ANCIENT MONUMENTS LABORATORY

REPORT

3636

SERIES/No CONTRACTOR

AUTHOR Peter Murphy March 1982

TITLE Charred remains of crop plants and weed: North Shoebury, Essex

Site	: North Shoebury
County	: Essex
Code	: TQ 98/24
Type of site	: Multi-period; settlement, field system
Geology	: Calcareous brickearth on gravel
Type of material	: Charred plant remains, marine and terrestrial mollusca
Director	: J. Wymer

North Shoebury, Essex : Charred remains of crop plants and weeds

Sampling, extraction and identification

Bulk samples, normally up to about 20kg in weight, were taken by the excavators from features of all periods. Where appropriate, smaller samples comprising obvious discrete patches of charred material within contexts were also taken. Sampling was not probablistic, but an attempt was made to sample all types of features present, including ditches, pits, ovens/kilns and cremations.

For practical reasons bulk sieving and flotation on site were not possible. Charred plant remains were extracted from sub-samples in the laboratory by manual flotation using an 0.5mm collecting mesh.

The flots were dried and sorted under low power of a stereoscopic binocular microscope. The non-floating residues were washed out over a 1mm mesh, dried and sorted for bone, shell and artefacts.

The firm silt loam matrix of the samples presented a number of problems. Firstly, disaggregation was difficult. Pre-soaking in hot water overnight was reasonably effective, but some soil aggregates were resistant even to treatment with H_2O_2. Secondly, the disaggregated sediment was found to clog meshes finer than 0.5mm. during flotation. Finally, some of the charred plant remains had a thin silty coating which filled any concavities on their surfaces. In some cases this coating obscur ed features necessary for identification but could not be removed since re-wetting or scraping with a needle tended to cause fragmentation. Other incomplete or tentative identifications resulted from poor preservation (deformation during charring, weathering or fragmentation). Plant remains identified are listed in Tables

The crop plants

1. Bronze Age Since details of very few crop plant remains of this period have been published, some description and illustration of this material is necessary.

a) *Pisum sativum* (peas) Fig.
Seeds were recovered from 1412 (samples 55 and 48). The dimensions of 30 seeds are as follows:

	Length	Breadth (of cotyledons)	Thickness (across cotyledons)
minimum	3.4mm	2.7mm	3.2mm
mean	4.35mm	3.66mm	3.87mm
maximum	5.3mm	4.6mm	4.7mm

A few of these seeds are approximately spherical but the majority are distinctly angular with irregular (frequently silt-filled) depressions. The hilar grooves of many specimens are also obscured by silt. Few seeds show any trace of the testa and only a small proportion show indistinct remnants of hilums. These are not measureable, but are small and ovate.

b) Triticum spp. (wheats)
The wheat caryopses are predominantly of emmer-type (Fig.). A fragmentary specimen from 1412, consisting only of the basal part of the grain (Fig.) shows some features characteristic of einkorn (T.monococcum). It is slender with a fairly sharp dorsal ridge. Sample 9 from cremation 0021 contained a short grain of a free-threshing wheat (Triticum aestivum/compactum). (Fig.)

The spikelet fragments from these samples consist exclusively of glume bases, spikelet forks and rachis internodes from glume wheats. 1412 (Sample 55) produced several well-preserved glume bases of emmer (T.dicoccum)and spelt (T.spelta). The spelt glumes have suffered some surface damage but their widths (1.2mm) fall clearly within the range characteristic of T.spelta (Helbaek 1952, 218). Forks from 1412 (Sample 48) are small and very distorted. (Fig.), but one probable emmer fork retains its internode. The glume bases and spikelet forks from 1202 A and B and 0021 are all emmer-type (Fig.).

c) Hordeum sp. (barley)
The barley grains from Bronze Age features are not well preserved, though specimens from 1202 A and B are clearly hulled (Fig.), and there are some probable lateral grains. 1202A also produced a barley rachis node (Fig.) but almost none of the internode survives.

d) Avena sp. (oats)
Fragmentary caryopses and awn fragments were recovered from 1412 (Sample 55). It is impossible to determine whether these represent a wild or cultivated oat.

e) Camelina sativa (gold of pleasure) (Fig.)
Seeds of this oil-plant came from 1412 (Sample 55). The better-preserved

examples are 1.3-1.9mm in length with prominent radicles very little shorter than the entire seed.

2. Iron Age and Roman

The charred cereal remains from features of these periods are of spelt, emmer, a free-threshing wheat, hulled barley and wild or cultivated oats. Detailed descriptions of such material with criteria for identification have been given by Helbaek (1952) and Jones (1978). The present material is very similar to the plant remains described by these authors and for this reason detailed descriptions will not be given here.

The glume wheats spelt and emmer are represented by well-preserved glume bases and spikelet forks. Additional glume wheat remains include rachis internodes, fragmentary or silt-encrusted glume bases, spikelet bases (lacking the internode and all but the extreme basal part of the [illegible]) and elongate caryopses. Although these are undoubtedly of spelt or emmer they are not sufficiently well-preserved or distinctive to be referred to a particular species. Free-threshing wheats (bread or club wheat) are represented by a single rachis node from 1364 B and by short grains from 1575 B. Wheat awn fragments showing a clustered irregular pattern of barbs were present in several samples.

The barley caryopses in samples of these periods were not well preserved, and fine details of grain morphology rarely survived. 1561 B contained a single lemma base, apparently of 'plain' form. The rachis internodes are generally fragmentary, but the intact examples include both lax- and dense-ear forms. 1592 D produced fragments of barley awn with two prominent rows of large barbs.

Oat caryopses and twisted awn fragments were present in a number of samples, but the only floret base was of *A.fatua*-type from 1592 D.

3. Early Medieval

The samples from medieval pits and ditches consisted predominantly of free-threshing hexaploid wheat grains, (*Triticum aestivum* or *compactum*). These are poorly preserved and show signs of distortion and puffing. The associated rachis fragments consist of nodes with fragmentary internodes attached but the overall proportions of the internodes cannot be determined. Small numbers of rye (*Secale cereale*) caryopses were present, together with a few rye rachis nodes. Awn fragments of wheat or rye occurred in two samples. A few poorly-preserved barley and oat grains were also identified, and 0352 produced a single seed of pea (Pisum sativum).

Presence analysis of crop plants

A total of fifty-five samples produced remains of nine crop plants. The results are most conveniently summarised by Presence analysis (Hubbard 1975) and are presented in this form in Table .

The frequencies of presence for any given species are related in part to methods of processing and consumption and to purely chance factors. Consequently this form of analysis need not necessarily indicate the relative importance of crops in the economy of the site. However, there is a marked predominance of wheats in most site phases, despite wide variations in sample composition with respect to grains and spikelet fragments.

The main wheat species identified in the Bronze Age samples is emmer (Triticum dicoccum), though a fragmentary grain possibly of einkorn (Triticum monococcum), a short grain of free-threshing wheat (Triticum aestivum or compactum) and two glume bases of spelt (Triticum spelta) were also present. Comparative information from other Bronze Age sites in lowland Britain is sparse (Helbaek 1952; Legge 1981) but on the available evidence emmer appears to have been the principle wheat crop at this period. The identification of spelt is of particular interest since, with the exception of an isolated deposit from a Neolithic pit at Hembury (Helbaek 1952, 207; Hillman 1981, 187), spelt has not been reported elsewhere from definite pre-Iron Age contexts, although Jones (1978, 108) has identified the species from a possible Bronze Age feature at Abingdon. Until further data are available the importance of this crop in the Bronze Age must remain uncertain.

Late Iron Age samples produced remains of indeterminate wheats, spelt and emmer. In the Roman samples spelt is by far the most abundant wheat, with lesser quantities of emmer and rare grains and rachis nodes of a free-threshing wheat, either bread or club wheat. This range of wheats is very characteristic of Iron Age and Roman crop remains over a wide area of Southern and Eastern England (Jones, ibid; Murphy 1977). The early medieval samples from the site contained only free-threshing wheat.

The barley (Hordeum sp.) remains are not well-preserved, but appear to be of a

	Bronze Age	Bronze Age/ Early Iron Age	Late Iron Age	Late Iron Age/Roman	Roman	Early Medieval
Triticum sp. (indeterminate wheat)	4	2	18	2	20	-
Triticum c.f. *monococcum* (einkorn)	1	-	-	-	-	-
Triticum dicoccum (emmer)	5	-	5	-	5	-
Triticum spelta (spelt)	1	1	7	1	15	-
Triticum aestivum/compactum (bread/club wheat)	1	1	-	-	2	6
Hordeum sp. (barley)	5	-	8	-	9	4
Avena sp. (wild or cultivated oats)	2	-	6	-	4	3
Secale cereale (rye)	-	-	-	-	-	3
Pisum sativum (pea)	2	-	-	-	-	1
Camelina sativa (gold-of-pleasure)	2	-	-	-	-	-
Total number of samples	6	3	18	2	20	6

Table : Presence analysis

hulled variety in all site phases. Rachis internodes from Iron Age and Roman contexts are generally fragmentary, but include both lax- and dense-ear forms. Presence analysis tends to inflate the apparent importance of this crop since, although it occurrs in a relatively large number of samples, in no site phase is it numerically as abundant as wheats (Tables). The significance of the remains of oats (Avena spp.) is difficult to assess since floret bases, which are necessary for specific determination, were rare. Some, at least, of these oat remains must be of wild species, and Avena fatua was certainly present in one late Iron Age cremation. The presence frequencies of Avena are, moreover, inflated by the extreme durability of its charred awn fragments, which in some samples were the only remains of this genus. Rye (Secale cereale), represented by grains and rachis fragments was identified only in samples from early Medieval features.

Pulse crops are in general uncommon at British prehistoric sites. The deposit of charred peas (Pisum sativum) from a Bronze Age pit (1412) is therefore particularly interesting. Legge (1981, 94) reports a single pea seed from a Bronze Age midden at Grimes Graves, Norfolk, but there appear to be no other early records of the crop. A comparably large deposit of field beans (Vicia faba var minor) dated to 2760 ± 80 b.p. or 810 b.c. (HAR 2502) has been recovered from a pit at Frog Hall Farm, Fingringhoe, Essex (Murphy forthcoming). Iron Age and Roman features at North Shoebury produced no pulse seeds, but a single pea was identified from an early Medieval pit (0352).

Camelina sativa (gold-of-pleasure) is reported from Neolithic contexts in Hungary and from Iron Age deposits in Scandinavia and Holland (Renfrew 1973, 168; Van Zeist 1970, 87). It has also been identified in association with flax seeds from Boudiccan destruction levels at Colchester (Murphy, forthcoming). Camelina is a common weed of flax, but has also been grown as an oil crop in its own right (Renfrew, ibid).

The wild plants

The distribution of fruits and seeds of wild plants determined to generic or specific level is summarised in Table . The species identified are grouped for ecological interpretation, though inevitably such grouping is artificial due to the wide habitat ranges of many of these plants.

As would be expected the majority of these charred seeds are from arable weeds,

	Species	Bronze Age	Late Iron Age	Roman	Early Medieval
1.	*Raphanus raphanistrum*	-	+	-	-
	Camelina sativa	+	-	-	-
	Stellaria media-type	-	+	-	+
	Atriplex spp.	+	+	+	+
	Chenopodium album	+	+	+	-
	Polygonum aviculare	-	+	+	-
	Polygonum convolvulus	-	+	+	-
	Rumex acetosella	+	+	+	-
	Rumex (*crispus*-type)	+	+	+	+
	Lithospermum arvense	-	-	+	+
	Plantago lanceolata	+	+	-	-
	Galium aparine	+	+	-	+
	Anthemis cotula	-	+	+	+
	Tripleurospermum maritimum	+	+	+	+
	Centaurea cf. *cyanus*	-	-	-	+
	Avena spp.	+	+	+	+
	Avena fatua	-	+	-	-
2.	*Malva* sp.	+	+	-	-
	Medicago lupulina	+	+	+	-
	Vicia tetrasperma	+	-	+	-
	Vicia sativa	-	-	+	+
	Lathyrus nissolia	-	-	+	-
	Bromus sp.	+	+	+	+
	Arrhenatherum elatius	+	+	-	-
3.	*Oxalis acetosella*	+	-	-	-
	Corylus avellana	-	-	-	+
	Sambucus nigra	+	-	-	-
4.	*Pteridium aquilinum*	-	+	-	-
	Stellaria graminea	-	+	-	-
5.	*Ranunculus* sp.	?	-	+	-
	Montia fontana subsp. *chondrosperma*	+	+	-	-
	Eleocharis sp.	-	-	+	-
	Carex sp.	+	-	-	-
	Scirpus maritimus	-	-	+	-

Table : The distribution of seeds of wild plants

The species identified are grouped for ecological interpretation as follows:

1. Arable weeds (many also present in otherdisturbed-ground habitats) *Camelina* anc *Avena* are here considered as possible weeds.
2. Species of grassland and field margins
3. Woodland and scrub plants
4. Species characteristic of grassland and heath on light sandy soils
5. Wetland and damp grassland plants

either species growing directly in the crop or in grassy areas at field margins (Groups 1 and 2). The majority of these plants are of widespread distribution on many soil-types and under a variety of cultivation methods but a few are more informative.

Jones (1978, 106) has drawn attention to *Galium aparine* as a characteristic weed of autumn-sown crops. At North Shoebury it occurs in samples from prehistoric and early medieval contexts. This is of particular significance for the Bronze Age material, since the direct evidence for pre-Iron Age autumn sowing is at present slight, although Hillman (1981, 146-148) considers that autumn sowing of wheats has probably always been customary in temperate Europe. In the present samples *Galium* fruits are associated with spelt, emmer, barley and peas. Of these crops the glume wheats seem most likely to have been autumn sown.

Anthemis cotula has been identified in samples from the Late Iron Age onwards. It is a weed largely confined to arable habitats on heavy alkaline poorly-drained soils. Its absence in Bronze Age contexts may simple indicate that at this date it had not been introduced to the British Isles (there are no pre-Iron Age records; Jones, ibid), or alternatively could suggest some subsequent deterioration in drainage conditions as a result of soil compaction. Another species of mayweed, *Tripleurospermum maritimum*, is present in all site phases.

As was noted above, the status of *Camelina sativa*, present in Bronze Age features only, is uncertain at this site. It is a common and characteristic weed of flax (Hjelmqvist 1950) and its presence may indicate the proximity of flax cultivation. Alternatively it may be a crop.

The third ecological group distinguished consists of woodland and scrub plants. A charred seed of elder (*Sambucus nigra*) came from a Bronze Age pit (1202B), and an early medieval pit (0352) produced charred hazel-nut shell fragments (*Corylus avellana*). These no doubt reflect the gathering of wild fruits and nuts. The provenance of the seeds of wood-sorrel (*Oxalis acetosella*) in a large deposit of peas from a Bronze Age pit (1412) is, however, less certain. Wood-sorrel is common in woods on light soils (Clapham, Tutin and Warburg 1968, 141) and in Eastern England is strongly associated with ancient woodland (Rackham 1980, 54). Although it clearly could not have tolerated the disturbed conditions of arable land, it could have persisted, as it does today, in hedge-banks and, presumably, in areas where the arable fields directly abutted uncleared forest. From these situations it may perhaps have spread by means of its creeping rhizome into the relatively undisturbed field margins where its capsules or seeds could have been accidently harvested with the pea-crop if the haulms were cut low or uprooted.

Species characteristic of grassland and heath on light soils (Group 4) are very rare, and were recovered only from one Iron Age cremation (1592D). The single bracken pinnule and seed of Stellaria graminea are presumably derived from material incorporated in the pyre.

The final group of wetland and damp grassland plants (Group 5) includes small numbers of seeds and nutlets of Montia fontana (blinks), Eleocharis sp. (spike-rush) and sedges (Carex sp.) from Bronze Age-Roman features. Jones (ibid, 105) reports charred remains of these species in association with cereals and suggests that this may indicate an extension of cultivation onto damp ground. Seeds of damp grassland plants are, however, rare in samples from North Shoebury, and this seems to indicate that cultivation was largely confined to better-drained soils. 1642 C produced charred fruits of Scirpus maritimus, the sea club-rush. This species occurs in shallow water at muddy margins of tidal rivers and ditches; possibly these fruits reached the site with plants harvested for thatch or litter.

Contexts and composition of the samples

Charred plant remains were recovered from a range of archaeological contexts at the site and the samples show considerable variation in composition with respect to their relative contents of grains, spikelet fragments, straw fragments and weed seeds. From these characteristics it is possible to reconstruct to some extent the activities which led to their deposition (Dennell 1972; Hillman 1981).

The plant remains from 0021, a Bronze Age cremation, include seeds of crop plants and wild species from several distinct habitats. Wetland and damp grassland plants (Montia fontana, Carex), ruderals and segetals (Leguminosae, Plantago lanceolata), grains and spikelet fragments of cereals (emmer, bread/club wheat, barley) were identified. The sample also produced abundant tubers of the onion couch (Arrhenatherum elatius var bulbosum) and charcoal of oak and an indeterminate diffuse porous wood. This oddly mixed assemblage is closely comparable to plant remains from some Bronze Age cremations in Oxfordshire (Jones 1978, 107-8). Cereals and tubers from these cremations were interpreted by Jones as deliberate inclusions in the cremation pyre, presumably ritual food offerings. The food plants from 0021 at North Shoebury may be of similar origin, whilst the other plant remains from this context are probably remnants of kindling and fuel from the pyre.

The large deposit of peas from a Bronze Age pit (1412, sample 55) clearly represents a fully cleaned crop with no legume or haulm fragments and few weed seeds. The few cereals from this deposit may perhaps be original contaminants of the pea crop, but this feature also included a small discrete patch of charred material consisting mainly of cereals (1412, sample 48). Some mixing of material from these two deposits by root action and burrowing animals could easily have occurred in this pit. The circumstances in which the peas were charred is far from obvious but such a dense deposit (c. 650 seeds per kg of soil) may indicate a catastrophic fire in storage.

The remaining Bronze Age and Bronze Age/Early Iron Age samples consist of small numbers of cereal grains with spikelet fragments, rare culm nodes and weed seeds. It is probable that these were produced by intentional and accidental charring during crop processing and waste disposal in the vicinity.

Late Iron Age cremations from the site contained charred cereals, weed seeds and bracken. As with the Bronze Age cremation 0021, the crop plants remains may represent intentional food offerings, or alternatively could be derived from incompletely-threshed cereal ears and straw used as kindling for the pyre.

The Iron Age and Roman ditches, thought to demarcate field boundaries, included fairly thin scatters of charred cereal grains, spikelet and culm fragments and weed seeds, and in a few of these features (e.g. 1640B) there were denser concentrations of cereal and weed remains. One possible source for these plant remains is stubble-burning: on newly-burnt stubble fields today large quantities of charred cereal remains can be seen on the soil surface. Such material could easily be blown or washed into field ditches, producing deposits of this type.

Other Iron Age and Roman features producing charred plant remains include pits and flues associated with kilns or ovens. Most of the pits contained thin scatters of material similar to the assemblages from the ditches. They may include material derived from stubble-burning or crop processing. Samples from 1610, a Roman pit and 1575, a Roman flue, consist largely of grain and weed seeds with rather few spikelet fragments. These deposits apparently represent a late stage of crop-cleaning.

The cereal samples from the medieval features are all remarkably similar in composition, consisting almost exclusively of bread/club wheat grains, with a few grains of other cereals, rare spikelet and culm fragments and weed seeds.

Clearly these deposits represent fully-cleaned wheat crops, and in view of their very similar composition a common source seems possible. Perhaps the most likely interpretation of these deposits is that charring occurred during a large-scale granary fire and that the resultant charred debris was subsequently dispersed and became incorporated into a variety of contexts.

Loam soils and early agriculture in East Anglia

Loam soils formed on loessal deposits known as coverloam (Corbett and Tatler 1974) and on brickearth deposits, in turn representing wind-blown material, occur in North-East Norfolk and in the river valleys of Essex and south Suffolk (Catt 1978, Fig. 1). The silty texture and large porosity of these soils minimise the effects of low rainfall on crop yields, yet the soils are well-aerated and thus easily worked. Soils with loess-containing surface horizons are significantly more fertile than soils formed on glacial sands and gravels in the same area. Corbett and Tatler (ibid, 124) report the following barley yields from a single Norfolk field within which there was a range of soils from sandy to deep loam: Freckenham series (sandy) 1.5 t/ha; Hall series (thin cover loam over sand) 2.3 t/ha; Sheringham series (cover loam > 70cm thick) 4.3 t/ha. Sturdy and Eldridge (1976) have confirmed by means of soil and crop yield surveys, that deep loamy soils produce significantly higher yields than do sandy soils in East Anglia. The site at North Shoebury is located on an area of brickearth and is classified by the Ministry of Agriculture, Fisheries and Food as Grade I agricultural land, a category in which only 2.3% of agricultural land in Essex is included (ALC, 1969). There can be little doubt that the fertility of the soils of this area and the ease with which they may be cultivated would have encouraged arable farming from prehistory onwards. Indeed it seems that the potential of loam soils in East Anglia as a whole for prehistoric and early historic farming has been under-estimated, since until recently there has been little evidence for early crop production on these soils. The evidence now available is summarised in Table .

Site	Period	Crops
Springfield Barns, Chelmsford, Essex.	Neolithic	Emmer, bread/club wheat, ? spelt
Wherstead, Suffolk	Bronze Age or later	Emmer, spelt, barley, wild/cultivated oats
West Runton, Norfolk	Late Bronze Age	Indeterminate cereal (straw)
Witton, Norfolk	Late Bronze Age	Emmer
Fingringhoe, Essex	Late Bronze Age	Field bean
North Shoebury, Essex	Middle-Late Bronze Age	? Einkorn, emmer, bread/club wheat, spelt, barley, pea, gold-of-pleasure wild or cultivated oats.
	Late Iron Age	Spelt, emmer, hulled barley, wild/cultivated oats.
	Roman	Spelt, emmer, bread/club wheat, barley, wild/cultivated oats.
	Early Medieval	Bread/club wheat, barley, rye, wild/cultivated oats, pea

Table : Charred crop plant remains from loam soil sites in East Anglia
All Murphy (forthcoming)

These results provide evidence for cereal farming from the Neolithic onwards and for the introduction of pulses (beans and peas) during the Bronze Age, if not before. Though prehistoric arable farming was clearly widespread geographically on loam soils no estimates of the intensity of agriculture or the arable area are possible at present. Investigation of valley-floor alluvial deposits reflecting increased erosion as a consequence of cultivation seems most likely to produce information of this type (cf. Shotton 1978). However, there seem to be good grounds for suspecting that early economies on these loam soils included a substantial, if not predominant, arable component.

To conclude on a note of speculation, it is possible that loam soils in coastal areas were centres of innovation for prehistoric agriculture? At North Shoebury we have an area of Grade 1 soils readily accessible to traders or farmers from the continent. This combination of circumstances seems ideal for the introduction of new crops and for trials of their agricultural potential. The early records of spelt, peas and <u>Camelina</u> from North Shoebury and of beans from Fingringhoe provide some support for this speculation, but until further information on pre-Iron Age crops in the British Isles is available it will be impossible to form any definite conclusion.

Acknowledgement

I am most grateful to Dr Gordon Hillman for checking certain identifications and for determining or commenting on some species of Cyperaceae and Gramineae which I was unable to identify.

Oxalis acetosella		-	-	-	-	-	-	-	-	16
Medicago lupulina		-	-	-	-	2	-	-	-	-
Trifolium/Lotus sp.		3	-	-	-	-	-	-	-	-
Vicia tetrasperma		-	-	-	-	-	1	-	-	-
Vicia/Lathyrus sp.		1+1co	-	1	-	4co	7co+2	-	1co	11+24co
Umbelliferae indet. cf. *Pastinaca*		-	-	-	-	-	-	-	-	2
Rumex acetosella		-	-	-	-	1	-	-	-	-
Rumex sp.		-	-	-	-	-	-	-	-	3
Polygonaceae indet.		-	-	-	-	1	-	-	1	-
Plantago lanceolata		3	-	-	-	-	-	-	-	-
Galium aparine		-	-	-	-	1	-	-	-	6
Sambucus nigra		-	-	-	-	-	1	-	-	-
Tripleurospermum maritimum		-	-	-	-	-	-	-	-	1
Compositae indet (f)		-	-	-	-	-	-	-	5	4
Carex spp		38	-	-	-	-	1	-	-	-
Bromus mollis/secalinus		-	-	-	-	-	-	-	-	8+fr
Arrhenatherum elatius var *bulbosum*	tu	69+fr	-	-	-	-	-	-	-	-
Gramineae indet.		-	20	-	-	1	2	-	5	3
Gramineae (? cereal)	cb	1	-	-	-	-	-	-	-	-
Gramineae (? cereal)	cn	-	-	1	-	-	-	-	-	-
Indeterminate	st.fr	+	-	-	-	-	-	-	-	-
Indeterminate		6	9	1	1	4	-	-	-	23
Sample wt (kg)		11.9	2.8	5.0	5.0	12.7	14.0	0.4	0.2	7.5

Table : Charred plant remains from Bronze Age and possible Early Iron Age features (2 sh[illegible])

All taxa are represented by fruits or seeds unless otherwise indicated.

Abbreviations: a - awn; ca -caryopsis; cb - culm base; cn - culm node; co - cotyledon; fr - fragment; gb - glume base; p - plumule and primary root fragments; spb - spikelet base; spf - spikelet fork; st - stem; rn - rachis node.

Notes (a) Poorly preserved caryopses and fragments
(b) Emmer-type or poorly preserved
(c) Spelt/emmer glume bases; fragmentary or silt-encrusted
(d) Numbers from sample 55 estimated from sub-sample
(e) Silt-encrusted
(f) Incomplete. Tripleurospermum/Anthemis-sized

Sample No.			9	15/20	29	30	34	36	38	48	55
Context			0021	1000	1236A	1236B	1202A	1202B	1203	1412	1412
Date			B.A.	BA/1A	BA/1A	BA/1A	B.A.	B.A.	B.A.	B.A.	B.A.
Cereal indeterminate (a)		ca	1(fr)	-	6	2	3	9	1	9	2
		p	-	-	-	-	-	-	-	-	+
Triticum sp.	(b)	ca	-	1	-	1	3	3	-	19	16
	(c)	gb	-	2	-	-	3	2	-	6	3
		spb	-	-	-	-	5	-	-	-	-
Triticum c.f. monococcum		ca.fr	-	-	-	-	-	-	-	-	1
Triticum aestivum/compactum		ca	1	-	2	-	-	-	-	-	-
Triticum dicoccum		gb	-	-	-	-	8	2	-	13	1
		spf	1	-	-	-	4	-	-	2	-
Triticum spelta		gb	-	-	1	-	-	-	-	-	2
Hordeum sp.		ca	1	-	-	-	4	9	-	1	1fr
		rn	-	-	-	-	1	-	-	-	-
Avena sp.		ca	-	-	-	-	-	1(?)	-	-	3fr
		a.fr	-	-	-	-	-	-	-	-	+
Pisum sativum	(d)		-	-	-	-	-	-	-	1+15fr	4900
Camelina sativa			-	-	-	-	-	-	-	5	29
c.f. Ranunculus sp.			1	-	-	-	-	-	-	-	-
Caryophyllaceae indet.			-	-	-	-	-	-	-	-	1
Montia fontana subsp. chondrosperma			2	-	-	-	1	-	-	-	-
Atriplex sp.			-	-	1	-	-	1	-	-	-
Chenopodium sp.			-	-	-	-	-	-	-	2	-
Chenopodium album			-	-	-	-	-	-	-	-	8
Chenopodiaceae indet (e)			-	-	-	-	-	-	-	3	5
Malva sp.			-	-	-	-	-	-	-	-	4

Sample No.		22	23	25	26	41	49	60	61
Context No.		1161	1161	1161	1161	1232	1367	1592B	1592D
Other details		pit fills		vessel	cont.	pit fills		vessels	
Cereal indet	ca	6fr	3fr	3fr	-	-	-	22	12
	cn	-	-	-	-	-	-	-	3
Triticum sp.	ca	1	2	2	1	2	3	11	8
	afr	-	-	-	-	-	-	-	+
	gb	2	3	-	-	-	-	12	13
	bri	-	-	-	-	1	-	1	2
	spb	-	-	-	-	-	-	3	2
Triticum spelta	gb	-	-	-	-	-	-	5	8
Triticum cf. dicoccum	spf	-	-	-	-	-	-	1	-
Hordeum sp.	ca	-	-	-	-	-	-	4	3
	afr	-	-	-	-	-	-	-	+
Avena sp.	ca	-	-	-	-	-	-	1	-
	afr	-	-	-	-	-	-	+	+
Pteridium aquilinum	pi	-	-	-	-	-	-	1	-
Raphanus raphanistrum	sifr	-	-	-	-	-	-	-	1
Stellaria media-type		-	-	-	-	-	-	-	1
Stellaria cf. graminea		-	-	-	-	-	-	-	1
Montia fontana subsp. chondrosperma		-	-	-	-	-	-	1	3
Chenopodium album		-	-	-	-	-	-	+	2
Atriplex sp.		-	-	-	-	-	-	+	-
Malva sp.		-	-	-	-	-	-	-	1
Vicia/Lathyrus sp.	co	-	-	1	-	-	-	-	1
Polygonum convolvulus		-	-	-	-	-	-	6	3
Rumex sp.		-	-	-	-	-	-	-	1
Galium sp.		-	-	-	-	-	-	1	-
Compositae indet.		1	-	-	-	-	-	-	-
Gramineae indet.		-	-	-	-	-	-	3	8
Avena fatua-type	f/o	-	-	-	-	-	-	-	1
Bromus mollis/secalinus		-	1	-	-	-	1	4	1
Indeterminate		-	-	-	-	-	-	2	10
Sample wt (kg)		6.3	8.9	4.1	1.1	11.8	11.6	1.7	1.7

Table : Charred plant remains from Late Iron Age cremations

(1 sheet)

a-awn; bri-brittle rachis wheat internode; ca-caryopsis; cn-culm node; co-cotyledon; f/o-floret; fr-fragment; gb-glume base; pi-pinnule; si-siliqua; spb-spikelet base; spf-spikelet for; + present but fragmentary.

Indeterminate	3	-	-	5	-	7
Sample wt (kg)	5	3.5	0.8	5	5	5

Table : Charred cereals and crop weeds from Iron Age and Roman ditches
(4 sh[illegible])

Taxa are represented by fruits or seeds unless otherwise indicated.

Abbreviations: a-awn; bri-brittle-rachis wheat internode; ca-caryopsis; cn-culm node; co-cotyledon; fr-fragment; gb-glume base; ri-rachis internode; rn-free-threshing wheat rachis node; si-siliqua; spb-spikelet base; spf-spikelet fork;

-						-	-	1	1	1	-
3	3	2.1	3	3	5	5	5	5	5	5	5

Sample No.		74	51	72	69	42	70
Content		1525/0	1561/B	1596/F	1640/B	1346B	1642C
Date			Iron Age			Iron Age/Roman	
Indeterminate cereal	ca+fr	22	68	1	36	1	5
	p	-	+	-	2	-	-
	cn	-	-	-	+	-	-
Triticum sp.	ca	9	9	1	14	-	-
	afr	-	-	-	+	-	-
	bri	1	-	-	4	-	-
	rn	-	-	-	-	-	-
	gb	5	-	-	19	-	1
	spf	-	-	-	-	-	-
	spb	1	-	-	2	-	-
Triticum dicoccum	gb	-	-	-	-	-	-
	spf	-	-	-	2	-	-
Triticum spelta	gb	3	1	-	46	1	-
	spf	-	-	-	4	-	-
Hordeum sp.	ca	-	15	-	-	-	-
	ri	-	4	-	1	-	-
Avena sp.	ca	1	3	-	-	-	-
	afr	+	+	-	+	-	-
Raphanus raphanistrum	sifr	-	-	-	2	-	-
Montia fontana subsp. *chondrosperma*		-	2	-	2	-	-
Chenopodium album		-	-	-	-	-	1
Atriplex patula/hastata		-	-	-	-	-	-
Chenopodiaceae indet.		-	-	-	2	-	-
Medicago lupulina		-	-	-	1	-	-
Vicia sativa		-	-	-	-	-	-
Vicia/Lathyrus sp.		5co	4+5co	-	12+7co	-	-
Leguminosae indet		1fr	3	-	2fr	-	-
Polygonum aviculare		-	-	-	1	-	1
Polygonum convolvulus		-	-	-	1	-	-
Rumex acetosella		-	-	-	4	-	-
Rumex sp.		-	-	-	3	-	1
Polygonaceae indet.		-	-	-	1	-	-
Galium aparine		-	-	-	7	-	-
Anthemis cotula		-	-	-	-	-	-
Tripleurospermum maritimum		-	1	-	11	-	-
Scirpus maritimus		-	-	-	-	-	7
Bromus mollis/secalinus		8	1	-	50	-	-
Arrhenatherum elatius	tu	2fr	-	-	-	-	-
Gramineae indet		-	-	-	21	-	2

28	28	28	28	28	52	47	43	45	44	46	63
1036	1036	1036	1036	1036	1240G	1328J	1364A	1364B	1364C	1364D	1598B
0-10cm	10-20cm	20-25cm	25-35cm	35-40m	Roman						
2	1	6	2	1	2	3	4	8	3	7	1
1	-	-	-	-	-	-	1	1	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-
-	2	-	-	1	1	1	7	14	3	2	2
-	-	-	+	-	-	-	-	-	-	-	-
-	2	2	3	2	-	-	3	1	4	-	-
-	-	-	-	-	-	-	-	1	-	-	-
5	10	12	4	8	-	-	4	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	2	7	-	-	-	1	2	-	-
-	-	-	-	-	-	-	-	-	-	2	-
-	-	-	-	-	-	-	-	-	-	-	-
3	6	6	5	6	-	1	22	5	7	-	-
-	-	-	-	-	-	-	2	-	1	-	-
-	-	-	1	1	-	1	-	-	-	-	1
-	-	-	-	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	+	-	-	-	-	-	+	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	2	-	1	-	-
-	-	-	-	-	-	-	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	4	-	-	1	-
-	-	-	-	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	1co	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1	-	-
-	-	-	1	-	-	-	1	1	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	1	-	-	-	-
-	-	-	-	-	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	1	-	-	-	1	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	2	-	1	-	-	-	1	-	-	-

<u>Eleocharis sp.</u>	-	-					
Gramineae indet.	-	-	6	-	-	-	-
<u>Bromus mollis/secalinus</u>	-	-	1fr	-	-	-	-
Indeterminate	-	-	6	2	-	-	-
Sample wt (kg)	0.6	1.3	5.1	7.5	5	5	0.15

<u>Table : Charred crop plant remains from various Iron Age and Roman contexts</u>

(A, site C)

Taxa represented by fruits or seeds unless otherwise indicated.

Abbreviations: a-awn; bri-brittle-rachis wheat internode; ca-caryopsis; cn-culm node; co-cotyledon; fr-fragment; gb-glume base; p-plumule and primary root fragments; ri-rachis internode; spb-spikelet base; spf-spikelet fork.

1	-	2	-	-	-	3
1	-	-	1fr	-	-	4
12	3	5	3	1	-	4
5	5	17.0	18.9	13.3	6.8	5

Sample No.		14	37	16	21	31	32	59
Context		1008	0704B	1008B	1044	1209A	1290B	1424B
Feature-type		Vessel	Pit	Pit	Pit	Pit	Pit	Flue
Dating				Iron Age				Roman
Indeterminate cereals	ca+fr	-	1	12	15	3	3	5
	p	-	-	-	-	-	-	-
	ri	-	-	-	1	-	-	-
	cn	-	-	-	-	-	-	-
Triticum sp.	ca	1	1	3	-	1	5	2
	afr	-	-	+	-	-	-	-
	bri	-	-	3	-	-	-	1
	gb	1	-	29	12	-	-	1
	spf	-	-	-	-	-	-	-
	spb	-	-	3	3	-	1	4
Triticum dicoccum	gb	1	-	9	7	-	-	-
	spf	-	-	-	3	-	-	-
Triticum spelta	gb	-	-	8	6	-	-	5
	spf	-	-	1(?)	-	-	-	-
Hordeum sp.	ca	-	-	2	1	1	1	-
	ri	-	-	-	-	-	1	-
Avena sp.	ca	-	-	-	-	-	-	-
	afr	-	-	+	-	-	-	-
Ranunculus sp.		-	-	-	-	-	-	-
Caryophyllaceae indet.		-	-	-	5	-	-	-
Chenopodium album		-	-	-	-	-	-	-
Atriplex patula/hastata		-	-	-	-	-	-	-
Chenopodiaceae indet.		-	-	2	1	1	-	-
Medicago lupulina		-	-	-	-	-	-	-
Vicia c.f. *tetrasperma*		-	-	-	-	-	-	-
Lathyrus nissolia		-	-	-	-	-	-	-
Vicia/Lathyrus sp.		-	1	-	-	-	-	-
Leguminosae indet.		-	-	-	2	-	-	-
Polygonum aviculare		-	1	-	-	-	-	-
Polygonum convolvulus		-	-	-	-	-	-	-
Rumex sp.		-	-	-	1	-	-	-
Rumex acetosella		-	-	-	-	-	-	-
Polygonaceae indet.		-	-	-	-	-	-	-
Lithospermum arvense		-	-	-	-	-	-	-
Plantago lanceolata		-	-	1	-	-	-	-
Galium aparine		-	-	-	-	1	-	-
Anthemis cotula		-	2	-	-	-	-	-
Tripleurospermum maritimum		-	-	1	-	-	-	-

53	54	17	18	13	19	57
1575A	1575B	1002	1003	1013	1035	1610
Flue	Flue	Pit	Pit	Pit	Pit	Pit
			Roman			
15	5	22	11	4	8	53
-	-	-	1	-	-	1
-	-	-	-	-	-	-
-	-	-	-	-	-	-
24	4	12	9	-	-	197
-	-	-	-	-	-	-
-	-	2	1	1	1	2
-	-	9	5	2	-	7
-	-	1	2	-	-	-
-	1	4	1	1	1	-
-	-	4	1	-	-	2(?)
-	-	10	6	2	-	-
1	-	2(?)	1	2	-	18
-	-	1(?)	-	-	-	-
-	-	6	3	-	-	2
-	-	1	1	1fr	-	-
-	-	-	-	-	-	2
+	-	-	-	-	-	-
1	-	-	-	-	-	1
1	-	-	-	-	-	-
-	-	1	-	12	-	-
-	-	-	-	-	-	2
-	-	-	-	-	-	-
10	5	-	-	-	-	-
4	-	-	-	-	-	-
-	-	-	-	-	-	1co
1+12co	7+5co	-	-	-	-	1+7co
-	-	1	1	-	1	-
-	-	-	1	-	-	5
-	-	1	-	-	-	1
19	16	-	-	-	-	1
-	-	-	-	-	1	1
1	-	-	-	-	-	-
-	-	-	-	-	-	6
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

Context No.		0329	0304	0343	0352	0354	034
Sample No.		2	3	4	5	6	7
Context-type		Pit	Ditch	Ditch	Pit	Ditch	Dit
Indet. cereal	ca(a)	1	20	20	5	16	77
Indet. cereal	cn	-	2	-	-	1	1
Triticum aestivum s.l.	ca	2	135	72	10	128	736
Triticum aestivum s.l.	rn	-	14	1	-	2	12
Secale cereale L.	ca	-	6	-	-	?3	7
Secale cereale L.	rn	-	4	-	-	2	7
Triticum/Secale	rn(b)	-	3	-	-	-	2
Triticum/Secale	af(c)	-	-	-	-	+	+
Hordeum sp.	ca	-	2	1	-	2	10
Avena sp.	ca	-	6	-	-	?4	12+?1
Stellaria media (L) Vill		-	-	-	1	-	-
Atriplex patula/hastata		-	-	-	-	-	1
Leguminosae indet.	co(d)	-	17	3	-	8	17
Leguminisae indet.	s(e)	-	17	3	2	2	28
Vicia c.f. sativa L.	(f)	-	-	-	-	-	1
Vicia spp.	(g)	-	3	1	-	-	7
Pisum sativum L.		-	-	-	1	-	-
Rumex sp.		-	1	-	-	1	2
Corylus avellana L.	fr	-	-	-	+	-	-
Lithospermum arvense L.		-	-	-	-	1	-
Galium aparine L.		1	1	-	-	-	-
Compositae indet. (frag.)		-	1	-	-	-	-
Anthemis cotula L.		-	2	1	-	8	6
Tripleurospermum maritimum		-	-	-	-	-	2
Centaurea c.f. cyanus L.		-	-	-	-	-	2
Bromus mollis/secalinus		-	-	-	-	-	1
Gramineae indet.		-	2	1	-	1	6
Indeterminate		-	1	-	-	1	1
Sample wt (kg)		3	6	0.4	3	2.8	2

Table : Charred cereals and crop weeds from medieval features.
Taxa are represented by fruits or seeds unless otherwise indicated.

Abbreviations:

af	awn fragments	fr	fragments
ca	caryopses	rn	rachis nodes
cn	culmnodes	s	seeds
co	cotyledons		

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Fig. : North Shoebury: Charred crop plant remains from Bronze Age contexts.

a.b. Triticum dicoccum caryopses 1412

c. Triticum aestivum sensu lato caryopsis 0021

d. Hordeum sp. hulled caryopses 1202A

e,f. Pisum sativum seeds. 1412

g,h,i. Triticum dicoccum spikelet forks 1412 and 1202

j. Triticum c.f. monococcum caryopsis fragment 1412

k. Triticum dicoccum, glume base 1412

l. Triticum spelta glume base 1412

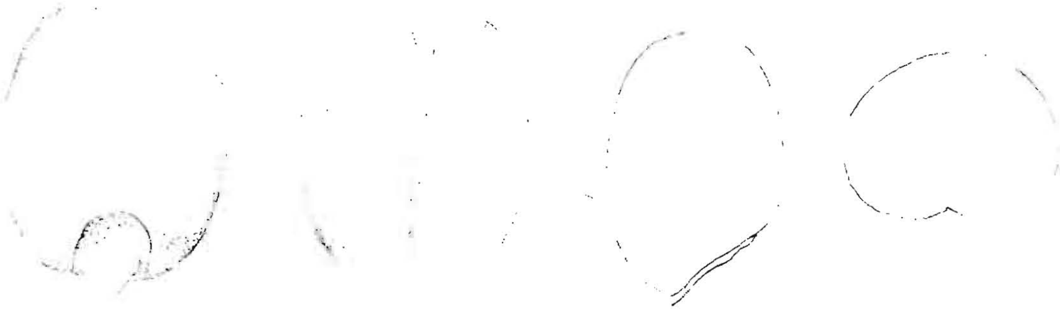
m. Hordeum sp. rachis node 1202A

n. Camelina sativa seed 1412

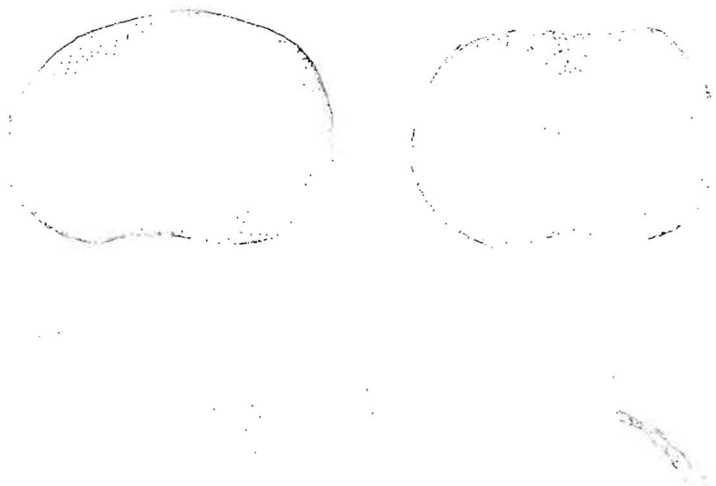
Scales graduated in millimetres

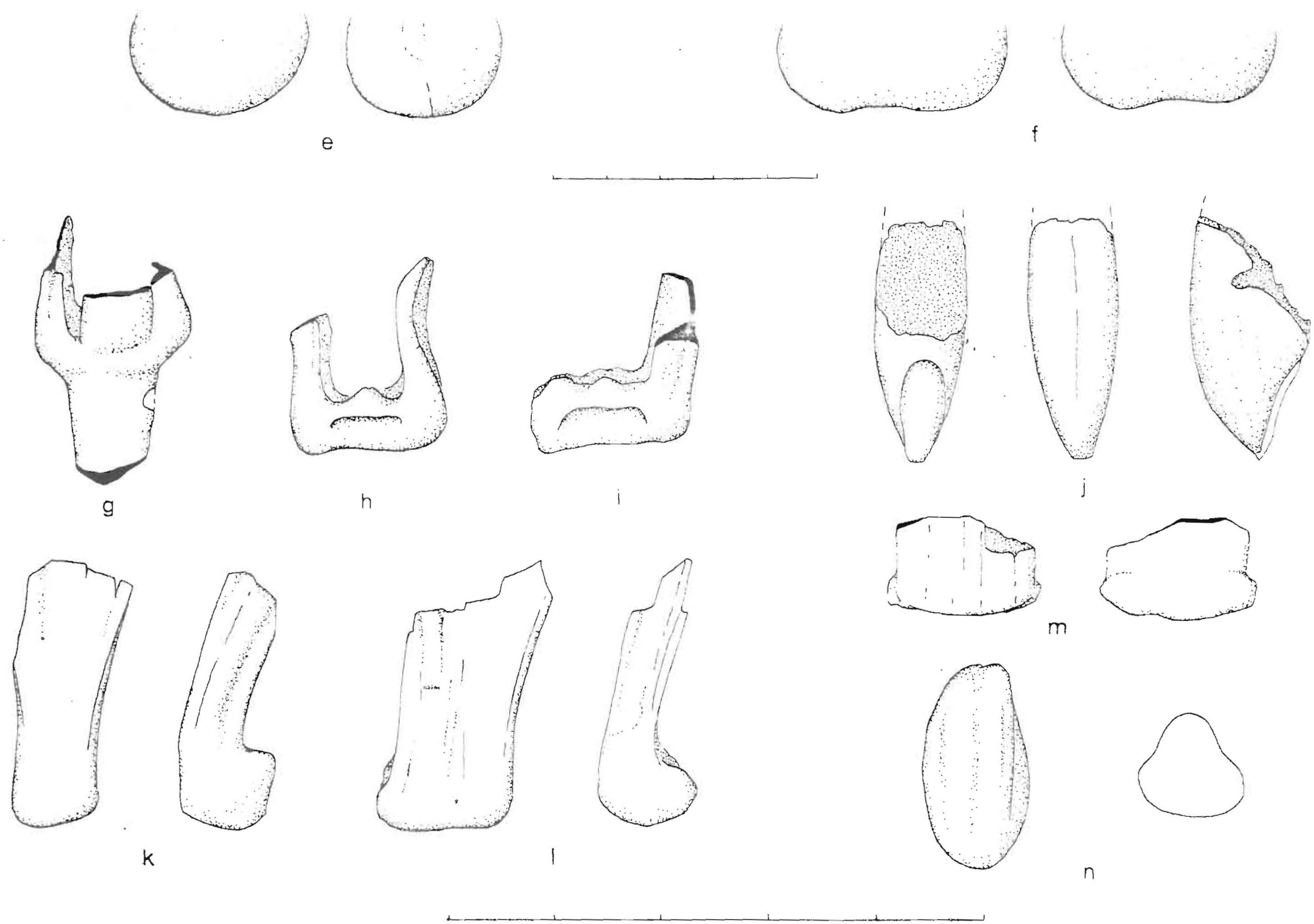
a

b



d





(For reduction to 1/2 linear)

North Shoebury, Essex : Marine molluscs

Shells of marine molluscs were collected by hand during excavation, and further shells and fragments were extracted by wet-sieving from soil samples.

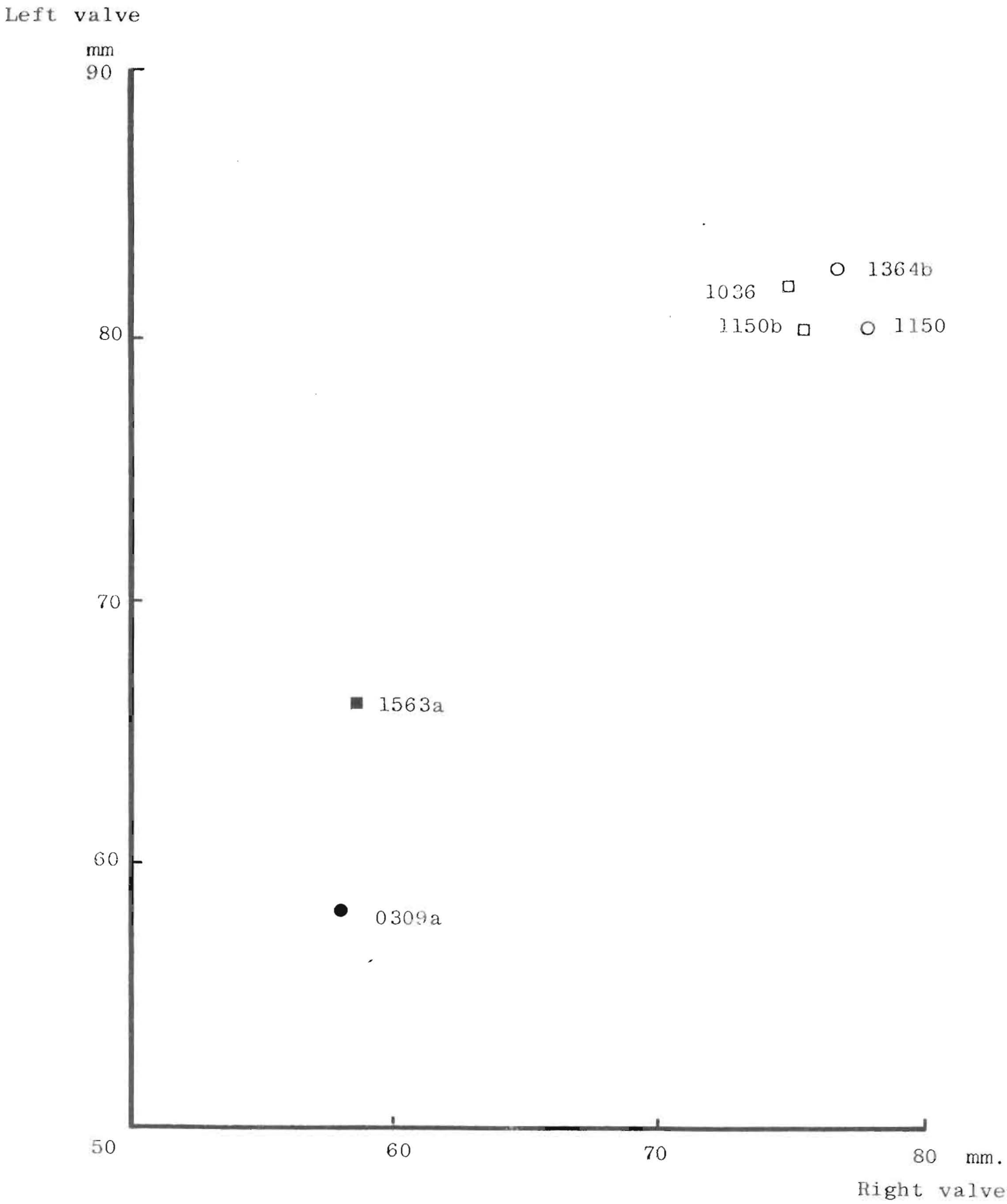
1. Ostrea edulis L.

The flat or native oyster was the only species of Ostrea identified. Valves were present in small numbers in a wide variety of contexts, and there were several very large deposits of dumped shell in medieval and Roman features, predominantly ditches. Two aspects of these large oyster deposits have been examined in detail: shell size and lower valve attachment.

Hinge-gape dimensions have been obtained where possible from 100 upper (right) valves and 100 lower (left) valves from each deposit, although poor preservation has necessitated a smaller sample size for several deposits. Almost all valves had sustained some marginal damage which inevitably has reduced the possible accuracy of measurement. Since the upper valves are seated within the cupped lower valves in the living animal they are somewhat smaller. Means and ranges ranges calculated from these measurements are given in Table

The oyster lives cemented to firm substrates by the lower valve (Tebble 1966, 52). The area of attachment often shows a negative cast of the substrate. In the majority of lower valves the nature of the substrate cannot be determined or else consisted of dead oyster valves, but a number of lower valves clearly show attachments to Cerastoderma, Mytilus or Littorina shells (either 'negative casts' or the shells themselves) and a few are attached to other bivalves, probably Venerupis sp. and Scrobicularia plana. Frequencies of attachment to these species are given in Table

The results of these two lines of investigation are shown in Fig. . There are clearly two quite distinct groups. Shells from 1036, 1150, 1150B and 1364B have a large mean size (more than 80mm for left valves) and very few or none (Maximum 0.8%) are attached to shells other than oyster. Valves from 0309A and 1563A are smaller (mean size for left valves 59-66mm) and show higher frequencies of attachment to shells of other molluscan species (24 and 12% respectively). Moreover, though this is difficult to illustrate quantitately valves from 0309A and 1563A tend to be more rounded with fewer grossly distorted specimens.



Lower valve attachment;

- ● 20 - 30% attached to molluscs other than oyster.
- ■ 10 - 20% attached to molluscs other than oyster.
- □ 0 - 1% attached to molluscs other than oyster.
- ○ 0% attached to molluscs other than oyster.

NORTH SHOEBURY. OYSTER DIMENSIONS (MEAN FIGURES) AND ATTACHMENT.

Context	Date	Mean hinge-gape (mm) Left valve	Right valve	Range (mm) Left valve	Right valve	Mo. measured Left valve	Right valve
0309A	Medieval	58.79	58.01	42-103	40-101	62	57
1036	Roman	82.14	75.00	58-107	28-105	88	96
1150	Roman	80.32	77.67	39-108	45-110	100	100
1150B	Roman	80.57	75.73	30-119	27-111	100	100
1364B	Roman	82.94	76.32	53-110	56-101	85	82
1563A	Roman	66.43	59.21	36-89	31-81	75	73

Table : Oyster valve dimensions

Note: Most valves from 1563A were poorly preserved; only specimens from Find No. 1063B were suitable for measurement.

Context	Date	Ostrea/Indeterminate	Cerastoderma	Mytilus	Littorina	? Venerupis	? Scrobicularia
0309A	Medieval	86 (76.1%)	21 (18.6%)	3 (2.7%)	1 (0.9%)	2 (1.8%)	-
1036	Roman	133 (99.2%)	-	1 (0.8%)	-	-	-
1150	Roman	212 (100%)	-	-	-	-	-
1150B	Roman	207 (99.5%)	-	1 (0.5%)	-	-	-
1364B	Roman	100 (100%)	-	-	-	-	-
1563A	Roman	174 (88.3%)	13 (6.6%)	9 (4.6%)	-	-	1 (0.5%)

Table : Oyster lower valve attachment

These two groups are thought to represent two distinct types of oyster population. The first group shows characteristics which might be expected to occur in a natural population, not significantly modified by human exploitation: it appears to represent a bed in which a high proportion of individuals attained maturity and where there was a degree of crowding resulting from natural spatfall. Since no unmodified natural populations survive today there is, unfortunately, no way of testing this by comparison with modern shells. The second group has a smaller mean shell size and this suggests a greater intensity of exploitation, fewer individuals surviving to maturity. The significance of the high percentages of attachment to shells other than oyster is less easily assessed. The depth ranges of the two main species involved only just overlap: Ostrea edulis is found from about low water to 45 fathoms (82.3m), but Cerastoderma edule is an intertidal species occurring from mid-tide level to just below low water (Tebble 1966). It is possible that currents exhumed dead shells of cockle and transported them, along with shells of the other intertidal species, to a relatively shallow-water oyster bed where they formed part of the substrate for oyster attachment. Equally probable, however, is that these shells were food refuse deliberately deposited with oyster shells as 'cultch' (Yonge 1949, 282). One further consideration tends to support the second interpretation: if natural currents were carrying cockle shells to the oyster beds then shells of other infaunal bivalves from sandy and muddy substrates (eg. species of Tellina, Spisula, Ensis, Mya, Macoma balthica and Scrobicularia plana) should have been transported in comparable numbers. However, almost all the non-oyster attachments are to edible species.

The evidence is, then, open to more than one interpretation but on balance is thought to indicate that 0309A and 1563A (dating from the medieval and Roman periods respectively) are from populations which were being managed, or at least encouraged by the deposition of waste shell from food refuse as 'cultch' and which were being heavily exploited, whereas the remaining Roman oyster deposits are from natural populations lightly exploited.

2. Mytilus edulis L.

Mussel shells were collected from features of all periods. Shells of this species are particularly prone to fragmentation and it is therefore likely that mussels are consistently under-estimated in the counts of hand-collected shells. Mussels are present from high in the intertidal zone to depths of a few fathoms, attached to solid substrates by byssus threads (Tebble 1966, 41). Mussels also form self-supporting clumps in sheltered intertidal areas where they may be gathered by hand at low tide.

3. Cerastoderma edule (L)

Many of the cockle shells from the site were received in an unwashed state and were not inspected in detail. It is therefore possible that some C.lamarcki may be present but have been overlooked. C.edule is an infaunal intertidal species particularly common on sandy shores, but also extending into muddy areas. Cockles are traditionally gathered by hand-raking and digging at low tide (Tebble 1966, 105; Yonge 1949, 285).

4. Buccinum undatum L.

This appears to be the only species of whelk represented, though some abraded fragments could be of this species or Neptunea antiqua. B.undatum is a subittoral gastropod, occurring from L.W.M. to 1200 fathoms. It is a predator, and is collected using baited wicker pots shot from vessels offshore (McMillan 1968, 10 and 52).

5. Littorina littorea (L)

The small size and generally dark colouration of winkle shells has probably resulted in relatively poor recovery. Winkles are very common between tidemarks, occurring both on rocks and also in association with mussel clumps and weed (McMillan 1968, 30; Yonge 1949, 286). It is possible that some specimens from the site were not intentionally gathered, but were accidentally collected with mussels.

6. Non-edible marine molluscs and other invertebrates

The shells collected by hand included the following non-edible marine species:

0320 (Medieval) Scrobicularia plana
0324 (Medieval) Venerupis c.f rhomboides
0715A (Roman or later) Macoma balthica

Soil samples from 1364 and 1642A wet-sieved primarily for the extraction of land molluscs produced the marine species listed in Table .

	1364A	1364B	1364C	1642C
Sample wt (kg)	2	2	2	5
Foraminifera	-	+	-	-
Bryozoa	+	+	-	+
Ostracoda	-	+	-	-
Balanus	+	+	+	+
Mytilus edulis L. (< 2mm)	-	5	-	-
Cerastoderma sp. (∿ 1mm)	2	-	-	-
Macoma bathica (L)(frag)	-	-	1	2
c.f. Mya sp. (immature hinge)	1	-	-	-
Indet. bivalves (<3mm)	1	1	-	-
Hydrobia ulvae (Pennant)	-	1	-	-
Rissoa sp.	1	-	-	-

Table : Non-edible marine molluscs and other invertebrates from soil samples

Remains of organisms attached to or boring in shells of oyster, cockle and mussel include Bryozoa, Balanus balanoides, Clione celata, Polydora sp. and oyster spat.

Macoma balthica, Hydrobia ulvae and Scrobicularia plana are common molluscs on and in muddy substrates, the latter two species occurring particularly in regions of lowered salinity (Yonge 1949, 247-257). There seems little doubt that these species and indeed most other small molluscs and other invertebrates were brought to the site with edible shellfish, either as individuals gathered in error, directly attached to other shells or in encrusting intertidal mud.

Changes in species frequency

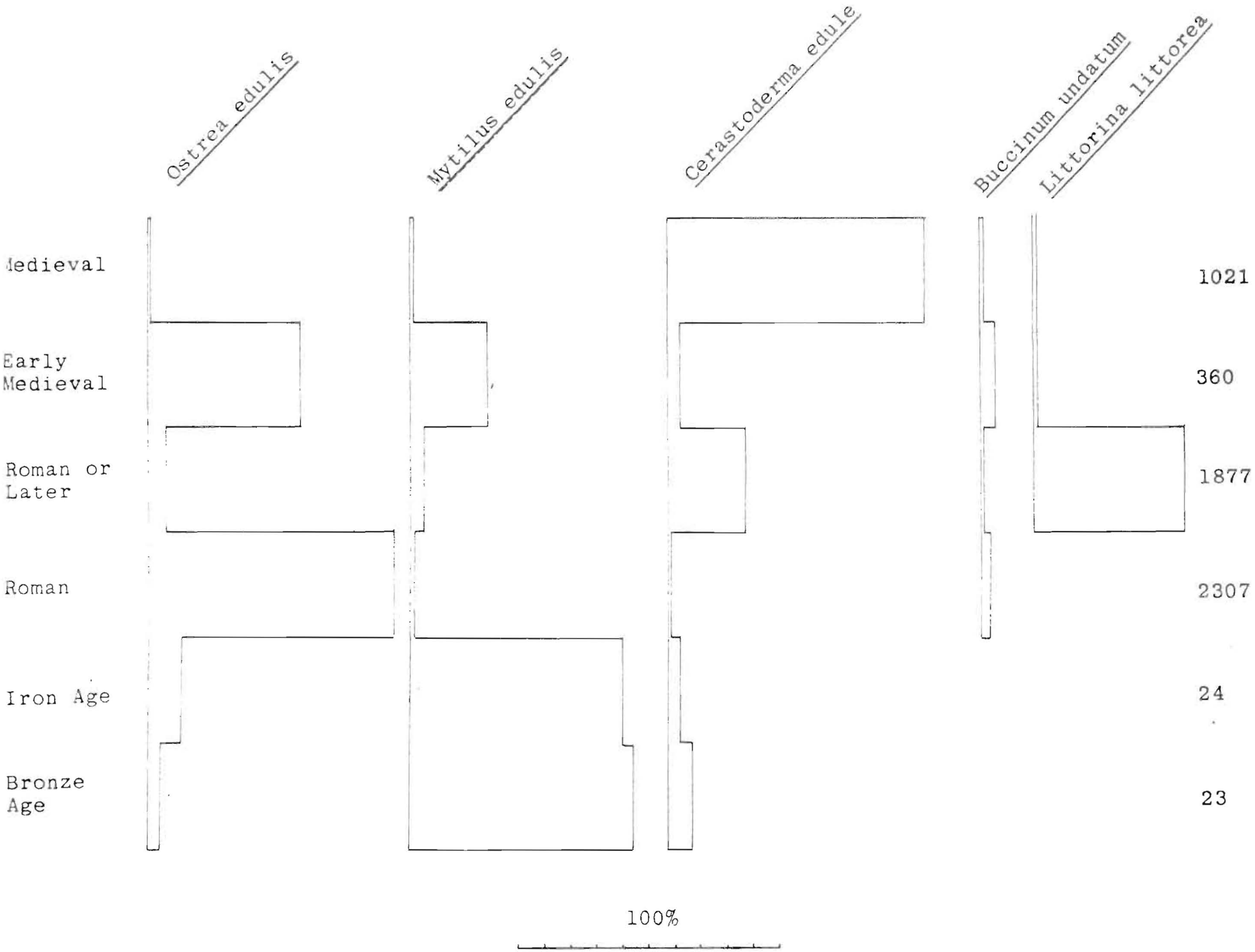
Marine mollusc shells were recovered from Bronze Age (Ardleigh Urn), Late Iron Age, Roman and Early Medieval features. Variations through time in the frequencies of the species identified are given in Table and summarised in Fig. . The two main factors potentially influencing these variations are coastal change and changes in the nature of shellfish collection.

Devoy (1979, 391) has distinguished three marine transgressions (Thames III-V) separated by two minor regression phases (Til bury IV and V) in the Thames Estuary between about 4000 B.P. and the present, giving a net rise in relative sea-level of something over 5m in this period. These transgressions and

	Bronze Age	Iron Age	Roman	Roman or later	Early Medieval	Medieval to Late Medieval
Ostrea edulis	1 (4.3)	3 (12.5)	2171 (94.1)	123 (6.6)	208 (57.8)	13 (1.3)
Mytilus edulis	20 (86.9)	20 (83.3)	50 (2.2)	109 (5.8)	112 (31.1)	2 (0.2)
Cerastoderma edule	2 (8.7)	1 (4.2)	3 (0.1)	552 (29.4)	18 (5.0)	1003 (98.2)
Buccinum undatum	- -	- -	83 (3.6)	9 (0.5)	20 (5.5)	2 (0.2)
Littorina littorea	- -	- -	- -	1084 (57.8)	2 (0.5)	1 (0.1)
Totals	23	24	2307	1877	360	1021

Table : Counts and percentages (in parenthesis) of main molluscan species

These counts refer to minimum numbers of individuals



North Shoebury: Main molluscan species.

regressions would have resulted in lateral movement of the littoral zone, but there seems no reason to suppose that there would have been any marked changes in the types of intertidal and sublittoral habitats available for mollusca other than on a local level. The observed variations in species freqency at the site are therefore attributed primarily to changes in the scale and type of exploitation.

1. Bronze Age (Ardleigh Urn)

A total of 39 mussel valves, 4 cockle valves and one oyster valve were recovered by hand from Bronze Age contexts during excavation. Of the ten soil samples taken from Bronze Age features five produced mussel-shell fragments and one of these also contained cockle-shell fragments. On the basis of this material there is no evidence for anything other than gathering in the intertidal zone. Both mussel and cockle are intertidal species, and though oysters are mainly found in shallow tidal creeks where they are not exposed, some beds may be found on the shore at low tide (Yonge 1949, 283).

2. Late Iron Age

Very few shells were collected from Iron Age features during excavation: two oyster lower valves and one mussel valve from 1525E. Additionally, mussel fragments were present in soil samples from 1209B, 1346B, 1592B and 1592D; 1642C produced fragments of oyster, mussel, cockle and *Macoma bathica*; and a sample from 1640B contained 38 mussel valves and fragments of oyster and cockle. Taken together this small collection of shell is similar to that from the Bronze Age features and seems to indicate a continued emphasis on gathering in the intertidal zone.

3. Roman

The shell deposits from Roman features differ from the prehistoric deposits both in size and species composition. The deposits are much larger and it is difficult to avoid the conclusion that exploitation was on a greatly increased scale. Deposits of this period also show a marked shift away from the consumption of intertidal bivalves (mussels and cockles), the beginning of whelk-fishing offshore and most clearly an emphasis on oyster consumption Evidence for possible management of oyster-beds at this period has been noted above, though it seems that natural oyster-beds were also exploited.

4. Roman or later

Pit 0715 overlying the intersection of 0692, 0722 and 0725 produced large quantities of shell comprising a very different assemblage from the securely-dated Roman features at the site, and reflecting a much greater emphasis on intertidal molluscs and in particular winkles (58%) and cockles (29%). It is clearly impossible to be sure why winkles, which hitherto and subsequently were a largely neglected species, are so abundant in this feature, but it is at least possible that this deposit reflects an episode of scarcity when species with such a small meat weight were worth collecting from the shore on a fairly large scale.

5. Early medieval

The shell assemblages from this period consist predominantly of oysters (58%) and mussels (31%),with cockles (5%), whelks (5%) and a few winkles (o.5%). This appears to indicate similar exploitation to that of the Roman period, with a somewhat greater emphasis on mussels.

6. Medieval-Late Medieval

Small numbers of shells were recovered from several contexts, reflecting continued exploitation of the main species. The totals are, however, biased by a single large deposit of cockle valves (2006 in total) from 0645.

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North Shoebury: Hand-collected marine mollusc counts

Context no.	Find no.	Date	Ostrea uv	Ostrea lv	Mytilus	Cerastoderma	Buccinum	Littorina	Others
0001	2	Late Med	–	1	–	–	–	–	–
0134	24	Late Med	–	1	–	–	–	–	–
0065	32	?	1	–	–	–	–	–	–
0301A	61	Early Med	–	2	–	–	2	1	–
0303A	62	Early Med	1	1	–	–	1	–	–
0302A	63	Early Med	1	1	–	–	–	1	–
0301C	65	Early Med	1	–	–	–	–	–	–
0301G	66	Early Med	1	–	–	–	–	–	–
0301C	68	Early Med	2	1	–	–	–	–	–
0302C	69	Early Med	–	1	–	–	–	–	–
0302B	71	Early Med	1	–	–	–	–	–	–
0303A	74	Early Med	2	–	–	–	–	–	–
0303D	75	Early Med	–	1	–	–	–	–	–
0313	76	Early Med?	–	1	–	–	1	–	–
0302C	80	Early Med	1	3	–	–	–	–	–
0312J	83	Early Med	2	–	–	–	–	–	–
0307A	84	Early Med	2	–	–	–	2	–	–
0308	88	Early Med	4	1	–	–	–	–	–
0304	89	Early Med	1	1	–	–	–	–	–
0304	95	Early Med	–	1	2	–	3	–	–
0322	96	Late Med	3	4	–	–	–	–	–
0320	97	Med?	–	–	–	–	1	–	Scrobicu plana 1
0308	98	Early Med	–	–	–	–	–	–	Cepaea
0311	100	Early Med	3	2	–	–	–	–	–
0321	101	Med?	–	2	–	–	–	–	–
0339	110	Early Med	2	–	–	–	2	–	–
0309	102	Early Med	–	1	–	–	–	–	–
0324	105	Med?	–	–	–	–	–	–	Venen cf rhor
0318	106	Early Med?	23	28	14	–	1	–	–
0322	107	Late Med	–	4	1	–	~~2~~ –	–	–
0341	109	Early Med	1	1	–	2	–	–	–
0309A	113	Early Med	111	113	208	28	5	–	–
0645	383	Med.	–	–	2	2006	+ (2)	–	–

North Shoebury: Hand-collected marine mollusc counts

Context no.	Find no.	Date	Ostrea		Mytilus	Cerastoderma	Buccinum	Littorina	Other
			uv	lv					
1150	422	Roman	223	212	–	–	48	–	–
1150B	446	Roman	209	208	1	–	1	–	–
1036	299	Roman	139	134	–	–	–	–	–
0332	112	Med	–	1	–	–	–	–	–
0304C	114	Early Med	4	4	–	–	–	–	–
0346	115	Late Med	–	–	–	–	1	–	–
0304E	134	Early Med	19	29	1	5	3	–	–
0084A	163	?	–	–	–	–	–	–	
0158	272	B.A.?	–	–	–	–	–	–	Land mollusc
1036	313	Roman	–	–	3	–	1	–	–
1150B	451	Roman	–	–	5	–	8	–	–
1150B	480	Roman	–	–	2	–	2	–	–
1240D	565	Roman	4	4	3	–	1	–	–
1240B	566	Roman	11	13	–	1	–	–	–
0704A	558	?Roman	–	–	–	–	–	–	Balan
0704A	567	?Roman	–	–	80	–	–	24	
0715A	568	Roman +	1	1	10	51	–	79	–
1240C	571	Roman	10	6	–	–	–	–	–
1240A	576	Roman	7	7	–	1	–	–	–
0715C	580	Roman +	–	–	–	–	–	2	–
0715B	591	Roman +	17	20	10	226	4	159	–
0715E	592	Roman +	6	2	3	17	1	33	–
0715D	593	Roman +	43	32	35	20	–	80	–
0715D	594	Roman +	–	–	–	–	–	1	–
1240E	609	Roman	17	16	1	–	–	–	–
1240G	610	Roman	4	–	1	–	–	–	–
1240F	623	Roman	25	29	6	1	1	–	–
1239	730	B.A.	–	1	8	–	–	–	–
1342C	739	Late IA	–	–	–	–	–	–	–
1237B	751	B.A.	–	–	9	–	–	–	Land mollu
1237	752	B.A.	–	–	10	1	–	–	–
1237A	753	B.A.			2	2			–

North Shoebury: Hand-collected marine mollusc counts

Context no.	Find no.	Date	Ostrea		Mytilus	Cerastoderma	Buccinum	Littorina	Othe[r]
			uv	lv					
1237C	780	B.A.	–	–	12	1	–	–	–
1328H	795	? Roman.	–	–	–	–	or Neptunea frag	–	–
1364B	917	Roman	97	100	32	–	21	–	–
1364C	920	Roman	1	1	–	–	–	–	–
1328J	928	Roman.	–	–	–	–	–	–	Land snails c
1364C	929	Roman.	3	4	–	–	–	–	–
1328J	928	Roman.	4	3	–	–	–	–	–
1525D	983.	Roman.	–	1	1	–	–	–	–
1346D	989	Roman.	1	2	–	–	–	–	–
1346E	990	Roman	2	1	–	–	–	–	–
1525E	1000	Late IA.	–	2	1	–	–	–	–
1548	1021	Roman.	1	3	–	–	–	–	–
1563	1046.	Roman	–	–	1	–	–	–	–
1563A	1047	Roman	–	–	2	–	–	–	–
1563F	1105	Roman	45	36	19	2	–	–	–
1563B	1112	Roman	4	2	11	1	–	–	–
1563E	1125	Roman	16	26	–	–	–	–	–
1563E	1135	Roman	6	11	9	–	–	–	–
1563H	1171	Roman	14	4	–	–	–	–	–
1563I	1176	Roman	4	8	–	–	–	–	–
0715A	579	Roman +	53	43.	159.	789	4	730	H bel (1)
1563F	1165	Roman.	26	23	–	–	–	–	–
1610	1182	Roman	31	37	–	–	–	–	–
1563G	1126	Roman	44	71	1	–	–	–	–
1610	1192	Roman	80	80	1	–	–	–	–
1563D	1067	Roman.	62	47	–	–	–	–	–
1364A/B	918	Roman.	160	159	–	–	–	–	–
1563A	1046'B	Roman	87	132	v. poor –	condition –	–	–	–
1563A	1063B	Roman	164	197	(includes 8	paired upper	/lower valves)	–	–
1563A	1047B (3 bags)	Roman	179	168	–	–	–	–	–
			188	184	1	–	–	–	–
			169	127	–	–			
	(3 bags)								

North Shoebury: Land and freshwater molluscs

The fills of archaeological features at the site were generally decalcified and land snails were therefore normally absent apart from shells of Cecilioides acicula and very rare shells of other species which are perhaps modern contaminants introduced by burrowing animals. However, in deposits from an early medieval pit (0329), the basal fill of the medieval enclosure ditch (0157D) and from several Roman ditches (1240G, 1328J, 1346B, 1364A-D, 1598B and 1642C), consisting of dumped layers of marine mollusc shell or associated with such layers, base-rich conditions had been maintained. The prehistoric features unfortunately contained almost no land molluscs, though a single fragmentary shell of Clausilia sp. was isolated from 1236B, a Bronze Age/Early Iron Age pit. This is grey in colour and appears to have been subjected to heat; possibly this has altered its crystal structure making the shell more resistant to leaching.

Mollusca were extracted from samples of 0157D, 0329, 1364 and 1236B using the method of Evans (1972, 44). Shells were identified with reference to Evans (ibid) and Kerney and Cameron (1979) and all identifications were confirmed by comparison with modern reference specimens.

Discussion

The isolated shell of Clausilia sp. from 1236B appears to have been subjected to heat. The Clausiliidae are rupestral snails frequently found in crevices in bark. This specimen may therefore have been collected with firewood and heated in a domestic hearth.

Interpretation of the snail assemblages from the Roman ditch 1364 is complicated by two main factors:

1. The layers of dumped marine shells would have represented a base-rich microhabitat with numerous shaded cavities of relatively high humidity including decaying remnants of uneaten shellfish. These conditions must have influenced the species composition of the mollusc fauna, and this is most apparent with respect to the shade-requiring component of the fauna. The assemblages recovered are clearly unusual in species composition: some common 'shade' snails (eg. Discus rotundatus and the Clausiliidae) are absent, other

Context	1364A	1364B	1364C	1364D
Sample No.	43	45	44	46
Carychium tridentatum (Risso)	1	2	-	-
Cochlicopa spp.	3	83	20	4
Truncatellina cylindrica (Ferussac)	1	1	-	-
Vertigo pygmaea (Draparnaud)	-	2	3	-
Vertigo sp. (b)	-	7	2	-
Pupilla muscorum (Linne)	-	1	-	-
Lauria cylindracea (da Costa)	-	7	-	-
Vallonia costata (Muller)	16	104	15	8
Vallonia excentrica Sterki	2	11	1	3
Vallonia sp. (a)	9	19	23	8
Ena obscura (Muller)	-	1(d)	-	1
Punctum pygmaeum (Draparnaud)	-	43	11	-
Vitrina pellucida (Muller)	2	12	9	2
Vitrea contracta (Westerlund)	2	15	3	1
Vitrea sp. (a)	1	6	1	-
Nesovitrea hammonis (Strom)	-	1	-	-
Aegopinella spp.	2	49	10	-
Oxychilus sp.	-	12	-	-
Zonitdae indet (a)	4	45	30	5
Limacidae indet.	-	2	-	-
Cecilioides acicula (Muller)	104	110	25	21
Trichia hispida (Linne)	3	17	9	2
Trichia c.f. hispida (a)	5	57	33	18
Trichia hispida/striolata (c)	-	1	-	-
Cepaea/Arianta sp. (a)	-	14	6	1
Cepaea hortensis (Muller)	-	-	-	1
Helix aspersa Muller	-	(+)	1	(+)
Sample wt (kg)	2	2	2	2

Table : Land molluscs from ditch 1364 (systematic list)

Notes: (a) Young juvenile and/or weathered shells
(b) Apices only; no apertures
(c) Distinct keel at periphery but surface detail of hispida-type
(d) Not present in 2kg sample but specimen extracted from 5kg

		1364A	1364B	1364C	1364D
	Zonitidae	17.6	24.8	24.9	10.9
Shade-requiring molluscs	*Carychium*, *Lauria*, *Ena*	2.0	1.9	-	1.8
	Punctum, *Vitrina*, *Nesovitrea*	3.9	10.9	11.3	3.6
	Total shade molluscs	23.5	37.6	36.2	16.3
Catholic molluscs	*Cochlicopa*, *Cepaea*, *Arianta*, *T.hispida* *Limacidae*	21.6	33.9	38.4	47.3
	Vallonia costata	31.4	20.3	8.5	14.5
Open-country molluscs	*Vallonia excentrica*	4.0	2.1	0.6	5.4
	Vallonia sp.	17.6	3.7	13.0	14.5
	Vertigo, *Pupilla*, *Truncatellina*	2.0	2.1	2.8	-
	Total open country	55.0	28.2	24.9	34.4
Syanthropic	*Helix aspersa*	-	0.2	0.6	1.8
Total numbers of shells		51	513	177	55

Table : Ecological groups of land molluscs from 1364 (percentage frequencies) excluding *Cecilioides acicula*

Context No.	0329	0157D
Sample No.	2	8
Lymnaea truncatula (Muller)	4	2
Vallonia pulchella (Muller)	4	-
Vallonia excentrica Sterki	1	-
Vallonia sp.	4	-
Trichia cf. *striolata* (Pfeiffer)	-	2
Trichia sp	-	1
Helix aspersa Muller	1	+
Discus rotundatus (Muller)	-	2
Zonitidae inet	-	2
Pisidium sp.	-	2
Sample wt (kg)	3	5

Table : Land and freshwater mollusca from medieval features common species (eg. Carychium tridentatum) are rare and yet the Zonitidae are relatively abundant. However, unlike other 'shade' snails the Zonitidae together with Vitrina pellucida, are facultative carnivores and it therefore seems possible that the high frequencies of these taxa are related primarily to the food resource provided by the shell dumps. If this is so then the value of these faunas as indicators of vegetational structure in the vicinity is slight. It should, however, be noted that the Zonitidae occur at the highest frequency in 1364C, whereas marine shell is most abundant in 1364A and B.

2. The assemblages include a high proportion of catholic mollusca (Cochlicopa, Cepaea, Trichia hispida, Limacidae) which, by virtue of their wide habitat ranges, are of little value in environmental interpretation. Punctum pygmaeum and Vitrina pellucida which are able to tolerate more open habitats than the majority of shade snails are also fairly common.

These factors, together with the fact that the assemblages from 1364A and D are small, limit the degree of certainty possible in ecological interpretation. However, bearing these problems in mind, the snails from 1364 appear to indicate fairly open conditions during the formation of 1364 D (open-country and 'catholic' snails total 81.7% of the assemblage from the sample at this level), followed by a degree of shading over of the habitat in 1364B and C (open-country and catholic snails here totalling 62.8% and 63.3% respectively). In 1364A open-country and catholic snails comprise 76.6% of the assemblage, perhaps reflecting a return to more open conditions. These variations may reflect vegetational change in the ditch itself, or may be a result of dumping of waste shell, but in either case need not be related to land use in the adjacent field. However, the relative proportions of the two species of Vallonia may be relevant. Vallonia costata, the predominant species in these samples, is very rarely found in arable land (Evans 1972, 154), whereas V.excentrica, which is rare in the present samples, is able to tolerate the disturbed conditions of cultivated fields (ibid, 162). This gives grounds for suggesting either that the ditch system existed to sub-divide pasture or that the ditch fills were formed after the cessation of arable farming in the fields.

The sparse assemblages from the medieval features are not fully interpretable. The terrestrial species include synanthropic snails (Helix aspersa, Trichia striolata)as well as snails characteristic of grassland and shaded habitats.

Shells of *Vallonia pulchella*, *Lymnaea trancatula* and *Pisidium* sp. indicate locally damp and 'freshwater slum' habitats.

References

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