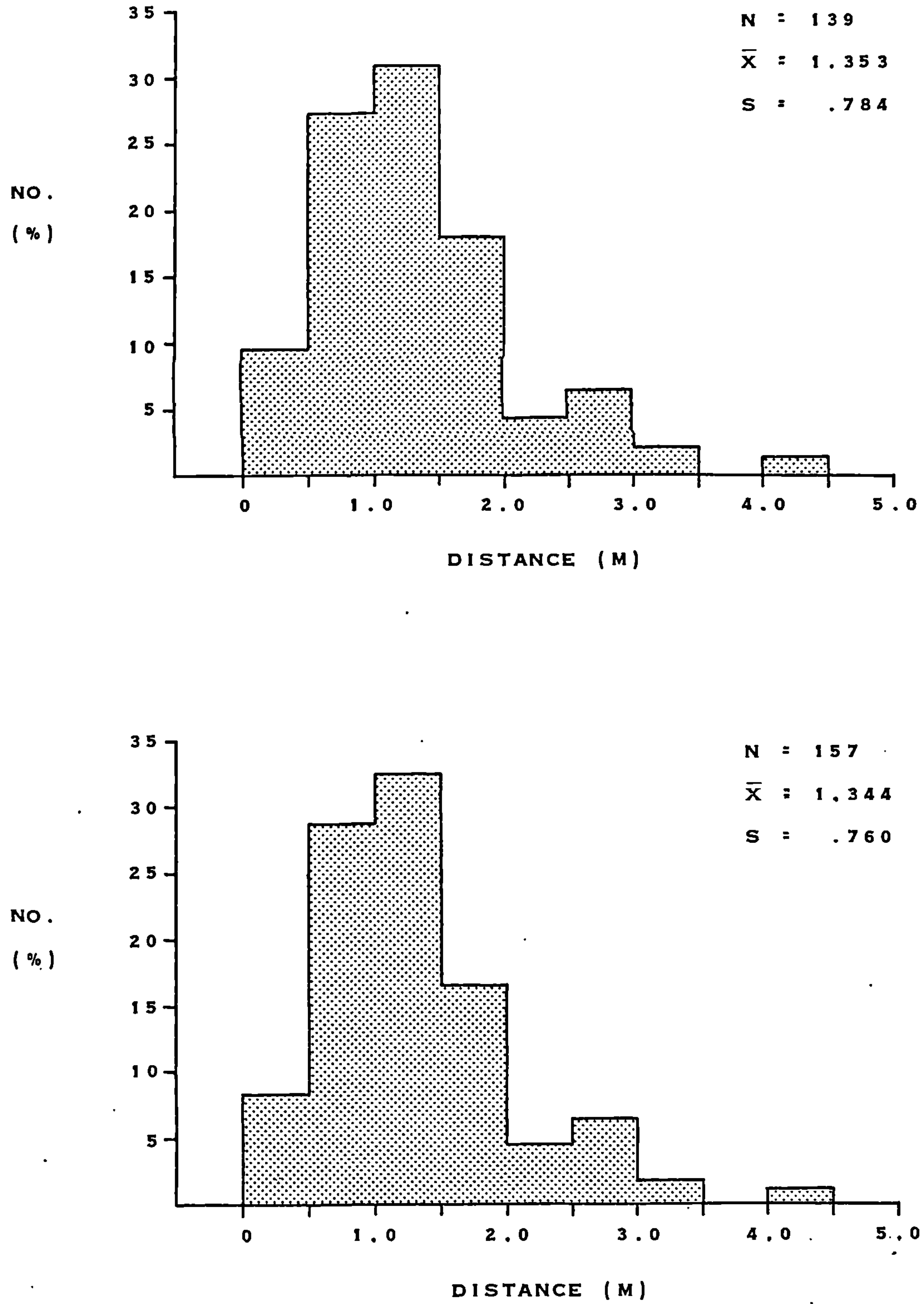

Figure 23. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Potential Stone Limpet Scoops (top) and for Potential Stone Limpet Scoops Together with Potential Stone Limpet Scoops/Hammers (bottom).

isolated items scattered around the site. However, in Levels 12 (Fig. 118) and 14 (Fig. 119), there are two pairs of associated P.S.L.S./H., each of which has a third specimen located nearby. As well, both of these groupings are found in quite close proximity to a hearth, being less than 1.0 m away. In fact, in terms of their spatial association with hearths as measured by the distances to the centre of their nearest hearths, P.S.L.S./H. are very similar to P.S.L.S. As with P.S.L.S., although no P.S.L.S./H. occurs right on the edge of a hearth, most are quite near a hearth -- 7 of them (38.9%) are within 1.0 m and all but two (88.9%) are within 2.0 m. And the summary statistics for these two sets of data, shown in Table 32, demonstrate that the two distributions are very similar[1], except for the fact that the range of distances for P.S.L.S. is greater (i.e. no P.S.L.S./H. occurs beyond 3.0 m away from a hearth). Thus, despite the formal differences used to distinguish between the two groups, the spatial distributions of P.S.L.S. and P.S.L.S./H. are sufficiently alike in all regards to consider these two categories of elongated beach pebbles as a single population. Hence, Figure 23 (bottom histogram) shows the distribution of distances to hearths for this combined data set -- not surprisingly, the inclusion of P.S.L.S./H. with P.S.L.S. has almost no effect on the shape of the histogram or the mean distance to the nearest hearth.

U.S.L.S. and S.L.H. It can be seen from Figure 115 that both U.S.L.S. and S.L.H. are indeed widely scattered around the site as expected, except for a pair of U.S.L.S. and a S.L.H. in the southern area of Lane H which occur close together and in association with the loose cluster of P.S.L.S. noted above. However, this general lack of clustering in itself is not necessarily a strong indication that these items can be interpreted as rested de facto refuse -- with so few of these artifacts having been

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[1] A t-test demonstrates that the difference between these two distributions is not significant. This t-test yielded a t value of 0.41 which, with 155 degrees of freedom, is not significant at the 5% or 1% levels.

Table 32. Summary of the Distances (in metres) to the Centre of the Nearest Stratigraphically Related Hearths for Four Types of Elongated Pebble Tools.

Type	No.	Mean	St. Dev.	Min.	Max.
P.S.L.S.	139	1.353	.784	.081	4.417
P.S.L.S./H.	18	1.275	.556	.703	2.779
U.S.L.S.	9	1.363	.767	.224	2.846
S.L.H.	6	1.338	.816	.338	2.674

deposited in the midden, this observed scattered distribution might well have resulted from different discard processes, such as the tossing of items unwanted for further use. In other words, although expectations B and C might be seen to be confirmed, it is expectations E and F which presumably would provide stronger evidence that these artifacts were indeed rested de facto refuse.

If we examine the distribution of U.S.L.S. and S.L.H. in relation to the locations of hearths, it can be seen from the distribution plots that three of these items occur more or less right on the edge of a hearth -- a U.S.L.S. in Level 15 (Fig. 120; see also Lane 5 = Fig. 123), a S.L.H. in Level 14 (Fig. 119; see also Lane 4 = Fig. 122), and another S.L.H. in Level 15 (see Lane I = Fig. 127). The remainder of these artifacts are also found in quite close proximity to hearths. Overall, 12 of the 15 U.S.L.S. and S.L.H. (80.0%) occur within 2.0 m of a hearth and 11 of them (73.3%) within 1.5 m, with only three (two U.S.L.S. and one S.L.H.) beyond 2.0 m and none beyond 3.0 m. The summary statistics for these two classes of beach pebble artifacts are shown in Table 32. From this, it can be seen that they are very similar to P.S.L.S./H. and even to P.S.L.S., except for the fact that the latter have a much greater range of distances due to five specimens which occur beyond 3.0 m from a hearth. It may therefore be concluded that the U.S.L.S. and S.L.H. in Cnoc Coig are generally found in close proximity to hearths, thereby confirming expectations E and F.

Summary and Conclusions

We have just seen that, except for three of the 15 U.S.L.S. and S.L.H. and 22 of the 157 P.S.L.S. and P.S.L.S./H., all of these elongated pebble artifacts occur within 2.0 m from the centre of their nearest stratigraphically associated hearths, and the majority of these are in fact within 1.5 m. In comparison with other classes of artifacts from Cnoc Coig which are discussed below, these data strongly suggest that all four categories of these elongated beach pebbles generally are indeed well associated spatially with hearths. Thus, expectations D, E and F have been substantially confirmed.

Likewise, expectations B and C have been confirmed, since U.S.L.S. and S.L.H. occur as isolated specimens scattered around the site, except for a pair of U.S.L.S. in Lane H. Consequently, it is not unreasonable to conclude that most of the U.S.L.S. and S.L.H. in the midden can be interpreted as rested items which were abandoned as de facto refuse, although a minority of these artifacts -- such as the U.S.L.S. in Lane F/G and the S.L.H. at the extreme western side of the site in Lane 7 -- would seem to be referrable to processes of purposeful discard rather than abandonment.

Can the same cultural formation processes be attributed to P.S.L.S. and P.S.L.S./H.? The answer is essentially "no". Or more accurately, it would seem that the reverse is true -- that is, a minority of P.S.L.S. and P.S.L.S./H. might be interpreted as de facto refuse, but it would be very difficult to extend this interpretation to the majority of these artifacts. This is because expectation A has essentially not been substantiated. We have seen that there are a few compact clusters of P.S.L.S. and two pairs of P.S.L.S./H. which occur quite close to hearths, thus conforming to expectations A and D, and which might therefore be interpreted as the remnants of positioned caches which were abandoned as de facto refuse. However, there are only four such clusters of P.S.L.S. and these contain only 13 (9.4%) of all these artifacts found in situ. Many other P.S.L.S. also occur in small groups, but these are loose scatters rather than compact clusters which in no way could be interpreted as positioned caches. Moreover, a fairly large number of P.S.L.S. occur as isolated specimens scattered around the site, and the same applies to the majority of P.S.L.S./H. Of course, it would not be possible to distinguish between individual items which might be the remnants of positioned caches and those which were purposefully discarded by other disposal modes (such as dropping or tossing), since positioning is identified by the presence of compact clusters. Yet, it would be stretching the point to absurd extremes to suggest that so many P.S.L.S. and P.S.L.S./H. could represent single items which were the remnants of positioned caches. And it seems scarcely more tenable to suggest that all of these single items were rested and then abandoned as de facto refuse, although a few specimens might be interpreted in these terms.

Thus, if only a small minority of these artifacts appear to be referrable to processes of abandonment (by positioning or resting), then to what discard processes can the remaining 90% of P.S.L.S. and most P.S.L.S./H. be attributed? For the 22 P.S.L.S. and P.S.L.S./H. which are scattered around the midden beyond 2.0 m from a hearth, it might be suggested that tossing is the most likely disposal mode responsible for their distribution. On the other hand, some of the loose scatters (especially the two most notable ones mentioned above) have the appearance of dumped refuse, even though both of the most notable ones occur quite near a hearth. Given this latter observation, it is also possible that dropping might have been the mode of disposal employed in their discard. In either case, the many isolated specimens scattered around hearths might be most reasonably interpreted as refuse which had been dropped in hearth-centred activity areas, although resting perhaps might also be involved with at least a few of these items.

In any event, it would seem that the majority of P.S.L.S. and P.S.L.S./H. had been purposefully discarded (either by tossing, dumping or dropping), and we may ask why this should be so for these still usable artifacts. The reason may relate to the fact that one feature of these elongated pebble artifacts was overemphasized in the initial expectations, while another one was not sufficiently taken into account. Central to the expectations outlined above is the fact that all of these artifacts were still potentially usable. Yet, an equally important feature is the fact that elongated beach pebbles are a raw material which was locally available in abundance, so much so that the amount of effort involved in their procurement would be negligible (see Appendix B). As a consequence, it is perhaps misleading to suggest that this raw material would have been conserved with the degree of parsimony implied in the initial expectations. Thus, it seems quite likely that many P.S.L.S., which had been brought to the midden (during a period when antler was not available and S.L.S. were being used) but which were never used (if a supply of antler became available), might simply have been discarded out of the way whenever they were no longer required for the moment, rather than being cached for future, perhaps long-term use.

Other P.S.L.S. and P.S.L.S./H. may have been discarded for different reasons. During a period of S.L.S. use, we may presume that not all elongated beach pebbles which had been collected and brought to the midden were equally suitable for use as S.L.S. Some may have been deemed less suitable, perhaps because the pebble was not an easily flaked mudstone, or perhaps because its end was too wide or too thick to be an effective S.L.S. Whenever such pebbles were encountered in a collection of P.S.L.S., they may simply have been discarded (by tossing or dropping) as unsuitable raw material. This might account for many of the isolated specimens scattered around the site. Of course, this idea could be tested by a thorough comparative study of the assemblage of P.S.L.S. and S.L.S. from Cnoc Coig. A metrical analysis might be expected to show that some P.S.L.S., particularly the isolated specimens, were in some attribute (such as the width or thickness of the end) deviant from those which had been used as S.L.S., while a petrological analysis of the hardness or the fracturing properties of different types of elongated beach pebbles might reveal differences between S.L.S. and some discarded P.S.L.S. In the absence of such a study however, this can only be mentioned as a possible future line of inquiry.

We may conclude that various disposal modes are responsible for the pattern of distribution of these four types of elongated beach pebble artifacts in Cnoc Coig. The majority of U.S.L.S. and S.L.H., and a minority of P.S.L.S. and P.S.L.S./H., may be interpreted as abandoned de facto refuse, either as rested items or in the form of positioned caches. On the other hand, the majority of P.S.L.S. and P.S.L.S./H., as well as a few U.S.L.S. and S.L.H., seem to be referrable to processes of discard rather than abandonment. Some of the loose scatters of P.S.L.S. might be attributed to dumping or perhaps dropping, while the many scattered specimens might be ascribed primarily to dropping and secondarily to tossing. Covering all these cases of abandonment and discard, the large quantity of still potentially usable elongated pebbles found in Cnoc Coig must to a large extent be seen to reflect the fact that such a locally abundant and available raw material was not highly conserved or treated with the same degree of frugality as a more desirable but less available raw material such as antler.

CHAPTER 9

SPATIAL ANALYSIS: PITTED PEBBLES AND SHELLS

It has just been seen that P.S.L.S. cannot in general be interpreted to be abandoned de facto refuse, as was expected. Nevertheless, there are a number of other types of artifacts which, for similar reasons, might also be expected to have been abandoned as de facto refuse rather than discarded. These include the 49 in situ pitted pebbles and the in situ utilitarian shells -- the 207 pecten, 21 cyprina and 14 prickly cockle shells. As a point of contrast, we may also consider the remains of the only food mollusc which were recorded in situ, namely, the 92 oyster shells.

Expected Distributions

The 49 pitted pebbles consist of hammerstones, hammer/anvilstones and anvilstones which are interpreted to be multi-purpose tools used in a wide variety of tasks -- the edges of the pebbles being used for hammering and pounding a variety of objects and materials, and the anvilstone faces of the pebbles providing a hard surface on which various breaking, crushing or cutting tasks were carried out. The utilitarian shells are interpreted to be multi-purpose containers, scoops and ladles. Because of the multi-purpose nature of all of these tools, we might expect that these objects were continuously in use during an occupation of the site and were only discarded when they broke, which would particularly apply to the utilitarian shells -- in short, that they were tools with relatively long uselives.

In effect, these objects may be seen to have most of the properties of what Binford (1978a: 339-340; 1979b: 263-264) has called "site furniture", that is, the site-specific hardware that "goes with the place" and is available for use by any occupant whenever needed. In terms of the site furniture which Binford recognizes at the Mask Site, the stone anvils and kaotah would be the most analogous items to the pitted pebbles and utilitarian shells found in Cnoc Coig. Similarly, these artifacts in Cnoc Coig may be seen to conform to Gould's (1980: 71-72) concept of "appliances", that is, tools which are left in a convenient location to be used whenever needed. However, Gould's term connotes long-term use over several occupational episodes, as indeed does Binford's notion of site furniture in at least some instances, and this aspect of appliances <u>may</u> not be appropriate for all of these Obanian artifacts.

In any case, given this view of these artifacts, it follows that, upon the termination of an episode of use, resting would have been the disposal mode employed -- that is, the object would have been returned to some convenient location from where it could be readily retrieved when later required. Consequently, we may anticipate that such rested items entered the archaeological record primarily through processes of abandonment (as de facto refuse) rather than discard. This would apply most particularly to pitted pebbles and the complete pecten, cyprina and prickly cockle shells. On the other hand, because they were broken and no longer serviceable, we may expect that incomplete utilitarian shells were discarded by either dumping or tossing and hence, that they should reveal a different pattern of distribution. Likewise, because they represent food refuse, oyster shells may be expected to have been discarded, by dumping most probably, and the nature of their distribution should contrast with that of the whole utilitarian shells.

If these assumptions and arguments are valid, we may propose a number of expectations regarding the spatial distribution of these various remains in Cnoc Coig. First of all, since the oyster is interpreted to have been a food resource, it is reasonable to presume that oysters were procured and processed in batches rather than individually, and that their shells were discarded in an analogous fashion to other shellfish refuse. Consequently, we may suggest that dumping was the primary disposal mode for this refuse, so that we should expect that the *in situ* oyster shells will reveal a strongly clustered pattern. Since this mode of disposal has been attributed to much of the mammal bone assemblage, the pattern of distribution of oyster shells should be very similar to that observed for the mammalian remains within the site.

In contrast, if most pitted pebbles were not discarded as such, but rather abandoned as de facto refuse, we should expect that these items will not have a clustered distribution, but rather, that they will be found spread around the midden in a much more dispersed pattern. Nevertheless, since there were presumably some tasks which required using a hammerstone in conjunction with an anvil-stone, we might anticipate occasionally finding a pair of of pitted pebbles which had been rested together. With regards to the specific locations for rested pitted pebbles, if we assume that these items were most often used in hearth-centred activity areas, we might suggest that they would be found in the vicinity of hearths, and perhaps even right on the edges of hearths, which might be judged to be the prime locations facilitating easy retrieval. Of course, a few pitted pebbles may have been discarded and so may be less well associated with hearths, but in general, we should expect that this would be the exception.

Likewise, we may expect that prickly cockle shells and complete cyprinas and pectens will be scattered throughout the midden and will not have a clustered distribution. Thus, the pattern of distribution of these utilitarian shells should be in marked contrast to that of oyster shells which are interpreted to be dumped food refuse. It is possible that some small groupings of utilitarian shells in the form of loose scatters may be found since we might expect that on occasion several of these shells were rested in the same general area of the site, but, despite this, the overall pattern of distribution of complete utilitarian shells should *not* be clustered. Once again, we may suggest that the likely locations for resting these artifacts would be in the vicinity of hearths, so that they would not be found in dumping areas more distantly removed from hearths.

On the other hand, it may be suggested that broken or incomplete cyprina and pecten shells would have been purposefully discarded since upon breaking they would no longer have been of any use. We may further suggest that tossing and possibly also dumping would have been the disposal modes employed in the discard of these items. In either case, we can expect a dispersed pattern of distribution because presumably utilitarian shells would not have been broken in quantity at one point in time, so that, even if they were dumped (along with other kinds of refuse) instead of being tossed, only one or two of these shells would typically have been discarded in particular dumping episodes. Thus, unlike dumped food refuse such as oyster shells, the dumping of broken utilitarian shells would generally not result in clusters of several items found together; instead, their pattern of distribution would be very much like that of complete utilitarian shells despite the fact that they are attributed to different cultural formation processes. However, the difference between broken and complete utilitarian shells is that, whereas the latter were predicted to be found in the general vicinity of hearths, we should expect that the former would occur in dumping areas more distantly removed from hearths.

If there is a meaningful tendency for complete utilitarian shells to occur in the vicinity of hearths and for broken shells to occur further away from hearths, then we may further anticipate that complete and incomplete utilitarian shells should statistically be significantly segregated from each other -- that is, there should be a definite tendency for shells of these two categories to have as their nearest neighbours shells of the same category. We may test whether this expectation is met by using the coefficient of segregation. Because of the very small sample size, the cyprina shells on their own are not an adequate data set to use for this purpose, and the same applies to the flat valve pecten shells. However, the convex valve pecten shells provide a large sample size on which the coefficient of segregation may be run, and of course, the total assemblage of pecten shells would also be an adequate data set.

We may summarize the preceding arguments regarding the spatial distributions of these various artifacts into the following expectations:

(A) oyster shells as dumped food refuse will reveal a strongly clustered pattern of distribution;

(B) pitted pebbles will not be clustered but rather will be widely dispersed around the site, although a few associated pairs of pitted pebbles may occasionally be found;

(C) pitted pebbles will generally be found in the vicinity of hearths, and some may even occur right on the edges of hearths which may be judged to be prime resting locations;

(D) prickly cockle shells will be scattered around the site and will not have a clustered distribution;

(E) and likewise for complete cyprina shells;

(F) and also for complete pecten shells, both flat and convex valves, although a few small loose clusters may be anticipated;

(G) prickly cockle shells will generally occur in the immediate vicinity of hearths rather than being more distantly removed from hearths;

(H) and likewise for complete cyprina shells;

(I) and also for complete pecten shells;

(J) broken or incomplete cyprina shells will reveal a dispersed pattern of distribution;

(K) as will incomplete pecten shells, although a few small clusters may be found where several broken shells were discarded together;

(L) incomplete cyprina shells will be less well associated with hearths than will complete shells;

(M) and likewise for incomplete pecten shells;

(N) if expectations H, I, L and M are valid, then complete and incomplete utilitarian shells should overall be significantly segregated from each other.

Observed Distributions

Oyster Shells

The distribution of all *in situ* oyster shells in Cnoc Coig is shown in Figure 128. From this depth-compressed horizontal plot, it can be readily seen that oysters do exhibit a marked clustering tendency as expected. Although about one-third of them occur as isolated specimens scattered around the site, the majority clearly occur in small, well-defined groupings.

Of course, we must investigate the possibility that these clusters are merely a by-product of the compressed nature of the plot shown as Figure 128. This can be achieved by using a series of depth-selective horizontal plots in conjunction with various sectional plots. For purposes of illustration, three of the more informative sectional plots are included as Figures 129 to 131 which show the occurrence of oyster shells in Lane 10, Lanes 14 and 15, and the central portion of Lane H respectively. It can be seen from these plots that in a few cases one or two shells do not depositionally belong to a nearby cluster, while in two cases (e.g. see Fig. 131) an apparent cluster is in fact shown to consist of stratigraphically separate groupings. Despite these few exceptions however, it is abundantly clear that virtually all of the apparent groups have depositional integrity and are not merely by-products of the compressed nature of the plot shown as Figure 128.

Thus, it may be concluded that expectation A is confirmed, and that the nature of the distribution of oyster shells conforms very well to the notion that these remains represent dumped food refuse. It was suggested above that, if this were the case, then the pattern of distribution of oysters should be very similar to that of the mammal bones in the site. If the various depth-compressed horizontal plots and sectional plots are compared (e.g. cf. Fig. 128 with Figs. 41, 60, 62 & 63), it can be seen that oyster shells do indeed reveal a very similar pattern of distribution to that of the bones of most mammal species, and this similarity must lend confidence to our ability to identify refuse that results from dumping.

One final comment should be made regarding the oyster remains in Cnoc Coig. The several well-defined clusters mostly consist of between two and four shells, with the largest group containing merely ten shells -- obviously, the amount of food that these clusters represent is virtually negligible! Of course, it should be recalled that the remains of oyster which were recorded in situ represent only the largest and most conspicuous shell fragments and, therefore, that the amount of food obtained from oysters during individual collecting episodes may have been greater than is indicated by these clusters of in situ shells. Having said this however, due to the comparative robustness of oyster shell, the in situ remains must represent a relatively large proportion of oysters in the site. Consequently, it remains true that in comparison with limpets, and even dog whelks and periwinkles, oysters would have constituted only a very minor component of the shellfish resources exploited by the Mesolithic inhabitants of Cnoc Coig.

Pitted Pebbles

Figure 132 shows the distribution of all in situ pitted pebbles in the midden. From this depth-compressed plot, it can be seen that the pattern of distribution of these artifacts is dispersed rather than clustered, and the dispersed nature of pitted pebbles is even more apparent when the depth dimension is taken into account. Figures 133 to 140 are a series of depth-selective horizontal plots which show the distribution of pitted pebbles and hearths (along with prickly cockle and cyprina shells) in Levels 6 to 17, while Figures 141 to 146 are six vertical plots which show the distribution of these items in Lanes 4, 5, 6, 7, H and I respectively. Although there are a few loose groupings of two or three pitted pebbles shown in Figure 132, it can be seen from these other plots that most of these are vertically separated and, therefore, that these artifacts are even more dispersed throughout the midden than Figure 132 alone would suggest. Thus, expectation B would seem to be well substantiated.

Nevertheless, Figures 133 to 146 also show that there are four instances of a pair of pitted pebbles being found together, less than 50 cm apart -- one pair in Level 6 (Fig. 133; see also Lane H = Fig. 145), another in Level 10 (Fig. 134; see also Lane 6 = Fig. 143) with a third specimen nearby, a third pair in Level 12 (Fig. 136; see also Lane 7 = Fig. 144), and the fourth one in Level 13 (Fig. 137). Of course, these few cases do not contradict the observation that pitted pebbles overall reveal a dispersed pattern, and indeed, the occurrence of some associated pairs of these artifacts conforms precisely to what was anticipated. Therefore, it may be concluded that expectation B has been shown to be fully verified.

We may thus turn our attention to expectation C. From Figures 133 to 140, it may be observed that there are some pitted pebbles which are located right on the edge of a hearth, as was anticipated -- two in Level 11 (Fig. 135; see also Lane 5 = Fig. 142), one in Level 14 (Fig. 138; see also Lane H = Fig. 145), one in Level 15 with a hearth in Level 14 (see Lane 4 = Fig. 141), another in Level 15 with a hearth either just above in Level 14 or just below in Level 16 (see Lane 5 = Fig. 142), and three in Levels 16 and 17 (Fig. 140; see also Lane 4 = Fig. 141). Many other pitted pebbles also occur in the general vicinity of hearths, but others are found more distantly removed.

The overall spatial proximity of pitted pebbles to hearths may be assessed by determining the distances of pitted pebbles to the centre of the stratigraphically associated hearth nearest to each of them. The distribution of these distances is shown in Figure 24. It should be noted that two pitted pebbles are so far removed from any hearth that it is not really feasible to identify the one nearest to them, and consequently, they are not included in this analysis -- these two pitted pebbles are ones which actually lie below the midden deposits in Lane I (Fig. 146). The first observation to make from Figure 24 is that this distribution appears to be rather skewed towards lower values. For items whose deposition is not spatially influenced by the locations of hearths, one would expect a more or less normal distribution with some items occurring fairly close to hearths (say, within 1.0 m), then with increasingly more items at moderate distances and finally with numbers gradually falling off for increasingly larger distances. On the other hand, for items which are spatially well associated with hearths, one would expect a distribution which is skewed towards lower values, which is essentially what is found with pitted pebbles -- 15 or 31.9% of them are within 1.0 m, 24 or 51.1% are within 1.5 m, and 36 or 76.6% are within 2.0 m. Perhaps the most conspicuous feature about the histogram in Figure 24 is the sharp break in the distribution that occurs around 2.0 m. This feature would seem to indicate that there is some definite patterning in which at least the majority of pitted pebbles tend to be found in reasonably close proximity to hearths.

As a comparison, we may similarly examine the distribution of distances from the 92 oyster shells to the centre of the hearth nearest to each of them. These data are summarized graphically in Figure 25. It can immediately be seen that oyster shells occur further away from hearths than do pitted pebbles. Only 8.7% of them lie within 1.0 m of a hearth and only 22.8% within 1.5 m, which contrasts considerably with pitted pebbles which have 31.9% and 51.1% respectively within these distances. In fact, the vast majority of oysters, 71 or 77.2%, occur beyond 1.5 m and fully 48 or 52.2% lie beyond 2.0 m. Moreover, a t-test demonstrates that the difference between these two distributions is highly significant (see Table 34 below). This difference is certainly consistent with the attribution of different disposal modes to these remains -- namely, oysters being attributed to dumping and pitted pebbles primarily to resting followed by abandonment.

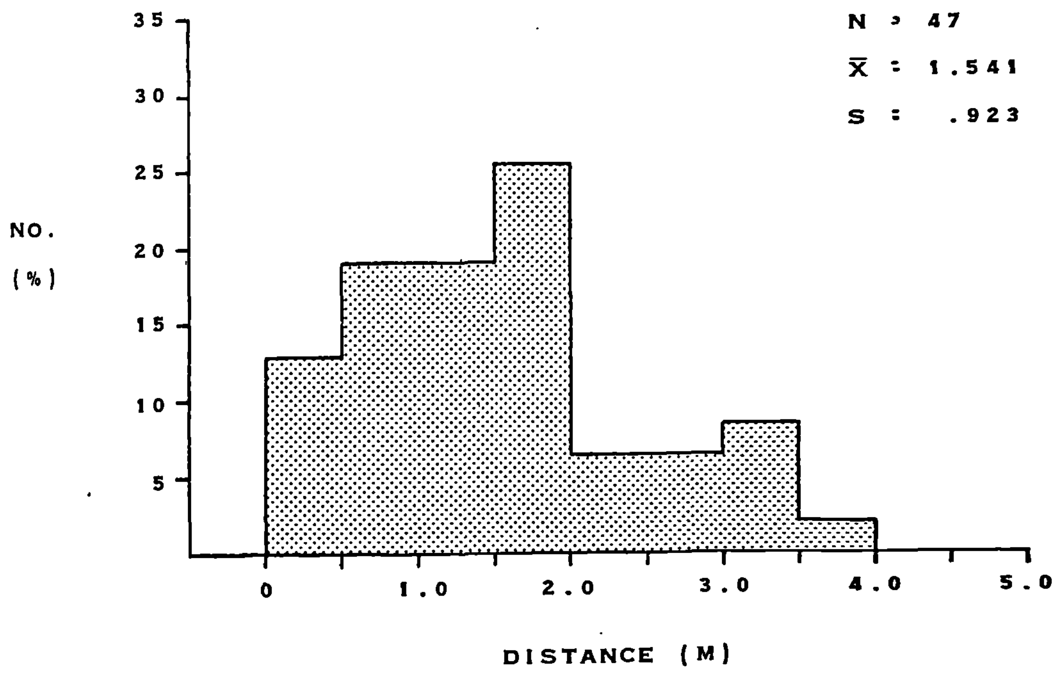


Figure 24. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Pitted Pebbles.

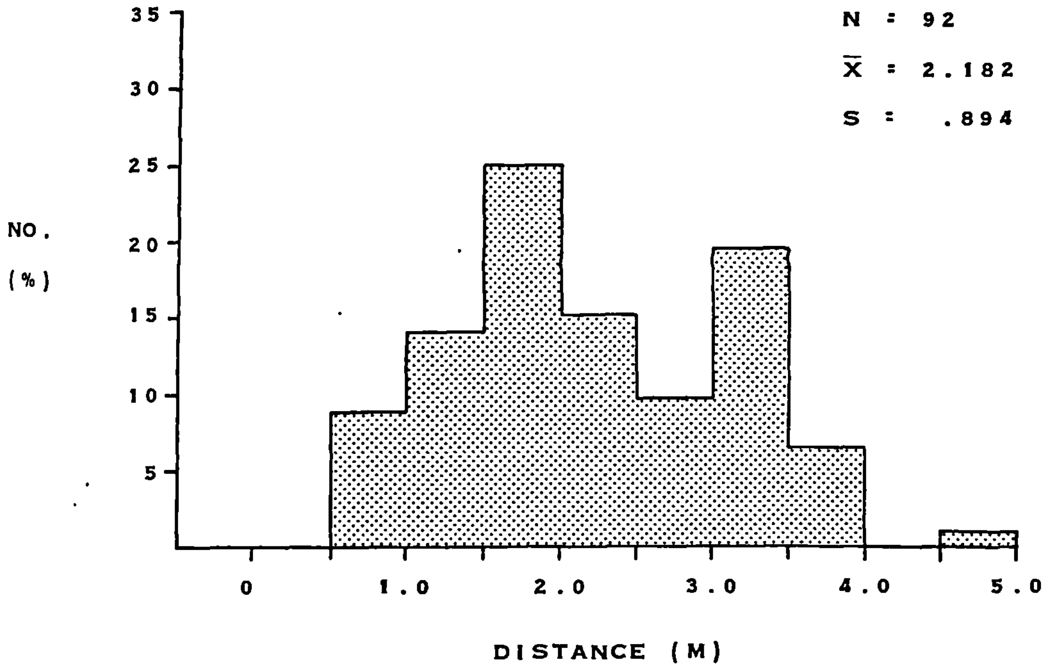


Figure 25. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Oyster Shells.

Therefore, this comparison with oyster shells supports the idea that there is a definite tendency for pitted pebbles to occur in relatively close proximity to hearths. The majority of these artifacts, particularly those which lie within 1.5 m of a hearth, may be regarded as items which were indeed rested and then abandoned as de facto refuse in hearth-centred activity areas -- in short, these items conform nicely to expectation C. But what about the rest of the pitted pebbles, particularly those which lie beyond 2.0 m from a hearth? Can they be attributed to the same cultural formation processes? It is of course possible that these pitted pebbles are also rested de facto refuse, but that they were used and then abandoned in activity loci further away from hearths than were the majority, since there is certainly no reason to think that all of these artifacts must have been used in locations within 1.5 or 2.0 m of a hearth. Alternatively, these pitted pebbles, or at least some of them, may represent items which, for whatever reasons, were purposefully discarded out of the way from hearth-centred activity areas. On spatial criteria alone, there is no possible way to distinguish between these two alternatives. In either case however, it is clear enough that many pitted pebbles can be interpreted as rested de facto refuse occurring in the vicinity of hearths, and therefore that expectation C is substantially verified, even though some of these artifacts may be interpreted in different terms since they clearly do not support expectation C.

Prickly Cockle and Cyprina Shells

The distribution of all in situ prickly cockle and cyprina shells is shown in Figure 147. From this depth-compressed plot, it can be seen that the pattern of distribution of these shells is dispersed rather than clustered, and that this pattern is in marked contrast to that of oyster shells which were interpreted to be food refuse. The scattered nature of these remains is even more apparent when differences in depth are also considered, as can be seen from the series of depth-selective horizontal plots

(Figs. 133-140) and the several sectional plots (Figs. 141-146). Except for one pair of prickly cockles in Level 14 (Fig. 138; see also Lane 4 = Fig. 141) and one pair of broken cyprina shells in Levels 12 and 13 (Figs. 136 & 137; see especially Lane 7 = Fig. 144), no possible groupings of either prickly cockle or cyprina shells can be defined. Thus, expectations D, E and J are well substantiated.

In order to determine if expectations G, H and L are also verified, the locations of these utilitarian shells in relation to hearths may now be examined. From the depth-selective horizontal plots and the sectional plots, it can be seen that many prickly cockle and cyprina shells do occur in close proximity to hearths, and that a few are even found right on the edge of a hearth. With regards to the distances to their nearest stratigraphically associated hearths, it may be noted that there are no strikingly obvious differences among these three categories of utilitarian shells. With all three, the vast majority of them are within 1.75 m of the centre of the nearest hearth -- 11 or 78.6% of the prickly cockles, 7 or 87.5% of the complete cyprina shells, and 11 or 84.6% of the broken cyprinas. Table 33 provides summary descriptive statistics of the distances of these utilitarian shells to the centre of the hearth nearest to each of them. It can be seen from this that all three types have very similar values for the mean distance to hearths, and that a series of t-tests comparing these three distributions demonstrates that none are significantly different from either of the others. Therefore, expectation L must be rejected since it is clear that broken cyprina shells are no less well associated with hearths than are complete cyprinas or prickly cockles.

Having established this however, the question remains whether or not these utilitarian shells are relatively well associated spatially with hearths. Although individually the sample sizes of these utilitarian shells are really too small to compare them with pitted pebbles and oyster shells, we may combine them in order to facilitate such comparisons. Figure 26 graphically displays the

Table 33. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Prickly Cockle and Cyprina Shells, with t-Tests Assessing the Significance of Observed Differences.

Type of Shell	No.	Mean	Std. Dev.	Min.	Max.
Prickly Cockle Shells	14	1.323	.858	.301	2.997
Complete Cyprina Shells	8	1.164	.567	.676	2.286
Broken Cyprina Shells	13	1.256	.855	.100	3.114

Types Compared	t Value	Degrees of Freedom	Significant at level: .05	Significant at level: .01
Prickly Cockles vs. Complete Cyprinas	0.47	20	no	no
Prickly Cockles vs. Broken Cyprinas	0.20	25	no	no
Complete Cyprinas vs. Broken Cyprinas	0.27	19	no	no

distances of these 35 utilitarian shells to the centres of their nearest hearths. We may observe that fully 16 or 45.7% of them are within 1.0 m of a hearth, while 22 or 62.9% are within 1.5 m and 29 or 82.9% are within 2.0 m. This contrasts considerably with oyster shells which have only 8.7%, 22.8% and 47.8% respectively within these distances (cf. Figs. 25 & 26). Not surprisingly therefore, their respective mean distances to hearths are considerably different and a t-test shows that the difference between the two distributions is highly significant (see Table 34). The fact that oysters are so different from prickly cockle and cyprina shells in terms of their spatial association with hearths is further support for the idea that the former are interpreted to be dumped food refuse whereas the latter are artifacts which can be attributed to different cultural formation processes.

In contrast, if we compare prickly cockle and cyprina shells with pitted pebbles (cf. Figs. 24 & 26), any observed differences are far less striking -- 45.7% of the former lie within 1.0 m of a hearth compared to 31.9% for the latter, and 82.9% of the former are within 2.0 m compared to 76.6% for pitted pebbles. There would thus seem to be only a slight tendency for prickly cockle and cyprina shells to occur closer to hearths than do pitted pebbles. Although this slight difference is reflected in their respective mean distances to hearths, a t-test demonstrates that the difference between these two distributions is not significant (see Table 34). Therefore, these two groups of artifacts are broadly similar in terms of their occurrence in relation to hearths, both having the large majority of specimens lying within 2.0 m of the nearest hearth, and this similarity is exactly what would be expected for two artifact categories which have both been interpreted to be rested de facto refuse.

Therefore, we may conclude that the large majority of prickly cockle and cyprina shells may be regarded as items which were rested and then abandoned as de facto refuse in hearth-centred activity areas. However, six of

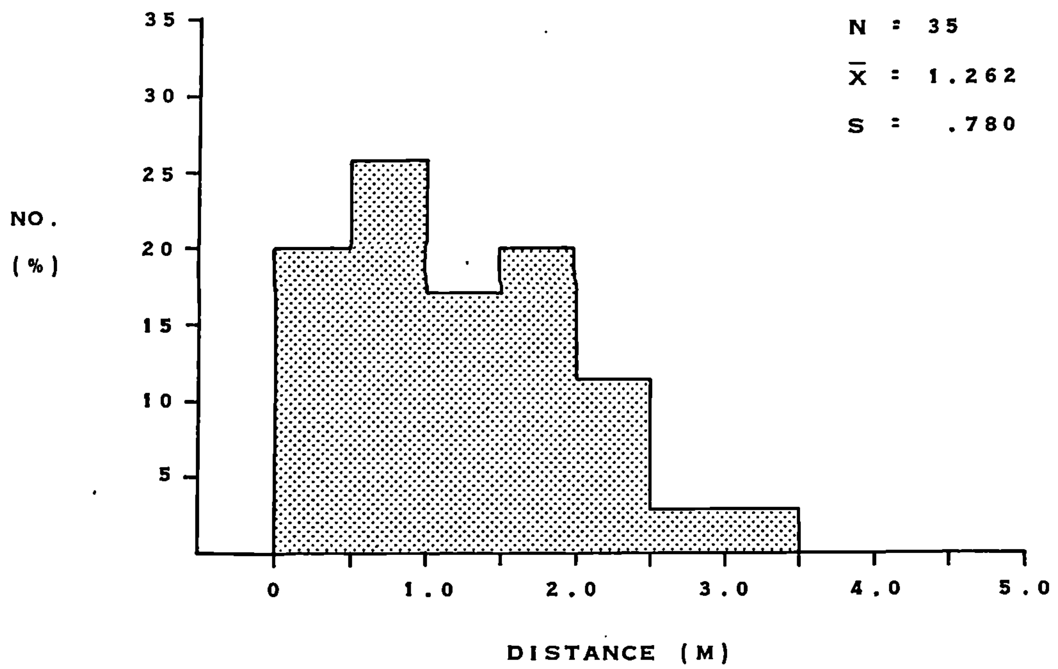


Figure 26. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Prickly Cockle and Cyprina Shells.

Table 34. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Pitted Pebbles and Four Types of Shells, with t-Tests Assessing the Significance of Observed Differences.

Type	No.	Mean	Std. Dev.	Min.	Max.
Pitted Pebbles	47	1.541	.923	.102	3.648
Oyster Shells	92	2.182	.894	.543	4.722
Prickly Cockle & Cyprina Shells	35	1.262	.780	.100	3.114
Pecten Shells	207	1.742	.930	.161	5.046

Types Compared	t Value	Degrees of Freedom	Significant at level: .05	.01
Pitted Pebbles vs. Oyster Shells	3.95	137	yes	yes
Pitted Pebbles vs. Prickly Cockle & Cyprina Shells	1.45	80	no	no
Oyster Shells vs. Prickly Cockle & Cyprina Shells	5.36	125	yes	yes
Pecten Shells vs. Prickly Cockle & Cyprina Shells	2.89	240	yes	yes
Pecten Shells vs. Pitted Pebbles	1.33	252	no	no
Pecten Shells vs. Oyster Shells	3.82	297	yes	yes

these shell artifacts (or 17.1%) are found much further away from hearths than are the rest; in fact, all of them are beyond 2.25 m from their nearest hearths. As with pitted pebbles, it is certainly possible that these few items are also rested de facto refuse, but that they were abandoned in locations further away from hearths than was the norm. Alternatively, these artifacts may represent items which were intentionally discarded away from the immediate vicinity of hearths, and this might be seen to be particularly appropriate for the two broken cyprina shells which might have been tossed aside once broken. However, once again, there is no possible way to distinguish between these two alternatives, but in either case, the fact remains that the large majority of prickly cockle and cyprina shells do occur in the vicinity of hearths and so may be interpreted as rested de facto refuse. Therefore, expectations G and H are on the whole confirmed, while expectation L must be rejected since there is no firm indication that incomplete cyprina shells are any less well associated spatially with hearths than are complete cyprinas or prickly cockles.

Pecten Shells

By far the most abundant utilitarian shells found at Cnoc Coig are the 207 in situ pecten shells, which have been classified into four types (see Table 15). The distribution of complete and broken flat valve pecten shells is shown in Figure 148, while that of complete and broken convex valve pectens is shown in Figure 149. Displayed differently, Figures 150 and 151 show respectively the distribution of complete and incomplete pecten shells of both valve types.

The Nature of Their Distribution. It can be seen from Figure 148 that flat valve pectens reveal a rather dispersed distribution, although there are some small groupings of a few associated shells. On the other hand, Figure 149 shows that the convex valve pecten shells appear to have a much more clustered distribution, although there are a fair number of these shells individually scattered around the site. When mixed together however, as in Figures 150 and 151, it can be seen that many of the seemingly isolated flat valve shells occur in small clusters or loose scatters which are predominately composed of the much more numerous convex shells. Overall therefore, the pattern of distribution of pecten shells in Cnoc Coig would appear to be more clustered than dispersed, in contradiction to expectations F and K.

However, these depth-compressed horizontal plots on their own do not necessarily provide an accurate indication of the tendency towards clustering, since many of the apparent groupings may simply be a by-product of the compressed nature of these plots. Figures 152 to 162 are a series of depth-selective horizontal plots which show the distribution of all four types of pecten shells in Levels 9 to 28. In addition, Figures 163 to 174 are vertical plots showing the distribution of pecten shells in Lanes 4 to 6, 10 to 14, H, I, L and M respectively. If these various plots are examined, it can be seen that pecten shells are overall less clustered and more dispersed than Figures 150 and 151 suggest. Many of the groupings apparent on the depth-compressed plots are in fact shown not to have depositional integrity, and many pecten shells are seen to be rather scattered throughout the midden deposits.

Nevertheless, there clearly are several depositionally meaningful clusters of pecten shells. The largest of these is a loose cluster with some associated scatter consisting of 12 complete and ten broken convex valve pecten shells, plus one complete flat valve shell. It occurs on or near the surface of the midden in the western one-third of Lanes 4 to 6 (Figs. 163-165); on the horizontal plots, the main core of this grouping appears in Levels 10 to 12 (Figs. 153-155). More will be said about this group later, but one conspicuous feature of it, which can be seen especially when viewed in section, is that it lies above the many hearths which occur in this area of the site, so that it is not spatially associated with them. Below this large grouping is a smaller, more compact cluster which is interspersed among the hearths. It consists of five broken and one complete convex valve pecten shells in Levels 14 and 15 (Figs. 157 & 158; see also Lanes 5 & 6 = Figs. 164 & 165). There are also a number of other convex valve pecten shells scattered around the hearths in this area of the site (see Levels 13 to 15 = Figs. 156-158).

Two other loose clusters of pecten shells occur in the north-central area of Lanes H and I (Figs. 171 & 172; see also Lanes 10 & 11 = Figs. 166 & 167). One grouping consists of six complete and three broken convex valve shells plus one complete flat valve, lying on a fairly flat surface in the lower part of the midden in Levels 12 to 14 (Figs. 155-157). Above it, in Levels 8 and 9 and sloping slightly westwards to Level 11 (see especially Level 9 = Fig. 152), is another loose cluster which comprises two complete and two broken convex valve pecten shells with one complete flat valve shell. A small number of other pecten shells further to the west might also be depositionally related to the uppermost of these two loose clusters (see especially Lane 11 = Fig. 167).

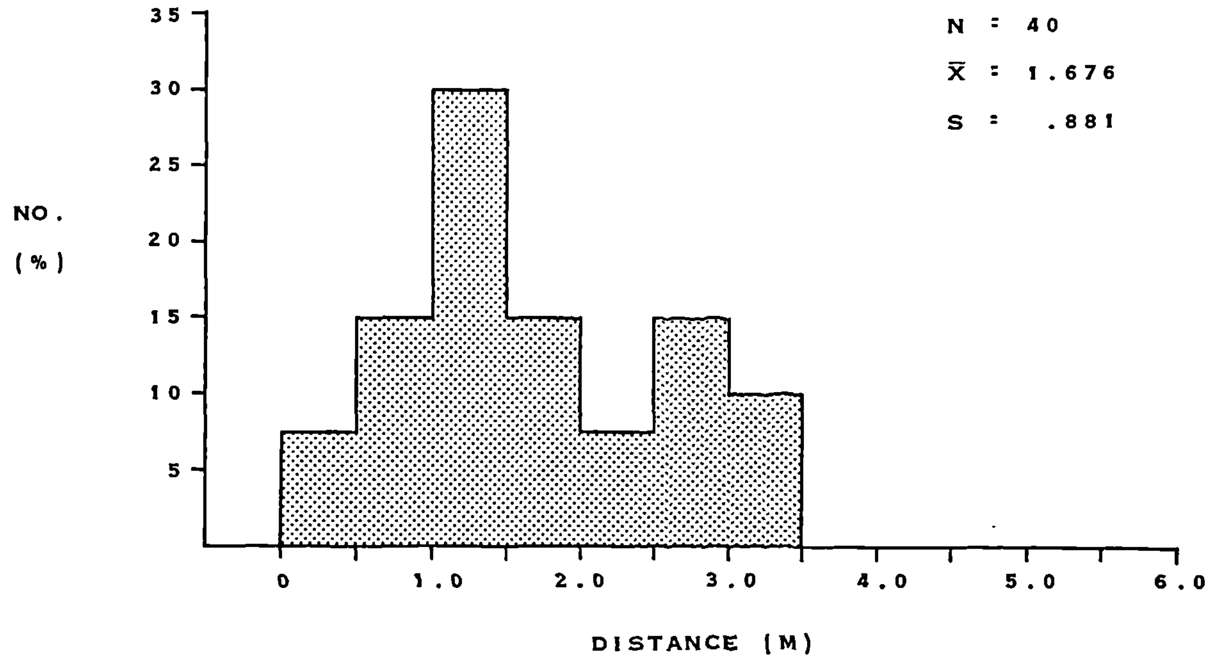
In Levels 14 and 15 (Figs. 157 & 158), in the central area of Lane 14 (Fig. 170), there is a small cluster consisting of four broken convex valve pectens, while in Levels 16 and 17 (Figs. 159 & 160), at the western end of Lane 10 (Fig. 166), is a compact cluster of two complete convex valve shells and one complete flat valve shell. In the southern end of Lanes L and M (Figs. 173 & 174; see also Levels 21 to 28 = Figs. 161 & 162) are two small loose clusters of convex valve pecten shells which are stratigraphically separated -- the upper one in Lane L contains three complete and perhaps as many as five broken convex valves, and the lower one in Lanes L and M consists of one complete and five incomplete convex valve shells. In addition to these various groupings, there are a number of other small clusters of two or three pecten shells found in various areas of the site, while many other shells occur as isolated specimens scattered throughout the midden.

To summarize, we may firstly observe that pecten shells are rather widely distributed throughout the midden, although this distribution is by no means ubiquitous. One area in particular -- namely, the north-central and north-eastern areas of the site comprising the eastern half of Lanes 4 to 7 (see especially Figs. 150 & 151) -- has very few pecten shells in proportion to its volume of midden deposit, whereas other areas have proportionally many more pectens. These "pecten-rich" areas result from the fact that they contain one or more moderately sized groups of pecten shells; these few groups tend to be rather loose clusters or scatters of shells. In addition to these, there are many other small groups containing two or three pectens, while many other pecten shells occur as isolated specimens scattered around the site. Yet overall, it is clear enough that the distribution of pecten shells in Cnoc Coig is more clustered than dispersed. *However, this* clustering tendency is clearly less marked than that observed for food refuse such as oyster shells. In this sense then, pecten shells are intermediate between clustered oyster shells on the one hand and dispersed pitted pebbles, prickly cockles and cyprinas on the other. Therefore, it may be concluded that the distribution of pecten shells does not conform very well to expectations F and K. Although some small clusters of broken pectens were anticipated, the number, size and composition of the observed groupings of pecten shells firmly contradict our expectations, since the overall distribution of pecten shells can in no way be characterized as being dispersed. Expectations F and K must consequently be rejected.

Their Association with Hearths. Turning our attention now to expectations I and M, an examination of Figures 152 to 174 reveals that pecten shells are rather variable in terms of their spatial association with hearths. It has already been pointed out that the largest grouping of pectens, which occurs near the surface of the midden towards the western end of Lanes 4 to 6, lies above the large number of hearths in this area of the site, so that the pecten shells in this loose cluster are rather distantly removed from the nearest stratigraphically associated hearth. It has also already been noted that the smaller cluster and the several isolated pectens which lie below this large grouping are interspersed among the hearths in this area of the site; hence, these pectens lie comparatively close to their nearest associated hearth.

Once again, we may characterize the spatial association of these items with hearths by determining their distances to the centres of the stratigraphically associated hearth nearest to each of them. The first question to consider is whether any of the types of pecten shells are different from any of the others. Figure 27 shows two histograms which summarize the distribution of distances to the nearest hearths for flat valve and convex valve pecten shells. From these, it can be seen that both valve types are quite similar. In both cases, the vast majority of these items occur between 0.5 and 3.0 m from a hearth -- 33 or 82.5% of the flat valve shells and 147 or 88.0% of the convex valve shells. Their mean values are quite similar, and not surprisingly, a t-test demonstrates that the difference between these two distributions is not significant. Moreover, a series of t-tests comparing the various combinations of complete and broken flat valve pectens with complete and broken convex valves (Table 35) reveals that there are no significant differences between any of these paired combinations of pecten shell types.

Of course, in the preceding discussion on the cultural formation processes of pecten shells, a difference between flat and convex valve pectens in terms of their spatial association with hearths was not anticipated, and hence, these results are not too surprising. However, a difference between complete and incomplete pecten shells was expected, and we may examine the available data to determine if this expectation is verified. Figure 28 shows two histograms which summarize the distribution of distances to the nearest hearths for complete and broken pecten shells. Once again, it is immediately apparent that these two categories of pectens are very similar. In both



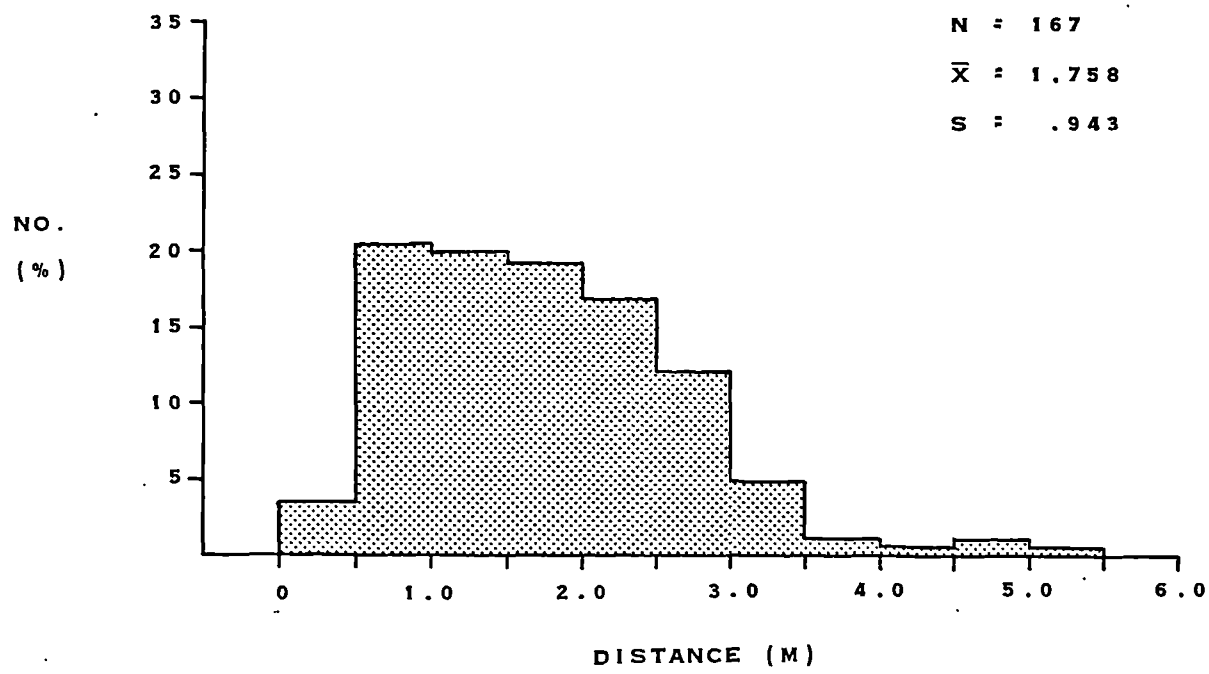


Figure 27. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Flat Valve Pecten Shells (top) and Convex Valve Pecten Shells (bottom).

Table 35. Results of t-Tests Comparing the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Various Paired Combinations of Flat Valve and Convex Valve Pecten Shells.

Types Compared	No.	Mean Distance	Std. Dev.	t Value	Degrees of Freedom	Significant at level: .05	Significant at level: .01
Flat valve, all	40	1.676	.881				
vs.				0.50	205	no	no
Convex valve, all	167	1.758	.943				
Flat valve, complete	22	1.796	.966				
vs.				0.34	87	no	no
Convex valve, complete	67	1.878	.986				
Flat valve, broken	18	1.529	.766				
vs.				0.65	116	no	no
Convex valve, broken	100	1.677	.910				
Flat valve, complete	22	1.796	.966				
vs.				0.55	120	no	no
Convex valve, broken	100	1.677	.910				
Flat valve, broken	18	1.529	.766				
vs.				1.39	83	no	no
Convex valve, complete	67	1.878	.986				

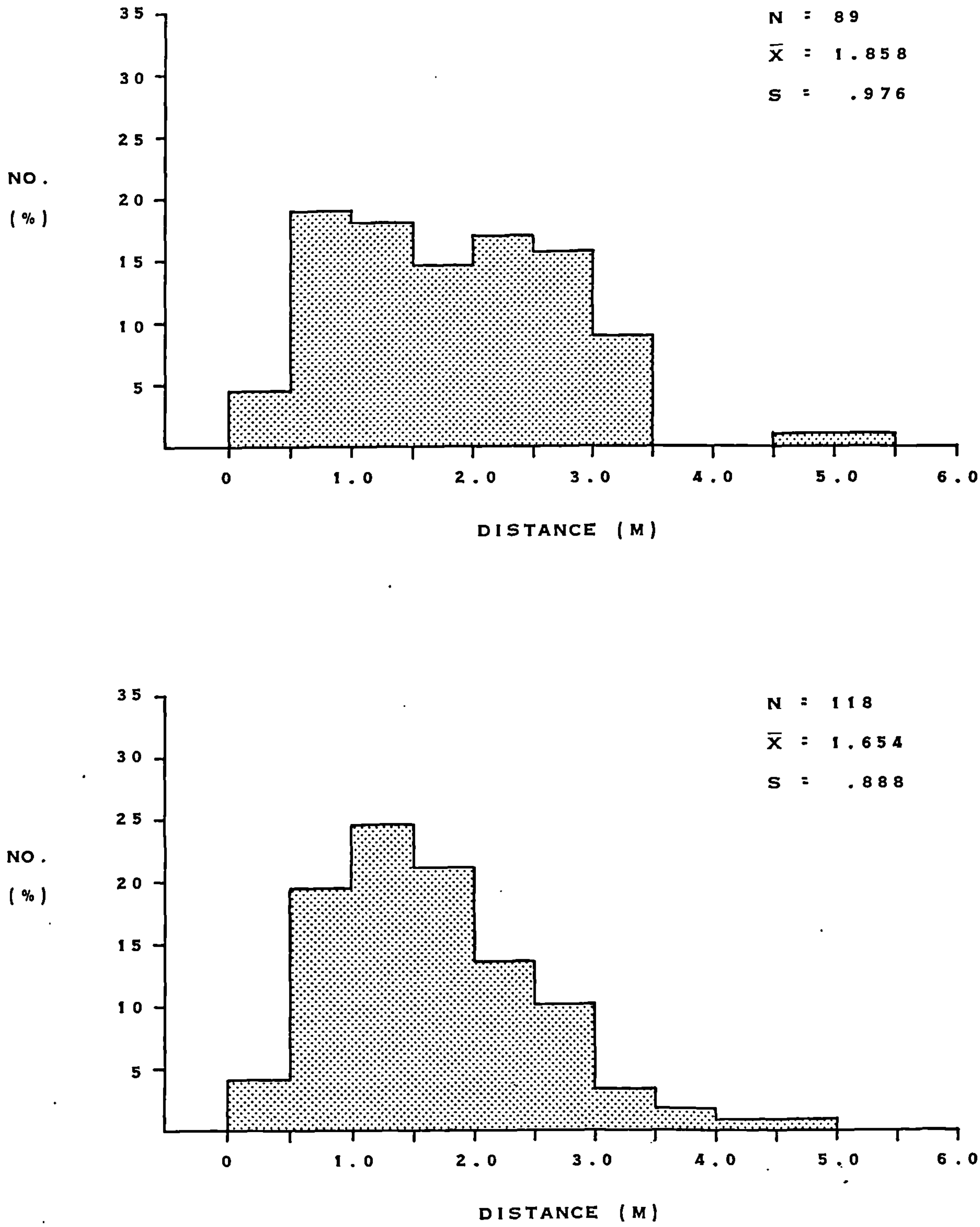


Figure 28. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Complete Pecten Shells (top) and Incomplete Pecten Shells (bottom).

Table 36. Results of t-Tests Comparing the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Various Paired Combinations of Complete and Incomplete Pecten Shells.

Types Compared	No.	Mean Distance	Std. Dev.	t Value	Degrees of Freedom	Significant at level: .05	Significant at level: .01
Complete, both valves	89	1.858	.976				
vs.				1.57	205	no	no
Broken, both valves	118	1.654	.888				
Complete, flat valve	22	1.796	.966				
vs.				0.95	38	no	no
Broken, flat valve	18	1.529	.766				
Complete, convex valve	67	1.878	.986				
vs.				1.36	165	no	no
Broken, convex valve	100	1.677	.910				
Complete, flat valve	22	1.796	.966				
vs.				0.55	120	no	no
Broken, convex valve	100	1.677	.910				
Complete, convex valve	67	1.878	.986				
vs.				1.39	83	no	no
Broken, flat valve	18	1.529	.766				

cases, very few pectens lie within 0.5 m of a hearth and very few lie beyond 3.0 m from a hearth, with the large majority of both types being between these two distances -- 75 or 84.3% of the complete pecten shells and 105 or 89.0% of the incomplete shells. The mean values are slightly different with, contrary to our expectations, the complete shells having the higher mean distance to the nearest hearth, but a t-test demonstrates that this difference is not significant at the 5% level. Furthermore, a series of t-tests comparing other paired combinations of complete and incomplete pecten shells (Table 36) reveals no significant differences.

Therefore, it must be concluded that broken pecten shells are no less well associated with hearths than are complete shells, and as a consequence, expectation M must be firmly rejected. Given this result, when the coefficient of segregation is applied to the pecten shell data, it should hardly come as a surprise to find that the distributions of complete and incomplete pecten shells are not significantly segregated, but rather, that they are randomly intermingled. Table 37 shows the results of two tests using the coefficient of segregation, one based on the complete and broken shells of both valve types and the other on the convex valve pectens only. Thus, expectation N is clearly not substantiated and must likewise be firmly rejected.

In summary therefore, there are no indications that any category of pectens differs in any meaningful way from any other category, so that the whole assemblage of pecten shells may be regarded as a single, homogeneous group. Yet, although expectation M has been unequivocally rejected, the question remains as to whether or not pecten shells as a whole are spatially well associated with hearths, as expectation I states to be the case for complete pectens. In order to investigate this, the distribution of distances to hearths for all 207 pecten shells in Cnoc Coig may be summarized in a single histogram (Fig. 29), and this may be compared to the histograms which summarize the distribution

Table 37. Results of the Test of Segregation between Complete and Incomplete Pecten Shells for the Entire Midden in Three Dimensions Using Weighted Nearest-Neighbour Values.

I. 89 Complete and 118 Broken Pecten Shells (Both Valve Types):

	1st Nearest Neighbour			2nd Nearest Neighbour		
	Complete	Broken	Total	Complete	Broken	Total
Complete	35.8	47.0	82.8	33.3	47.8	81.1
Broken	47.4	62.9	110.3	49.2	57.3	106.5
Total	83.2	109.9	193.1	82.5	105.1	187.6
	S = 0.002796			S_2 = -0.051550		
	Sign. level = .484			Sign. level = .698		

II. 67 Complete and 100 Broken Pecten Shells (Convex Valves Only):

	1st Nearest Neighbour			2nd Nearest Neighbour		
	Complete	Broken	Total	Complete	Broken	Total
Complete	29.5	32.1	61.6	24.4	34.8	59.2
Broken	36.0	56.6	92.6	37.6	52.9	90.5
Total	65.5	88.7	154.2	62.0	87.7	149.7
	S = 0.088872			S_2 = -0.003275		
	Sign. level = .144			Sign. level = .494		

of distances to hearths for pitted pebbles, oyster shells, and prickly cockle and cyprina shells.

Comparing the whole assemblage of pectens (Fig. 29) with oyster shells (Fig. 25) first of all, it can be seen that, although the overall range of distances for these two types of shells is similar, oysters clearly tend to occur further away from hearths than do pectens. Whereas only 8.7% and 22.8% of oysters lie within 1.0 and 1.5 m of a hearth respectively, 23.7% and 45.4% of pectens lie within these distances; and 52.2% of oysters occur beyond 2.0 m compared to 36.2% for pectens. These differences are reflected in their respective values for the mean distance to a hearth, and a t-test demonstrates that the difference between these two distributions is highly significant (see Table 34 above). Furthermore, it may be recalled that the overall distribution of oyster shells is markedly more clustered than that of pectens.

If we compare pectens (Fig. 29) to prickly cockle and cyprina shells (Fig. 26), rather marked differences are also observed. In contrast to the figures of 23.7% and 45.4% for pectens, 45.7% and 62.9% of prickly cockles and cyprinas lie respectively within 1.0 and 1.5 m of a hearth. Moreover, only 17.1% of the latter occur beyond 2.0 m in comparison with 36.2% for pectens, and no prickly cockle or cyprina shells are beyond 3.5 m from a hearth. Once again, these differences are reflected in the respective mean distances to a hearth, and a t-test demonstrates that the difference between the two is highly significant (see Table 34). Additionally, it was observed that the patterns of distribution of these two groups of utilitarian shells are different, with pectens revealing a somewhat clustered distribution overall in contrast to the dispersed pattern observed for prickly cockle and cyprina shells.

Finally, we may compare pectens (Fig. 29) with pitted pebbles (Fig. 24). In this case, any differences are far less striking. The relative frequencies of pitted pebbles and pecten shells which occur within 1.0, 1.5 and 2.0 m from a hearth are broadly similar -- 31.9% compared

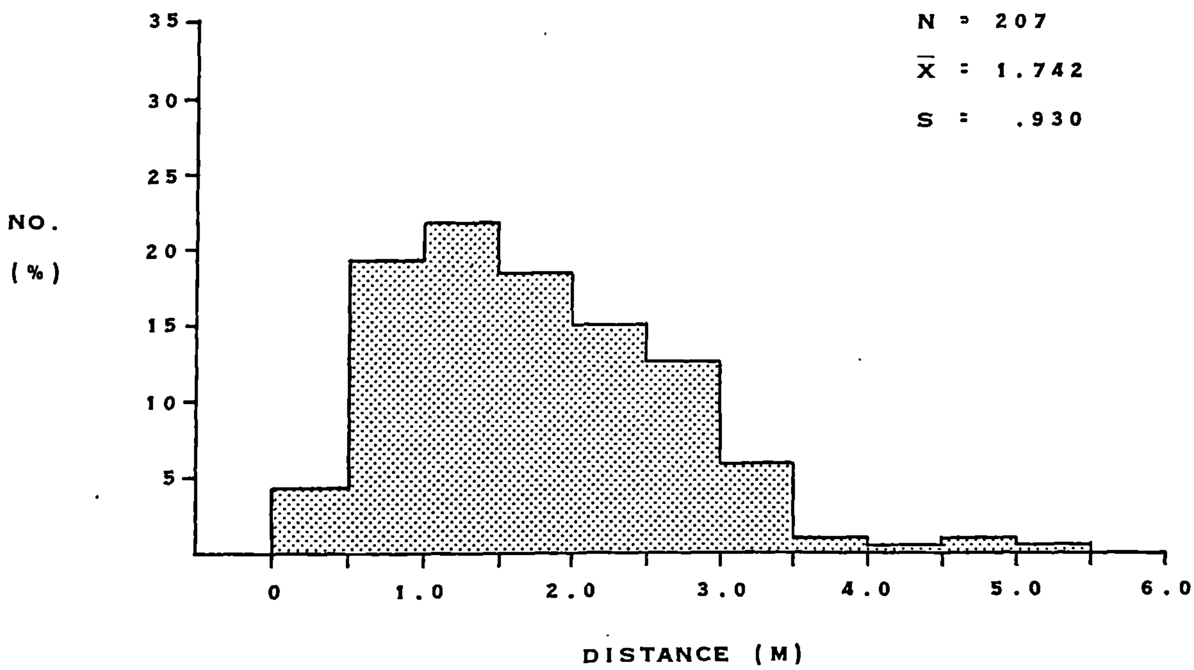


Figure 29. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for All Pecten Shells.

to 23.7%, 51.1% compared to 45.4%, and 76.6% compared to 63.8% respectively. These data suggest that there is only a slight tendency for pitted pebbles to occur closer to hearths than do pectens, and this is reflected in their respective mean distances to a hearth, but a t-test shows that the difference between the two distributions is not significant at the 5% level (see Table 34). Nevertheless, there are some differences between these two categories of artifacts. In terms of their association with hearths, pitted pebbles reveal a sharp break in the distribution around 2.0 m, and of the 23.4% lying beyond this distance, none occur beyond 4.0 m; on the other hand, the number of pecten shells gradually falls off with increasing distances up to just over 5.0 m from a hearth. Moreover, it should be recalled that the pattern of distribution of pitted pebbles is dispersed which contrasts with the more clustered distribution of pectens.

These three comparisons demonstrate that, in terms of their spatial association with hearths, pecten shells are intermediate between oyster shells on the one hand and prickly cockle and cyprina shells on the other, but bearing some resemblance at least to pitted pebbles. Taken together however, the data summarized in Figure 29 and the above comparisons with other remains in the site do not strongly suggest that pecten shells can be said to reveal a marked tendency to occur in the general vicinity of hearths. Consequently, it must be concluded that expectation I is not very well substantiated.

Summary and Conclusions

It has been shown that expectation A has been substantiated since the clustered distribution of oyster shells conforms very well to the idea that these remains represent dumped food refuse. In contrast, it has been noted that the pattern of distribution of pitted pebbles is dispersed overall, and this observation is not negated by the presence of four pairs of associated pitted pebbles;

indeed, the occurrence of a few such associated pairs of these artifacts was anticipated. Thus, expectation B has been fully confirmed. We have also seen that expectation C is at least partially verified since there is a definite tendency for most pitted pebbles to occur in the vicinity of hearths. Therefore, it may be concluded that the majority of pitted pebbles can be interpreted as de facto refuse which had been rested and then abandoned in the general vicinity of hearths. However, a reasonably large number of the pitted pebbles in the site are less well associated spatially with hearths. Although these may also represent de facto refuse, which had however been abandoned in activity loci further away from hearths, they might alternatively (and perhaps more likely) represent items which had been purposefully discarded away from the areas around hearths. In either case, the majority of pitted pebbles may be seen to conform to our expectations.

Like pitted pebbles, the pattern of distribution of prickly cockle and cyprina shells is dispersed and so confirms expectations D, E and J. Although it has been demonstrated that broken cyprina shells are no less well associated with hearths than are complete cyprinas or prickly cockles, and hence that expectation L must be rejected, it has been shown that prickly cockle and cyprina shells reveal a definite tendency to occur in close proximity to hearths. Similar to pitted pebbles, a small number of these shell artifacts are found much further away from hearths than are the rest, and although these few finds may well represent purposefully discarded items, it is clear enough that the large majority of prickly cockle and cyprina shells do occur in the immediate vicinity of hearths. Thus, expectations G and H are substantially verified, and in general, these two categories of shell artifacts may be interpreted as rested de facto refuse.

Finally, we have seen that the pecten shells in Cnoc Coig reveal a somewhat clustered pattern of distribution. Hence, since their spatial distribution is clearly not dispersed, expectations F and K must be firmly rejected. Yet this clustering tendency is certainly less marked than that observed for oyster shells, and in this sense, pectens are intermediate between oysters on the one hand and dispersed pitted pebbles, prickly cockles and cyprinas on the other. It has also been shown that broken pecten shells are no less well associated with hearths than are complete pectens, as a result of which expectation M must likewise be rejected. Given this result, it is hardly surprising to find that the coefficient of segregation does not confirm expectation N. Finally, the data on the spatial association between pecten shells and hearths do not substantiate expectation I.

In short, none of our expectations regarding the pecten shells in Cnoc Coig have been borne out. Given this, and the rather notable differences between pecten shells and prickly cockle and cyprina shells, and also the somewhat less marked differences between pitted pebbles and pectens, it would be difficult in the extreme to interpret pecten shells as de facto refuse which had been *rested and* then abandoned in hearth-centred activity areas. In terms of cultural formation processes, how else may these remains be interpreted? Given the contrast between pecten and oyster shells, it is clearly not possible to interpret pectens in the same terms as oysters, that is, as dumped food refuse discarded in locations comparatively distantly removed from hearths.

The pecten shells in Cnoc Coig are thus rather enigmatic. It seems certain that the arguments upon which our expectations are based must in some way be faulty. Central to these arguments is the functional interpretation which has been ascribed to these utilitarian shells, namely, that they are multi-purpose scoops and containers. Might not this functional interpretation be the source of our expectations going so far awry? Could pecten shells have had some more specific purpose other than that of multi-purpose scoops and containers, or at least in addition to such a purpose?

It has been suggested that at least most pecten shells might be interpreted, not as multi-purpose containers, but rather as containers specifically used in the preparation and consumption of food -- in short, as "dishes" (P. Mellars, personal communication). If we examine the implications of this suggestion, then the nature of the distribution of pecten shells in Cnoc Coig becomes much less enigmatic. The use of an object as a food vessel is in general a much messier function than using it for containing other kinds of materials such as artifacts. In this context, it should be recalled that two utilitarian shells from Cnoc Coig -- one a prickly cockle shell and the other a cyprina shell -- were found with caches of cowrie shells placed inside them. Of course, these finds provide rather strong support for the idea that these two types of shells functioned as containers. Yet suggestively, not a single pecten shell was found in Cnoc Coig which unambiguously contained a cache of items, in spite of the fact that there are six times as many in situ pecten shells recovered from the midden as there are prickly cockle and cyprina shells combined.

In any case, as a result of the comparative messiness of such a function, when one uses an object as a food container, one is faced with a simple alternative upon completion of a particular episode of use -- either discard the object and replace it with another, or clean it out for further use. If pectens were indeed used as dishes, it is not unreasonable to suppose that the Mesolithic inhabitants of Cnoc Coig frequently opted for the former of the two alternatives, given that replacements in the form of shells washed up on beaches would have been, more often than not, abundantly and readily available. This is not to say that pecten shells would never have been used more than once, but only that in many instances discarding an overly dirty pecten dish and replacing it with a clean one would be easier than cleaning it out.

This might well account for a number features of the utilitarian shells found at Cnoc Coig. Firstly, if prickly cockles and cyprinas were not primarily used as food containers, perhaps because they were too small, then presumably their uselife would be much longer than that of pectens because of their less messy function; as a result, the discard rate of pectens, and not just broken ones, would be much greater. This would of course accord with the fact that pectens are vastly more numerous at Cnoc Coig than are prickly cockles and cyprinas. Their much greater number on the site, therefore, would not just be a function of the fact that they are larger and so generally more useful as containers than are prickly cockles and cyprinas, but also it would be a function of the differing uselives and discard rates of these different utilitarian shells.

Secondly and more importantly, this functional interpretation would account for much of the seemingly enigmatic aspects of the spatial patterning of pectens observed at the site. It was observed above that there are no discernible differences in the patterning of broken and complete pectens, particularly in terms of their spatial association with hearths, which is in contrast to what had been expected. With the revised functional interpretation however, this observation becomes understandable, since complete but dirty pectens would be as likely to be discarded away from hearths as would broken shells. The fact that pectens reveal a somewhat clustered distribution overall, which is due to the presence of several depositionally meaningful groupings of these shells, also becomes understandable, as is the fact that the observed clusters are as likely to contain whole pectens as they do broken ones. This is because one would expect that there would be times when several dirty pecten dishes (including whole shells) would be dumped together after an episode of use. In addition to the few clusters, the presence of isolated specimens would also be readily accounted for. Of course, pectens which had been broken and so had become useless might simply have been tossed out of the way, but likewise, it is not difficult to envisage instances of complete but dirty shells also being discarded individually by tossing; and others, which were still usable, might have been rested, individually or collectively, in the vicinity of a hearth and then abandoned as de facto refuse. This variety of discard processes for pecten shells, in which some were collectively dumped away from hearths and other were individually tossed away and others still were left as de facto refuse, would account for the observations that pecten shells are in general less clustered but more associated with hearths than is dumped food refuse (such as oyster shells) and, on the other hand, that they are more clustered but less well associated with hearths than are items (such as pitted pebbles, prickly cockles and cyprinas) which are inferred to be rested de facto refuse. In short, it would account for the observation that, in terms of the degree of clustering and their proximity to hearths, the nature of the distribution of pecten shells as a group is intermediate between oysters on the one hand and pitted pebbles, prickly cockles and cyprinas on the other.

In conclusion, the proposed model of the use and discard of pecten shells at Cnoc Coig embodied in our initial expectations is clearly inadequate to account for their observed pattern of distribution in the site. By comparison with pitted pebbles and prickly cockle and cyprina shells, for which similar initial expectations were held and whose distributions overall supported these expectations, it is clear that pectens cannot be interpreted as de facto refuse which had been rested and then abandoned in hearth-centred activity areas. Equally clearly, by comparison with oyster shells, they cannot be interpreted as dumped food refuse. Hence, some other formation processes must have been responsible for the occurrence of these remains in the midden. It has been suggested, therefore, that pectens are best seen as having functioned specifically as food vessels rather than as multi-purpose containers. The spatial implications of this revised functional interpretation for the discard processes of pecten shells would seem to correspond quite well with, and offer a better explanation of, the observed patterning of these utilitarian shells in the midden.

CHAPTER 10

SPATIAL ANALYSIS: UNWORKED ANTLER, ANTLER AND BONE TOOLS, AND ITEMS OF DECORATION

Aside from the many antler and bone limpet scoops which were discussed above in Chapter 8, many other antler and bone artifacts from Cnoc Coig were recorded _in situ_. These include an abundance of unworked antler fragments, plus much smaller quantities of several types of antler and bone tools (see Table 12). It is to these remains, in addition to a few items of decoration, that our attention will now turn.

Expected Distributions

Unworked Antler

The unworked antler fragments which were recorded _in situ_ at Cnoc Coig consist of ten antler bases (seven shed and three unshed), one large piece of beam, six forks from the upper end of the beam and crown, and 197 finds of small miscellaneous fragments. The latter group comprises considerably more fragments than 197, since many of these finds contain more than one fragment, in fact as many as a dozen or more in a few cases, although most consist of between one and five small pieces of antler. There can be little doubt that the vast bulk of this unworked antler represents discarded, useless waste left over from the manufacture of antler tools. The only exceptions to this are the one large piece of beam, the six forks and perhaps a few of the miscellaneous fragments which are large enough to have been potentially usable for the manufacture of smaller tools such as limpet scoops. In general then, the amount of discarded but still useful antler is not that great and, as discussed above (pp. 153-155), these few unused but utilizable pieces of antler could readily be accounted for as material which was either lost or abandoned as de facto refuse.

If most of the unused antler may be seen as discarded waste, we may expect that this material was disposed of in one of two possible ways -- either it was simply left as primary refuse which had been dropped *in situ* in an antler working locus, or it was purposefully swept up from such a locus and dumped out of the way in an area of low use intensity. In either case, we would expect that the overall pattern of distribution of unworked antler will be clustered. If this is so, how might we distinguish between the two possible modes of discard? If we assume that episodes of antler working would have been conducted in the vicinity of hearths (whether around hearths in generalized activity areas or around hearths in specialized craft working areas specially lit to keep the worker warm), then we would have a clear criterion by which the alternative modes of discard might be distinguished -- clusters found in close proximity to a hearth would represent primary refuse dropped in antler working loci, while clusters located further away from hearths would represent cleaned up, dumped refuse.

Of course, it is not necessarily the case that antler working *must* have been conducted around hearths. Nevertheless, we may legitimately ask why anyone working antler would remove themselves to an area of low use intensity away from the major activity areas which were used intensively on a day-to-day basis. Antler working is certainly not an activity which requires large amounts of space and so by its very nature must be located on the periphery of a camp, as are some ethnographically documented activities in hunter-gatherer camps (e.g. Binford 1983: 165-172, 187-188; Yellen 1976: 69; 1977: 92, 95). Moreover, there certainly are some examples derived from recent ethnoarchaeological research (e.g. Gould 1968: 107, 111, 119; 1977a: 166; O'Connell 1977: 122; Yellen 1976: 64-65, 68-69; 1977: 87-88, 90-91) of craft activities being conducted around hearths in the generalized activity areas of a settlement, although there are also examples of such activities being carried out in specialized activity areas (e.g. Binford 1983: 180-181). However, even if antler workers did remove themselves from the most intensively used activity areas for whatever reasons, in the relatively cold and damp environment of Oronsay, it is not unreasonable to imagine that such workers would light a fire for warmth. Hence, it does not seem unreasonable to assume that a craft activity such as antler working would have been conducted around a hearth. Consequently, this assumption will be adopted for our purposes here, on the basis that it does not seem totally unwarranted, but at the same time aware of the fact that this assumption is not invariably true in all instances.

Thus, we may anticipate that the expected clusters of unworked antler fragments will either be found away from hearths indicating the dumping of waste material, or they will be found near hearths as primary refuse thus indicating the loci of antler working. It is difficult to predict which of these two alternatives might be the more likely to be found, although it is not inconceivable that unworked antler fragments might be found in both contexts -- while some episodes of antler working might have been conducted in generalized activity areas and the resulting debris cleaned up and dumped away from such areas, other episodes might have been carried out away from the most intensively used activity areas of a particular occupation but still around a small hearth which had been specially lit to keep a worker warm during the performance of the task. At any rate, any evidence that is found for the dumping of antler refuse would presumably indicate a relatively high degree of maintenance of intensively used activity areas, because the reason for its being cleaned up and dumped would be to avoid messing up such areas and so interfering with other tasks later performed there; and the implication of such maintenance of activity areas of high use intensity would be that the occupations at Cnoc Coig were of relatively long duration (i.e. in terms of weeks rather than days) (see Andresen et al. 1981: 34; Binford 1983: 190).

These arguments pertain to the bulk of the unworked antler in the midden, which is interpreted as waste material. However, for the one large antler beam and the six antler forks, our expectations will be different. We might anticipate that these few relatively large pieces of still utilizable antler would not have been purposefully discarded, but rather, that they would have been abandoned as de facto refuse at the ends of particular episodes of occupation. If these few finds are indeed de facto refuse, it does not follow that they were abandoned in antler working loci as such, but rather, that they were left over from an episode of antler working and so had been rested in some convenient location for possible later retrieval when more antler was required; such locations may or may not correspond to the loci where the antler was worked. We might once again expect that such locations would be at the edges of (or at least near) hearths in the more intensively used activity areas, and we would certainly not expect them to be found further away from hearths discarded together with any clusters of dumped antler waste. Finally, it should be noted that we cannot reliably make any statements regarding the nature of the distribution of these antler fork/beam fragments, since it is not possible to talk about significant tendencies towards clustering or dispersion when dealing with so few items.

Antler and Bone Tools

This same statement would of course apply to the antler and bone tools from Cnoc Coig. Eight categories of worked antler and bone (excluding limpet scoops) have been defined, and the numbers of in situ finds assigned to each are listed in Table 12. As can be seen, all have less than 20 in situ finds and three of them are represented by only two. Obviously therefore, we cannot expect to recognize much in the way of significant patterning in these data in terms of tendencies towards clustering or dispersion.

Pins, Borers, Harpoons and Grooved Bones. However, despite this limitation to our expectations, we would certainly not expect to encounter small groupings with any of these tool types, even in the case of the relatively more abundant borers. This is because most of these antler and bone tools -- but most notably the pins, borers, harpoons and grooved bones -- may be seen to represent items which were highly curated and which therefore were only rarely discarded, when they had become broken beyond repair or worn out beyond any further possible use. In other words, because of the infrequency of their discard, the probability of two or more specimens of a particular tool type being discarded together is rather low.

In terms of the location of these objects relative to hearths, we can expect little in the way of clear patterning, since it is likely that various modes of disposal might have been employed in their discard -- perhaps more often than not these broken or worn-out tools might have been simply tossed away, while others may have been dropped (perhaps in hearth-centred activity areas), and others still may even have been dumped along with food or other refuse. If tossed or dumped, we would not expect these tools to be particularly well associated with hearths, while dropped items may or may not be near a hearth, depending on whether or not their locations of use were around hearths. On balance then, and especially if tossing was the disposal mode most frequently employed in their discard, we might anticipate that overall these antler and bone tools (as a general grouping rather than for each specific type) would not be very well associated spatially with hearths.

Bevelled Tine Tips. These comments and expectations would also apply to the bevelled tine tips, although there is some reason to think that these tools were less highly curated. Firstly, the amount of working involved with these bevelled tine tips is rather minimal, especially in comparison with other tools such as harpoons and grooved bones, though this in itself does not necessarily mean that they must therefore be more expedient tools. However secondly, although three of the six bevelled tines from Cnoc Coig are very short pieces which appear to be the snapped-off tips of larger implements, the other three are relatively long (60 to 110 mm) and would seem to represent complete implements. If so, then the fact that half of these tools found in the midden are not broken or worn out (in contrast to other tools for which no complete specimens were found in this site) might well suggest that these objects were less highly curated. If this were the case, this would imply that whatever activity these bevelled tines were used in was engaged in relatively infrequently; otherwise, we would expect to find more of such comparatively non-curated tools in the midden. In any case, these considerations regarding the possible degree of curation of bevelled tine tips do not alter the fact that our expectations for their spatial distribution would be the same as for the pins, borers, harpoons and grooved bones.

Antler Mattocks. In contrast however, antler mattock fragments might be expected to represent something of a special case. Like most of the other Obanian antler and bone tools, mattocks were undoubtedly highly curated, but once broken, as mentioned above (pp. 147-148), it seems very likely that they would not have been discarded immediately as were other tools; rather, being such large objects, it would seem likely that they would have been recycled as a useful supply of raw material for the manufacture of other, smaller implements (such as A.L.S.). As mentioned previously, this would of course account for the observation that relatively complete mattocks are rare on Obanian sites (one each from Cnoc Sligeach and Risga), and instead, that they are found (as at Cnoc Coig) as small broken up fragments. These fragments are recognized as being from mattocks because they contain portions of the bevelled end or the perforation, but obviously, any fragments which are not from these parts of a mattock would be indistinguishable from ordinary unworked antler. Thus, we would not expect that any mattock fragments found in the midden would have been tossed away or dropped as primary refuse as would other antler and bone tools, but instead, that they would have been discarded by the same processes as outlined above for unworked antler (since, once recycled, this is what they effectively had become). We might thus expect that mattock fragments would be found clustered in association with antler waste -- that is, not as clusters by themselves but within clusters of unworked fragments of antler.

Miscellaneous Worked Antler and Bone. The two categories of miscellaneous fragments of worked antler and bone also represent special cases which are not analogous to the other types of worked antler and bone. Unlike the six other categories which represent discrete artifact types, these two are generic categories of miscellaneous items which are grouped together only because they cannot be properly assigned to any specific tool type -- that is, they are categories which do not involve the degree of functional and behavioural integrity that the other types do. As was mentioned above (p. 150), several of these objects appear as though they might represent unfinished limpet scoops, while the remainder are idiosyncratic items about which little can be said except that they have been worked to some extent. However, one of these artifacts does perhaps merit special mention -- it is a long, straight piece of bone (or antler?) tapering to a point which is heavily eroded and was found broken in three. It might represent an unbarbed projectile point, although it is so badly eroded that this interpretation must remain tentative, and in this context, we might recall that no unbarbed projectile point has ever been found in any Obanian site. Nevertheless, even if this interpretation were accepted, this one object would be of little or no significance from the perspective of spatial analysis, since nothing could be said beyond noting its presence in the midden.

With this one possible exception then, these miscellaneous fragments of worked antler and bone could be seen to represent the following possibilities: (1) unfinished objects which were rested and then either lost or abandoned; (2) unfinished objects which were "false starts" and so purposefully discarded, thereby effectively being waste material; (3) eroded or otherwise unrecognizable fragments of completed artifacts of the recognized tool types found on the site; (4) fragments of finished idiosyncratic artifacts perhaps representing tools of an expedient nature. Objects representing the first of these possibilities would be de facto refuse, and we thus might expect them to be found rested in convenient locations for later retrieval, such as at the edge of or near a hearth. We might expect any objects which represent the second of these possibilities to be found as discarded waste, perhaps in association with fragments of unworked antler. Items representing the third and fourth of these possibilities might have been discarded in a number of ways, as applies to the formal types of antler and bone tools -- that is, having been tossed away from their loci of use, dropped as primary refuse, or perhaps even dumped together with other refuse. Therefore, if most or all of these possibilities are indeed represented by these miscellaneous fragments of worked antler and bone, we would expect that these remains would be scattered around the site, some perhaps in association with clusters of unworked antler and others not. As well, we would not anticipate them to be particularly well associated with hearths, since few of them are likely to represent rested de facto refuse, and especially if tossing or dumping were the modes of disposal most often employed for their discard. Thus, in terms of their spatial proximity to hearths, we would expect them to reveal a similar pattern to the more formally recognized antler and bone tools.

Pumice Stones and Items of Decoration

Finally, we must consider the pumice stone fragments and the few items of decoration which were found in Cnoc Coig and recorded <u>in situ</u>. If pumice stones were used for working antler as mentioned above (p. 161), we might anticipate that they would be found in association with discarded antler waste; this would particularly apply to the smaller fragments which would have been discarded because they were no longer usable. However, this expectation that functionally related objects would be spatially associated is probably overly simplistic. For one thing, small fragments of discarded pumice might well have been tossed rather than dumped along with antler waste. But in any case, the smaller fragments of pumice were unfortunately not found _in situ_. In fact, only six pumice stone fragments are _in situ_ finds and all of these are relatively large. For these larger specimens, which may well have still been usable, the possibility must be considered that they were not discarded as such but rather rested and abandoned as de facto refuse, once again perhaps in the immediate vicinity of hearths which would be locations facilitating their retrieval for later use. Alternatively, if they were intentionally discarded, we might expect to find them further away from hearths and _perhaps_ in association with antler waste. It is difficult to determine which of these two alternatives might be the more likely for these larger fragments of pumice stone. Unfortunately, given the rather tentative nature of the functional interpretation of these objects, and especially given the small number of them, it is doubtful whether significant patterning either way could be detected.

The items of decoration include one cache of 60 perforated cowry shells placed inside a cyprina shell, one cache of 16 unpierced cowries inside a prickly cockle shell, two isolated unperforated cowries, one isolated flat winkle shell with a single perforation, and 32 lumps of red ochre. Regarding the three isolated finds of cowry and flat winkle shells, nothing can be said about their distribution or locations within the midden since it is likely that they simply represent very small items which were lost. The caches of cowries, however, are more interesting. There can be little doubt that these caches were rested for later retrieval but were lost rather than abandoned. In these two cases, but especially in the case of the 60 perforated cowries, it seems very unlikely that they would have been intentionally abandoned as de facto refuse, as appears to be the situation for various other, more pedestrian objects which would have been easy to replace and/or were too large or heavy to merit being taken away at the end of an episode of occupation. It has been suggested above in several instances that prime resting locations for objects which were to be later retrieved is on the edges of, or at least in close proximity to, hearths -- these two caches of cowries should provide an interesting test of the validity of this suggestion.

Regarding the lumps of red ochre, most of which are quite small and so presumably represent residual pieces which were of no further use, we could envisage that some may have been dropped in the locations of their use, others tossed away and perhaps some even dumped together with other refuse -- there certainly seems to be no reason why only one disposal mode would have been employed in their discard. Consequently, we would expect to find red ochre to be scattered around the site in a rather dispersed manner, although we might also anticipate finding some small clusters which resulted from several fragments being dropped or dumped together. Additionally, we would not expect that the scattered pieces of red ochre would be found particularly close to hearths, except perhaps for some clusters (if any are present) which might therefore represent items dropped in activity loci where they were used.

Summary

We may summarize the preceding arguments regarding the spatial distributions of these various artifacts from Cnoc Coig into the following expectations:

(A) unworked antler fragments, including the small miscellaneous pieces as well as antler bases and tine fragments, will reveal a markedly clustered distribution;

(B) assuming that episodes of antler working were conducted around hearths, then clusters found in close proximity to hearths would represent dropped primary refuse, while clusters located further away from hearths would represent dumped refuse which had been cleaned up from antler working loci; although the latter situation might be the more expected of the two, we might anticipate encountering evidence of both;

(C) the few finds of antler beam and forks may be viewed as abandoned de facto refuse, and hence, we would expect to find them in close proximity to hearths and probably not in association with other antler (at least not with dumped clusters found away from hearths); because of the small number of these items, expectations regarding significant tendencies towards clustering or dispersion would not be warranted;
(D) pumice stone fragments will either be found as de facto refuse in close proximity to hearths or as discarded refuse in association with dumped antler waste, but the small number of these artifacts makes it doubtful whether clear patterning either way will be detectable;
(E) given the probable recycling of raw material represented by broken mattocks, mattock fragments can be seen as effectively being antler waste, and consequently, they can be attributed to the same processes of discard attributed to unworked antler in expectation B and can be expected to be found associated with clusters of unworked antler;
(F) due to the infrequency of their discard, pins, borers, harpoons, grooved bones and bevelled tine tips will be dispersed throughout the midden and not found as small groupings, although this expectation can legitimately only be applied to the relatively abundant borers, given the small numbers of the other tool types;
(G) given that a variety of modes of disposal are likely to have been employed in their discard, but most particularly tossing, these five types of antler and bone tools will in general not be spatially well associated with hearths;
(H) given the fact that they are generic categories which do not entail the same degree of functional and behavioural integrity of the other types, the miscellaneous pieces of worked antler and bone can be expected to be dispersed throughout the midden, some perhaps in association with any clusters of unworked antler waste;
(I) and since they may be attributed to a variety of modes of disposal, they should not be well associated with hearths and might be expected to reveal a similar pattern in this respect to the more formally recognized tool types;

(J) although no significant patterning can be expected from isolated specimens of decorative shells, the two caches of cowry shells may be regarded as being definitive examples of de facto refuse and so may be expected to be found on the edge of, or at least in the immediate vicinity of, hearths;
(K) red ochre fragments can be expected to reveal overall a dispersed distribution in the midden, although some small clusters might be anticipated;
(L) and red ochre would not be expected to occur in close proximity to hearths, except perhaps for some small clusters (if any are present) which would thus represent dropped refuse.

Observed Distributions

Unworked Antler

The distribution of all finds of unworked antler fragments recovered *in situ* from Cnoc Coig is shown in Figures 175 and 176, while Figures 177 to 181 are a series of depth-selective horizontal plots which show the occurrence of these antler remains and hearths in Levels 7 to 16. Figures 182 to 191 are ten vertical plots showing the distribution in section of these items for the following lanes respectively: the westernmost portions of Lanes 4 to 7, the eastern parts of Lanes 10 to 13, Lane F/G, and the central portion of Lane K.

The Nature of Their Distribution. From the depth-compressed horizontal plots (Figs. 175 & 176), it is immediately apparent that these unworked antler fragments do exhibit overall a markedly clustered distribution, as expected. Moreover, Figures 177 to 181 testify to the fact that this apparent clustering tendency is not simply a by-product of the compressed nature of the plots shown as Figures 175 and 176. They do, however, also show that a considerable number of unworked antler fragments do occur as isolated finds scattered throughout the midden deposits. Nevertheless, the overall clustered nature of the distribution of this material is clear enough, and thus, expectation A is seen to be fairly well substantiated.

The most conspicuous feature of the occurrence of these antler remains in Cnoc Coig, which is most strikingly conveyed by Figure 176, is the large concentration of antler in Trenches A and E (i.e. Lane F/G = Fig. 190). This comparatively small area of the site contains 74 (or 37.6%) of the 197 miscellaneous antler fragments and, when the tines and bases are included, 79 fragments overall, which is 33.2% of all the in situ unworked antler from the site (excluding the fork/beam fragments). This quantity of antler material in this area is considerably in excess of the proportion of the total midden deposit which it contains (approximately 9% of the volume of the midden represented by the areas of the site used in the present study). This trench on the eastern (seaward) side of the site is in the prime area of "shell heaps" (see Mellars 1978: 389) where the shells are largely unbroken and the deposit is relatively loose, indicating little or no trampling, the implication of which is that this is an area of low use intensity. Consistent with this are the facts that this trench contains no hearths at all and that there are very few hearths even in the large excavated area to the immediate west of the trench. Furthermore, when Lane F/G is viewed in section (Fig. 190; see also Lanes 11 to 13 = Figs. 187-189), it can be seen that this antler material is scattered throughout the full depth of midden deposit, and that there are no apparent "lenses" which might be seen to represent surfaces on which antler working was carried out and the waste material was dropped. Therefore, there would seem to be little doubt that this antler material represents dumped refuse rather than primary refuse dropped in antler working loci. Also, the way in which the antler fragments are sprinkled throughout the deposit in Lane F/G demonstrates that this material cannot simply be attributed to one or two dumping episodes. What all this suggests is that there was a notable redundancy over a considerable period of time in the use of this part of the site as an area for discarding waste antler.

The remaining unworked antler is rather more dispersed throughout the midden. Nevertheless, there are several notable small clusters or loose scatters of antler: one cluster containing six fragments including two tines near the midden's surface in Lane K (Fig. 191; see also Lane 10 = Fig. 186, and Levels 7 & 8 = Fig. 177); another cluster somewhat deeper down in Lane K (Fig. 191; see also Lane 11 = Fig. 187, and Levels 10 & 11 = Figs. 178 & 179), comprising six fragments including one tine, with two antler bases nearby; a tight cluster of four fragments including one tine located near the extreme western end of Lane 4 (Fig. 182; see also Levels 12 & 13 = Figs. 179 & 180); to the east of this and closer to the midden's surface, another cluster in Lanes 4 and 5 (Figs. 182 & 183; see also Levels 10 & 11 = Figs. 178 & 179), consisting of four miscellaneous fragments plus one tine fragment and one base; and immediately to the south of this, a loose cluster of six miscellaneous fragments in Lane 6 (Fig. 184; see also Levels 11 & 12 = Fig. 179); and adjacent to this but somewhat deeper, a tight cluster of six fragments including one tine in Lane 7 (Fig. 185; see also Levels 13 & 14 = Fig. 180). The large concentration of antler in Lane F/G plus these six small clusters from elsewhere in the site amount in total to nearly half of the unworked antler in the midden. The other half of the antler in the site is clearly much more dispersed, although a few very small groupings of two or three fragments can be identified within this material. Thus, although the pattern of distribution of antler has been characterized as being clustered overall, it must be appreciated that this generalization obscures the fact that a large proportion of finds of unworked antler are dispersed throughout the midden deposits and are not spatially well associated with other, more clustered antler remains.

<u>Their Association with Hearths</u>. It was mentioned above that there are no hearths in Lane F/G, and that in fact there are very few hearths even in the large excavated area of the site immediately west of this trench. As a consequence, the antler remains in Lane F/G obviously do

not occur in close proximity to any stratigraphically contemporaneous hearths, and this is strikingly shown in Figure 30 (top histogram) which graphically summarizes the distribution of distances from these antler fragments to their nearest stratigraphically associated hearths. As can be readily seen from this histogram, all of these fragments lie beyond 1.0 m from the centre of their nearest hearth and fully 93.2% of them lie beyond 2.0 m. With a mean distance of 2.620 m, this assemblage of unworked antler is even less well associated spatially with hearths than are oyster shells (Fig. 25), which are by a considerable margin the items most distantly removed from hearths of any category discussed so far. To reiterate, the antler remains in Lane F/G would appear to be refuse which had been removed from their loci of use and dumped in locations relatively far away from any possibly active hearths, as the data summarized in Figure 30 graphically illustrate.

This same interpretation would appear to apply to some of the unworked antler from elsewhere in the site, most notably to four of the six small clusters defined above. Since the two groupings in Lane K lie above the only two hearths in this central area of the site and are not therefore contemporaneous with them, the closest possibly stratigraphically related hearths are some distance away. Likewise, the two more diffuse clusters in the western area of Lanes 4 to 6 (one in Lanes 4 and 5, and the other in Lane 6) lie above the many hearths in this part of the midden, so that they are not in close proximity to any possibly stratigraphically related hearth. However, these four clusters contain only 19 (or 15.4%) of the 123 miscellaneous unworked antler fragments from the rest of the site (i.e. excluding Lane F/G).

In contrast to these four clusters, the one compact cluster in Lane 4 is immediately adjacent to a hearth, while the other compact cluster (in Lane 7), although lying directly above one hearth, is in very close proximity to three others. Although it is always possible that they were discarded in these locations as dumped refuse when

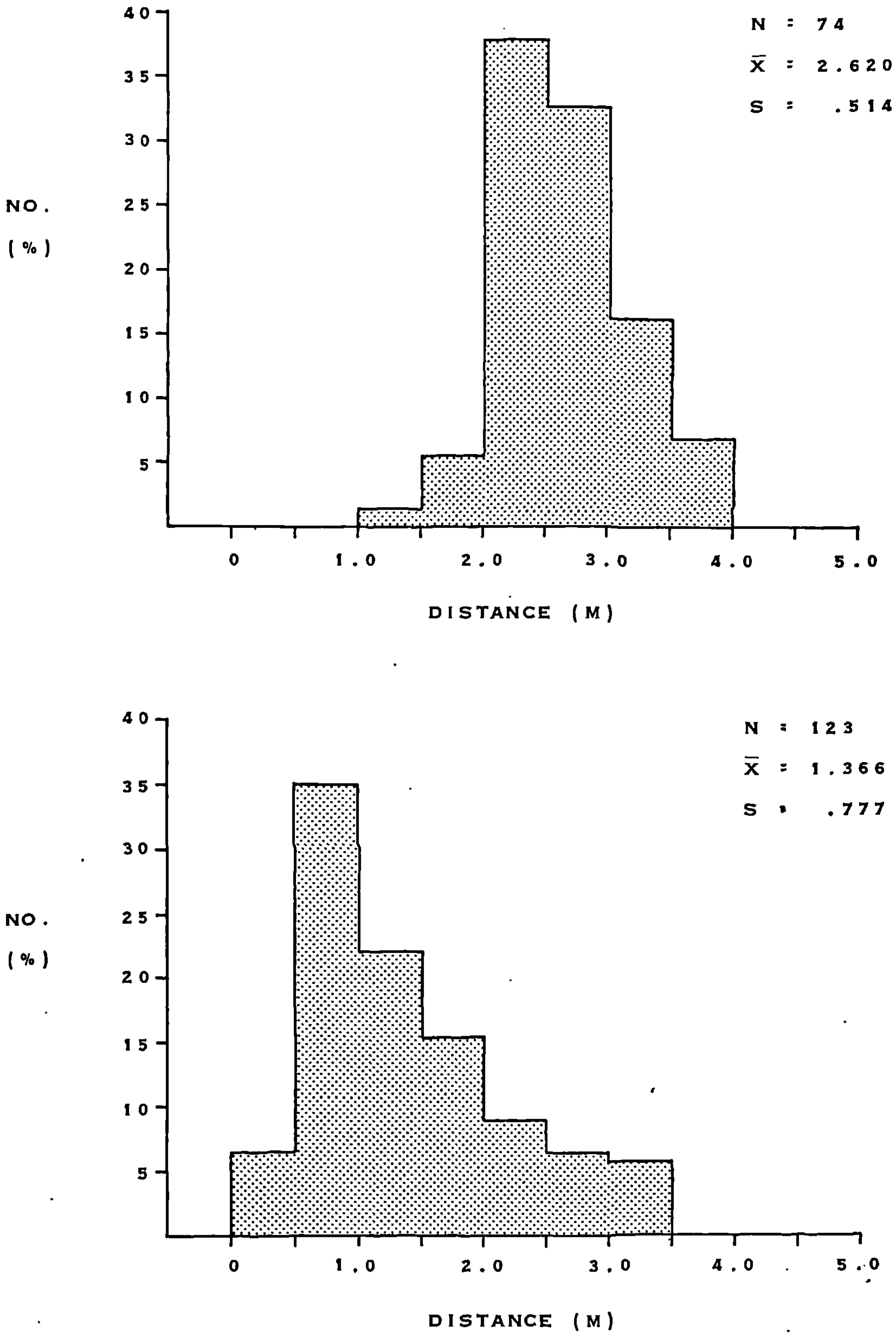


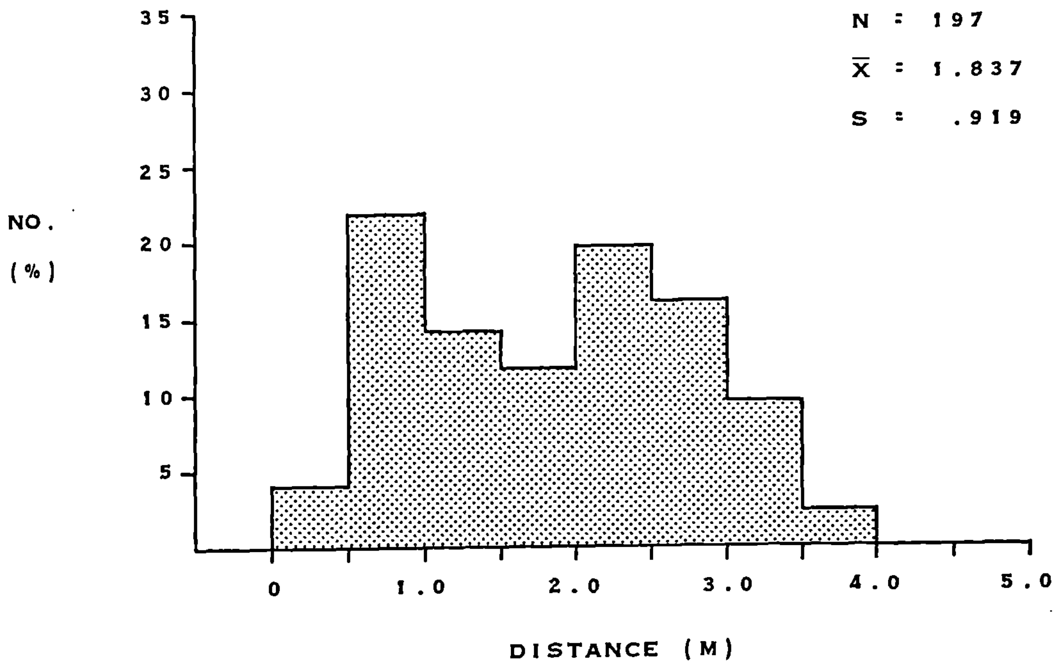
Figure 30. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for the Miscellaneous Fragments of Unworked Antler from Lane F/G (top) and from the Rest of the Site (bottom).

these hearths were not in active use (having been removed from their loci of use somewhere else in the site), it is at least equally possible that they represent primary refuse dropped within antler working loci adjacent to hearths. This same interpretation might well apply to much of the remaining unworked antler fragments, namely, the other half of the antler which is more dispersed throughout the midden. Certainly some of this more scattered antler waste does not occur in the immediate vicinity of any hearths and so also might represent refuse which was dumped or tossed away from its immediate locus of use. However, most of it does occur scattered around hearths. The clearest example of this involves some two dozen fragments located in the north-central area of the midden, in the central portions of Lanes 4 to 7 (Figs. 182-185). When viewed on the depth-compressed horizontal plots (see especially Fig. 176), these fragments appear to constitute a rather large, diffuse scatter -- but when viewed in section and on the depth-selective horizontal plots (Levels 11 to 16 = Figs. 179-181), it can be seen that these remains represent either isolated fragments or an occasional pair of fragments scattered throughout the deposit, all of which are in close proximity to one or more of the many hearths in this area of the site. Aside from this example, there are many instances where an occasional fragment or two is located in the immediate vicinity of hearths, although these cases are less striking because these other areas of the midden do not have the concentration of hearths which is found in the north-central area of the site. At any rate, Figure 30 (bottom histogram) summarizes the distribution of distances to the nearest stratigraphically associated hearth for the antler remains from all areas of the site except Lane F/G. From this, it may be noted that 41.5% of these antler fragments occur within 1.0 m of a hearth, 63.5% within 1.5 m and 78.9% within 2.0 m. Thus, only 21.1% lie beyond 2.0 m, and these are mostly the fragments contained in the four clusters mentioned above. In short, this histogram provides a striking contrast with the one for the antler remains in

Lane F/G. It does not seem unreasonable to regard these isolated antler fragments scattered around hearths, as well as the two small compact clusters mentioned above, as representing primary refuse which was dropped and left in antler working loci around hearths.

Treating the miscellaneous unworked antler fragments as a whole, Figure 31 (top histogram) combines into a single histogram the data contained in the two histograms of Figure 30. What is noticeable from this is that the dichotomous nature of these antler remains in terms of their spatial association with hearths, as observed in Figure 30, is not obliterated. Two peaks are clearly visible, one between 0.5 and 1.0 m and the other between 2.0 and 3.0 m, and these essentially correspond respectively to the scattered (dropped) remains found near hearths and the more clustered (dumped) material found further away from hearths. Moreover, the inclusion of antler bases and tine fragments with the miscellaneous fragments (Fig. 31, bottom histogram) does not obliterate this patterning.

We have just seen that about half of the miscellaneous unworked antler fragments in Cnoc Coig -- including the large concentration in Lane F/G, as well as four of the six small clusters and even some of the more scattered fragments from elsewhere in the site -- appear to represent antler waste which was dumped away from hearths. The other half of the material is found much closer to hearths and is primarily represented by isolated fragments or very small groupings which are highly dispersed throughout the midden deposits. These remains might well represent in terms of discard processes the <u>residual</u> material which remained as primary refuse after the bulk of the antler waste resulting from episodes of antler working had been cleaned up and dumped in low use intensity areas of the site. If this interpretation is valid, then it would be the relatively few isolated specimens found near hearths, and not the large concentrations or clusters, which would indicate the locations of antler working loci!



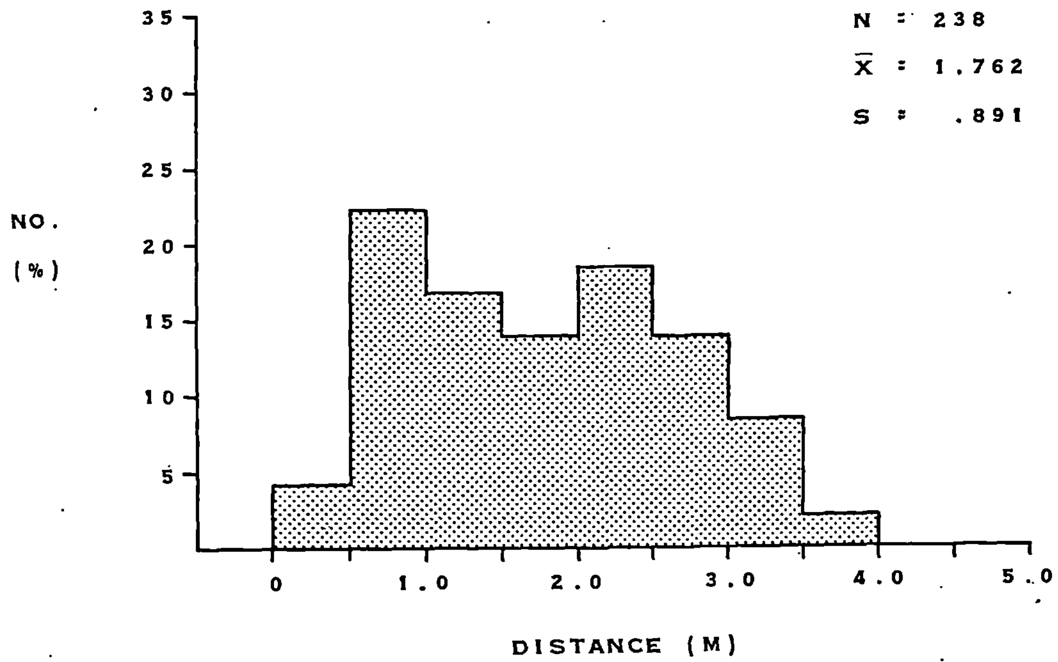


Figure 31. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for All of the Miscellaneous Fragments of Unworked Antler (top) and for These Same Fragments Together with Antler Bases and Tine Fragments (bottom).

Against this interpretation, one might point out that this so-called "residual material" accounts for around half of the finds of unworked antler from the site, which hardly suggests that the bulk of waste antler was cleaned up and dumped. In response to this point however, it might be noted that the antler which is herein recognized as being dumped occurs mostly in Lane F/G, which is located in the area of "shell heaps" on the seaward side of the site. Yet, it is primarily this side of the midden which was not extensively excavated during the recent work at the site, and if much of this unexcavated area is as antler rich as Lane F/G, then the relative proportions of dumped versus dropped waste antler would be much more in favour of the former as one would expect, rather than being roughly equal as they now are on the basis of the presently available excavated material. Of course, this rejoinder can carry only so much weight, since obviously all we have is that which has been excavated. Nevertheless, this does bring us to another point -- namely, that the current discussion is not based on all the excavated data, but rather only on the antler which was recorded in situ. From Table 12, it can be seen that there are nearly as many "other" finds of miscellaneous unworked antler fragments as there are in situ finds, and ideally, a full consideration of this matter should also include this material. Moreover, rather than simply considering the number of finds of antler (which is the basis of the distributions discussed here), it would be preferable to assess the amount of antler, measured either in terms of the total number of fragments or, better still, in terms of the weight of the material. If the data were available in this form, then the relative proportions of dumped versus residual waste based only on the available excavated material might well demonstrate that there already is more dumped than residual antler. Indeed, we would expect that the finds herein recognized as dumped waste would represent more in terms of weight, because presumably the bits of antler which remained as residual material after cleaning up following an episode of antler working would be the smaller, less conspicuous fragments. In any case, until such an analysis is done, this all remains conjectural and the interpretation suggested here regarding dumped (i.e. clustered) versus dropped residual (i.e. dispersed) antler waste must remain tentative. Nevertheless, regardless of how these various remains may be interpreted in terms of disposal modes, these observations suggest that expectation B has only been partially substantiated -- although much of the miscellaneous fragments of unworked antler occur in clusters well removed from hearths, there are hardly any clusters of unworked antler found in close proximity to hearths.

Antler Bases and Tines. According to expectations A and B, it was stated that antler bases and tine fragments would be found in association with, and in similar contexts to, the more numerous miscellaneous unworked antler fragments. However, a detailed examination of Figures 175 to 191 demonstrates that only a minority of these finds are in fact associated with the miscellaneous fragments of unworked antler.

It has already been mentioned that the large concentration of antler in Lane F/G contains one base and four tine fragments, and that the six most notable clusters from elsewhere in the site include six other tine fragments and one other base, as itemized above (p. 380), with two other bases being quite near one of the clusters in Lane K. Thus, ten of the 31 tine fragments and perhaps as many as four (if we err on the side of inclusion) of the ten bases can indeed be said to be directly associated with the clustered remains of dumped antler waste. This means, however, that something like two-thirds of both bases and tines are not well associated with dumped antler, although they do generally occur fairly close to one or more of the scattered fragments of antler, and they can therefore be seen as belonging to the more dispersed component of the antler assemblage. In the case of tines, this should perhaps not be too surprising, since many of them are quite small bits from the very tips of tines which understandably could belong to the scattered residual fragments which "escaped" being cleaned up. The fact that antler bases also belong more to the dispersed than to the clustered component of the antler assemblage is perhaps equally understandable, though for different reasons. Since bases represent the largest pieces of waste antler which may well have been detached from the beam as an initial step in the process of working antler, it is not unreasonable to suggest that they might often have been tossed away from antler working loci rather than being left there to be cleaned up and dumped later -- in other words, because of their large size, they were treated differently in terms of discard processes than were smaller fragments of waste antler. In this context, attention should be particularly drawn to the two bases at the extreme western periphery of the midden in Lanes 5 and 7 (see Levels 12 & 15 = Figs. 179 & 181), neither of which occurs particularly close to a hearth nor even to some of the more scattered fragments of antler.

Regarding their association with hearths, we may compare the observed distances to the centres of the nearest stratigraphically associated hearths for the various categories of unworked antler. These comparative data for the whole of the site are shown in Table 38. From the summary statistics, we may note that the miscellaneous fragments appear to be less well associated spatially with hearths than are antler bases and tines, and the t-tests demonstrate that the observed difference between the miscellaneous fragments and tines is highly significant, although there is no significant difference between bases and the miscellaneous fragments. However, these data in Table 38 are somewhat biased by the inclusion of the antler material from Lane F/G. In terms of relative proportions, Lane F/G contains very few bases and tines compared to the miscellaneous fragments, which means that the inclusion of Lane F/G increases the values of the summary statistics for the miscellaneous fragments much more than for the bases and tines. Because of this, and because the antler bases and tines essentially belong to the dispersed component of the antler assemblage, it is better to omit Lane F/G and

Table 38. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for the Four Categories of Unworked Antler, with t-Tests Assessing the Significance of Observed Differences.

Category	No.	Mean	Std. Dev.	Min.	Max.
Miscellaneous fragments	197	1.837	.919	.246	3.777
Tine fragments	31	1.354	.619	.311	3.036
Antler Bases	10	1.548	.699	.668	2.936
Fork/Beams	7	1.159	.501	.360	1.756

Categories Compared	t Value	Degrees of Freedom	Significant at level: .05	.01
Misc. fragments vs. Tine fragments	2.83	226	yes	yes
Misc. fragments vs. Antler Bases	0.98	205	no	no
Misc. fragments vs. Fork/Beams	1.94	202	yes	no
Tine fragments vs. Antler Bases	0.84	39	no	no
Tine fragments vs. Fork/Beams	0.77	36	no	no
Antler Bases vs. Fork/Beams	1.26	15	no	no

instead base the comparisons on the antler from the rest of the site. These data are shown in Table 39. A comparison between Tables 38 and 39 shows how the inclusion of the remains in Lane F/G affects to varying degrees the descriptive statistics for the different categories. In Table 39, the values of the statistics for the miscellaneous unworked antler fragments are much reduced and are quite comparable to those for the bases and tines; moreover, the t-tests demonstrate that none of the observed differences are significant.

All things considered therefore, the distribution of antler bases and tine fragments does suggest that they can be accommodated by the inferred patterns of discard attributed to the miscellaneous fragments, although most of them would relate to the dispersed (dropped) rather than the clustered (dumped) component of the antler assemblage. The only exception to this conclusion is that some of the bases might have been tossed individually rather than having been dumped along with other antler waste or dropped within antler working loci. Considering these three categories of unworked antler as a single population for the whole of the site, Figure 31 (bottom histogram) shows their spatial relationship to hearths. It can be seen from Figure 31 that the inclusion of bases and tines with the miscellaneous fragments has little effect either on the shape of the histogram or on the mean distance to the nearest hearth.

Antler Fork/Beams. Turning our attention to the one antler beam and the six antler forks found at Cnoc Coig and thus to expectation C, it may be observed from Figures 175 to 191 that none of the fork/beam fragments occurs in the large concentration of unworked antler in Lane F/G nor in any of the small clusters located elsewhere in the site. In short, in accordance with our expectations, they are not associated with any of the unworked antler waste which seems to represent dumped refuse.

Table 39. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for the Four Categories of Unworked Antler, Excluding Material from Lane F/G, with t-Tests Assessing the Significance of Observed Differences.

Category	No.	Mean	Std. Dev.	Min.	Max.
Miscellaneous fragments	123	1.366	.777	.246	3.383
Tine fragments	27	1.279	.624	.311	3.036
Antler Bases	9	1.502	.726	.668	2.936
Fork/Beams	7	1.159	.501	.360	1.756

Categories Compared	t Value	Degrees of Freedom	Significant at level: .05	.01
Misc. fragments vs. Tine fragments	0.55	148	no	no
Misc. fragments vs. Antler Bases	0.51	130	no	no
Misc. fragments vs. Fork/Beams	0.70	128	no	no
Tine fragments vs. Antler Bases	0.89	34	no	no
Tine fragments vs. Fork/Beams	0.47	32	no	no
Antler Bases vs. Fork/Beams	1.07	14	no	no

In fact, three of these large pieces of antler are located in the north-central portion of the site (see Levels 15 & 16 = Fig. 181; also Lanes 4 to 6 = Figs. 182-184), which is precisely the area mentioned above (p. 383) that contains a large number of miscellaneous fragments of antler scattered throughout the midden deposit amidst the many hearths in this part of the site -- if, as suggested above, these scattered fragments indicate the location of antler working loci, then it is tempting to regard these three form/beams as being de facto refuse which had been rested in these locations to be retrieved for later use. Not only are all three of these fork/beam fragments relatively close to their nearest hearth, but one of them is located right on the edge of a hearth. Similarly, the antler fork in Lane I (see Levels 13 & 14 = Fig. 180) occurs directly on a hearth's edge. Indeed, all seven fork/beams are relatively close to a hearth -- all are within 2.0 m of the centre of their nearest hearth, five of the seven are within 1.5 m and three are within 1.0 m. From the perspective of the total assemblage of unworked antler from Cnoc Coig, these seven fork/beams are clearly among the portion of the assemblage which occurs in close proximity to hearths. The descriptive statistics in Tables 38 and 39 illustrate this quite well, although the number of fork/beams is clearly too small to place too much emphasis on comparative statistical data (and indeed, the t-tests do demonstrate that none of the observed differences between fork/beams and other categories of unworked antler can be regarded as being significant).

Thus, as much as the limitations of such a small sample size permit, it would seem that the location and distribution of these few relatively large pieces of unworked antler, in relation to other unworked antler and in terms of their association with hearths, are consistent with the view that they represent rested de facto refuse. In short, expectation C is as verified as one could reasonably expect from the available data.

Pumice Stones

Regarding expectation D, Figure 192 is a depth-compressed horizontal plot showing the locations of the six *in situ* fragments of pumice stone recovered from Cnoc Coig. If we compare the distribution of these finds with that of unworked antler, it is abundantly clear that pumice stones are *not* associated with any dumped antler waste -- that is, either with the large concentration in Lane F/G or with any of the small clusters from elsewhere in the site. Hence, the second of the alternatives expressed in expectation D is clearly refuted.

Does then the distribution of pumice stones support the other alternative, namely, that these artifacts are de facto refuse found in close proximity to hearths? We may answer this question in the affirmative, albeit only very tentatively. Once again, the exceedingly small number of these objects means that it is not possible to make any firm conclusions, especially since the *in situ* finds of pumice are such a small proportion of the total number of these objects from the midden. Nevertheless, the *in situ* pumice stone fragments do occur relatively close to hearths -- all six are within 2.0 m of the centre of the nearest hearth, four are within 1.5 m and three are within 1.0 m, while the mean distance is only 1.116 m (with a standard deviation of 0.473). These distances compare very favourably with those for other items -- such as antler fork/beams, and prickly cockle and cyprina shells -- which are also found near hearths and have been interpreted as de facto refuse. It does not seem unreasonable, therefore, to interpret pumice stones in a like manner. However, given the small size of most of these fragments of pumice stone, it could be argued that they might be more reasonably interpreted as refuse which had been dropped in their loci of use rather than as rested de facto refuse. At present, aside from noting that the *in situ* pumice stones definitely do occur in close proximity to hearths, it is not possible to choose between these alternative interpretations.

Antler and Bone Tools

Figures 193 to 195 are three depth-compressed horizontal plots showing the distribution of all *in situ* finds of the eight categories of worked antler and bone found in Cnoc Coig. Using these, in addition to a series of depth-selective horizontal plots and a variety of sectional plots, we may determine if our expectations regarding these antler and bone tools are borne out. For purposes of illustration, three of the depth-selective horizontal plots are included here as Figures 196 to 198; these show the occurrence of six of the categories (i.e. excluding the miscellaneous worked antler and bone fragments) in Levels 11 to 16, which are the levels containing a majority of these artifacts.

Turning first of all to antler mattock fragments and expectation E, it may be noted that most mattock fragments are dispersed around the midden as isolated specimens. However, the three of them in the east-central area of the site (i.e. in the central portions of Lanes H and I) do occur close together in the form of a small, loose scatter (see Levels 13 to 15 = Figs. 197 & 198). What is particularly interesting is that this small grouping is scattered around a hearth, and it might therefore be suggested that this represents the remnants of a single broken mattock which were discarded in the location where it had been broken up to be recycled for the manufacture of other antler tools. Similarly, it is also interesting to observe that in fact all mattock fragments occur in very close proximity to hearths -- all of them occur within 2.0 m of a hearth, all but one within 1.5 m and seven within 1.0 m (with two others just beyond 1.0 m). This proximity to hearths is reflected in their very low mean distance to a hearth (see Table 40). These data might suggest that all mattock fragments represent refuse which had been discarded in the locations where defunct mattocks were broken up as a supply of recycled raw material.

It should also be pointed out that no mattock fragments occur in Lane F/G where the large concentration of unworked antler is located, or in association with any of the clusters of unworked antler from elsewhere in the site (cf. Figs. 179-181 with Figs. 196-198). It is thus abundantly clear that they are not associated with any dumped antler waste. This observation casts serious doubt on expectation E. Could however mattock fragments be said to be associated with the dispersed component of the unworked antler assemblage? This is a more difficult question to answer given the very scattered nature of these remains. Nevertheless, it might be pointed out that this would be rather difficult to envisage -- although mattock fragments are only small portions of complete mattocks, they are relatively large pieces of antler compared to most of the miscellaneous unworked fragments, and it is doubtful that such fragments (and, more to the point, every single one of them) would represent residual material which had "escaped" being cleaned up. But more importantly, it does not seem that mattock fragments could be said to be well associated with the dispersed component of unworked antler, since there is almost a total absence of unworked antler fragments around all the hearths where mattocks are found. This is rather puzzling since, if broken mattocks were treated as supplies of raw material (which remains a reasonable assumption), then we might expect either that other antler waste (unrecognizable as being from mattocks because they are not from the perforation or the bevelled end) would also occur in association with mattock fragments, or that at least some mattock fragments would have been discarded along with dumped antler waste. In other words, it is difficult to imagine why essentially only pieces which are recognizable as being from mattocks should occur in loci where we might expect that the recycling of mattocks had been carried out, and why no mattock fragments at all were discarded elsewhere along with dumped antler waste. In terms of discard processes then, the distribution of mattock fragments is rather enigmatic, at least in terms of our expectations. Nevertheless, the pattern of distribution of mattock fragments clearly demonstrates that mattocks and unworked antler fragments are not spatially well associated, and that the former would not appear to be referrable to the same processes of discard attributed to the latter -- in short, that expectation E must be firmly rejected, difficult though it may be to explain why this should be so.

Despite the enigmatic nature of mattock fragments in terms of our expectations, it should be noted that their pattern of distribution conforms precisely to that of the other five types of antler and bone tools at Cnoc Coig. Like mattocks, these artifacts are indeed rather scattered throughout the midden (see Figs. 193, 194 & 196-198), as anticipated in expectation F. However, this is not a very startling observation given the small numbers of harpoon fragments, grooved bones, bevelled tine tips and pins -- and indeed, with such small samples, one must be cautious about detecting significant patterning in this respect. However, more interesting are the more numerous borers, which are in fact rather scattered around the site, though somewhat less so than expected. In Lane H, on the north-eastern edge of the excavated area of the site, there are two borers immediately adjacent to one another (see Fig. 198), while southwest of them in Lane I is another associated pair which lies less deep within the midden and is depositionally later. As well, in Lane 7 near the surface of the midden, there are four borers occurring in a linear distribution (spanning ca. 5 m) on either side of a hearth, although the borers in this "linear scatter" might not all be depositionally contemporaneous. In any case, the distribution of borers can be characterized as being generally dispersed, despite the presence of at least a couple of pairs of spatially associated specimens. Thus, the distribution of these five types of antler and bone tools does broadly conform to the anticipated pattern as expressed in expectation F, at least to the degree that the pattern of distribution of these artifacts can certainly not be called clustered.

Table 40. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Six Types of Antler and Bone Tools.

Tool Type	No.	Mean	Std. Dev.	Min.	Max.
Delicate Bird Bone Awls (Pins)	2	2.071	---	1.682	2.459
Robust Antler/Bone Awls (Borers)	17	1.119	.506	.221	2.224
Bevelled Tine Tips	5	1.344	---	.728	2.164
Harpoon fragments	2	1.005	---	.991	1.018
Mattock fragments	11	0.880	.428	.471	1.842
Grooved Bone fragments	2	1.236	---	.604	1.868
Five Types (i.e. all except mattocks)	28	1.227	.561	.221	2.459
All Six Types	39	1.129	.545	.221	2.459

Figures 193 and 194 demonstrate that, except for one pin, none of these tools are found in Lane F/G or are closely associated with any of the clusters of unworked antler found elsewhere in the site -- in short, they are clearly not associated with dumped antler waste. In terms of their proximity to hearths, Table 40 provides summary statistics of the distances of these various antler and bone tools to the centres of their nearest hearths; and combining the data for all types excluding mattock fragments, Figure 32 (top histogram) graphically displays the distribution of these distances. As can be seen, most of these artifacts actually occur in the immediate vicinity of a hearth -- all 28 finds of these tools occur within 2.5 m of a hearth, all but three (or 85.7%) within 2.0 m and fully 21 (or 75.0%) within 1.5 m. Table 41 shows the results of a series of t-tests comparing this distribution to those of various other artifacts discussed previously. In case the visual comparisons of the various histograms were not sufficiently informative, these t-tests demonstrate

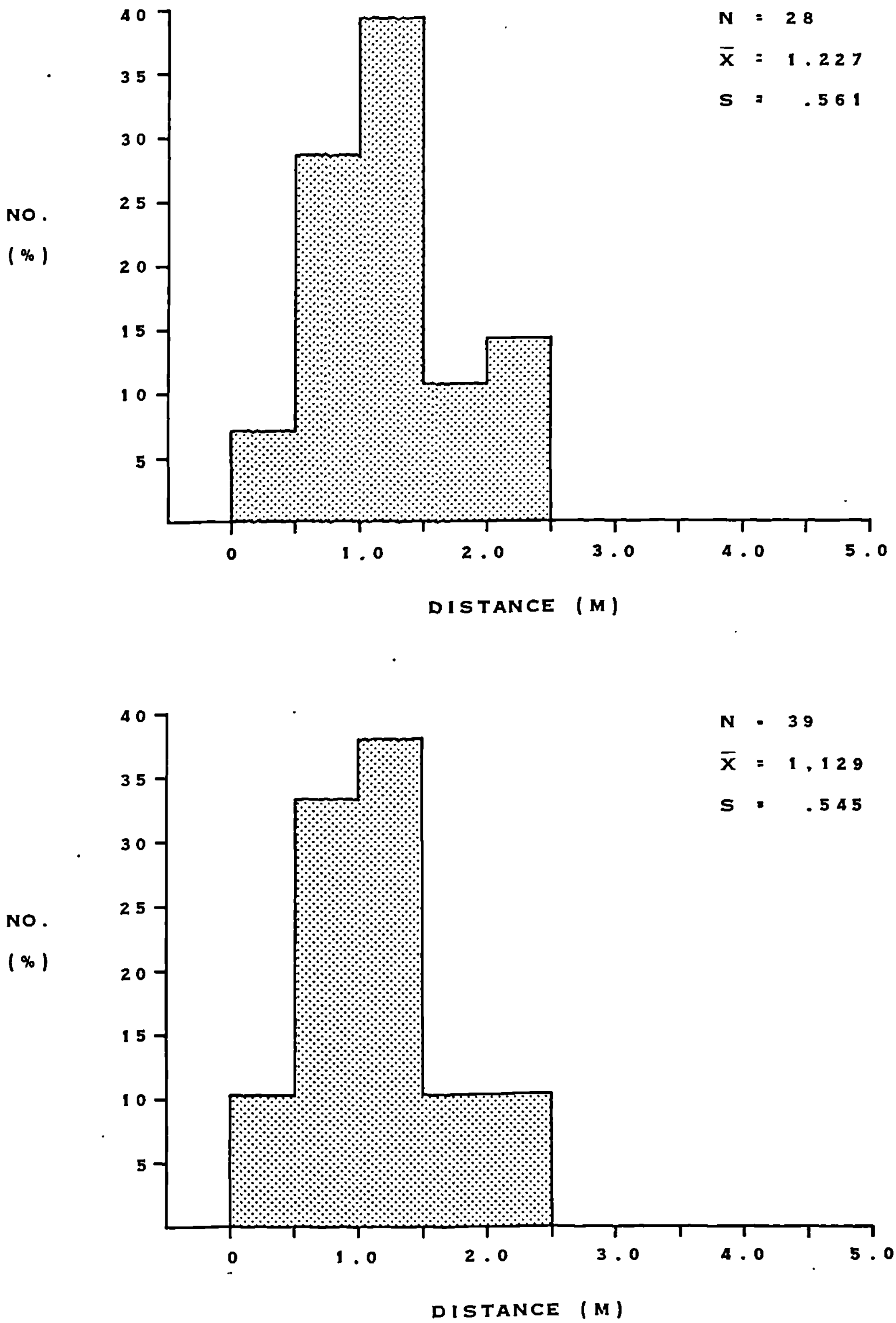


Figure 32. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Pins, Borers, Bevelled Tine Tips, Harpoons and Grooved Bones (top), and for These Five Antler and Bone Tool Types Together with Mattock Fragments (bottom).

Table 41. Results of t-Tests Comparing the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for the Five Antler and Bone Tool Types with Various Other Artifact Categories, and for the Five Antler and Bone Tool Types plus Mattock Fragments with the Same Other Artifact Categories.

5 Antler & Bone Tools vs.	t Value	Degrees of Freedom	Significant at level: .05	Significant at level: .01
Oyster Shells	5.33	118	yes	yes
Unworked Antler (except fork/beams)	3.10	264	yes	yes
Pecten Shells	2.85	233	yes	yes
Pitted Pebbles	1.63	73	no?	no
P.S.L.S.	0.80	165	no	no
Antler Fork/Beams	0.29	33	no	no
Prickly Cockle & Cyprina Shells	0.20	61	no	no
6 Antler & Bone Tools vs.				
Oyster Shells	6.83	129	yes	yes
Unworked Antler (except fork/beams)	4.30	275	yes	yes
Pecten Shells	3.98	244	yes	yes
Pitted Pebbles	2.46	84	yes	yes
P.S.L.S.	1.67	176	yes	no
Antler Fork/Beams	0.13	44	no	no
Prickly Cockle & Cyprina Shells	0.85	72	no	no

that these antler and bone tools are significantly closer to hearths than are oyster shells, pecten shells and unworked antler (bases, tines and miscellaneous fragments), which have been attributed either primarily to dumping (in the case of oysters) or to dumping in combination with other disposal modes (in the case of pectens and unworked antler). On the other hand, they compare quite favourably with items such as antler fork/beams, prickly cockle and cyprina shells, pitted pebbles and P.S.L.S., which have been attributed either primarily to resting or to resting in combination with other disposal modes. In the case of these antler and bone tools, resting is an unlikely mode of disposal for them, except perhaps for some of the borers which might not have been broken or worn out beyond further use. Therefore, like mattock fragments, these artifacts would appear to have been dropped in locations immediately around hearths, which might correspond to major generalized activity areas and/or to some more specialized activity areas. In any event, it seems abundantly clear that neither dumping nor tossing are very likely to have been disposal modes employed in the discard of these antler and bone tools, which flatly contradicts expectation G and demands its rejection. Finally, since the distribution of mattock fragments does not resemble that of unworked antler as expected, but rather that of the other types of antler and bone tools, we may combine the data for all the antler and bone tools from Cnoc Coig (except of course limpet scoops) to produce a single histogram (Fig. 32, bottom). Given that mattock fragments are in very close proximity to hearths, this combined data set for all six antler and bone tool types reveals a pattern of even greater spatial association with hearths -- and when compared to other artifact categories (Table 41), it is seen to be significantly closer to hearths than all other artifacts except for antler fork/beams and prickly cockle and cyprina shells, which are the only of these other artifacts which have been attributed primarily to resting. In short, these six types of antler and bone tools reveal a quite striking tendency to occur in close proximity to hearths.

Lastly, we may turn our attention briefly to the miscellaneous worked pieces of antler and bone, the distribution of which is shown in Figure 195. Even though these two categories are generic ones which do not involve the same degree of functional and behavioural integrity as do the other types of worked antler and bone, a few observations concerning their spatial distribution are warranted. First of all, these artifacts are indeed widely scattered throughout the midden, as was anticipated in expectation H. Even in the few instances where two or three of these items appear to be associated as seen in Figure 195, when viewed in section, they can be seen in fact to be stratigraphically separated. Secondly, also as predicted, at least a few of these artifacts are associated with unworked antler waste. Most notable in this regard are the six fragments (three of antler and three of bone) found scattered throughout the deposit in Lane F/G where the largest concentration of unworked antler is located. It seems quite likely that these fragments were discarded in this area along with the antler waste, perhaps as unfinished objects which were "false starts" or which broke during manufacture. In any case, expectation H is fully substantiated.

In terms of their proximity to hearths, Figure 33 summarizes the distances from these miscellaneous pieces of worked antler and bone to the centres of their nearest hearths. As this shows, the majority of these artifacts do occur relatively close to hearths -- all but six of them (79.3%) occur within 2.5 m of a hearth, 21 (72.4%) within 2.0 m and 18 (62.1%) within 1.5 m. Comparing Figures 32 and 33, it can be seen that these items reveal a somewhat wider range of distances than do the other six categories of worked antler and bone -- most particularly, six of them occur beyond 2.5 m whereas none of the six types of antler and bone tools lie beyond this distance. However, it is precisely the presence of these few items (most of which are the ones from Lane F/G mentioned above) which creates the differences between these fragments and the six other

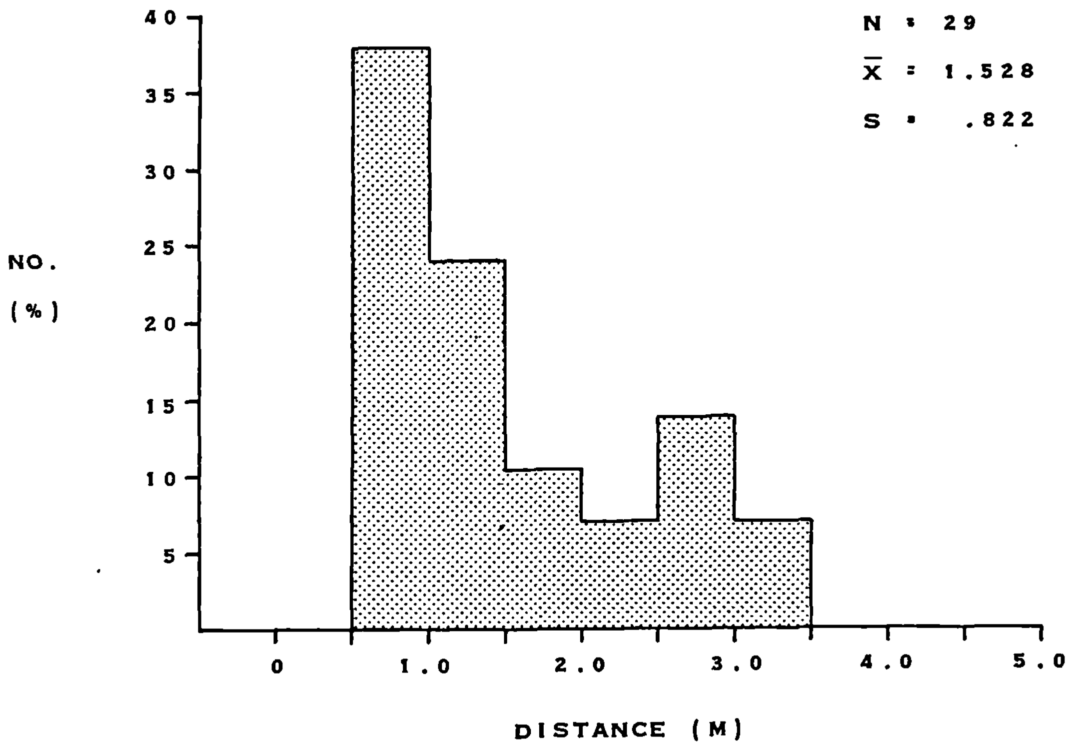


Figure 33. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for the Miscellaneous Fragments of Worked Antler and Bone.

categories of worked antler and bone artifacts. In other words, except for the items dumped in Lane F/G, the large majority of the miscellaneous worked fragments of antler and bone are very similar to the more formally recognized tool types. In this one respect, expectation I has been substantiated. However, otherwise and like expectation G, it must be rejected since these antler and bone artifacts generally are quite well associated with hearths, and they would appear to have been dropped in locations adjacent to hearths and not discarded by a wide variety of disposal modes. In conclusion, other than a few items which may be interpreted to have been dumped in locations further away from hearths, these pieces of worked antler and bone would appear to be essentially referrable to the same discard processes as the six more formally defined antler and bone tool types.

Items of Decoration

The overall distribution of the few decorative shells is shown in Figure 199. Aside from noting their presence, the locations of the three single decorative shells (two cowries and one pierced flat winkle) are of minimal importance since they presumably represent lost items, and in any case, with so few of them, it would be meaningless to refer to significant patterning in these data. Nevertheless, it might be noted that none of these occur in the immediate vicinity of hearths, the three of them lying between 1.5 and 2.5 m from the centre of the nearest hearth. In contrast, the two caches of cowry shells are found in very close proximity to hearths. In fact, both are less than 0.5 m from the centre of the nearest hearth, lying very near the edge of the hearth, and both are in areas where other possibly contemporaneous hearths are also quite nearby (ca. 0.8 and 1.2 m to their next closest hearths) -- these various hearths are shown in Figure 199. Therefore, these two cowry shell caches conform remarkably well to our expectations regarding de facto refuse and indeed, as "definitive" examples of such, they lend confidence to the suggestion that de facto refuse can be recognized, at least to a large extent, by its being located near hearths. At any rate, we have seen that expectation J is fully substantiated.

Finally, the distribution of the in situ finds of red ochre are shown in Figure 200, while Figures 201 and 202 are two vertical plots of the red ochre fragments found in the south-central portions of Lanes I and J. From the depth-compressed horizontal plot (Fig. 200), it can be seen that much of the red ochre occurs as isolated fragments scattered around the midden, and when differences in depth are also taken into account, this dispersed pattern is even more evident. However, about half of the red ochre fragments are found in the east-central area of the site (in Lanes H to K) and, especially in this area, a number of small groupings can be defined (see Figs. 201 & 202). These fragments are, therefore, in contrast to the otherwise generally dispersed pattern of distribution and, since these few groupings account for about half of the in situ red ochre, it is doubtful whether the overall distribution can be described as dispersed. In either case, since all of the groupings are very small and so do not seriously contradict our expectations, it may be concluded that expectation K is reasonably well confirmed.

Expectation L stated that red ochre fragments would not generally occur close to hearths. Figure 34 summarizes the distances to the centres of the nearest hearths for the finds of red ochre. From this, it can be seen that 10 (31.3%) red ochre fragments occur within 1.0 m of a hearth, 18 (56.3%) within 1.5 m and fully 24 (75.0%) within 2.0 m; and the mean distance is only 1.538 m. These data suggest that, in terms of the proximity to hearths, red ochre fragments compare quite favourably with such artifacts as antler fork/beams, the various antler and bone tools, prickly cockle and cyprina shells, and P.S.L.S. -- and they are particularly similar to pitted pebbles. These various artifacts, or at least the majority of finds of each type, have been interpreted to be either de facto refuse or primary refuse which had been dropped in hearth-centred

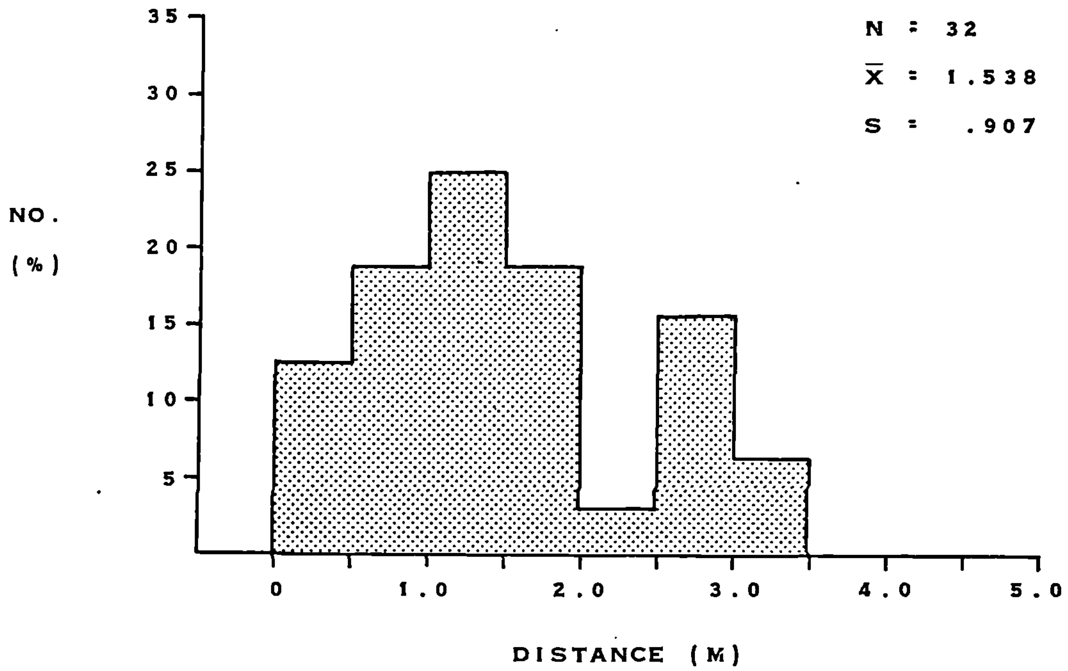


Figure 34. Frequency Distribution of the Distances to the Centres of the Nearest Stratigraphically Related Hearths for Red Ochre Fragments.

activity areas; and presumably one of these interpretations would also apply to red ochre. What is particularly interesting about the data shown in Figure 34 is the gap in the distribution that occurs between 2.0 and 2.5 m within which only one fragment is located; and in fact, this gap is even greater than this histogram suggests because this one fragment is the only one between 1.695 and 2.701 m, a gap therefore of fully one metre. This could suggest that we are dealing with a non-homogeneous population, with one group (the large majority) occurring near hearths and the remainder being much more distantly removed; and presumably, different disposal modes would be involved with each. In any case, it is clear enough that expectation L is not substantiated.

However, the reason for this seems clear enough, and indeed, it was even embodied in expectation L. Four of the seven definable groupings of red ochre (including the three groupings with more than two fragments) occur quite near a hearth (within 1.5 m from the hearth's centre), and these few groupings account for nearly 40% of the <u>in situ</u> red ochre from the site. Consequently, expectation L went awry because it did not anticipate that a few small clusters near hearths would comprise such a large proportion of the red ochre assemblage, thereby affecting the data to the degree that they have. Nevertheless, it is clear that, aside from these four small clusters, most of the scattered isolated fragments also occur relatively close to hearths. Thus, expectation L really does underestimate the degree to which red ochre fragments are found near hearths. Because of the small size of most red ochre fragments, it seems doubtful that they represent rested de facto refuse; rather, it seems more likely that they represent primary refuse which was dropped within hearth-centred activity areas and which was not later cleaned up and dumped elsewhere (as with antler waste), presumably because these fragments were neither large enough nor sufficiently numerous to interfere with other activities carried out in these areas. This explanation would apply to the three-quarters of the red ochre fragments which occur within 1.7 m of a hearth.

The remainder of this apparently non-homogeneous population (i.e. the remaining one-quarter of red ochre fragments which lie beyond 2.7 m from a hearth) might be thought to represent either discarded lumps which were tossed further away from hearth-centred activity areas or possibly refuse which had been dropped in a locus of use not immediately adjacent to a hearth. In either case, it may be concluded, in contradiction to expectation L, that most of the *in situ* red ochre fragments from Cnoc Coig do occur in relatively close proximity to hearths and may be interpreted as refuse dropped in their loci of use.

Summary and Conclusions

Returning now to our set of expectations, it may be recalled that expectation A involved the prediction that unworked antler would reveal a markedly clustered distribution overall. As we have seen, this is indeed the case but only to a certain extent -- that is, much of the unworked antler in the site does occur in association with other antler, but there is also a considerable amount of it which is much more dispersed throughout the midden. Stemming from expectation A, expectation B involved a somewhat ambiguous prediction in which *clusters* of antler would either be found around hearths (representing primary refuse dropped within antler working loci) or further removed from hearths (indicating dumped refuse which had been cleaned up from antler working loci), or possibly even in both contexts. In fact, one aspect of this dichotomous expectation has been largely borne out -- that is, antler does indeed occur both near hearths and further away. However, the idea that these would *both* involve clusters of antler has not been substantiated, since it is clear that the most notable clusters (with two exceptions) and the very large concentration in Lane F/G occur away from hearths, and that it is isolated specimens or occasional pairs of fragments which are found near hearths. Therefore, expectation B has essentially not been verified, or at best it has been only partially substantiated. Yet, it would appear that the reasons for this may be quite understandable in terms of discard processes. We have seen that about half of the miscellaneous fragments of unworked antler, including most clusters and the large concentration in Lane F/G, appears to represent antler waste which had been dumped away from hearths. The other half of the material, which is found much closer to hearths and primarily consists of isolated fragments or very small groupings which are highly dispersed throughout the midden, might well represent the residual material which remained as primary refuse after the bulk of the antler waste had been cleaned up and dumped in areas of low use intensity. While this interpretation must remain somewhat tentative, the dichotomous nature of the observed pattern of distribution of unworked antler is certainly explained better by it than by the rather ambiguous interpretation embodied in our initial expectations.

One other aspect of expectation A was that antler bases and tine fragments would be found in association with, and in similar contexts to, the miscellaneous fragments of unworked antler -- that is, that they would essentially be referrable to the same processes of discard. The observed distribution of bases and tines does bear this out to a large extent. However, only a minority of the finds of these two categories of unworked antler are directly associated with the dumped clusters of miscellaneous fragments, and the majority of them relate to the more dispersed component of the unworked antler assemblage at Cnoc Coig. Nevertheless, this observation can readily be understood in terms of the likely processes of antler working and discard, and it does not compel us to think that antler bases and tines cannot be accounted for by the discard processes attributed to the miscellaneous fragments, with the important exception that tossing may have been an additional disposal mode for bases not employed for other antler waste. Finally, despite the limitations imposed by the small number of them, the antler fork/beams do conform very well to expectation C, namely, that they represent items which had been rested in convenient locations to be retrieved for later use but which had been abandoned as de facto refuse in these locations near hearths.

Regarding the assemblage of worked antler and bone artifacts at Cnoc Coig, it has been seen that three of our five expectations have been rejected. Since mattock fragments are not spatially well associated with unworked antler and particularly with the dumped clusters of unworked antler, it would appear that they cannot be attributed to the same processes of discard. Therefore, expectation E must be rejected. The other five types of antler and bone tools are indeed rather dispersed throughout the site so that, despite the presence of two pairs of associated borers, expectation F is effectively confirmed. Likewise, expectation H is substantiated since the miscellaneous fragments of worked antler and bone are also dispersed throughout the midden, a few of which are associated with dumped antler waste as anticipated. However, expectation G is not substantiated because the antler and bone tools are very well associated with hearths, and they would appear not to be referrable to a variety of disposal modes nor in particular to tossing; rather, they seem to have been dropped, or perhaps rested in a few cases (especially borers), in locations immediately adjacent to hearths. The same would apply to the miscellaneous worked fragments of antler and bone, except for the few specimens which were discarded in dumping locations away from hearths. Expectation I must therefore also be rejected. In summary, all eight categories of worked antler and bone reveal a quite strikingly similar pattern of distribution. Except for a couple of pairs of associated borers, all of them are very scattered throughout the midden, which presumably reflects the infrequency of their discard as a result of their (generally) curated nature. More importantly, other than a few dumped fragments of miscellaneous worked antler and bone, all of them show a consistent pattern of being closely associated with hearths, and it may be suggested that these artifacts were primarily discarded by being dropped within the immediate vicinity of hearths.

It has been seen that pumice stones are not associated with any of the apparently dumped antler waste, which thereby refutes the second of the two alternatives expressed in expectation D. On the other hand, the *in situ* pumice stone fragments do occur in close proximity to hearths, which might be seen to support the other alternative expressed in expectation D, namely, that they represent rested de facto refuse. However, because of the small size of these pumice stone fragments, they might be more reasonably interpreted as refuse dropped in their loci of use. In either case, given the exceedingly small number of these objects and particularly the fact that the *in situ* finds of pumice are only a small proportion of their total number in the site, it is not possible to make any firm conclusions.

Likewise for decorative shells, little can be said about the spatial patterning of these objects because there are so few of them. Nevertheless, it is interesting to note that the two caches of cowry shells are found very close to hearths, lying very near the edges of their nearest hearths and quite close to their next nearest hearths, which conforms remarkably well to expectation J that they represent rested de facto refuse. Finally, we have seen that the red ochre fragments are rather scattered around the site, although a few very small groupings can be defined. Because these groupings are so small, they do not seriously contradict expectation K. However, expectation L has not been substantiated since the large majority of red ochre fragments do occur in close proximity to hearths. These fragments are probably best interpreted as refuse dropped within hearth-centred activity areas, while the remaining few red ochre fragments which are considerably more distantly removed from hearths may be referrable to other discard processes (such as being tossed away from their loci of use).

CHAPTER 11

SUMMARY AND SYNTHESIS

Up to this point, we have examined the spatial distributions of all categories of material whose precise three-dimensional locations were recorded during the recent excavations at Cnoc Coig. This has involved two basic aspects: (1) characterizing the distributions in terms of tendencies towards clustering on the one hand and towards dispersion on the other; (2) examining the occurrence of various materials in terms of their spatial association with the many hearths within the midden. It remains for us to make a few general remarks concerning the problems associated with the spatial analysis of shell middens, to discuss briefly the wider relevance of the present study, to summarize the main features regarding the observed patterns of distribution of materials in Cnoc Coig, and to make a few concluding statements concerning prehistoric human behaviour and the nature of the occupations represented by the shell midden deposits at Cnoc Coig.

The Spatial Analysis of the Cnoc Coig Shell Midden

Problems and Limitations

As a very minimal result, this study has amply demonstrated that patterning is highly evident in the distribution of material within the Cnoc Coig shell midden, or in other words, that the site is highly structured in spatial terms. Of course, this should hardly come as a surprise, since hopefully no archaeologist today would seriously argue that shell middens are simply random accumulations of discarded refuse. Indeed, it would be absurd to suggest that any archaeological site (barring large-scale disturbance) would be totally spatially unstructured and contain no spatial information whatsoever.

Nevertheless, there may be some who feel that shell middens, because of their low degree of resolution, are sites for which the results of spatial analysis would not be sufficient to justify the time and effort required to excavate large areas and to record the precise locations of objects within the deposits. It is certainly true that obtaining the kind of detailed information which is needed for an adequate spatial analysis of a shell midden is fraught with practical difficulties and is comparatively expensive on time and manpower resources. And from the analysis point of view, it is also true that, given the palimpsest nature of shell midden deposits, identifying spatial patterning in the data can be relatively difficult and time-consuming, while interpreting the observed patterning or structure is also fraught with problems.

However, it should be noted that this observation also applies to many other kinds of sites, referring especially in the present context to those generated by hunter-gatherers. As was mentioned in Chapter 2 (pp. 32-33), recent ethnoarchaeological research of hunter-gatherer settlements, especially in non-aggradational (i.e. stable or degradational) environments, has shown that reuse of settlement locations is quite common, resulting in archaeological sites which are palimpsests of debris from numerous overlapping occupational episodes which may even involve situationally different kinds of settlements in the same place (e.g. see Binford 1982; 1983: 131; Gould 1968: 107, 112, 119; 1977b: 33; 1980: 26-27, 199). Such sites, therefore, are also characterized by an extremely low degree of resolution. Moreover, other research (Gifford 1978: 81-83; Gifford & Behrensmeyer 1977: 257-258; Yellen 1977: 103) has shown that, on sites with fairly loose sandy surfaces, trampling can result in individual occupations being represented by a considerable depth of deposit with a size sorting of objects by depth (see also Baker 1978). Thus, even in many aggradational environments, multi-occupation sites may in fact have suffered some vertical mixing due to occupational disturbance and other processes

(Villa 1982; Villa & Courtin 1983), with the result that the degree of resolution of seemingly discrete levels in multi-component sites may not be as high as many researchers have assumed. In short, the point is simply that shell middens are not unique among hunter-gatherer sites in terms of having low resolution and being palimpsests of several occupational episodes.

Thus, there are problems with many kinds of hunter-gatherer sites in defining depositionally meaningful assemblages of items to use as "spatial units of analysis" in order to enable the identification of spatial patterning in the data which is potentially behaviourally meaningful; and of course, interpreting observed patterning in terms of human behaviour is not a simple, straightforward task even when dealing with high resolution spatial units of analysis. Consequently, it is quite unjustified to single out shell middens as sites which are unworthy of investigation from the perspective of spatial analysis. Naturally, individual researchers will have to judge each specific case on its own, but if the time and manpower resources are sufficient to cope with the task of excavation and recording, there is certainly reason to believe that shell middens can be a rich source of data pertaining to spatial archaeology at the intra-site level. Thus, at the very least, the present study of Cnoc Coig has served to demonstrate that shell middens are <u>not</u> spatially unstructured and uninformative sites which should be shunned from the perspective of spatial archaeology, but rather, that they can be expected to be highly structured in spatial terms and may be expected to be potentially informative about human behaviour and the cultural formation processes which are responsible for their formation.

Of course, the key phrase here is "potentially informative". As with all sites, identifying patterning or structure is one thing, but interpreting observed patterning in behaviourally meaningful terms is another matter altogether. Indeed, the main challenge to spatial archaeology at all levels is not developing methods of analysis to detect and define patterning in data, important though this is. Rather, as Binford (e.g. 1983: 190-192) has often recently stressed, the main challenge is to develop a body of theory which increases the ability of archaeologists to interpret more reliably and more accurately recognizable patterns in archaeological data, in this case with respect to site structure. The main limitations to the present study, therefore, are not so much a result of the particular difficulties associated with studying shell middens, nor of the lack of quantitative techniques which can be employed at a site such as Cnoc Coig, as they are a result of the lack of adequate theory which would increase our ability to interpret the abundant spatial patterning in the data which is already readily observable. Nevertheless, despite the problems of analysis and interpretation, not only has the present study revealed much patterning in the distribution of material within the midden, but Binford and other researchers have begun the process of theory building which enables us to put forward some tentative interpretations of the site *structure observed at Cnoc Coig*.

The Wider Relevance of Cnoc Coig

Before these results and interpretations are summarized however, reference should be made to the wider relevance of the present study since it should not be seen as being simply an exercise in archaeological particularism. As noted in Chapter 1, the detailed spatial analysis of a single site such as Cnoc Coig is of obvious importance for the Obanian as a whole given that previously very little had been known in detail about the spatial composition of an Obanian shell midden. While of course no single site can be claimed to be typical in every detail, many broader aspects of the spatial patterning observed in the distribution of material within one site can be extended to other similar sites. A couple of examples should be sufficient to illustrate the wider relevance of the present study for the Obanian as a whole.

Firstly, given the large numbers of limpet scoops found in all Obanian shell middens, the ubiquitous nature of the distribution of limpet scoops found in Cnoc Coig (see pp. 304-308) is undoubtedly typical of Obanian sites. Similarly, given that the same formation processes may be presumed to have been in operation, the proposed model of limpet scoop discard and the pattern of spatial segregation between A.L.S. and S.L.S. observed in Cnoc Coig (see pp. 308-318) undoubtedly apply to all of the Obanian shell middens on Oronsay; and consequently, the implications that this model has for the exploitation of red deer (see pp. 432-433 below) pertain to all of the Obanian occupations on the island and not just to Cnoc Coig.

A second example concerns what the spatial analysis of the mammal bone assemblage implies about the number of occupations which the Cnoc Coig shell midden represents. As is discussed in Chapter 6 (pp. 268-269; see also p. 436 below), when the mammal bones at Cnoc Coig are reduced to groupings of spatially associated bones, the number of definable groupings is quite low. Indeed, as few as ten or 12 <u>major</u> depositional episodes of mammal bones might be indicated by these groupings; and since some individual occupations might account for more than one of these major depositional episodes, the total number of episodes of occupation at Cnoc Coig indicated by the mammal bone groups could be even less than ten or 12. Alternatively, if this low number of occupational episodes is too low to account for the quantity of other material within the midden, as would seem to be the case with mollusc remains for example, then what this implies is that mammals were a relatively minor food resource for the Mesolithic inhabitants of Cnoc Coig. In other words, even though the overall quantity of extant mammal remains in Cnoc Coig is impressively large compared to most other Mesolithic sites in Britain, when this mammal bone assemblage is broken down either into a number of definable spatial groupings or into M.N.I. estimates (see Grigson 1985), and when the amount of food so indicated is spread over many episodes of occupation, then this suggests that mammals played a relatively minor role in the overall subsistence economy of the Mesolithic inhabitants of Cnoc Coig and, by extension, of the other Obanian sites on Oronsay which have not been as thoroughly excavated or analysed as has Cnoc Coig.

In addition, the present study potentially is archaeologically relevant from a number of perspectives wider than simply that of the Obanian "culture" of western Scotland. Firstly, it hopefully has some relevance to the archaeological study of hunter-gatherer camp sites in general. An attempt has been made in the present study to utilize a basic concept embodied in Binford's (1978a) ethnoarchaeological study of the Mask Site. It should be emphasized, however, that this has not involved attempting to fit the archaeological distributions observed at Cnoc Coig into Binford's (1978a: Fig. 4; 1983: Fig. 89) idealized model of individuals seated around an outside hearth with its resulting drop and toss zones. As is discussed further below, the study of prehistoric hunter-gatherers will hardly be advanced if this model seating plan is simply superimposed on all archaeological distributions at ancient hunter-gatherer camp sites, an approach which would simplistically result in all hunter-gatherer sites in the archaeological record becoming variants of the Mask Site! Rather, it is argued here that archaeologists should develop criteria to identify objectively disposal modes in the archaeological record, which would be a necessary prerequisite to delimiting on the ground specific disposal localities (such as drop zones or toss zones) rather than assuming from the outset the presence of such disposal localities within specific archaeological distributions. In the present study of Cnoc Coig, Binford's concept of disposal modes has been utilized in an attempt to identify the modes of disposal employed in the discard of various materials (especially artifacts) in the site, even though it was not feasible in this case to go on from this to delimit specific disposal localities within the midden. Thus, rather than simplistically applying Binford's Mask Site model seating plan, the current investigation of Cnoc

Coig has attempted to use in a less naive fashion some ethnoarchaeological observations by Binford and others, which hopefully points to at least one possible direction forward for the spatial analysis of ancient hunter-gatherer camp sites in general.

Another area of general relevance concerns techniques used in the present study which might be widely applicable to the analysis of shell middens and to spatial analysis generally. For example, sectional or "lane" plots were extensively used for investigating spatial relationships within the Cnoc Coig shell midden, particularly for examining relationships in terms of the relative depths within the midden deposits. These lane plots were found to be a very flexible and highly useful tool for examining and displaying spatial relationships, and of course such lane plots could be equally useful for the spatial analysis of any shell midden, or indeed any archaeological site for which investigating spatial distributions in terms of the depth dimension might be of interest. Although sectional plots have occasionally been used before in archaeology (e.g. Bunn et al. 1980), their effectiveness in the present study amply demonstrates that such lane plots could be employed far more extensively in intra-site spatial analysis in archaeology.

Similarly, the use of Pielou's (1961: 258-259; 1969: 182-183) coefficient of segregation to test for the presence of segregation in the distributions of A.L.S. and S.L.S. within Cnoc Coig (see pp. 308-318) provides a good example of how this statistical technique can be useful to archaeological spatial analysis in general, and this example is all the more important given that this technique has sometimes been misused when applied to archaeological data (see pp. 56-58). Even more importantly, for its use in the present study, Pielou's coefficient of segregation has been extended to deal with three-dimensional distributions and a statistically more sound method of assessing the significance of the results of this test has been developed (see pp. 205-210; Fieller et al. 1983), all of which increases the general archaeological utility of this statistical technique which of course may be employed in the spatial analysis of any archaeological site.

Finally, mention should be made of another point of general relevance which the detailed investigation of Cnoc Coig may offer to shell midden analysis. The large-scale areal excavations at Cnoc Coig and the present spatial analysis of the midden which is based on these should provide an invaluable comparison with the results of Peacock's (1978) research at the site in order to assess how successful his probabilistic sampling strategy was in terms of obtaining truly representative samples of the midden's contents. Although this comparison is not within the scope of the present study, some of the results of the spatial analysis of Cnoc Coig should contribute to this comparison which is of obvious interest to shell midden analysis in general. Thus, the present study of Cnoc Coig is potentially of wider archaeological relevance from a number of perspectives. At any rate, we may now summarize the preceding discussions in Chapters 6 to 10 regarding the observed patterning in the distributions of material within Cnoc Coig.

The Nature of the Distributions

Tendencies towards Clustering or Dispersion

As stated above, the distributions of all classes of material whose precise three-dimensional locations were recorded during the recent excavations at Cnoc Coig have been characterized in terms of tendencies towards clustering or dispersion. Such characterizations have been based on the "subjective" assessment of the distributions by means of the visual inspection of a wide variety of computer-generated horizontal and vertical distribution plots, rather than by means of some "objective" statistical measure, such as some form of univariate distance method of point-pattern analysis (i.e. "nearest-neighbour analysis"). The use of some such statistical method was precluded from the present study for two reasons. Firstly, such methods are designed to analyse two-dimensional data, whereas the distributions at Cnoc Coig are three-dimensional; it would of course be an absurd waste of time and resources to ignore the depth dimension and simply carry out a nearest-neighbour analysis on three-dimensional data as if they were two-dimensional, since the results would be more or less meaningless. And secondly, even if some univariate distance measure could be adapted to analyse three-dimensional data, the highly irregular nature of the excavated areas at Cnoc Coig would effectively preclude the use of nearest-neighbour analysis, given the major problem of boundary effects with such methods. Moreover, these univariate distance methods are reductionistic in that a large amount of distributional data is reduced to a single statistic -- some of the interesting features of the distributions within Cnoc Coig would thus be obscured or overlooked. Having said this however, it is true that such nearest-neighbour statistics could be used to complement the visual inspection of distribution plots, and they need not be seen as antagonistic to the traditional "eyeballing" method of spatial analysis. In short, there is no doubt that some objective measure of the relative degrees of clustering versus dispersion would be of some utility, but given the practical difficulties of employing such a measure in the present study, the subjective assessments of the various distribution plots will have to suffice.

With these preambulatory remarks in mind, we may summarize the observations contained in Chapters 6 to 10 by displaying the various categories of material in the Cnoc Coig midden along a continuum ranging from highly clustered at the one extreme to highly dispersed at the other. This is shown as Table 42. The first thing to note from this table is that, except for the bones of the category I birds, all the categories which represent food refuse occur at or near the highly clustered end of the continuum -- or stated differently, all the items which are highly clustered represent food refuse, except for the clustered half of

Table 42. Summary of the Relative Tendencies towards Clustering or Dispersion for the Mammal and Bird Bones and the Various Artifact Categories from Cnoc Coig.

Highly Clustered	Clustered with some Dispersal	Dispersed with some Clustered	Highly Dispersed
seal	red deer		8 birds (category I)
otter			
pig	9 birds (category II)	A.L.S./S.L.S.	
human		P.S.L.S.	S.L.H.
Bewick's swan		P.S.L.S./H.	U.S.L.S.
teal		pitted pebbles	
curlew		red ochre	
quail	pecten shells		prickly cockle & cyprina shells
oyster shells			pumice
ca. ½ unworked antler		ca. ½ unworked antler	
			antler bases
		antler tines	antler forks
			6 antler/bone tools

the unworked antler in the site. On the other hand, all the material towards the highly dispersed end of the continuum are artifactual remains, except for the eight species of category I birds (and these are the species of birds which are represented by a very small number of finds and some of which may even be present in the midden due to non-human agents). The remains of red deer occupy a more central position along the continuum than do the remains of other mammals, which reflects the fact that some of this material represents food refuse while some of it is essentially artifactual in nature (in the form of metapodial bones used as raw material for tool manufacture).

However, the occurrence of these various categories of material along this continuum relates not so much to whether the items should be regarded as food refuse versus artifactual remains, as to the (inferred) disposal modes employed in the discard of the various categories. Items which are highly clustered are thus material which has been attributed to dumping or dropping, while highly dispersed items are remains which have been attributed primarily either to resting (as de facto refuse), to dropping, or to tossing. The few categories of artifacts which are characterized by being generally dispersed with some clustering (in the form of small groupings) are attributed to resting and/or dropping. The only exception to this are limpet scoops which have been interpreted to be either tossed or dumped -- in the latter situation, their dispersed nature results from being dumped along with large numbers of limpet shells in which only one or a few limpet scoops were discarded in any one dumping episode. Finally, the items which are characterized by a higher degree of clustering but still a moderate degree of dispersal (i.e. pecten shells and red deer bones) are attributed to a combination of disposal modes, consisting of a moderate amount of dumping (a few items per episode but presumably together with some other refuse) along with some tossing and resting of individual items.

Spatial Association with Hearths

The second way in which the distributions of the various categories of material within Cnoc Coig have been characterized is in terms of their occurrence in relation to the many hearths within the midden. For the mammal and bird bones, this has simply involved a few general observations as to whether the definable groupings of bones of the various species occur in relatively close proximity to hearths, or whether they occur in locations more distantly removed from hearths. In other words, no attempt has been made to determine specifically the distances of each particular bone to their nearest stratigraphically associated hearth, and thereby to derive a set of measurements which assesses in quantitative terms their spatial proximity to hearths. This is partly because such a procedure is very time-consuming, particularly for a large number of finds such as that represented by the assemblage of in situ mammal and bird bones at Cnoc Coig, and partly because of the fact that these remains tend to be rather clustered (except for the bones of the category I birds), which means that the definable groupings can be treated as units, and thereby their spatial proximity to hearths can be assessed fairly accurately without the need to rely on the much more time-consuming, find-by-find assessment. In other words, with the more dispersed materials in the midden (i.e. the artifacts), the spatial proximity to hearths can only be assessed on a find-by-find basis; this has thus been done for all the artifactual remains in Cnoc Coig except for limpet scoops. This has not been done with limpet scoops mainly because of the time-consuming nature of the task for such a large number of finds, but also partly because the ubiquitous distribution of limpet scoops in the site might well mean that any observations concerning their spatial association with hearths would be more a reflection of their ubiquity throughout the midden deposits than anything else (such as the disposal modes employed in their discard).

In any event, Table 43 summarizes the data presented in Chapters 8 to 10 regarding the distances to the centres of the nearest stratigraphically associated hearths for the various categories of artifacts as well as for oyster shells; it also includes the data for the 100 randomly located points (Fig. 22C). This table shows the summary statistics for each of the categories, ranking them according to their mean distances, and it also includes the results of a series of t-tests which assess whether or not the various categories of material differ significantly from the pattern of 100 randomly located points. The first 13 categories listed in Table 43 -- i.e. from mattock fragments down to miscellaneous unworked antler (rest of site) -- represent the objects which are most closely spatially associated with hearths and which have been interpreted as items that were either dropped as primary refuse or rested as de facto refuse in hearth-centred activity loci. Except for two categories (S.L.H. and U.S.L.S.) which contain only a very few finds each, these categories are shown by the t-tests to be significantly closer to hearths than the pattern of 100 randomly located points. In contrast, the next 11 categories are not significantly different from the pattern of 100 randomly generated points. Interestingly, these are the materials which have been attributed to various combinations of disposal modes, particularly the pecten shells and unworked antler which most closely resemble a random pattern. The final two categories are the only ones which have been attributed primarily to dumping, and consistent with this interpretation is the fact that the t-tests demonstrate that these two categories are significantly more distantly removed from hearths than the 100 randomly located points.

Of course, the use of a summary statistic (such as the mean distance) to display relative degrees of association with hearths can potentially be misleading, since differences or similarities may be masked or exaggerated. To demonstrate that this is not a problem with the data presented in Table 43, a series of graphs may be used to

Table 43. Summary of the Distances (in metres) to the Centres of the Nearest Stratigraphically Related Hearths for Various Artifact Categories from Cnoc Coig, with the Results of t-Tests Comparing Each of These Categories with the Pattern of 100 Randomly Located Points.

	Summary Statistics:				Results of t-Tests:		
						Significant at level:	
Artifact Category	Mean	Std. Dev.	Min.	Max.	t Value	.05	.01
Mattock fragments	0.880	.428	.471	1.842	5.57	yes	yes
Pumice Stone fragments	1.116	.473	.631	1.720	2.99	yes	yes
5 Antler/Bone Tools & Mattocks	1.129	.545	.221	2.459	5.01	yes	yes
Antler Fork/Beams	1.159	.501	.360	1.756	2.84	yes	yes
5 Antler/Bone Tools	1.227	.561	.221	2.459	3.80	yes	yes
Prickly Cockles & Cyprinas	1.262	.780	.100	3.114	3.08	yes	yes
P.S.L.S./H.	1.275	.556	.703	2.779	3.02	yes	yes
S.L.H.	1.338	.816	.338	2.674	1.20	no	no
P.S.L.S. & P.S.L.S./H.	1.344	.760	.081	4.417	3.80	yes	yes
P.S.L.S.	1.353	.784	.081	4.417	3.60	yes	yes
Antler Tine fragments	1.354	.619	.311	3.036	2.80	yes	yes
U.S.L.S.	1.363	.767	.224	2.846	1.44	no	no
Misc. Antler (rest of site)	1.366	.777	.246	3.383	3.42	yes	yes
Misc. Worked Antler & Bone	1.528	.822	.522	3.163	1.27	no	no

Table 43. Continued.

Artifact Category	Summary Statistics: Mean	Std. Dev.	Min.	Max.	Results of t-Tests: t Value	Significant at level: .05	.01
Pectens (flat valve, broken)	1.529	.766	.554	3.312	1.11	no	no
Red Ochre fragments	1.538	.907	.108	3.351	1.17	no	no
Pitted Pebbles	1.541	.923	.102	3.648	1.31	no	no
Antler Bases	1.548	.699	.668	2.936	0.86	no	no
Pectens (convex valve, broken)	1.677	.910	.161	4.706	0.59	no	no
Pectens (all four types)	1.742	.930	.161	5.046	0.09	no	no
100 Randomly Located Points	1.752	.886	.122	4.298	--		
Misc. Antler, Tines & Bases	1.762	.891	.246	3.777	0.10	no	no
Pectens (flat valve, whole)	1.796	.966	.242	3.170	0.20	no	no
Misc. Antler (all of site)	1.837	.919	.246	3.777	0.77	no	no
Pectens (convex valve, whole)	1.878	.986	.321	5.046	0.84	no	no
Oyster Shells	2.182	.894	.543	4.722	3.34	yes	yes
Misc. Antler (Lane F/G)	2.620	.514	1.304	3.777	8.12	yes	yes

compare and contrast the relative spatial associations of these various materials with hearths. Drawing on all the measured distances to hearths, these graphs show in a cumulative fashion the percentages of the finds of a particular category (along the Y-axis) within each increasing 0.5 m distance from a hearth (along the X-axis). By looking at the slope of the lines plus the points where the lines begin and end (in terms of the X-axis), an immediate visual impression is gained of the relative proximity to hearths for different objects.

Figure 35 plots the objects most closely associated with hearths (i.e. antler and bone tools, and antler forks) and contrasts these with the assemblage of unworked antler from the site -- the latter are much less well associated with hearths than the former, and the difference is strikingly apparent in Figure 35. Figure 36 shows P.S.L.S. and related pebble artifacts, while Figure 37 compares the four types of pecten shells. Figure 38 compares prickly cockle and cyprina shells, pitted pebbles, pecten shells (all four types combined) and oyster shells. To facilitate comparison between the lines plotted in Figures 35 to 38, Figure 39 shows six of these on one graph. From these graphs, it can be seen that the ranking of the various categories based on the mean distances to hearths as shown in Table 43 is reflected precisely in these cumulative graphs, and indeed, these graphs display very vividly the differences and similarities between various categories of objects.

Overall then, a consistent pattern would appear to emerge in which three broad groups can be defined. First are those materials which have been attributed in varying degrees to some combination of disposal modes, which presumably accounts for the fact that they appear to reflect a random pattern of association with hearths. The other two groups include those artifact categories which are significantly different from a pattern of randomly located points. On the one side are those materials which are significantly more closely associated with hearths, which

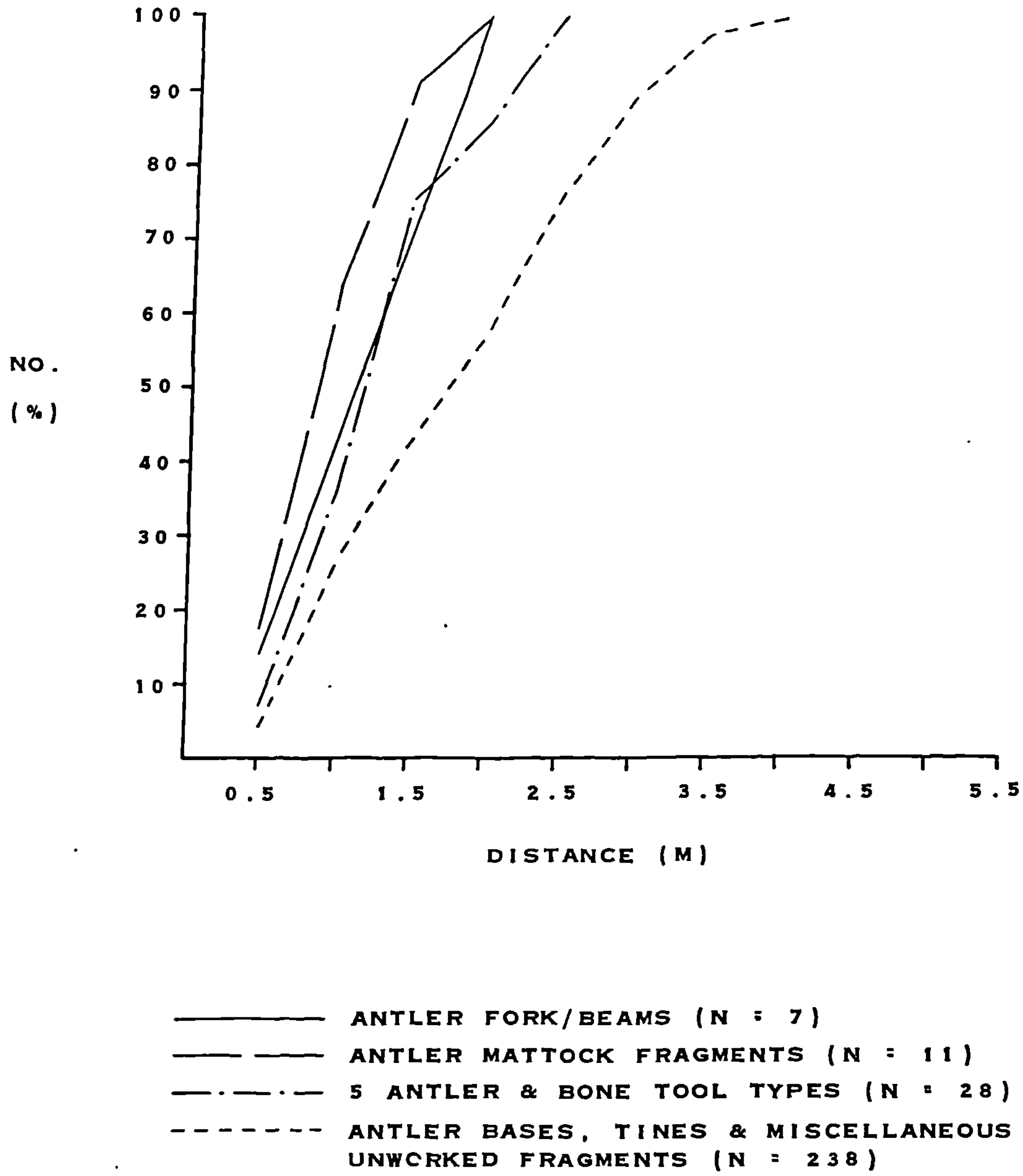


Figure 35. Cumulative Graph of the Distance Relationships to Hearths for Various Categories of Antler and Bone Artifacts.

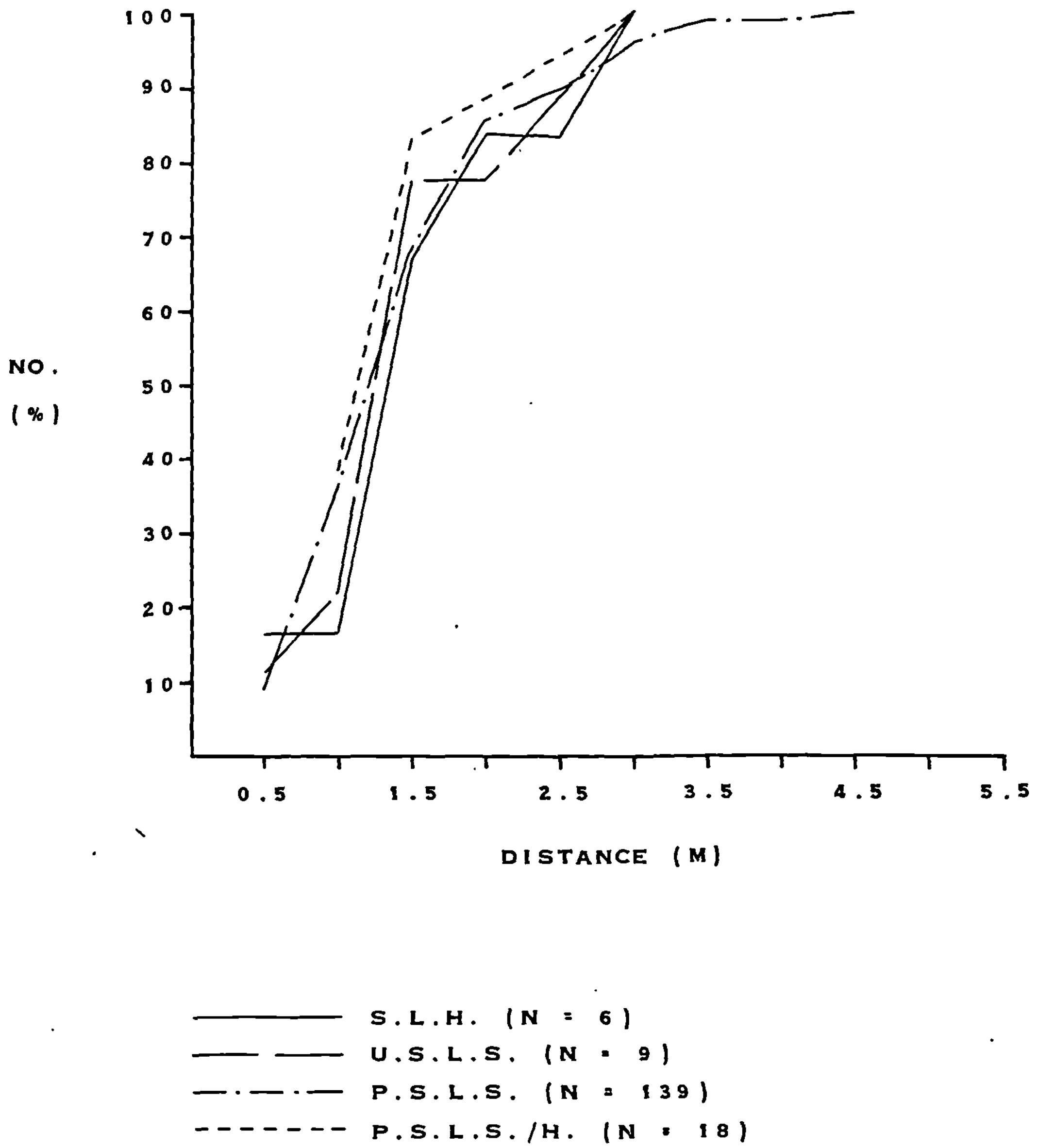


Figure 36. Cumulative Graph of the Distance Relationships to Hearths for Four Types of Elongated Beach Pebble Artifacts.

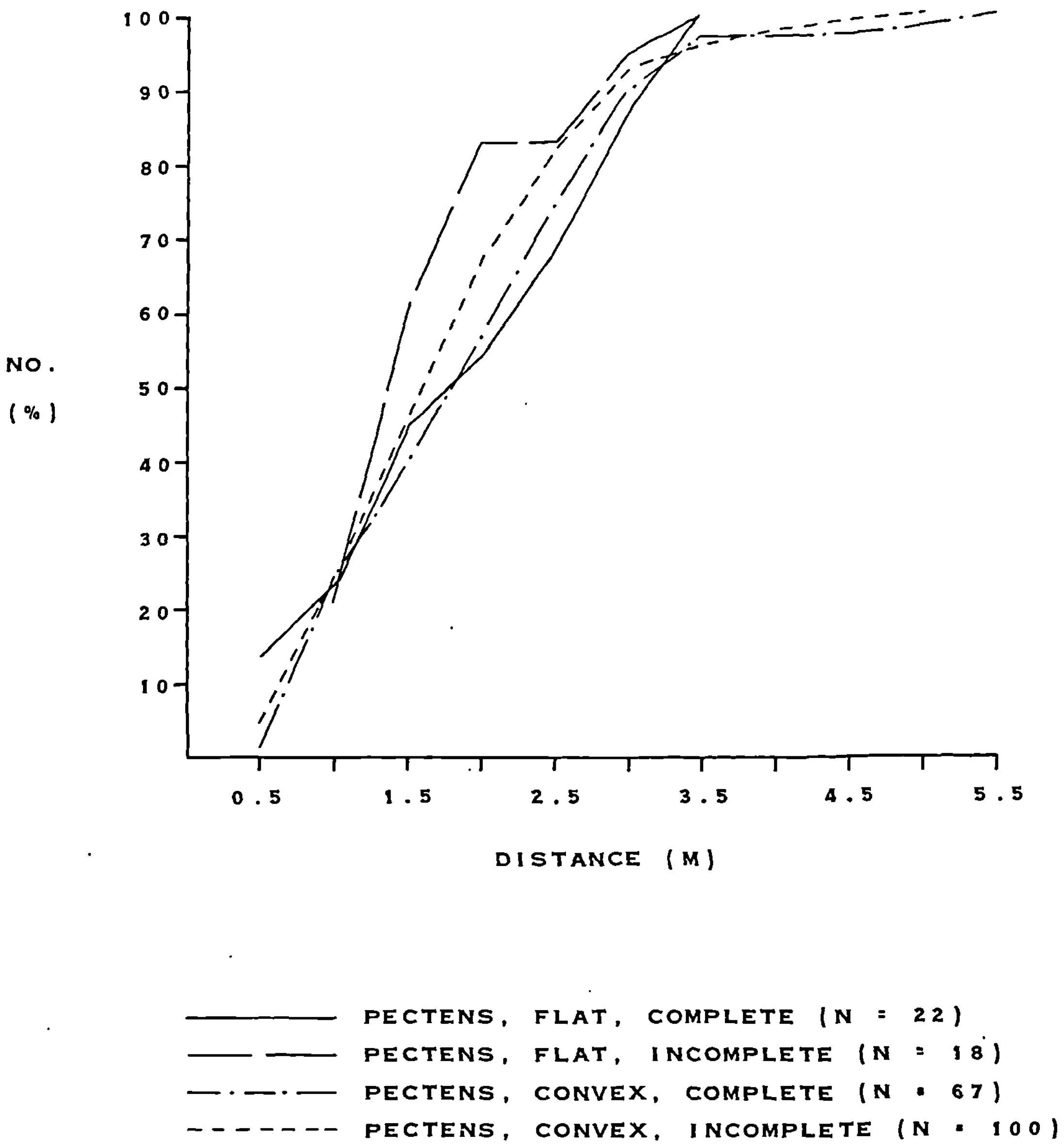


Figure 37. Cumulative Graph of the Distance Relationships to Hearths for the Four Types of Pecten Shells.

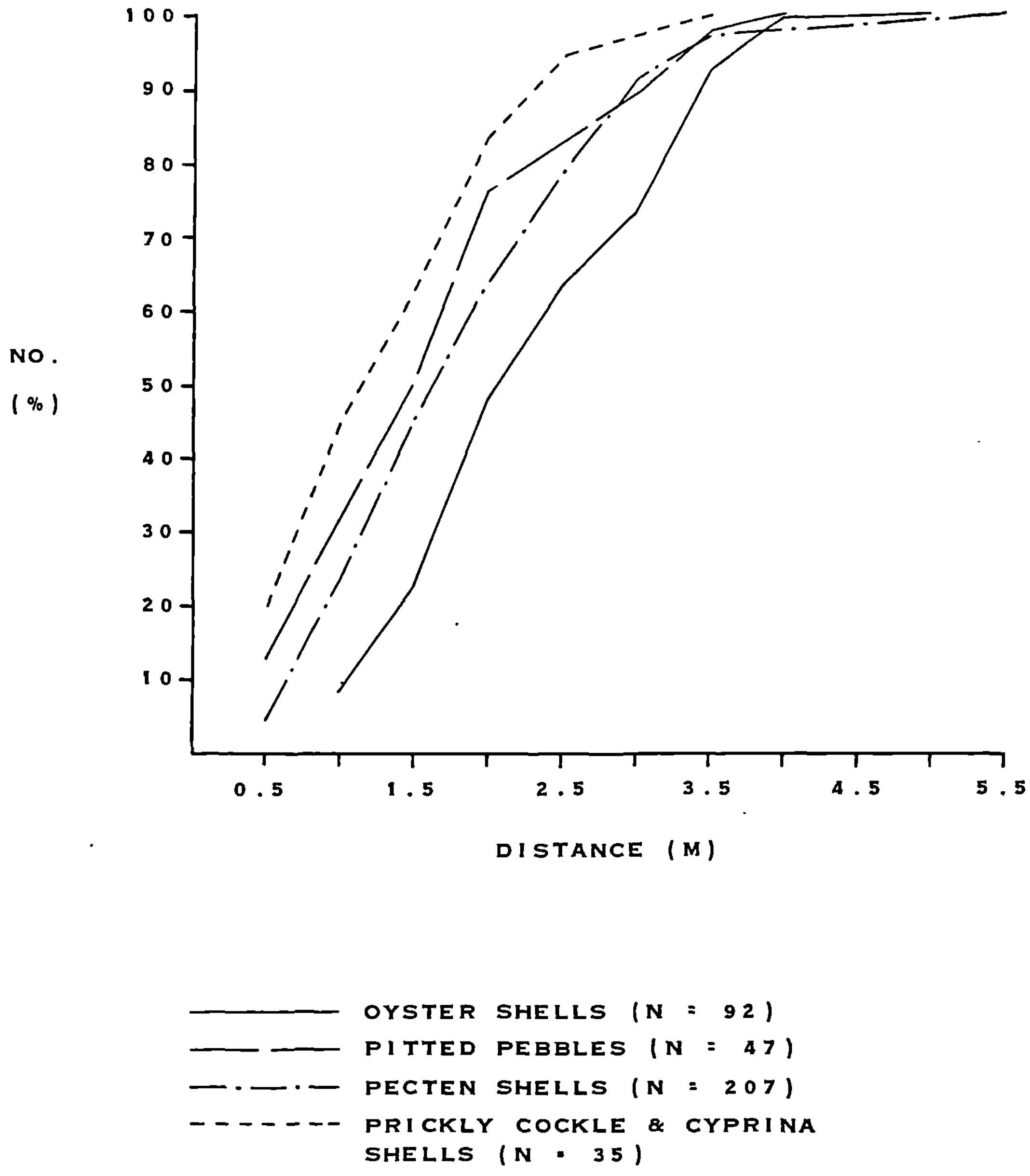


Figure 38. Cumulative Graph of the Distance Relationships to Hearths for Pitted Pebbles, Pecten Shells, Oyster Shells, and Prickly Cockle and Cyprina Shells.

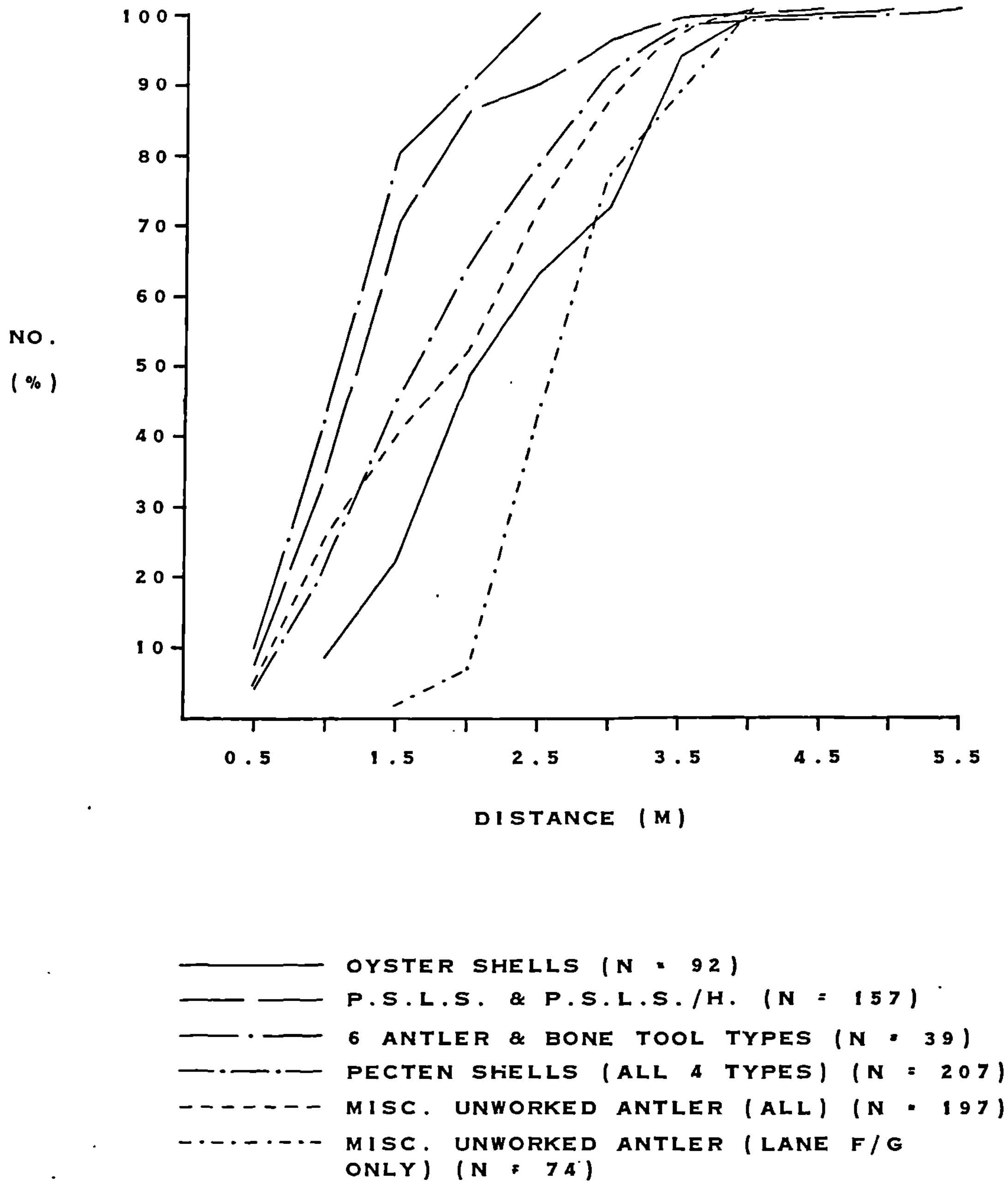


Figure 39. Cumulative Graph of the Distance Relationships to Hearths for Six Artifact Categories.

is consistent with the interpretation that they have been either dropped or rested in hearth-centred activity loci; and on the other side are the two categories which are significantly more distantly removed from hearths, which is consistent with the interpretation that they primarily represent dumped refuse.

Synthesis: Identifying Disposal Modes

As was stated previously, the main challenge for intra-site spatial archaeology is to develop a body of theory which will enable archaeologists to interpret more reliably and more accurately the site structure observed in the archaeological record. It has been argued here that Binford's (1978a: 344-348) concept of disposal modes may be seen to be central to the development of this body of theory. The identification of disposal modes in intra-site distributions, and the resulting recognition of drop zones, toss zones and dumping localities, are potentially of great archaeological utility since they should provide a foundation upon which may be based an understanding of how activities were spatially organized within a settlement and how activity space was variably maintained; and these in turn have direct implications for a number of other structural properties of past cultural systems.

However, the potential utility of the concept of disposal modes will in the long-term depend upon the development of a reliable and objective methodology. Presumably as an example to illustrate its general archaeological utility, Binford (1983: 158-159, Figs. 92 & 93) has used his ethnoarchaeological observations at the Mask Site to reinterpret the well-known French Palaeolithic site of Pincevent No. 1. Having made adjustments for scale, Binford (1983: Fig. 92) has simply superimposed his model of men seated around an outside hearth from the Mask Site onto the distribution of bone artifacts at Pincevent No. 1, but the fit is not as convincing as he claims. In any case, it is perhaps not surprising that by following this simple procedure Binford interprets Pincevent No. 1 as being derived from activities conducted around outside hearths, just like at the Mask Site! However, regardless of the validity of his reinterpretation of this site, Binford's use of this procedure is unfortunate if it suggests that it is generally adequate simply to superimpose Binford's model of drop and toss zones derived from his ethnoarchaeological study of a single site onto all archaeological distributions around hearths, having made adjustments for scale and rotated them until the best fit is obtained. Although presumably Binford is not advocating the adoption of such a simplistic approach, the potential utility of the concept of disposal modes will only be realized if a more sophisticated, reliable and objective methodology is developed.

It is argued here that, as a necessary prerequisite to delimiting on the ground particular disposal localities within sites, archaeologists must develop and employ objective criteria which consist of specific observations on the intra-site spatial distributions of objects. These criteria would be used to identify the disposal modes used for various categories of material, which in turn would (in combination with distribution plots) form the basis for delimiting on the ground different kinds of disposal zones within a site. Such diagnostic criteria might include the following: (1) the relative tendencies for items to be clustered or dispersed; (2) where clusters on the ground can be delimited, the density of discernible clusters; (3) where clusters of different objects overlap, the composition of clusters in terms of the variety of items that they contain; (4) the sizes of the items within clusters, whether these are single-object or multiple-object clusters; (5) the locations of clusters and individual objects in relation to hearths or to other observable facilities which provide the site framework around which activities were organized. Most of these criteria can be precisely quantified and may involve the use of statistical methods of spatial analysis, which will facilitate comparisons and avoid purely subjective assessments of the patterns of distribution.

Of course, the present study can make no pretence to exploring fully the potential utility of the concept of disposal modes. Owing to the complexity of the spatial relationships in the Cnoc Coig shell midden as a result of the palimpsest nature of the deposits, particularly in contrast to single component sites where the contemporaneity of materials may be assumed with a reasonable degree of certainty, not all of these suggested lines of inquiry have been pursued in the present study. Nevertheless, as we have seen, both the relative degree of clustering/dispersal and the relative proximity to hearths of the different categories of material have been used in an attempt to relate these various materials to the modes of disposal employed in their discard. It is interesting to note that, if Tables 42 and 43 are compared, it can be seen that there is a correlation between the relative tendencies towards clustering or dispersal on the one hand, and the relative spatial proximity to hearths on the other. For example, the highly clustered items (oysters and miscellaneous unworked antler fragments from Lane F/G) are the most distantly removed from hearths, whereas those items most closely associated with hearths are among the most dispersed materials (e.g. mattock fragments, the five types of antler and bone tools, pumice stone fragments and antler fork/beams). And items which are intermediate in terms of the degree of clustering/dispersal (pecten shells and red ochre fragments) are only moderately well associated with hearths. These correlations are summarized in Table 44.

Thus, when these two characteristics of the distributions are combined, the following generalizations regarding the identification of disposal modes in Cnoc Coig may be made:

1. Dumping is identified by a high degree of clustering, with the clusters occurring relatively far away from hearths. Examples are oyster shells and much of the mammal bone material in the site.

Table 44. Summary Comparing the Relative Proximity to Hearths with the Relative Degree of Clustering/ Dispersion for the Various Artifact Categories and Faunal Remains from Cnoc Coig.

Closely Associated with Hearths ——— Distantly Associated with Hearths

Highly Dispersed

mattocks

pumice

antler forks — antler bases — some birds

5 antler/ bone tools

S.L.H.

U.S.L.S.

antler tines

pr. cockles & cyprinas — pitted pebbles

P.S.L.S./H. — some birds

misc. antler (rest of site)

P.S.L.S.

red ochre

misc. antler (all of site)

pecten shells

some birds — misc. antler (Lane F/G)

some mammals — oyster shells

most mammals

Highly Clustered

2. Dropping of food refuse results in highly clustered distributions with a high degree of association with hearths. Some of the mammal bone clusters on the site are the only examples of this.

3. Dropping and resting of artifactual remains are identified by highly dispersed distributions in which the objects are very closely associated with hearths. Distinguishing between artifacts which are individually dropped in hearth-centred activity areas and those which are rested in such locations is not possible on the basis of the study of distributions alone. However, on the basis of technological criteria, we might suggest that worn-out or broken artifacts were dropped (e.g. some of the antler and bone tools), whereas items which are still utilizable (e.g. antler fork/beams, unbroken prickly cockle and cyprina shells, and some of the antler and bone tools) might be viewed as material which was rested and then abandoned as de facto refuse.

4. Positioning might be identified by the presence of very compact clusters (i.e. caches) located in close proximity to hearths. Positioning has only been identified at Cnoc Coig for the two caches of cowry shells and possibly for a couple of compact clusters of P.S.L.S. which might be interpreted in these terms.

5. Materials which are discarded primarily or exclusively by tossing would be characterized by much more dispersed distributions (with perhaps a small degree of clustering in the form of two or three associated objects, particularly articulating bone elements) which occur more distantly removed from hearths. Tossing would appear not to be the primary disposal mode employed for materials at Cnoc Coig, with the exception of some of the bird bones.

6. Objects which are not discarded primarily by one disposal mode (i.e. which are discarded by some combination of disposal modes) will reveal distributions which overall are characterized by intermediate degrees of clustering/ dispersal and by moderate degrees of association with

hearths. The specific degree of clustering/dispersal or spatial association with hearths will depend on the particular combination of disposal modes employed and their relative proportions (in terms of the number of items discarded by each disposal mode). Of course, many (and perhaps most) categories of material may involve more than one disposal mode (cf. Binford 1978a: Table 5), but it is only when one disposal mode is not significantly predominant that these comments regarding multiple modes apply. Pecten shells are the best example of a combination of disposal modes at Cnoc Coig; while many of them were dumped as small clusters (presumably along with other refuse), sufficient numbers were either rested or tossed or perhaps even dropped to produce only moderate degrees of clustering and of spatial association with hearths.

The Model of Limpet Scoop Discard

The most abundant artifactual remains in Cnoc Coig (which were recorded as *in situ* data) are the various types of limpet scoops, and these artifacts have not been analysed in the same terms as the other artifacts for the reasons outlined above. In Chapter 8, it was shown that the most conspicuous feature of the distribution of limpet scoops is their ubiquity throughout the midden deposits. This is in striking contrast both to other artifactual remains and to the bone material in Cnoc Coig, and this feature is not just a product of their abundance in the site. As a result of this ubiquity, the distribution of limpet scoops can be characterized as generally dispersed, although small, loose clusters can be identified which presumably represent depositionally contemporaneous groups.

More interesting than this aspect of their distribution is the occurrence of different types of limpet scoops in relation to each other -- especially A.L.S. in relation to S.L.S. (since B.L.S. are relatively rare). In Chapter 4 (pp. 123-126), an explanation was put forward to account for the variable presence of different material types of limpet scoops in different Obanian assemblages.

Basic to this explanation was an assumed ranking of bone over antler over stone as preferred raw materials. The relative proportions of the three material types of scoop in any Obanian site would thus be a function of how adequately these material preferences could be met by the differential availability of the three raw materials. On Oronsay in general and at Cnoc Coig in particular, red deer antler and metapodial bones were not locally available, since red deer populations were available only on other islands, with the result that supplies of these raw materials would have been sporadic and perhaps unreliable. On the other hand, though a less preferred raw material, stone in the form of elongated beach pebbles was locally available in abundance. Accordingly, whenever antler and bone were available in sufficient quantities (though it should be remembered that these materials were required for many other industrial purposes), limpet scoops would be made from these materials for as long as supplies lasted, after which stone would be utilized for this purpose until a further supply of the preferred raw materials was obtained.

This hypothesized pattern of limpet scoop use has clear implications for our expectations regarding the spatial distribution of limpet scoops in Cnoc Coig -- most particularly, there should be observable and significant segregation between the occurrence of A.L.S. on the one hand and S.L.S. on the other. In Chapter 8 (pp. 308-318), the coefficient of segregation was applied to the distributions of A.L.S. and S.L.S. to determine if these two types are indeed spatially segregated as the proposed model of limpet scoop discard predicts. The results obtained from the coefficient of segregation confirmed that the A.L.S. and S.L.S. in Cnoc Coig are significantly segregated overall. And from the distribution plots, it is clear that this segregation is <u>not</u> simply a result either of horizontal separation in which the two types occur generally in different areas of the site, or of vertical/stratigraphic separation in which they are generally found in separate levels. Rather, it is a result of "patchiness" of distribution in which each limpet scoop type tends to be found in small clumps or patches of points of its own type, which is in full accordance with the proposed model of limpet scoop discard. In conclusion, the nature of the distribution of limpet scoops and the segregation between A.L.S. and S.L.S. as demonstrated by the coefficient of segregation confirm the proposed model of limpet scoop discard.

Behavioural Implications and the Nature of the Occupations at Cnoc Coig

The above conclusions regarding the distribution of material in Cnoc Coig have some behavioural implications for the Mesolithic occupations at Cnoc Coig in particular and on Oronsay in general, and it is to these broader behavioural issues that our attention will now turn.

Implications for the Exploitation of Red Deer

It has just been mentioned that the spatial distribution of limpet scoops in Cnoc Coig confirms the proposed model of limpet scoop discard. According to this model, the use of elongated beach pebbles for limpet scoops in place of preferred red deer antler or metapodials is a result of the fact that supplies of the preferred materials were sporadic or otherwise insufficient to satisfy all industrial needs. This implies that the Mesolithic inhabitants of Oronsay did not have regular and reliable access to red deer populations. Of course, as was noted above (Table 5, pp. 245-247) and as is more fully discussed by Grigson (1985), the pattern of bone element representation for the assemblage of red deer bones at Cnoc Coig also suggests this -- clearly whole deer were not being butchered on the site, but equally clearly substantial amounts of meat in the form of joints were not introduced onto the midden (since meat-bearing bones are very poorly represented in the assemblage), which would be expected to be the case if red deer were regularly hunted and butchered on some island other than Oronsay, such as Colonsay or Jura (since clearly Oronsay would not have been large enough to sustain a population of red deer). It is certainly the case that red deer antler is fairly abundant in Cnoc Coig, but it seems equally certain that the supply was insufficient to meet all industrial needs.

As a result of Grigson's (1985) analysis of the size of the red deer bones from Cnoc Coig, it would appear that two geographically distinct populations of red deer were being exploited by the Mesolithic inhabitants of Oronsay, one being a population of large red deer (comparable in body size to contemporaneous deer on the mainland of Scotland and in England), and the other being a "dwarf" population which presumably derives from an island. One of two possibilities is that the dwarf population existed on Colonsay, with the larger deer deriving from Jura, Islay or the Scottish mainland. But if this were the case, given the proximity of Colonsay to Oronsay and therefore the accessibility of an exploitable red deer population from the shell midden settlements on Oronsay, one would expect that the supply of red deer metapodials and especially antler would have been much more sufficient for manufacturing needs than would appear to have been the case. In short, the implications of our model of limpet scoop discard is that Colonsay did not support a red deer population in Mesolithic times and, by extension, that Grigson's (1985) alternative explanation for the sizes of red deer bones must apply -- that is, that the small red deer must derive from some other island (e.g. Jura or Islay) and that the large deer presumably derive from the adjacent Scottish mainland. Of course, this line of argument does not conclusively demonstrate this, but it does add further support for this latter interpretation of the locations of the red deer populations exploited by the Mesolithic occupants of Oronsay.

Site Structure and Activity Organization

Narrowing our focus to the intra-site level, it is unfortunately very difficult to make any definitive concluding statements regarding the implications which the site structure observed at Cnoc Coig have for the organization of activities on the site. Attributing various modes of disposal to the different categories of material on the basis of their distributions does provide some understanding of activity organization, but most spatial analyses of intra-site distributions attempt a broader understanding and even elaborate reconstructions. Thus, one might wish to address a wide variety of questions: Can specific toss zones and drop zones be defined? Can dwelling structures be identified and related to drop and toss zones? Can toolkits of activity-related artifacts be defined? Can discrete occupations and particular activity areas within these be delimited? If so, can estimates of population size and the duration of occupation be established?

At sites which can be demonstrated (or at least be reasonably assumed) to represent single occupations, such questions can be answered at least in part, although severe difficulties arise even here with some of these questions (especially the definition of toolkits, and estimating population size and duration of occupation). Also, if the different occupations of a multi-component site can be stratigraphically distinguished, then the resulting stratigraphically defined entities may be used as "spatial units of analysis" in order to tackle some of these questions. However, if this is not possible, as at Cnoc Coig or indeed any stratigraphically complex multi-component site with a low degree of resolution, such questions unfortunately remain very difficult to answer.

Population Size and Duration of Occupation. There have been a number of attempts by archaeologists to derive estimates of the population size of settlements represented by archaeological sites (Cook & Treganza 1950; Cook & Heizer 1968; Baumhoff 1958; Ascher 1959; Naroll 1962; Wiessner 1974; Yellen 1977: 98-131; Read 1978). Generally, these methods have been based on some ethnographic or ethnoarchaeological observations. Except for attempts to relate settlement population to a single resource dimension (such as fishing-miles or mussel-collecting-miles along a stream or a coastline)(Baumhoff 1958: 35; Ascher 1959: 175-176), or to estimate it by analysing the amount of food represented by a unit of shell midden deposit (Ascher 1959: 172-174; cf. Glassow 1967), these efforts are based on establishing a relationship between settlement population size and either floor area or the total areas of sites. In terms of general archaeological applicability, all of these efforts suffer from being particularistic in one way or another. For example, aside from some general problems with his measure (LeBlanc 1971), Naroll's (1962) well-known method is inappropriate for most hunter-gatherer societies, for a number of reasons (Wiessner 1974: 343). Although overcoming some of the problems inherent in the earlier formulations, the more recent efforts by Wiessner (1974), Yellen (1977: 98-131) and Read (1978) are all based on !Kung San data, and these attempts must be seen as initial formulations which, as both Wiessner (1974: 349) and Read (1978: 317) point out, require considerably more testing on additional data from camps of both the San and other hunter-gatherers. Regardless of some rather specific criticisms (Casteel 1979; cf. Wiessner 1979; Yellen 1979), perhaps the most serious limitation of these models based on !Kung data is that they assume (and require) a roughly circular arrangement of household camps in a settlement. This is explicitly pointed out by Read (1978: 317), but it also applies to Yellen's (1977: 98-131) "ring model" in which various measures are developed to determine both settlement group size and duration of occupation; severe problems regarding the general archaeological applicability of these measures were discussed in Chapter 2 (pp. 29-31; see also Binford 1978a: 358-360; 1983: 139-142; Casteel 1979).

In any case, even if we were to ignore completely any general or specific criticisms of these various methods, they could still not be employed at a site such as the

Cnoc Coig shell midden. This is because they require that the scatters of occupation debris have a high degree of resolution -- that is, that they represent and derive from a single occupational episode. It is not even remotely possible in Cnoc Coig to delimit reliably a scatter of debris which could be thought to be depositionally contemporaneous and so represent a single occupation, because the shell midden deposits are a massive palimpsest of material which derive from an unknown number of occupational events.

The Number of Occupations. At this point, the question might be asked: Is it possible to derive at least a rough estimate of the number of occupations represented by the Cnoc Coig shell midden? Solely on the basis of the analysis of the distribution of artifacts and faunal material, the answer to this question is an unambiguous "no", because the patterns of distribution presented in this study indicate nothing directly relevant to this question. Even detailed knowledge of the complex stratigraphy at Cnoc Coig (see Mellars 1985) scarcely helps to address this question.

Some other lines of evidence might at least suggest something about the number of occupations represented at Cnoc Coig, although they are by no means unambiguous or conclusive. As discussed in Chapter 6, the overall quantity of mammal bones and the number of definable groupings of these bones are quite small, and all of this material could easily be accounted for by a small number of occupations, perhaps around 10 or 12 but possibly even less. However, it is very doubtful if such a small number of occupations could account for the large quantity of shellfish refuse in Cnoc Coig. On the basis of the estimates given in Chapter 8 (pp. 304 & 307) and the fact that the excavated areas of the site used in the present study comprise (very roughly) around 50% of the entire midden deposit, and allowing for the fact that the midden deposits are not pure heaps of limpet shells, then the whole of Cnoc Coig may be estimated to contain around 15 million limpets! This number of limpets could be translated into an amount of food, on the basis of the meat weight of an "average" midden limpet (see Jones 1984). If we obtain an estimate of the likely per diem caloric needs and assume a percentage contribution to the diet by limpets, a very rough estimate of the total number of person/days represented by the limpet shells in Cnoc Coig could be derived. Such an approach would be similar to that used by Ascher (1959: 172-174) which, as Glassow (1967) has discussed in some detail, is fraught with problems. In any case, even if we were to ignore the fact that such a crude estimate is itself based on some very crude estimates, this would scarcely be of any value since the total number of person/days is a product of three interrelated variables -- the number of occupants, the duration of the occupations, and the number of occupations -- and it does not help to disentangle these three variables, all of which one would like to know. Other such "numbers games" could perhaps be played with the number of hearths used per occupation or with discard rates of limpet scoops or perhaps even other artifacts, but they would scarcely be of any more value (and indeed, they would arguably be of even less value). In short, the fact remains that deriving an estimate for the number of occupations represented by the Cnoc Coig shell midden remains as elusive as trying to estimate the number of occupants or the duration of individual occupational episodes. Unless stratigraphically distinct "mini-middens" (either within the main shell middens or elsewhere on Oronsay) can be identified and analysed, these basic questions regarding the Obanian occupations on Oronsay remain unanswerable, and the spatial analysis of the distribution of artifacts and faunal material in Cnoc Coig can unfortunately throw no light on these problems.

Hearths and the Use of Activity Space. Despite these rather negative remarks, however, a number of general comments can be made regarding the organization of activity space at Cnoc Coig. Firstly, Figure 40 is a depth-compressed horizontal plot which shows the overall occurrence of the 64 hearths in the midden. This plot vividly illustrates the rather striking concentration of overlapping

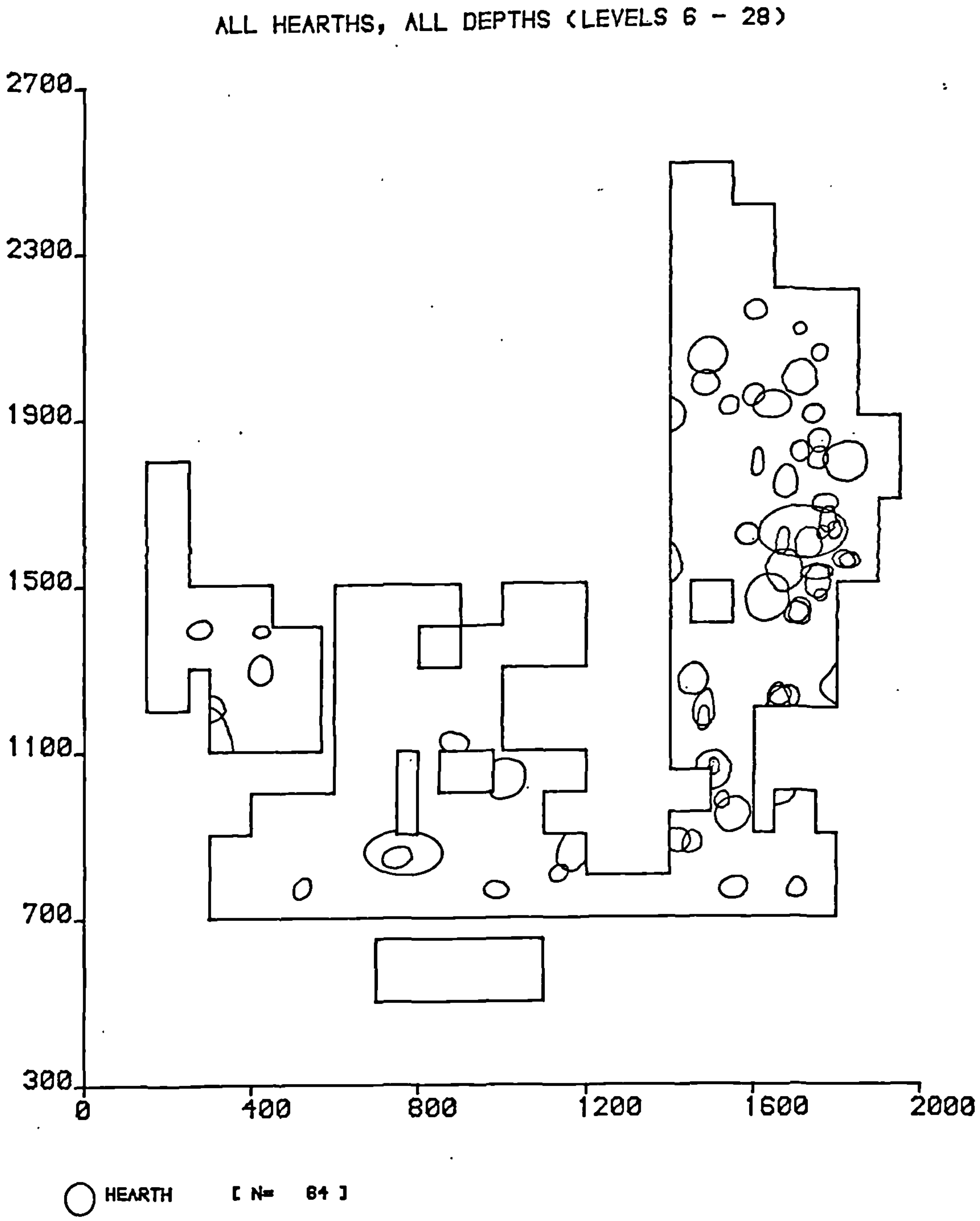


Figure 40. Depth-Compressed Horizontal Plot Showing the Location of All Hearths within the Midden.

and superimposed hearths in the northwestern and especially the north-central areas of the site, within which are located 35 (or 54.7%) of the hearths in Cnoc Coig. This part of the site is the stratigraphically distinct "western area" defined by Mellars (1985), and the number of hearths here is out of all proportion to the thickness of midden deposits (cf. Fig. 5). To the east, on the northeastern side of the site, the number of hearths is decidely fewer (16 or 25.0%) despite the fact that the midden deposits are much thicker -- this area essentially corresponds to the domed accumulations of the Phase 1 and Phase 2 deposits defined by Mellars (1985) on stratigraphic grounds. To the south of these, in the east-central area of the midden, the number of hearths is even less (eight or 12.5%) and these mostly lie in the lower part of the midden deposits. And finally, in the southern extreme of the site, there is a small concentration of five hearths.

The occurrence of over half of the hearths in Cnoc Coig in the "western area" clearly suggests marked redundancy over a considerable period of time in the use of this area as a location for lighting hearths (and so presumably as a focal point of hearth-centred activities).[1] The choice of this location for such a purpose is not too surprising -- the northern boundary in this northwestern part of the site is presently demarcated by a prominent rock outcrop which, as Mellars (1985) describes, was probably covered by a thick accumulation of dune sand at the time of the Mesolithic occupation which would have offered substantial protection from northerly and northwesterly winds to this part of the site. Numerous artifacts were found scattered amongst the many hearths in this area, including: a number of elongated pebble tools (P.S.L.S., S.L.H., etc.), most notably the one very compact cluster of five P.S.L.S.; one of the two caches of cowry shells; several pitted pebbles, and a few cyprina and

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[1] Various section plots, especially for Lanes 4 and 5, illustrate well the concentration of hearths in this part of the midden. For example, see Figures 122 and 123, or Figures 141 and 142, or Figures 163 and 164.

prickly cockle shells; a number of fairly scattered pecten shells; two large antler fork/beam fragments; a moderate quantity of scattered fragments of unworked antler, plus two of the small clusters of unworked antler; and only a very few finds of antler and bone tools (three mattock fragments, two borers and a bevelled tine tip). The bulk of this material has been attributed either to dropping (especially the scattered fragments of unworked antler), or to resting (the antler fork/beams, pitted pebbles, etc.), or to positioning (the cache of cowry shells and perhaps the compact cluster of P.S.L.S.). Moreover, there are almost no mammal or bird bone remains found amongst these hearths. However, there is a considerable amount of bone material in this "western area" -- most notably, the large concentration of seal bones in group 1, red deer groups 1 and 2, pig group 1 and otter group 1 -- but all of it except some of the otter bones lies near or at the surface of the midden above the many hearths in this part of the site. Also, a number of clusters of (presumably dumped) pecten shells occur in the upper part of the midden, which contrasts with the generally isolated finds of pecten shells dispersed amongst the hearths in the lower part of the midden deposits in this area of the site.

The clear implication of these observations is that this "western area" comprised a series of overlapping and shifting hearth-centred activity areas which spanned a considerable period of time and which form the lower portion of the midden deposits. At some point in time, this area was abandoned as a major focus of activity and was used instead as a dumping locality, although this use of the area would appear to have been short-lived since substantial deposits of dumped shell and other refuse did not accumulate above the hearth-dominated activity areas. Because of this, it might be suggested that this inferred change in the use of this part of the site took place during the later phases of occupation at the site. In any case, the concentration of hearths and the distribution of artifactual and faunal remains in this "western area" would seem to have strong implications for the use of activity space in Cnoc Coig over a considerable period of time (i.e. spanning several occupations), even though specific activity areas and any associated drop or toss zones within this complex of hearth-dominated deposits cannot be delimited.

It might be thought that other parts of the site would offer more opportunities for delimiting specific activity areas, at least in part, because of the lower number and the less complex pattern of concentration of hearths. The east-central area of the midden seemed to be the most promising area in this regard, since most of the small number of hearths here occur in the lower part of the midden sequence and there is not a complex pattern of overlapping and shifting hearths. Taking the five lowermost hearths in this area (in Levels 13 and 14) and the artifactual and faunal remains which occur in the lowest levels (Levels 13 to 17), an attempt was made to determine if the distribution of material around these hearths would enable the definition of drop or toss zones in these areas. Unfortunately, no clear or unambiguous patterning could be detected, and the material was scattered around the hearths in an apparently haphazard fashion. Two reasons might account for this. Firstly, there are five hearths (the central one of which is a large hearth complex presumably built up over a period of several occupations) and the pattern of use of these hearths, spanning an unknown number of occupations (though presumably several), would no doubt have been complex and variable -- that is, the hearth or hearths used at any one time, and the activities conducted around them, would not necessarily have been constant from one occupation to another or even during one occupation. As a result, any drop zones or toss zones which would have accrued around the hearths (i.e. barring maintenance of the area) could over time have simply merged into one another. Secondly and perhaps more importantly, the accumulation of subsequent deposits above these hearths could well have resulted in some material being deposited around the hearths and intermixed with the earlier remains which made up any existing drop or toss zones. Given the likelihood of such a process, and in the absence of being able to disentangle the resulting palimpsest of material, the apparent haphazard scatter of material should perhaps be none too surprising.

Nevertheless, one observation concerning the distribution of material in this east-central area of the site is worth particular attention, especially since it echoes the earlier observation made regarding the "western area". The large concentration of seal bones comprising group 8 lies directly above the large central hearth in this area, and indeed, the lowermost bones of this grouping (which are not burnt) lie virtually on top of this large hearth complex. As with the large groups of seal and other mammal bones in the "western area", the clear implication is that this area of the site was abandoned as a focal point of activity and subsequently used as a locality for dumping seal bones, shells and other refuse. Therefore, there would appear to be two cases where major hearth-centred activity areas, which were used as such for an unknown number of occupational episodes, were abandoned and then utilized as dumping localities. Consequently, the apparent redundancy over time in the use of these areas was not maintained throughout the whole period of Mesolithic occupation on the site -- in other words, despite the rather marked redundancy in the organization of activity space, there was to some extent a pattern of shifting activity organization throughout the history of formation of the Cnoc Coig shell midden.

Disposal Modes and Site Maintenance. A few other tentative statements can be made regarding the use of activity areas. On the basis of the nature of their distributions, the different categories of material in Cnoc Coig have been attributed to various disposal modes, and this at least provides a basis for understanding the organization of activities on the site, since the use of different disposal modes has implications for the use and maintenance of activity areas.

The occurrence of antler and bone tools, plus related artifacts such as antler fork/beams and possibly also pumice stones, in a demonstrably close association with hearths suggests that a range of activities represented by these artifacts took place in hearth-centred activity areas. In some cases, it might be presumed that these artifacts were used and then discarded in these locations -- pins (or "winkle-pickers") used for processing periwinkles, and borers used in the working of skins, would be the best two examples. In other cases, these hearth-centred areas may be regarded as craft-working activity loci where tools were manufactured and repaired (though not used), and then discarded either if broken during manufacture or repair or if items broken during use were used as a source of raw material for the manufacture of other items -- mattocks and perhaps harpoons are likely examples.

Other materials which involved relatively large amounts of refuse were discarded further away from hearths, either by dumping or tossing. This would particularly apply to refuse generated as a result of the preparation or consumption of food, including: oyster shells, limpet scoops (presumably along with limpet shells and other refuse), much of the mammal and bird bones, and "dirty dishes" in the form of pecten shells. The inferred dumping of much of this material, in place of more tossing or simply dropping, does imply that the main "living areas" on the site were at least fairly highly maintained. The apparent dumping of much of the waste antler also implies that craft-working loci (within major hearth-centred activity areas?) were also cleaned up and the resulting refuse dumped out of the way. _If_ we can accept that all this indicates a reasonably high degree of maintenance of hearth-centred activity areas, and recalling that the degree to which an area is maintained is related to the intensity of its use _and_ the duration of occupation (see Andresen _et al_. 1981: 33-34; Binford 1983: 190), then this might lead us to think that the occupations represented by the Cnoc Coig shell midden were residential bases occupied for relatively long periods of time (in terms of weeks rather than days) and, by implication, that the settlements included both males and females. In other words, this apparent maintenance of activity areas would lead us to think that we are not dealing with very transitory, special-purpose camps occupied by task-specific subgroups (e.g. seal hunters' camps). But one must be cautious about overinterpreting the implied high degree of maintenance which is based on the inferred dumping of refuse. Moreover, in shell middens, the volume of refuse generated by the processing of shellfish is so large that we might expect a relatively high degree of maintenance of major hearth-centred activity areas even in sites occupied for very short periods of time (such as for a few days).

Final Remarks. Nevertheless, this interpretation of the Mesolithic occupations at Cnoc Coig (and at the other Oronsay shell middens) would clearly seem to be supported by the wide range of activities which took place on the midden, as indicated by the range of artifactual materials and the diversity of exploited food resources found in the site. Certainly, the hunting and processing of mammals is indicated both by the bone assemblages themselves and by the presence of certain artifact types (especially harpoons and mattocks), while the gathering and processing of shellfish, crustaceans and hazelnuts is amply testified to by faunal and floral remains and by artifacts associated with these resources (limpet hammers, limpet scoops, pins or "winkle-pickers", and pitted pebbles). From some aspects of the mammal bone assemblage (see Grigson 1985) and from the presence of borers (presumed to be skin working tools), the working of seal and perhaps otter skins would seem to be indicated, while the presence of items of decoration (red ochre and cowry shells) must testify to the conducting of some non-subsistence (ceremonial?) activities.

Indeed, it would be difficult to envisage that the Oronsay shell middens represent brief, special-purpose camps established by task-specific subgroups from communities normally residing off Oronsay for the purpose of procuring one specifically targeted resource (such as seals). However, even if the occupations at Cnoc Coig do represent residential bases occupied by family groups for relatively long periods of time (weeks or even months rather than days), a number of vital questions still remain: How many family groups were involved? How long was the duration of occupation? Did the groups normally reside on Oronsay or did they come out to the island from some other locality? If the former, what was the nature of the pattern of utilization of resources (e.g. red deer and pig) found only on adjacent islands such as Colonsay, Jura and Islay? If the latter, what was the nature of the subsistence-settlement system of which the Oronsay shell middens only form one component? The spatial analysis of the Cnoc Coig shell midden cannot begin to address these broader questions. However, when the results from the present study are combined with knowledge of the detailed stratigraphy of the site and with what is known of the site structures of the Cnoc Sligeach and C.N.G. I shell middens (see Mellars 1985), and compared to the analysis of the "pre-midden" occupation at Cnoc Coig, then a more thorough understanding of the site will hopefully lead to some positive suggestions regarding some of these questions.