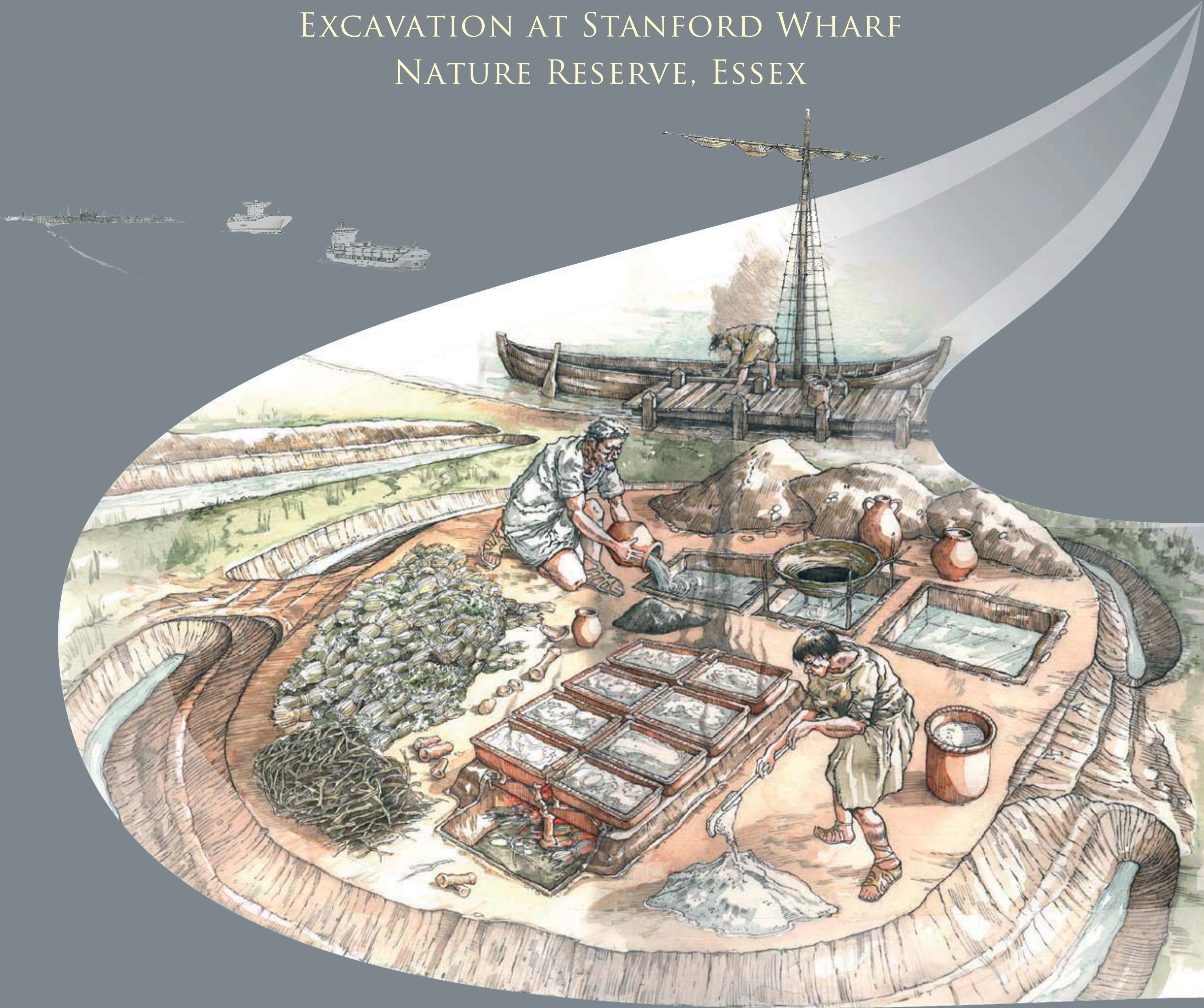
# London Gateway

## Iron Age and Roman Salt Making in the Thames Estuary

### Excavation at Stanford Wharf Nature Reserve, Essex



Specialist Report 16

Fish Remains

by Rebecca Nicholson

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## Introduction

Although in the majority of features fish remains were either absent or present in small quantities, a single deposit produced fish remains of outstanding quantity and quality. Sample 1160, from layer (5103) within Roman ditch 5099 produced 920g (2.5 litres) of tiny fish remains from a 10 litre sub-sample processed to 0.5mm by bulk flotation.

Sample 1160, dated to late Roman phase 2 (LR2), was described in the field as yellowish and 'peaty' and proved to be almost entirely composed of tiny fish bones (Fig. 16.1). The flot (780 mls) and fine residue (0.5-2mm: almost 2 litres; 500g) from the processed sub-sample was composed almost entirely of fish remains and included hundreds of thousands of tiny fish bones and scales, the majority of which were from either juvenile herrings (*Clupea harengus*) or sprats (*Sprattus sprattus*) and juvenile smelt (*Osmerus eperlanus*), although bones from a range of other small and tiny fish were also present (Table 16.1), together with an unquantified number of small crustacean carapace fragments.

## Methodology

In almost all cases, the dried residues from bulk soil samples previously processed by water flotation to 0.5mm (residue) and 0.25mm (flot) were sorted down to 4mm, with fish remains extracted by various OA South staff. Where fish remains were observed in the flots or finer fraction residues, these fractions were sorted by the author. If finer residues were large, a sub-sample (25% or 50% ) was sorted.

The exception to this sorting methodology was sample 1160 (5103). Given such a large and rich sample, it was clear from the outset that sorting more than a very small fraction would be unreasonably time consuming. The very large flot (210g) and 0.5-2mm residue (500g) fractions were composed of virtually pure fish bone which to the naked eye looked like fine sand. In contrast, the 2-4mm residue was small; only 40mls weighing 28g. To ensure that fish from the full range of taxa and sizes were recorded, without unnecessary expenditure of time, 50% of the coarse (>2mm) residue and 3mls of the fine residue (2-0.5mm) was sorted. Even with this strategy, sorting the fine residue sub-sample proved very difficult, and hence numbers of tiny vertebrae have been estimated based on a count of a proportion (roughly 1/5th). The flot was scanned and appeared extremely similar in composition to the 2-0.5mm residue, although having a higher proportion of clupeid (herring family) prootics (otic bulla).

**Results (Tables 16.1-3)**

The estimated number of clupeid and smelt vertebra from sample 1160 is around 1000 per gram of residue and based on counts of the most common skeletal element in the sorted fine residue, 10L soil sample represents a minimum of around 9500 individual clupeids. Most of the vertebrae have a hollow centrum and transparent walls, typical of very young fish in which ossification has only just begun. The estimated size of the great majority of the fish is 30-50mm, with only occasional specimens of 50-100mm. Bones from all parts of the skeleton are present (Table 16.2), although vertebrae appear somewhat over-represented, probably a consequence of preservation, since the tiny flat head bones tend to be broken. Salt or gypsum crystals were noticeable within the deposit, encrusting a proportion of the remains even after flotation (Fig. 16.1). The great majority of the fish remains come from juvenile herrings or sprats and immature smelt. Where clupeid bones could be identified to species, all are from juvenile herring. A range of other fish are also represented (Table 16.1); in the 0.5-2mm residue these include pipefish (*Syngnathus* spp.), gobies (*Gobidae*), stickeback(s) (*Gasterostidae*, including three-spined stickleback *Gasterosteus aculeatus*) and pogge (*Agonus cataphractus*), the last represented by its distinctive scutes. Present in lesser quanities are bones from eel (*Anguilla anguilla*), gurnards (*Triglidae*), small cottids, juvenile bass (*Dicentrarchus labrax*) and flatfishes (notably right eyed flatfishes, *Pleuronectidae*, and sole, *Solidae*). A small number of whiting (*Merlangius merlangus*) bones come from much larger fish of *c* 200-300mm. An unquantified number of shrimp or other small crustacean carapace fragments are also relatively frequent but have not been quantified.

Fish remains from other samples (Table 16.3) are relatively limited and in general come from a similar range and size of fish to those represented in sample

1160. In some cases the specimens may have blown in from deposit 5103 or at least represent small amounts of the same material. The only sample with significant numbers of bones is sample 1536, a fill in shallow ditch 5191 phased to LR2. The remains here were very similar to those found in fill 5013, but anchovy (*Engraulis encrasicolus*) was also present.

The identification of pike (*Esox lucius*) is based on a dentary fragment from a small fish and four small/tiny vertebrae from sample 1368 (1252), a later fill within possible cess pit 1249, phased to Late Roman 1 (LR1). This is the only evidence for fishing in freshwater. Other fish remains from this fill included stained and probably chewed bones from smelt, clupeid(s), eel, stickleback, pogge and flatfish. The condition of these bones is consistent with an origin in faeces.

**Discussion**

With the exception of the pike, which was probably caught in a local freshwater channel, all the remains are from fish which are currently found, at least seasonally, in the Thames estuary (Araújo *et al.* 2000). Currently, herring, sprat, three-spined stickleback and poor cod are the fish most commonly found during December to March, while sand goby, whiting, bass, plaice, and dab are more common in September to December, although young gobies used to be particularly common in the estuary during May (Murie 1903, cited in Wheeler 1979, 76), while Nilsson's pipefish (*Syngnathus rostellatus*) are particularly common in April-May and September-October (Araújo *et al.* 2000). Bass fry move into the Thames during the summer, and in common with all the migrating fish move upstream as far as Teddington and then downstream again in winter (http://www.the-river-thames.co.uk/wildlife.htm).

Smelt are present in the Thames estuary year-round and used to be extensively fished, spawning, like the Thames estuary herring, in February-March (Wheeler 1979, 151-2). Most of the herring and sprat sampled from West Thurrock power station, middle Thames estuary between 1977 and 1992 were less than one year old and followed regular patterns of seasonal occurrence (Power *et al.* 2000). Juvenile herring typically enter the estuary in July, and were most common in November-March, before declining. Juvenile sprat appear in September and peak in abundance in January, being the more common of the two fish in the earlier part of the year (ibid.;

Wheeler 1979, 76). Juvenile herring and sprat are marketed as whitebait. The whitebait fishery was the most important of the Thames fisheries, at least in the documented past. Brown shrimps (*Crangon crangon*) were an important catch in the lower reaches of the estuary, particularly in Gravesend and seawards towards Southend (Wheeler 1979, 81). The origins and early history of the whitebait fishery in the Thames is unknown, but traditionally these young fish were caught using a special fine meshed whitebait net, suspended about four to six feet (roughly 1.2-1.8m) from the surface of the water from a boat moored in the tideway with the mouth of the net positioned to face the flowing water (Wheeler 1979, 73-4). In the Roman world, casting nets (*amphiblêstron*) were regularly used to catch small fish; this bag-like net is weighted at the sides and sinks in the water, enveloping the fish before it is closed with a drawstring and hauled into the boat (Bekker-Nielsen 2007). Inevitably many young pelagic fish apart from young clupeids would be caught in these nets. Fishing using weirs or kiddles constructed on the tidal shore, or nets suspended above the river-bed, would capture mainly flatfish, particularly flounders (*Platychthys flesus* (L.)) and other bottom-feeding fish as well as migrating salmon and sea trout (Wheeler 1979, 80).

Based on these recent data, and bearing in mind that fish distributions may well have changed since the Roman period, it can tentatively be suggested that the most likely season of capture for the fish represented in sample 1160 would seem to be autumn.

Given the vast numbers and concentration of the fish remains in sample 1160, it is extremely unlikely to represent fish stranded by a receding tide, as has been suggested for a very much smaller collection of bones from tiny estuarine fish at a medieval saltern at Parson Drove, Cambridgeshire (Irving 2001). While it is possible that a concentrated collection of fish remains may represent the dumping of a day's catch, the excellent condition of the bones, a proportion of which are encrusted with salt or gypsum crystals, suggests a very unusual burial environment not explained by the silty, though not permanently waterlogged, ditch fill sediments. Tiny remains such as these are typically only recovered in waterlogged deposits or in latrine pits, where preservation is aided by phosphatisation, and in these contexts the fish remains are found at a much lower density. It therefore seems likely that this collection of tiny fish and crustacean remains represents the residue of a salted product, the salt inhibiting both microbial decay and scavengers.

Although only one large deposit of these remains has been identified, the abundance and concentrated nature of the material from sample 1160 suggests that the activity represented may not have been trivial or small-scale. Rather, the sample may represent a fortuitously preserved fragment of what may have been a significant by-product of salt production, at least in the late Roman period, namely the production of a fish sauce: *garum*, or probably more likely, *allec*, a term which in classical Latin designated the dregs (*faex*) of *garum* production or a specific product similar to, but distinct from, *garum* (Curtis 1984).

The Romans seem to have had four main types of fish sauce: *garum*, *liquamen*, *allec* and *muria* (Curtis 1991). *Garum* was the primary sauce produced by the hydrolysis of small whole fish and/or fish blood and intestines in the presence of salt through natural fermentation over several months; once strained, the liquid was *garum* and the undissolved fish material was *allec* (Curtis 1991). *Muria* seems to refer to the salty solution that resulted from the salting of whole, gutted fish or fish portions (the salted fish was called *salsamentum*). The precise nature of *liquamen* is unclear, but it seems very similar to *garum*, possibly an inferior product made by subsequent washings of *allec* with a salty solution (Curtis 1991). The medieval Latin *allec* also referred specifically to herring, although in the classical Latin *allec* or *alecula* probably referred to a number of species of small Mediterranean fish, usually the anchovy but probably also the sardine (*Sardina pilchardus* (Walbaum)) and shad (*Alosa* sp.) (Curtis 1984). All three of these fish, together with herring, sprats (*Sprattus sprattus* (L.)) and sardines are members of the order Clupeiformes and all can be found in the North Sea and English Channel, but herrings and sprats are not found in the Mediterranean.

Based on information from Roman literary sources, summarised by Curtis (2009), fish sauce was produced by placing small fish, particularly (in the Mediterranean) anchovies, sardines, and mackerel into a small vat together with a proscribed amount of salt and sometimes various herbs, spices or wine. The vat was then covered and left in the sun for several months before filtering by using a basket, and transfer of the products into amphora.

There can be little doubt that a salted fish product was made at Stanford Wharf during the late Roman period, but whether the practice occurred at an earlier date is unknown: the relatively few fish remains from middle Iron Age redhill deposit 5342 are similar in composition to the later Roman assemblages, but may be redeposited.

Elsewhere in Essex, fish remains have been reported in association with red hill deposits from Roman and medieval layers at Leigh Beck, Canvey Island. A very brief report suggests that one context (context 5) contained some bones from young fish of the herring family together with stickleback and a few whiting and flatfish bones (Jones 1995). However, it is clear that this deposit contained relatively few bones (13 identified from 29.7kg of sediment) although the author does state that a number of minute vertebrae remain to be identified.

In what is now Brittany a number of fish salteries operated between the 1st and 4th centuries AD, notably at Plomarc'h and Combrit. Although but no direct evidence of Roman salteries has been found in Britain, evidence for *garum* and similar salted and fermented fish products has been recovered from several English sites, the most significant of which was Peninsular House in London, where it was suggested that the product had been manufactured locally, from whole juvenile clupeids (Bateman and Locker 1982; Locker 2007). At St Mary Bishophill Junior, York, a collection of clupeid bones together with a single whiting dentary identified in a 100ml subsample has also been attributed to Roman or early post-Roman fish sauce production (Jones 1988) while deposits rich in small clupeids (herring and probably sprat) from late Roman Dorchester have also been interpreted as evidence for locally produced *allec* (Hamilton Dyer 2008). In Roman Lincoln too, large assemblages of small clupeids and sandeels (Ammoditidae) were also considered to possibly have derived from fish sauce (Dobney *et al*. 1996). In all these cases large quantities of salt and fresh fish would have had to be transported into the towns for sauce production to have taken place there. At Stanford Wharf, both salt and young fish would have been readily available. The inclusion of shrimps, smelt, sticklebacks, pogge, pipefish and other tiny and bony fish suggests that the product from Stanford Wharf was of a different quality to that recovered from London, York and Dorchester.

Bones of various species of fish, including herring, sea bream, and grey mullet, have been found at Silchester, and it is likely that they were transported as salted fish, although whether from fisheries off the coast of southern England or from further afield is unclear (Boon 1974, 261). Spanish mackerel (*Scomber japonicus*) heads found at Winchester Palace, London, in an amphora originating in Antibes, attests to the importation of fish, probably *salsamentum*, from the Mediterranean (Locker 1983; 2007). The remains of many young sardines, 60-80mm long, were recovered from a barrel at the 1st century site at Fos-Sur-Mer, southern France and have been interpreted as the remains of *garum* (Desse Berset and Desse 2000); the authors also point out that a fish condiment made from salted and fermented sardines and other tiny fish including gobies, anchovies and sprats is a traditional speciality from Nice and surrounding areas.

It is possible that the production of fish sauce at Stanford Wharf was a late Roman response to the disruption of trade with the rest of Roman world. The decline of the Roman empire and movement of Germanic tribes into Spain had a major effect on the Mediterranean, especially Spanish, salt-fish industry (Curtis 1984). Although some fish sauce production and trade continued into the 4th and 5th centuries, the activity of Spanish salted fish merchants in northern Europe was only a shadow of what it once had been, and there is no direct evidence for Roman trade in salt-fish in the northern provinces after the fourth century (ibid.).

**Conclusions**

The fish remains recovered from the excavations almost all date to the late Roman period. A dense concentration of remains of tiny fish and crustacean, probably shrimp, with fragments frequently encrusted with crystals of salt or gypsum, suggests the local manufacture of a salted fish product, probably *allec*, although *garum* may also have been produced. The kinds of fish represented are very typical of fish found today in the Thames estuary around Mucking, which strongly suggests that fishing took place close by, using fine 'whitebait' nets suspended in mid-water. Although the origins and extent of production are unknown, it is possible that it may have begun as a response to the disruption in trade from the rest of the Roman empire. Although much less abundant, the species and sizes of fish recorded from in deposit 1252 within pit 1249 are similar to those found in sample 1160. Since these bones exhibit evidence of chewing, it would seem likely that here we have evidence of local consumption of the product represented in sample 1160.

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# Fish Remains Tables

## TABLE 16.1: FISH REMAINS FROM THE SORTED PORTIONS OF SAMPLE 1160 (5103): NUMBER OF IDENTIFIED SPECIMENS

| **Species** | **10-4mm (from 100% of residue)** | **4-2mm (from 50% of residue)** | **2-0.5mm (from 3mls of residue)** |
|---|---|---|---|
| Herring family (Clupeidae) | 1 | 7 | 1760 |
| Herring (*Clupea harengus* L.) | | 2 | 4 |
| Shads (*Alosa* sp.) | | 4 | |
| Smelt (*Osmerus eperlanus*(L.)) | | 6 | 503 |
| Eel (*Anguilla anguilla* (L.)) | 1 | 26 | 8 |
| Pipefish (*Syngnathus* spp.) | | 2 | 72 |
| Cod family (Gadidae) | 5 | | |
| Whiting (*Merlangius merlangus* (L.)) | 46 | | |
| Bass (*Dicentrarchus labrax* (L.)) | | | 3 |
| Grey mullet cf. thin-lipped (*Lisa* sp.) | | 1 | |
| Gobies (Gobidae) | | 4 | 263 |
| Sand/common goby (*Pomatoschistus* spp.) | | | 61 |
| Gurnards (Triglidae) | | | 8 |
| Cottids (Cottidae) | 1 | 13 | 5 |
| Bullrout *Myoxocephalus scorpius* (L.) | | | 1 |
| Sea scorpion (*Taurulus bubalis* (Euphrasen)) | 3 | 1 | |
| Pogge (*Agonus cataphractus* (L.)) | 1 | 58 | 45 |
| Sticklebacks (Gasterostidae) | 6 | 118 | 61 |
| 3-spined stickleback (*Gasterosteus aculeatus* L.) | | | 12 |
| Flatfishes | | 3 | 12 |
| Right-eyed flatfishes (Pleuronectidae) | 3 | 17 | |
| Plaice (*Pleuronectes platessa* L.) | 1 | 1 | |
| Dab (*Limanda limanda* (L.)) | | 7 | |
| Soles (Solidae) | | | 3 |
| Dover sole (*Solea solea* (L.)) | | 14 | |
| Unidentified | | 7 | 176 |
| Grand Total | 68 | 291 | 2997 |

## TABLE 16.2: DISTRIBUTION OF CLUPEID (HERRING/SPRAT) SKELETAL ELEMENTS FROM THE SORTED PORTIONS OF SAMPLE 1160 (5103)

| **Bone** | **10-4mm (from 100% of residue)** | **4-2mm (from 50% of residue)** | **2-0.5mm (from 3mls of residue)** |
|---|---|---|---|
| Articular | | 1 | 24 |
| Atlas vertebra | | | 36 |
| Basioccipital | | 2 | 40 |
| Ceratohyal | | | 23 |
| Dentary | | 2 | 8 |
| Hyomandibular | | | 3 |
| Hypural | | | 19 |
| Maxilla | | | 20 |
| Opercular | | 2 | |
| Post temporal | | | 4 |
| Prootic | | | 43 |
| Premaxilla | | | 5 |
| Quadrate | | 1 | 25 |
| Supracleithrum | | 1 | 1 |
| Supramaxilla | | | 10 |
| Vertebra (est. no.) | 1 | | 1500 |
| Vomer | | | 3 |
| Grand Total | 1 | 9 | 1764 |

# TABLE 16.3: FISH REMAINS FROM SAMPLES EXCLUDING 1160: NUMBER OF IDENTIFIED SPECIMENS

| Sample | 1097 | 1115 | 1147 | 1149 | 1156 | 1163 | 1170 | 1192 | 1220 | 1253 | 1254 | 1297 | 1314 | 1356 | 1368 | 1378 | 1369 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Context | 1568 | 1834 | 5026 | 5015 | 5039 | 1536 | 5136 | 5429 | 5342 | 5790 | 5795 | 6052 | 6089 | 1248 | 1252 | 1627 | 6458 | |
| | Burnt layer | burntfill of post hole 1831 | Redhill deposit | fill of slot 5016 | occupation/trample layer | fill of shallow ditch 5191 | possible 'cessy' dump | fill in ditch terminus 5427 | Redhill deposit | fill of cut 5741 | layer of molluscs | dumping layer | dumped material | fill in pit 1249 | fill | Redhill deposit (G5) | fill | |
| Phase | LR2 | LR2 | IA-R | | | LR2 | | LR2 | MIA | | | | | LR1 | LR1 | | LR1 | |
| Thornback ray (*Raja clavata* L.) | | | | | 1 | | | | | | | | | | | | | 1 |
| Eel (*Anguilla anguilla* (L.)) | | | 1 | | | 2 | | | | | | | | | 1 | | | 4 |
| Smelt (*Osmerus eperlanus* (L.)*)* | | | 5 | | | 24 | | | | | | | | | 23 | | | 52 |
| Herring family (Clupeidae) | | 1 | 70 | 3 | | 375 | 12 | | 92 | | | | | 1 | 30 | 53 | | 637 |
| Herring (*Clupea harengus* L.) | | | | | | | | | | | | | | | | 1 | | 1 |
| Anchovy (*Engraulis encrasicolus* (L.) | | | | | | 3 | | | | | | | | | | | | 3 |
| Cod family (Gadidae) | | | | | | | | | | | | | | | | 1 | | 1 |
| Rockling (cf. *Ciliata* sp.) | | | | | | 1 | | | | | | | | | | | | 1 |
| Goby (Gobidae) | | | 1 | | | 28 | 4 | | 2 | | | | | | | 2 | | 37 |
| Gurnard (Triglidae) | | | | | | 3 | | | | | | | | | | | | 3 |
| Cottidae (Cottidae) | | | | | | | | | | | | | | | | 1 | | 1 |
| Pogge (*Agonus cataphractus* (L.)) | | | | | | | | | 1 | | | | | | 1 | 1 | | 3 |
| Pike (*Esox lucius* L.) | | | | | | | | | | | | | | | 5 | | | 5 |
| Stickleback (Gasterostidae) | | | 3 | | | | | | | | | | | | 2 | 3 | | 8 |
| Pipefish (*Syngnathus* spp.) | | | 1 | | | | | | | | | | | | | | | 1 |
| Flatfishes | | | 1 | | 2 | 3 | | | | 1 | | | 2 | | 3 | | | 12 |
| Right eyed flatfish (Pleuronectidae) | | | | | | | | | | | | | | | 1 | | | 1 |
| unidentified | 1 | | 9 | | 2 | 11 | | 1 | 3 | | 2 | 1 | | | 3 | 3 | 1 | 37 |
| Grand Total | 1 | 1 | 91 | 3 | 5 | 450 | 16 | 1 | 98 | 1 | 2 | 1 | 2 | 1 | 69 | 65 | 1 | 808 |


Figure 16.1: Fish bones from sample 1160, ditch 5099.
Images show a) abundant bones and b) salt- or gypsum-encrusted bones

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