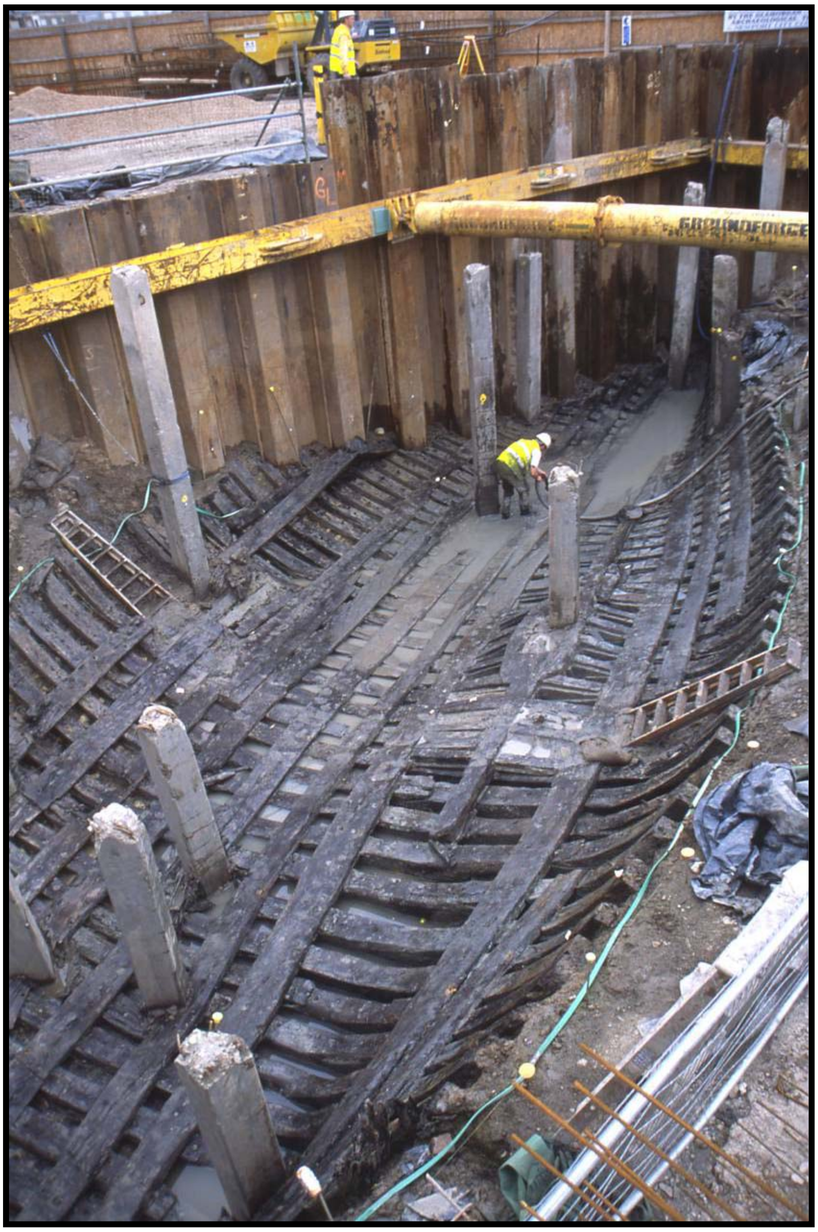
Newport Medieval Ship Project

Specialist Report: WATERLOGGED PLANT REMAINS



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Newport CITY COUNCIL
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Introduction

In 2002, during the construction of the Riverfront Theatre, on the banks of the River Usk in Newport, South Wales, an archaeological find of great significance was unearthed. In the summer of that year, while undertaking the excavations for the theatre's orchestra pit, the well-preserved remains of a 15th century clinker built merchant vessel were discovered.

The site, which was surrounded by a cofferdam, was being monitored by the Glamorgan Gwent Archaeological Trust at the time of discovery. The ship lay in what is locally known as a pill or small inlet, with its stern closest to the river and its bow facing into the inlet. The timbers were covered in thick alluvial mud, which created an ideal anaerobic environment for successful preservation. Seventeen strakes of planking remained on the port side and thirty-five on the starboard side of the ship. The vessel was approximately 30m in length.

A silver French coin was found purposely inserted into the keel of the vessel, dating the ship to after May 1447. Dendrochronological research has shown the hull planking to be from the Basque country and after 1449 in date.

After a much publicised 'Save Our Ship' campaign, it was decided that the ship would not be recorded and discarded but excavated with the aim to conserve. The riders, stringers, braces, mast step, frames and overlapping clinker planks and keel were dismantled one by one and lifted. Almost 2000 ship components as well as hundreds of artefacts were excavated.

This report examines and lists the waterlogged plant remains recovered during the Newport Medieval Ship excavation.

NEWPORT MEDIEVAL SHIP (467)
The Waterlogged Plant Remains
by Wendy J. Carruthers, incorporating information from the report by Allan Hall
February 2013

SUMMARY
Archaeobotanical analyses of waterlogged plant remains from the Newport Ship have provided evidence of a likely southern European origin for vegetation that had been used as packaging (dunnage). Ongoing DNA analyses hope to differentiate between two possible species of juniper (a major component of the dunnage; *Juniperus navicularis* or *J. oxycedrus*) identified from leaf characteristics which are currently found either in S.W. Portugal or occupy a wider region of southern Europe, though primarily the Iberian Peninsula. Heathers were the principal vegetation used as dunnage and these had been cut while in early flower (flower buds but no capsules), providing a time frame of late summer within which the fresh dunnage had been gathered (July/August). Today, dry coastal areas of the Iberian Peninsula support this type of open, scrubby vegetation or 'garigue'. Food remains, which primarily appear to have been derived from sewage and discarded food waste but which might also represent spillage from previous cargos, were more typical of a southern European than British diet, including frequent millet, pomegranate, walnut, grapes (probably present as raisins) and fig. Less abundant components included flavourings such as dill, coriander and mustard, as well as flax, hemp and hop. The recovery of these remains together with frequent fly puparia from the bilges of the ship provides an insight into the unsanitary conditions that prevailed on board merchant ships of this type in the fifteenth century.

Introduction
In the summer of 2002, while construction work was taking place on the banks of the River Usk in Newport, the remains of a fifteenth century merchant ship were discovered. The lower timbers of the hull lay within an infilled inlet perpendicular to the course of the river. Excavations in 2002 indicated that the clinker-built ship had been undergoing repairs/alteration or salvage before its abandonment. It was thought that there would have been time for cargos and useful timbers to have been salvaged from the ship, before tidal silts filled the hull and it was abandoned. The high incidence of Portuguese Merida ware pottery suggested that the vessel may have been linked to this region of the Iberian Peninsula. Dendrochronological research revealed the hull planking to have been made from timber from the Basque country. As the trade route between Bristol and the Iberian Peninsula in the late medieval period is well documented it is likely that the Newport Ship was involved in trade between these two destinations. A silver French coin found purposely inserted into the keel means the ship construction dates to after May 1447. Since shoring timbers forming a structure onto which the ship was heeled over have been dated to AD 1468 and AD 1469 this suggests deposition of the ship soon after AD 1469.

During the excavation of the ship the framing timbers were numbered from the foremost surviving frame station (F1) to the stern (F61). Sediments found between the frame stations (the 'bilges', located below the cargo deck), were particularly well-sampled for environmental evidence, since these deposits were likely to be associated with the use, life and function of the ship. This report is centred on analysis of waterlogged plant remains from the highly organic bilge deposits.

Sampling for environmental remains

The environmental sampling had to take into account the fact that the ship had lain within the tidal waters of the Usk for five and a half centuries, resulting in the deposition of around seven metres of alluvial sediments above the ships timbers. A wide range of samples were taken for environmental remains (186 samples in total) in order to investigate the complex taphonomic processes involved in the deposition of the biological material. In 2006 seventeen bulk samples, primarily from between the frame stations, were assessed (Caseldine and Griffiths, 2006). Processing involved a simple wash-over technique, with stacked sieves collecting the wash-over to a minimum mesh of 250 microns, and with residues being sieved to the same mesh size. The assessment revealed the high potential of samples from between the frame-stations, particularly at the bow and stern of the ship.

A further 92 bulk samples were processed and assessed in 2009 (Smith and Nicholson, 2010). They included samples from sediments above and below the ship to serve as comparisons with samples directly associated with the ship. Although most of the plant material was present in the wash-over 'flots', many of the denser fruit stones and nutshell fragments were found in the residues, confirming the importance of examining both fractions at the full analysis stage.

As a result of the assessments a targeted programme of full analysis was undertaken in 2012 by the author, concentrating on the following deposits in the bilges that had been largely unaffected by the disturbance of tidal movements (Toby Jones, pers. comm.):

Context 130 **–** This clean blue-grey alluvial clay overlay the rich organic layer (152) in the bilges described below. In places it was present both above and below the planking that formed the cargo deck. Context 130 was found in the inter-frame spaces, the bilge pump-hole amidships, the mast step and the interior of the hull. It was thought to represent the initial silting of the ship after its abandonment. This interpretation was investigated during the plant macrofossil analysis.

Context 153 – The organic brownish-silty clay was located in inter-frame space F6-7. It overlay the rich, organic layer 152.

Context 152 (≡ 171) – This highly organic, dark brownish black sandy silt contained visible organic content, such as fish bones and caulking material. It lay immediately above the hull planks in between the framing timbers. It reached a maximum depth of c. 50mm (though the timbers averaged c.200mm), and it did not lie forward of Frame 6. Towards the stern, near F59-61, it was given the ***context number 171***. Fifteen samples from 152 and one from 171 were fully analysed. An additional 17 samples from these contexts had already been assessed prior to the analysis.

Context 154 – The pale blueish clay was located in the base of F6-7, directly above the hull of the ship (context 120).

RESULTS

The results of the analysis are presented in Table 1. Nomenclature follows Stace (2010) and for Mediterranean species not included in Stace, Flora Europaea (Tutin *et al* 1964) was consulted. Plant macrofossils recovered as small finds have been identified and reported on by Allan Hall (this volume). These plant remains have been added to Table 1 where sufficient context information was available, in order to present a complete picture of the frequency and distribution of each taxon through the ship. They have also been included in the discussion below.

The samples contained mixed assemblages which have been grouped into rough 'habitat' categories in the table. Food remains have been split between smaller seeded items that are most likely to have originated from sewage (e.g. fig seeds, highly fragmented grape pips), and larger seeds such as plum stones and nut shells that were probably discarded as food waste. Ruderal weed seeds had probably been brought on board as contaminants of cargos, foods, animal fodder etc. They were sparse and un-specific in their ecology and geographic distribution, so their importance to the interpretation was minimal. With other, infrequent remains such as pine needles (*Pinus* sp(p).) assumptions were made that might be incorrect, but which appeared to make sense in relation to other taxa in the samples, e.g. the frequency of pine needles was greatest in samples with frequent other dunnage type taxa, so they were put into the dunnage group.

Because much of the material may have had an Iberian origin (see Discussion below) it is important to present the identification criteria of key species that contributed to this interpretation.

Notes on Identification

Ericaceae – Shoot tips, flowers and detached leaves were abundant from plants of this family, having been used as dunnage or packaging. Although a few heathers can easily be distinguished using these parts of the plant, in particular heather (*Calluna vulgaris*), the flowers and leaves of many species of *Erica* are very similar. Although the presence of petals confirmed that flowers rather than capsules were almost always present, the poor state of preservation of these delicate structures meant that it would have been difficult to identify each flower to a useful level. For these reasons the flowers were left as 'Ericaceae', unless leaves were present to assist in identification.

The *Erica* spp. leaves came in at least four distinct types, as listed below. Wherever possible fresh reference material was studied to form these groupings. In addition herbarium sheets from the National Museum of Wales were consulted with the generous assistance of Dr Tim Rich. Several useful websites such as Flora Vascular (www.floravascular.com) were also consulted. However, because the Iberian Peninsula possesses one of the most diverse ranges of *Erica* species in Europe, and leaves alone are not especially useful in differentiating between species of this genus, it has not yet been possible to confirm with certainty the identifications of non-British species of heather.

Investigations into the use of DNA barcoding (see de Vere *et al,* 2012; www.plosone.org, Vol 7, Issue 6, e37945) by Dr Natasha de Vere, Head of Conservation and Research at the National Botanic Garden of Wales, are currently underway in the hope that the non-British *Erica* spp. leaf types can be identified to species level in the near future. Some of the unidentified items described in section b) below have also been submitted for analysis.

Ericaceae leaf types in the Newport Ship samples:

I. Leaves long and linear with contiguous revolute margins giving an oblong to rounded profile (depending on width) and no underside visible:

a) *E. cinerea* –type (bell heather-type) – leaves medium length (4-5 (7) mm), c. 1.5mm wide and oblong in profile, glabrous but margin denticulate, often 'baggy' in appearance with slightly undulating epidermis. These were fairly confidently identified, but there may be some overlap with Mediterranean species so they were left at *Erica* *cinerea* -type. *E. cinerea* occurs widely across heaths in Europe, including the British Isles and most of the Iberian Peninsula, especially the north and west coasts.

b*) Erica australis/lusitanica/multiflora/arborea* -type – leaves long (7-11mm) and thin (<1mm wide), glabrous, rounded in profile. These species are not native to the British Isles. *E. australis* is widespread on oceanic heaths and scrub (Polunin and Walters, 1985) in Portugal and C and W Spain (Flora Europaea). *E. lusitanica* occurs on damp heaths and wood margins in Portugal northwards to S.W. France. *E. multiflora* has a more Eastern European distribution but is present in Eastern Spain. *E. arborea* occurs in woods and scrub across much of the Mediterranean and S.W. Europe. All four species are listed as being present today in the Iberian Peninsula on the Flora Vascular website.

II. Leaves wider and linear/oval with revolute margins but some of the lower leaf surface visible.
c) *E. tetralix* (cross-leaved heath) – short (2-5mm) leaves with a small part of underside visible and distinctive long hairs (often glandular). No other species that occurs in the Mediterranean can be confused with this species, and it is widely distributed in North and West Europe, including the British Isles and Iberian Peninsula.
d) *Erica* sp. unknown (possibly *erigena*-type) – Leaves 5-8mm, margins not quite contiguous, showing a small amount of undersurface beneath including a wide midrib. Glaucous appearance. *E. erigena* occurs on damper heaths and wetlands in some coastal regions of the Iberian peninsula, S.W. France and W. Ireland. Although it is not said to be glaucous, some herbarium material had a glaucous appearance because of dense, minute hairs on parts of the plant ('puberulent'). However, these were not seen on the archaeological material.

***Juniperus* sp.** – Abundant detached sessile leaves with two white stomatal strips on their upper surfaces were recovered, in addition to occasional stem fragments which were triangular in section and possessed three small sessile leaves at each node. Elongated cells on the lower leaf surfaces and the arrangement of leaves in threes indicated that the material originated from the Gymnosperms. The author is very grateful to Dr Allan Hall for suggesting juniper as a likely candidate.

Very fortunately for the project, the taxonomy of juniper divides the genus into sections and subsections using leaf characteristics. Junipers with needle-like adult leaves (rather than scale leaves in the adult plant) which have two white stomatal bands along the upper surface are placed either in the *Juniperus* sect. *Juniperus* subsect. *Oxycedrus* group (8 species) or *Juniperus* sect. *Juniperus* subsect. *Caryocedrus* (1 species) (Farjon, 2005; Adams, 2004). The only juniper native to the British Isles, *J. communis*, is not in either of these groups (it has a single white stomatal band).

Subsection *Caryocedrus* contains *J. drupacea* which is distributed in Greece and Israel. Because the leaves are much larger in this species (10-25 x 2-4mm) it has been ruled out as a possibility. However, it should be noted that some species of juniper observed in the herbarium (e.g. *Juniperus oxycedrus*) were very variable in their leaf size, being strongly affected by environmental conditions.

The following two species in subsection *Oxycedrus* were thought to be unlikely candidates for the following reasons;
J. formosa and *J. lutchuensis* – Asian species
J. deltoides – Eastern variant of *J. oxycedrus* (Adams *et al,* 2005).

In an attempt to narrow the information on origins further, herbarium sheets at the National Museum of Wales were examined, with the help of Dr Tim Rich (to whom the author is very grateful). In addition, leaf dimensions and forms were recorded from well-preserved material from sample 177, context 171.

J. macrocarpa – (≡ *J. oxycedrus* ssp. *macrocarpa* in Flora Europaea) much longer, wider leaves in herbarium and photographic examples seen, and a limited distribution across the Mediterranean/Iberia.
J. brevifolia (Azores juniper) – mountain slopes in the Azores. Strongly recurved leaves (not seen in Newport Ship material, but this could be due to preservation), acicular (needle-like point on apex).
J. cedrus (Canary Island juniper) – generally longer, thinner leaf in herbarium specimens.

The most likely species from Subsection *Oxycedrus* were thought to be the following;
J. navicularis (Portuguese prickly juniper; ≡*J.oxycedrus* ssp. *transtagana*) – leaves to 1.5mm wide, mucronulate.
J. oxycedrus (Western prickly juniper; ≡ *J.oxycedrus* ssp.*oxycedrus*) – leaves to 2mm wide, acuminate-subulate on young plants to scarcely mucronate on older.

Leaf sizes and shapes were examined in detail in order to try to separate the two most likely species; *J. oxycedrus* and *J. navicularis*. Since *J. navicularis* has a fairly restricted distribution in S.W. Portugal it would be useful to determine whether this species was present. One hundred well-preserved leaves from sample 177 (context 171) were measured and plotted in Figure 1. The strong relationship between shape (length/breadth) and leaf length shown in Figure 1 suggested that a single species may be present. However, the apices of the leaves in the Newport Ship samples ranged from acuminate (gradually tapering to a point) on longer, narrower leaves to submucronulate (having a very slight bristle on a more rounded apex) on broader, more rounded leaves. When twenty of the best preserved leaves were coded for apex type an apparent separation into two groups was observed, with some overlap (see Figure 2). Because leaves on the older wood of *J. oxycedrus* change from acuminate to 'scarcely mucronate' (Flora Europaea 1964) it is quite likely that a single species is present, with leaf shape changing slightly as the plant matures. Flora Europaea only separates these two taxa at the subspecies level, and there continues to be debate between taxonomists concerning the division of the genus, so it is perhaps not surprising that it has been impossible to confirm the identification on the basis of leaf morphology. The potential of separation on the basis of DNA barcoding is currently being investigated.

To conclude, on the basis of leaf dimensions (length 3.2-8.8, average 5.2mm; breadth 0.8-1.8, average 1.3mm) and apex shape, either the first of these species or both were present on the ship;
J. oxycedrus (≡*J. oxycedrus* subsp. *oxycedrus* – (Flora Europaea, p.32), 'Western prickly juniper' – on dry hills or mountain tracts, wide distribution in southern Europe. Apex acuminate, subulate but subobtuse and scarcely mucronate on old stems.
J. navicularis (≡*J.oxycedrus* subsp. *transtagana* (Flora Europaea, p.33)), 'Portuguese prickly juniper' – distribution on maritime sands in S.W. Portugal. Leaf apex obtuse and mucronulate.

This places the origins of the juniper either in southern Europe, or more specifically in S.W. Portugal. Either way, the results prove that the dunnage (or at least a large proportion of this material) had not been collected in the British Isles.

a) Uncertain identifications, perhaps due to surface erosion?
Possible olive stones and stone fragments (cf. Olea europea) – A few whole, oval, thick-walled stones were recovered (primarily from context 171) along with several fragments that were clearly from the same taxon. The dimensions of the stones were 11 to 13mm x 5.5mm and the shape was similar to olive or cornelian cherry (*Cornus mas*; see report by Allan Hall, this volume). The thickness of the walls suggested olive was the most likely taxon, but the external surface was much smoother than might be expected. When partially dried the cell structure of the internal membrane and the endocarp wall closely matched olive. In addition, small grooves began to appear in a few areas of the seed, as seen to a much greater extent in the reference material. It is clear from reference works such as Cappers *et al* (2009, pp.1029-1031) that olive stones vary widely in shape and the roughness of the endocarp surface, but small grooves are always present. These seeds are thought to have been olive stones that had rolled around the bottom of the ship for some time (being robust and resistant to decay), gradually becoming smoother. Stomach acids could also have had some effect on surface sculpting. The identification has been left at cf. olive until experimental work has taken place to try to replicate the conditions.

Unidentified Prunus sp. – possible eroded Prunus mahaleb/lusitanica/laurocerasus or domestica ssp. insititia – Four whole (one gnawed by a rodent) cherry/plum-type stones were recovered from context 130 (MSG 1085). Their dimensions (11.5 to 12.3mm x 8 to 9mm x 6.5 to 7.3mm) and smooth surfaces suggested that they may have been a type of cherry (possibly *Prunus maheleb*, *lusitanica* or *laurocerasus*). However they were less-rounded and pointed than the reference material and did not possess distinctive sculpting near the hilum. A better match for size and shape was made with reference specimens of bullace (*Prunus domestica* ssp. *insititia*) but the surface of the endocarp was much rougher in the reference material (see report by Allan Hall). As with the olive stones, it is possible that prolonged sliding around in the bilges had smoothed the surfaces of these robust stones.

b) Unidentified common items (matching reference material not yet found)
A. Half-capsules with traces of a central septum, ovate in shape, chestnut brown, rough external surface and slightly woody, c.5-6mm x 3.5-4.5mm. These items were common in the bow and stern samples (60 fragments in total). They probably originated from dunnage, perhaps consisting of male juniper cones, though it is also possible that they had an economic use.

B. Thick-walled, woody, rounded seeds, probably fitting together in threes (most likely from a berry). Vertically undulating external surface, length c.3-4 mm. Eleven seeds in total, mostly in context 171. They were thought to resemble *Viburnum*-type seeds but no match was found. They may originate from edible berries or dunnage.

C. Fragments of distinctive flattened, maximum of c. 2mm wide, orange/brown winged and ridged stems, woody and wrinkled. Distinctive hastate young leaves or bracts at nodes. The 82 fragments were mainly found in the stern (contexts 130, 152, 171), and were probably part of the dunnage.

DISCUSSION

I. Taphonomy

Before discussing the range of species recovered from the twenty five samples and small finds (see report by Allan Hall, this volume) it is important to consider the origins of the material and determine the extent to which contamination might have occurred. Many of the food remains recovered from the samples are commonly found in sewage (e.g. fig seeds (*Ficus carica*)), and others could have been growing along the banks of the Usk, so it is important to rule out contamination from more recent sediments being churned up by tidal movements. The following sources of evidence suggest that the samples contained fairly undisturbed material that had been laid down during the use of the ship.

a) Stratigraphy - Samples selected for full analysis were only taken from contexts considered to have been well sealed either by structural timbers (i.e. context 152, sealed by cargo deck planking in some areas) or by sediments that infilled the ship immediately after it sank (i.e. context 130). Deposits above and below these contexts were assessed by both Caseldine and Griffiths (*ibid.*) and Smith and Nicholson (*ibid.*), and were found to contain remarkably few identifiable plant remains relating to either human activity, or to saltmarsh and aquatic habitats that occur in the locality. Contexts 145 and 149 above alluvial clay 130 contained no identifiable plant remains (Smith and Nicholson, 2010, p70) whilst context 128 at the bow contained small amounts of economic plant remains, dunnage and weed seeds that had probably been moved upwards by currents disturbing the rich waste deposits in the bilges (Casseldine and Griffiths, 2006, Table 1). This may also be the case with plant remains in the alluvial clay 130, the deposit immediately above the basal deposits found in most of the inter-frame spaces. This deposit is discussed in more detail below. Therefore, some disturbance of the upper layers of the ship deposits seems to have occurred, but the riverine sediments contained so few plant remains (and virtually none from local plant communities) that contamination of the ship samples was considered to be negligible. It is likely that very little modern plant material would be washed into the river during normal weather conditions, since the high tidal reach means that the banks of the Usk largely consist of bare mud. Material being carried down the river from further upstream would mostly be washed straight out to sea due to the strong currents.

The location of the samples within the ship was defined by the frame stations between which they were recovered, as shown in figure 3. The context considered to have the highest potential was the organic deposit (152) in the bilges, stretching from F6-7 at the bow back to F59-60 at the stern, since this represented waste that had accumulated in the bottom of the ship during its voyages, being protected by the cargo deck immediately above. The bilges would have received material falling through (or being brushed into) gaps in the lower decking timbers, so fairly small fragments of vegetation brought on board as dunnage rather than large branches (e.g. heather shoot tips and juniper leaves), and medium sized fragments of food waste (e.g. up to half a walnut shell or peach stone), were present.

Material likely to have accumulated in the bilges includes;

- foods being consumed on the ship - present as sewage, waste from food preparation and discarded snacking waste
- spillages from cargos being transported

- packaging materials or 'dunnage' used to secure the cargo from rolling around the hull during the voyage
- animal fodder and bedding for livestock being transported on board, possibly including identifiable remains from dung
- smaller quantities of wild plant remains brought on board 'accidentally' – this includes contaminants of any of the above groups, plant materials brought on board by human and animal trampling, or deposited in bird droppings etc.

Bilge pumps in the centre of the ship (see Pump Related Artefacts Catalogue) were used to remove water accumulating in the bottom of the boat. Rebates, called limber holes, that were cut through the floor timbers enabled water to flow towards the pumps from both ends of the ship (Nigel Nayling pers. com.). However, obstructions were present at the bow, and possibly the stern, limiting the movement of materials in these areas and perhaps being responsible for the higher concentrations of waste being present in these samples. It is likely, therefore, that some movement of plant materials occurred along the length of the ship, and this was one of the questions that were examined during the analysis (see Section VI). Sixteenth century documentary references to the "fetid and poisonous stink of the water in the bilge" (Perez-Mallaina 1998, 145) make it clear that the accumulation of rotting organic material in the bottom of ships was one of the many discomforts to be tolerated on board ships of this period. The large number of fly puparia discussed by David Smith in the insect report (See Newport Ship Insect Report) and observed in most of the plant macrofossil samples (see the bottom of Table 1) confirmed that the Newport Ship also suffered from accumulations of foul-smelling, rotting organic waste which included sewage. This is discussed in more detail below.

b) Quantity of plant macrofossils: In most of the samples concentrations of waterlogged plant remains were much greater than might be expected in river sediments, and higher than in many medieval urban waterfront deposits where large amounts of waste and sewage were being deposited, such as Reading Abbey waterfront (Carruthers 1997) where fifteenth-century samples produced an average of 23 items per litre. The Newport Ship samples ranged from 1 to over 1800 items per litre (IPL), and in many cases economic plants were well represented. In comparison with the sediments above and below the ship, the Lampeter assessment suggested that they contained from 0 (context 120) to around 50 items per litre (IPL) (context 128, above context 130). Fully analysed samples from context 130 produced around 23 IPL on average, most of which came from two samples, one at either end of the ship (sample 160 at F6-7 and sample 72 at F59-60). It is likely that daily tidal movements washed some organic material from the surface layers of the bilge sediments, mixing them into overlying silts (e.g. contexts 130 and to a lesser extent 128). This means that some of the more recent remains in the river deposits could have become mixed into upper levels of the bilge deposits, or at least into context 130 where mixing from below was seen to have occurred. However, the river silts appear to have been notably clean of plant material so contamination is likely to have been slight (if at all). To conclude, the high concentrations of plant material in the bilges when compared with layers of silt above confirm that the source of plant remains was the ship itself, rather than more recent waste deposits thrown into the river.

c) The species composition of the assemblages: The bulk of the plant remains fall into two main categories of material;
1. <u>Food remains</u> - from consumed foods, flavourings and possible medicinal plants, deposited as discarded waste (discarded nutshells, fruit stones and perhaps cooking waste) and sewage. Vomit may also have been a source of seeds, as Pérez-Mallaina (1998, 135) notes that even experienced sailors often suffered from seasickness. Spilt

cargo may have contributed towards this group over time, although the highly fragmented items such as grape pips (>90% fragments) and pomegranate seeds (>80% fragments) had probably been chewed so were more likely to have come from sewage. Some weed and chaff contaminants may have been consumed inadvertently as food contaminants, although there is a suggestion from spatial patterning (see below) that the chaff may be associated with livestock.
2. Dunnage - vegetation gathered from dry heathland or garigue-type habitats used for packaging.

As a whole, the assemblages were made up of remains from the following types of materials;

26% consumed food plants e.g. small easily-swallowed seeds typically present in sewage
8% discarded food waste e.g. nut shells, large fruit stones
64% dunnage – includes juniper, heathers, broom, bracken etc.
2% weed seeds - from waste ground, cultivated land and grasslands, possibly present in dunnage and bedding, or as food contaminants, trample etc.
<1% plants of marsh, wetlands and aquatic plants, perhaps relating to local vegetation

It is possible that some of the latter two very small plant groups were blown or washed in from more recent sources but as they make up less than 3% of the assemblages they have very little influence on the overall interpretation.

Additional evidence that the plant assemblages were primarily associated with the ship was found in the range of foods, and types of vegetation used as dunnage, both of which included species not previously found in the British Isles, or found as rare items in much lower quantities. The presence of species such as millet, peach stones, pomegranate seeds and western or Portuguese prickly juniper leaves (*Juniperus oxycedrus/navicularis*) demonstrates that these deposits were not of local origin. This is discussed in more detail below. The closest parallel to this range of exotic foods in the British Isles is a late seventeenth-century waterfront site at Welsh Back, Bristol (Jones, forthcoming) which contained dumps of exotic foods being imported from the Continent, including a large quantity of grapes (see section VII below).

II. Economic plants represented in the bilges

Cereals – Seeds of the Poaceae family, which includes cereals, do not survive waterlogging well, so are unlikely to be recovered in the sort of quantities that represent their true importance. Chaff survives more often, though is rarely found in large quantities in waterlogged sediments. In the case of the Newport Ship a scarcity of cereal remains may be because cereals brought on board would most likely have been in a processed form, either as ships biscuits, flour or clean, processed grain. Any chaff found was probably present amongst clean grain as a low-level contaminant, or straw used for bedding/packing. This may also apply to some of the weed seeds, such as corn cockle (*Agrostemma githago*), corn marigold (*Chrysanthemum segetum*) and stinking chamomile (*Anthemis cotula*). However, if livestock were being kept on board, some unprocessed grain or sacks of crop processing waste could have been brought on as feed, and chaff could have been present in dung. Bracken (*Pteridium aquilinum*) frond fragments were recovered in small amounts from seven samples. Although this has been grouped with the dunnage it could also have been used as bedding material.

The cereals identified from traces of chaff consisted primarily of common millet (24 empty but intact husks consisting of palea and lemma (*Panicum miliaceum*) in eight samples; see Plate 1). Occasional large Poaceae grains were present and these were probably cereals (wheat or rye) but they were too fragmented and crumpled to be identified further. More robust and identifiable cereal chaff fragments included occasional free-threshing wheat rachis (with rivet/hard wheat (*Triticum turgidum/durum*) confirmed), rye rachis (*Secale cereale*), an oat glume (*Avena* sp.) and a few cereal-sized straw fragments. It is interesting to see that, although the millet was distributed through the ship, for the other cereal remains all of the probable grains, chaff fragments and straw fragments (27 items in total in four samples) were found in the stern, between frame stations 56 to 60 (see Table 2). It is likely that they were put to different uses, with millet being consumed by the crew and other cereals possibly being brought onboard amongst bedding or animal fodder. This is the first piece of evidence that suggests that at least some of the remains may retain a meaningful distribution pattern, despite water movements towards the pump in the bilges. This is discussed further below.

All of these cereals have previously been recovered from medieval sites in the Iberian Peninsula (Hopf 1991, pp. 266 & 268) and all except millet are commonly found on medieval sites in the British Isles. British records for millet in the Archaeobotanical Computer Database (ABCD; Allan Hall pers. com.) amount to a total of 4 florets from three sites (Roman London (Wilcox 1978); C14th Norwich (Murphy 1994) and C16th/17th Hull (Williams 1977)), demonstrating that the 24 millet husks from the Newport Ship are more likely to have had an Iberian, rather than British, origin. As a whole, the cereals were more typical of the northern Iberian Peninsula in that millet and rye were primarily grown in these regions in the Iron Age (millet) and early medieval periods (rye) due to being better suited to the climate (Hopf 1991, 272). Both are particularly useful crops in dry, sandy soils as millet has the lowest water requirement of the cereals and rye has a very long root-run. It is notable that rye was the main cereal recovered from the sixteenth-century *Mary Rose* and in the seventeenth-century Burgzand Noord 14 wreck, from the Netherlands (see Section VII below), although it is rarely found to be dominant in charred assemblages from British later- and Post-Medieval sites. It was also the only cereal found in the mid-fifteenth century Aber Wrac'h wreck discovered off the north coast of France (L'Hour and Veyrat 1989, 297) – a ship that has many similarities with the Newport Ship and is discussed further below. This may be a taphonomic issue, with the excellent preservation conditions and accidental nature of the deposits perhaps demonstrating that rye was more important than charred plant macrofossil evidence on dry-land sites suggests. It may also be because rye was being brought on board as identifiable whole grains (with remnants of chaff), whilst bread wheats were made into biscuits or brought on as flour. Alternatively rye may have been considered particularly useful on board ships, being well-suited to the making of highly nutritious 'hardbread' or crispbreads. Rye bran has a high water-binding capacity which maintains the full-feeling for longer and which is said to help protect against gall stones.

Pulses – As with the Poaceae*,* seeds from the Fabaceae family do not often survive in waterlogged deposits, particularly when they are whole. However, fragments of pulse (which includes peas, beans and vetches) are sometimes found, perhaps having been chewed and deposited in sewage, or ground up as flour. These are most easily recognised when the hilum (point of attachment in the pod) is present. Four fragments of pulse with dark brown testa (seed coat) and fairly short, oval hila were recorded from the bow and stern, frame stations F6-7 and F59-60. The dimensions of the hila fit into the size range for peas (*Pisum sativum*) but the dark brown seed coat is more typical of field peas than garden peas (*P. sativum* ssp. *arvense*; de Rougemont 1989). Field peas were used like split peas, ground into flour, or used as fodder, and their drier seeds would have lasted longer in storage. However, the range of colours for peas was greater in the past. A further possibility is bitter vetch (*Vicia ervilia*) which has a darker colouring and a hilum with similar dimensions to pea. However, bitter vetch was mainly used for fodder or as a famine food in the past, and Hopf (1991, 273) suggests that it was not common west of the Adriatic. A possible charred broad bean cotyledon (cf. *Vicia faba*) was identified by Allan Hall from the spot finds (see Hall, this volume). Documentary records from other ships (see section VII below) suggest that peas and beans were an important part of the diet on board ships in the late- and post-medieval periods, being easy to store for long periods if kept dry. It is likely that pulses such as peas and beans were under-represented in the Newport Ship samples.

Nuts – Four types of nutshell were identified, the most frequent of which was walnut shell (*Juglans regia*; 120 fragments, some large, plus 15 'small finds' including some half-nutshells (see Allan Hall report this volume)). Hazelnut shell fragments were almost as frequent (*Corylus avellana*; 116 fragments plus 21 small finds (Hall*, ibid*.)). A much smaller number of stone pine nut fragments (*Pinus pinea*; 10 fragments) was recovered and a single base of an almond shell (*Prunus dulcis*) was found in sample 160, context 130 F6-7 (see Plate 2). All four species have grown in most areas of the Iberian Peninsula since at least the prehistoric period. In the British Isles the only native species is hazel, the other two nuts having been introduced by the Romans but never being present as more than a few fragments on archaeological sites, even in more recent deposits (Allan Hall, ABCD inquiry). According to documentary sources, almonds were imported on a massive scale in the Medieval Period (Wilson 1991, 333), but very few archaeobotanical records exist, despite the robust nature of the nutshell. Today stone pine is primarily found around coastal areas of the Iberian Peninsula, forming maquis-type woods on the west and south coasts. Nutshell fragments were present in all parts of the ship, but when adjustments are made for quantities of sediment processed the highest concentrations of walnut and hazelnut were in the bow, as shown in Table 2. Large food items such as nut shell fragments represent discarded 'snacking' waste that had fallen through gaps in the decking, or possibly nuts from spilt cargo that became crushed.

Fruits – A variety of fruit remains was found in the samples, the most abundant and widespread being fig seeds (*Ficus carica;* 423 seeds) and grape seeds (*Vitis vinifera;* 22 whole seeds plus 226 fragments). Sixteen of the twenty-five samples contained fig seeds, and they were present in all areas of the ship. Fourteen samples from all areas contained grape seeds. Fig seeds, being very small and virtually impossible to spit out, are often an indicator of sewage. Because no storage containers were present in the ship when it was abandoned the likelihood of finding concentrations of traded goods is small, although traces of rotted-down spilled cargos may have built up in the bilges over time. In addition, cargos are quite likely to have been used as a source of food on board, so the indirect evidence suggests that luxury items such as grapes (most likely present as raisins), figs and walnuts were probably being transported. The widespread distribution of the remains below the decking timbers, and the fact that over 90% of the grape pips were fragmented, all point to the suggestion that most of the food remains represent sewage. Grape pips are more difficult to spit out when dried and consumed as raisins, so the high incidence of fragments suggests this was the form in which they had been transported. Customs records from the thirteenth to sixteenth century published by Gras (1918) provide evidence of goods being imported to ports such as Bristol, Carmarthen (a member of the port of Bristol) and Kings Lynn from places such as Gascony and Portugal. These include large quantities of wine, hops, raisins and figs (pages 346 and 624). Figs have been grown in the southern region of the Iberian

Peninsula since the Bronze Age (Hopf 1991, 272), whilst grape and olive were introduced by the Romans and have since been widely grown in the region.

Almost all of the possible olive remains (cf. *Olea europea;* three whole and 6 fragments) were recovered from context 171 in the stern of the ship. A single fragment was present in the bow (context 130). Olive stones have occasionally been recovered from Roman urban deposits such as a third-century Roman Riverside Wall on the Thames in London (Willcox 1977). However, they are rare in medieval contexts. On the Iberian Peninsula olives have been grown since the Prehistoric period. They are one of the crops that are likely to have been shipped to Bristol on a regular basis, being highly valued for oil.

Pomegranate seeds and seed fragments (*Punica granatum*) were present in 7 samples across all areas of the ship (Plate 3). Eight whole long, angular seeds with distinctive cell patterns plus 33 fragments were recovered. As with fig, these small seeds are unlikely to have been spat out, but were deposited in sewage. Pomegranate has been recorded from sites on the Iberian Peninsula (Hopf 1991, 272) but not from any medieval sites in the British Isles (Greig 1996, 220; ArachaoBotanical Computer Database, York and online Archaeobotany Group query). The only British record published to date was from a first century AD Roman make-up deposit in London (Davis 2011). However, there are fifteenth and sixteenth century customs records from London demonstrating that pomegranates were being imported in the later medieval period (Gras 1918, 514, 564, 576). Pomegranate is a drought-tolerant tree that can be grown in many countries where rainfall levels are not too high, as the roots are susceptible to rot. It is likely that the British climate would have been too wet to grow the fruits commercially, unlike the drier climate of the Iberian Peninsula. As with many of these fruits, pomegranates can be stored for long periods and, being enclosed in a tough skin, would have been a robust and useful source of vitamins on board a ship.

Other fruit remains present in much smaller quantities included apple pips (*Malus sylvestris*; 3 whole pips and 7 fragments from three samples), possible damsons and bullaces (*Prunus domestica* cf. *insititia*), cherries (*Prunus* sect. *Cerasus*), a sloe (*P. spinosa*) and plum-type (*Prunus* sp.) stone fragments. Seven of the plum/cherry remains were recovered as small finds and are listed in Allan Hall’s report (this volume). Only three of the *Prunus* sp. were present in the sample flots or residues and most of the remains were present in the bow. The apple and peach (*Prunus persica*) remains were only present between frame stations F6-7 at the bow of the ship. Two half peach stones were recovered as spot finds, possibly being too large to fall between the cargo deck planking.

A few other fruits, that can be found in woods, scrub and hedgerows in both the British Isles and the Iberian Peninsula, were present in very low numbers and could have been introduced amongst dunnage, rather than been consumed, or even been deposited accidentally, e.g. in bird droppings. These included three blackberry seeds (*Rubus* sect. *Glandulosus*), two elderberry seeds (*Sambucus nigra*), and two hawthorn seeds (*Crataegus* sp.). With exotic fruits such as grapes and figs readily available it is perhaps unlikely that less palatable, astringent fruits such as these would have been consumed. However, they may have been valued for their medicinal properties. Elderberries have long been used to cure colds when taken with hot water and sugar (Grieve 1992, 268), and hawthorn berries can be used to cure sore throats, and as a diuretic and tonic for heart troubles (Grieve 1992, 385). The dried fruits of blackberry are said to be a reliable cure for dysentery (Grieve 1992, 110).

Flavourings, possible medicinal plants and fibre crops – It may seem odd to group these economically important species together, but several of the taxa can be used for a variety of purposes. The low but regular occurrence of seeds from plants such as hemp (*Cannabis sativa*), flax (*Linum usitatissimum*) and hop (*Humulus lupulus*) suggest that the seeds themselves, rather than just the processed fibres or hop flowers, were being used. The occurrence of seeds from these three taxa on other ships, e.g. the *Mary Rose* (Smith and Green 2005) adds weight to this suggestion.

Hemp seeds were present in seven samples mainly located towards the stern of the ship, amounting to eleven seeds. Hemp stem fragments were present in 25 spot samples, some of which retained soft stem tissues around the tough bast fibres. This suggests that cordage had been made with rapidly processed stems, rather than stems left to rot until all of the soft tissues had rotted away (Hall, this volume). It is possible, then, that ships carried on board either the raw materials to make and repair ropes while at sea, i.e. dried bundles of hemp complete with seed heads, or bundles of rapidly retted (soaked and rotted) hemp, with some seed heads still attached. In the first case in particular, dried seeds, flowers, leaves and stem scrapings may then have been retained for medicinal purposes, since these are the parts of the plant that contain most of the narcotic resin. The main medicinal use of cannabis is pain relief. A single hemp seed was recovered from the *Mary Rose*, and hemp pollen was present in several locations including the bilge pump. Hemp fibre was used for all of the identifiable cordage (Scaife 2005, 628; Smith and Green 2005). Hemp and nettle pollen in the caulking samples of the *Mary Rose* indicated that these fibres were also the main constituents of the caulking (Scaife 2005). This was not the case in the Newport Ship, as the luting consisted of mixed animal hair and wood tar. Luting was placed between overlapping hull planks and served to make the joints watertight. However, hemp was used for most of the ropes examined by Allan Hall (this volume).

Five flax seeds, five fragments of flax seed and a possible flax capsule fragment were recovered from five samples positioned from bow to stern of the ship. Flax seeds can be consumed as a flavouring in bread, as well as being used externally and internally for medicinal purposes. When crushed the oily seeds make a useful poultice, and they can be used in cough medicines and to relieve constipation (Grieve 1992, 319). Two flax capsule fragments were present in a sample from the *Mary Rose*, but this was thought to have probably been accidental as the pollen was rare (Smith and Green 2005, 600).

Fifteen hop seeds were recovered from four samples, with fourteen of them being located in the stern of the boat. Hops grow in hedgerows and woodland margins in both the British Isles and most areas of the Iberian Peninsula. Four hop seeds were present in the *Mary Rose* samples, and it was suggested that this might have been accidental, having been brought on board with the beer rations (Smith and Green 2005, 596). Hops were beginning to be used in brewing in Britain during the fifteenth-century though both hopped 'beer' and un-hopped ale were still in production and hops were by no means universally accepted. As an alternative interpretation, the various culinary and medicinal uses of hop were listed by Smith and Green, including eating the young shoots as a vegetable, using the cones (clusters of flowers) in hop pillows to relieve toothache, stress and insomnia, and making an infusion of hops to cure a variety of ailments including intestinal and heart problems (Grieve 1992, 414).

Hemp, hop and flax were also present in seventeenth-century samples from Welsh Back on the north bank of the River Avon, Bristol (Jones, forthcoming). These dumps of material represented goods being imported from abroad, including a large cargo of grapes. They were also all present in moderate quantities in fifteenth to eighteenth century deposits from the waterfront in Reading (Carruthers 1997). Traces of hemp and flax were present on the seventeenth-century 'Buurgzand Noord 14' (Moolhuizen 2009) wreck off the Dutch coast. Flax seeds and capsule fragments are fairly common in waterlogged land-based deposits such as ditches and ponds, as retting (part of the processing) often took place in such water bodies. However, hemp and hops are less often found. The presence of these three taxa in quayside deposits and in wrecks suggests that they were being traded on a regular basis. This is confirmed by documentary sources such as the thirteenth to sixteenth-century customs records published by Gras (1918). Barrels of hemp seed, sacks of hops and bales of flax are listed in the customs accounts and book of rates. According to a table of trade carried on by denizens and aliens on page 111 the port of Bristol in the 1460's to 1480's was exporting and importing a range of shipments at a rate that was only surpassed by London and Southampton.

Other low-incidence taxa that were probably used as flavourings, and so are likely to have been deposited in sewage, include seeds of coriander (*Coriandrum sativum*), fennel (*Foeniculum vulgare)*, wild celery (*Apium graveolens*), carrot (*Daucus carota*) and possible black mustard (*Brassica nigra*-type and possibly *Brassica/Sinapis* sp.). These items were probably deposited in sewage, as they were distributed throughout the length of the ship (as far as can be told from the fairly small numbers of remains) and were often fragmented, but their origin may originally have been from cargos being transported. Barrels of mustard seed (or 'semen senapii') were common in a 1420-1421 customs document for the port of London studied by Gras (1918, 498, 503, 507-509), though the other spices may not have been traded in large enough quantities to have been itemised separately.

III. Dunnage or 'packaging'

Plant remains in this group were numerically the most abundant items in many of the samples (=64% of the total remains), particularly in the bow (context 152 = 153 fragments per litre (fpl)) and stern of the ship (contexts 130=279 fpl; c.152=198 fpl; c.171=>212 fpl). Figure 4 shows the relative quantities of dunnage compared to food remains through the ship. Context 171 (sample 177) was especially rich in dunnage, so much so that sorting for juniper leaves had to be abandoned three-quarters of the way through (though all other items were recovered from 100% of the flot and residue).

Dunnage was used to cushion the cargo in the hold, so a freely available, springy type of material that could absorb impacts without being totally crushed would seem to be the most suitable material. The principal remains in the samples assumed to have been used as dunnage were juniper leaves (Plate 4; plus a few small stem fragments) and heather (*Calluna vulgaris*) shoots, leaves and flowers (Plate 5). These small shrubs are woody enough to resist crushing, springy enough to absorb impacts, and freely available on dunes and cliffs around the Iberian and Mediterranean coasts. As outlined in the 'Notes on Identification' section above, identification to species level is not straight forward either for the *Juniperus* genus or *Erica* genus using only morphological characters of the leaves. However, the two white bands of stomata on the juniper leaves together with the leaf size range confirm that a southern European species was used; either Western prickly juniper (*Juniperus oxycedrus*) on its own, or together with Portuguese prickly juniper (*J. navicularis*). Both species grow in the S.W. coastal region of Portugal, and the former is widespread in southern Europe, but most common on the Iberian Peninsula.

Polunin and Walters (1985, 114) note that prickly juniper, gorse, broom and heathers can form a shrub layer in woods of maritime pine (*Pinus pinaster*) "on the sandy coastal areas of the western Mediterranean, with its main stronghold in the Iberian peninsula including the Portuguese coast". Included in the list of characteristic species is heather (*Calluna vulgaris*) and *Erica* heather species. These were the most frequent items in the dunnage from the Newport Ship, with juniper coming a close second. Pine needles in pairs (as found in maritime pine, but also a number of other species of pine) were present in the samples, though were not frequent, suggesting that they may have blown in from trees growing nearby. Broom spines (*Cytisus/Genista* sp.) and gorse spines (*Ulex* sp.) were present in small numbers, and small, petiolate broom-like leaves with a coarse cell structure and hairs (cf. *Genista* sp. leaf) were recovered.

The range of *Erica* species present is still under investigation, as noted above in 'Notes on Identification', but *Calluna vulgaris,* bell heather (*Erica cinerea)* and at least two possible southern European species were present in the samples. Whilst the first two heathers were frequent, leaves from the other two were rare. Heather flowers were common in the samples with very little evidence that they had started to form capsules and seeds. This suggests that the dunnage had been gathered at one time, probably prior to the final voyage, rather than being an accumulation of material from many voyages (unless gathering always occurred at the same time of year). Flowers are produced in late summer for species such as bell heather and *Calluna vulgaris* (July to September), but through the winter for southern European species in group b) (e.g. tree heath, Portuguese heath; January to April). Since most of the identified material was *Calluna vulgaris* and bell heather the flowers must have predominantly been from these species. Therefore, the dunnage was most likely cut during the late summer from 'brezales' type garigue (heather-rich) along the Iberian coast. When this type of vegetation dries out it can become brittle and less useful as shock-absorbent packaging, so it is likely that fresh dunnage would have been collected prior to each sea voyage. This would also make sense if, to reduce pest infestations, it was necessary to clean out the hold between voyages, probably by throwing the old dunnage overboard or perhaps selling it for fuel.

Unfortunately pollen samples taken from contexts 130, 152, 154 and 171 were mostly unproductive, though one sample from mid-ship (Frame 27, sample 57, context 152) produced a reasonable range of taxa (Jones, this volume). The frequency of *Calluna* and pine pollen could relate to the presence of the dunnage, though there were no taxa that helped to confirm a southern European origin.

IV. Weeds

Low quantities of seeds from general weeds of waste ground, cultivated land and grassland were present in most of the samples, though they only reached a maximum of 6% of the remains of any one sample (sample 67, context 153, F6-7). No species was particularly well represented, and all were fairly wide-ranging, geographically and in terms of soil preferences. Corn spurrey (*Spergula arvensis*) is an indicator of acidic, sandy soils and stinking chamomile (*Anthemis cotula*) grows in heavy, damp soils, but neither species was common in the samples. Species such as corn cockle (*Agrostemma githago*) and corn chamomile (*Chrysanthemum segetum*) were most likely contaminants of grain being brought on board, or amongst straw brought on as bedding. However, most of the other less habitat-specific weeds could have been introduced amongst a variety of materials, including dunnage, hay, dung from livestock and trample. Bird droppings are another possible source of occasional wild fruit and weed seeds.

V. Wetland plants

This was the smallest habitat group, and many samples (15 out of 25 samples) contained no plant remains in this category. Amongst the species recorded only two were coastal plants; sea arrowgrass (*Triglochin maritima*) and cf. annual sea-blite (cf. *Suaeda maritima*), both plants of saltmarshes. The latter identification was uncertain because of similarities with a number of other species in this family and only two seeds of the former were noted at the assessment stage (Caseldine and Griffiths 2006; context 171). Many of the other species could have been growing in marshier parts of the heathland from which the dunnage was gathered, for example sedges (*Carex* spp.), spike-rush (*Eleocharis* subg. *Palustres*) and common club-rush (*Schoenoplectus lacustris*). Therefore, no significant evidence of coastal, riverine or estuarine vegetation was recovered from the samples to suggest that contamination of the ship deposits by later river silts had taken place, or that marshy vegetation had been gathered as dunnage.

Comparing the upper samples from context 130 with those from context 152 in the bilges, 50% of the context 130 samples contained wetland plant remains at a average concentration of c. 0.3 wetland plant seeds per litre of soil processed, compared with 27% of samples at an average of 0.3 seeds per litre. In other words, only slight differences were observed. On the other hand, the Lampeter assessment (unquantified data) suggested that almost all of the wetland plant remains were either in context 128 (above 130) or 130, or in context 171 in the stern which is directly below context 130. A small influx of material from the river sediments to the ship sediments, therefore, is possible, but not enough to have produced misleading data in the bilge samples.

VI. Distribution through the ship

As noted above, it was uncertain whether spatial analysis would be possible because of the flow of water in the bilges which would have washed plant remains around the ship when it was at sea. Water entering the hull of the ship would have flowed around the bilges according to the motions of the vessel, before being pumped out by the bilge pumps in area F33-4 at the lowest point in the centre of the ship. It is likely that this was the reason that deposits in the bow and stern were richest in plant remains, as a 'tide mark' of material may have accumulated in these areas, being less frequently washed clean with bilge water. In addition, the fore and aft of the ship were probably used for accommodation (Toby Jones, pers. com.), and this would also explain why food remains like apple and grape pips were concentrated in these areas. Differences in the concentrations of food and dunnage material through the ship are shown in Figure 4.

A few plant taxa appeared to only occur in certain parts of the ship, either at the bow or stern, whilst others were distributed along the length of the ship. When examining distribution the different sizes of soil samples had to be taken into account, so samples where volume data was not available had to be omitted. Calculating the occurrence per litre of soil processed led to the following observations (see Table 2);

- Apple pips were only found in the bow of the ship (F6-7; 3 samples). This area also contained the highest grape pip, plum/cherry stone, peach, walnut shell and hazelnut shell fragment concentrations. Most of these items probably represent discarded food waste rather than sewage (larger seeds, fruit stones and nutshell) suggesting that living areas, food preparation or eating areas may have been situated at the bow of the ship.
- Cereal chaff (apart from millet) was only found in samples from the stern of the ship (F56-F60; 4 samples). Millet, on the other hand, was recovered from eight samples in most areas of the ship, much like the smaller seeds such as fig. This suggests the millet remains were probably deposited in sewage, which is quite

likely for a small-seeded grain of this type. The un-processed grains (preserved because the palea and lemma were still present) represented the occasional grain that slipped through processing. The other cereal chaff may represent packaging material or bedding/fodder for livestock being kept in the stern of the ship. Since whole chicken skeletons were present amongst the faunal remains, it is likely that at least poultry were being kept on board. The animal bone report (See Newport Medieval Ship Specialist Report: Faunal Remains) also suggests that some smaller livestock species may have been brought on board alive, so bedding, fodder and dung associated with perhaps goats/sheep may have contained cereal chaff and straw.

- As noted above, small seeded and fragmented items that were probably deposited in sewage occurred throughout the ship. This included fig seeds, pomegranate seeds, black mustard seeds, hemp, flax and hop seeds and other flavourings/medicinal seeds. Chewed fragments of grape pip also occurred throughout but whole seeds were mainly present at the bow and stern. Faecal material entering the bilges had obviously been washed through the ship with the movement of water in the bilges, whilst discarded food waste remained at the bow.

At first glance this distribution could be explained in terms of the physical properties of the remains, in that the larger items stayed at the bow and stern whilst the smaller, lighter items were washed through the bottom in the bilge water. However, the chaff fragments towards the stern suggest that other factors were also involved, since these small, light items would otherwise have also been washed through the ship, along with the sewage. It is likely, therefore, that both physical and behavioural factors were involved in the distribution of plant remains through the ship.

VII. Living Conditions

Since 21 of the 25 plant macrofossil samples analysed contained fly puparia it is apparent that highly organic, foul waste had accumulated in the bilges. The insect report (David Smith, this volume) confirmed that liquid cess was present due to the identification of flies such as *Fannia canicularis*, and a pollen sample from context 152 contained parasitic ova of *Trichuris* which is another indicator of excrement (Sarah Jones, this volume). The accumulated material in the bilges, therefore, must have made living conditions in the bottom of the ship extremely smelly, as described by C16th Spanish explorer Eugenio de Salazar, quoted in Perez-Malliana (1998);

"The moment most dreaded by all on board was when the bilge pumps were engaged to extract water that had filtered down to the bottom of the ship. Totally corrupted, it came out 'fuming like hell and reeking like the devil'"

David Smith also notes that the number of human flea heads recovered indicated a high level of parasite infestation amongst the crew. Although the diet appears to have been relatively varied compared to documented monotonous, scurvy-inducing diets of long-distance ships (Perez-Malliana 1998, 144), living conditions must still have been fairly unpleasant on the shorter-distance voyages of trans-European merchant ships.

With regard to diet, the Newport Ship evidence needs to be examined taking into account types of foods that will not have been preserved in the bilge deposits, such as ready prepared foods (including ships biscuits), dairy produce, meats, fish, oil and wine. When examining faecal material from cess pits, either mineralised or waterlogged, cereal bran often makes up the bulk of the material. In the bilges of the ship, however, preservation conditions were probably too wet for mineralisation to take place and too fluid for coprolites containing bran to survive (although coprolites were found in the Aber Wrac'h, (L'Hour and Veyrat 1989), see below). Therefore, the cereal part of the diet is probably greatly under-represented in these deposits. The fruits, nuts, flavourings and possible medicinal plants present in the samples give only part of the information, perhaps laying too much emphasis on fruits and nuts that were occasional snacks rather than a major part of the diet. From an archaeobotanical point of view, however, the fruit/nut/flavourings aspect of the diet is usually absent from dry-land charred plant assemblages, so the Newport Ship has provided important information about the diet of a fifteenth-century ship's crew.

Cooking took place in open stoves on deck during this period (Pérez-Mallaina 2005, 134), and the concentration of food waste in the bow of the Newport Ship suggests that this may have been the location for such a structure. As noted above, the occurrence of small amounts of cereal chaff and straw in the stern could indicate that livestock or bedding materials were located at this end of the ship.

VIII. Comparisons with other sites

Although quite a few shipwrecks in European waters have been excavated, particularly in the Mediterranean, relatively few have been systematically sampled for plant remains. A paper by Haldane (1990) outlining the history of shipwreck archaeobotany notes that routine sampling for plant remains on shipwrecks in the Mediterranean only began in the 1970's. Prior to that, archaeobotanical analyses had often been limited to material found in storage containers such as amphora and barrels. These contexts can produce remarkable food remains, and they can provide important information about trade, for example coffee beans in barrels on board the shipwreck in the Waddensee, Netherlands (Kuiper and Manders, 2009). However, they do not inform us about life on board ship. Unfortunately the cargo from the Newport Ship would have been removed prior to its refitting. However, samples from the bilges have provided important information about diet, living conditions and the origins of the ship that has greatly added to our understanding of the vessel. In addition, it is quite likely that at least some of the diet items, such as fruits and nuts, originated as cargo.

The closest comparable site in a geographical sense is the Magor Pill medieval wreck, the remains of a boat constructed in the thirteenth century that was found on the intertidal zone of the Gwent Levels in the Severn Estuary. Pollen and plant macrofossil analysis produced very little evidence of economic plants, but information was obtained about use of the local coastal salt-marsh. Traces of barley chaff (*Hordeum* sp.) in the caulking samples were thought to possibly represent a cargo carried on the boat (Caseldine and Barrow 1998).

The evidence suggests that the Newport Ship had probably been trading between the Iberian Peninsula and Bristol. Evidence from late seventeenth-century dumps on the north bank of the River Avon in Bristol, the site of Welsh Back, confirms that exotic fruits and nuts were being imported along this route in the post-medieval period. A large quantity of grape pips was recovered, probably representing a spoiled cargo being imported from southern Europe (Jones, forthcoming). Other exotic plant remains included walnut, water melon, melon, fig, dill, coriander and buckwheat. As noted earlier, hemp, hop and flax were also present, in addition to fruits and nuts that may have been grown locally or imported, including hazelnuts, apple, wild strawberry, cherry, and bullace/damson.

The closest wreck both temporally and in terms of construction and plant macrofossil assemblage is the mid fifteenth-century Aber Wrac'h wreck found off the north coast of Brittany (L'Hour and Veyrat 1989). Samples from the base of the boat produced evidence of human coprolites and plant macrofossil evidence of diet that is comparable to material from the Newport Ship. Rye was the only cereal present, though the most widespread and frequent taxa in the thirty-six samples examined were walnut, hazelnut, sweet chestnut and grape, with occasional bullace-type plums and apple pips. As in the Newport Ship, wild plant remains were infrequent and comprised common weeds of disturbed/cultivated land. The dominance of highly nutritious, storable nuts and fruits that could be dried was noted, as it was in the samples from the Newport Ship (Ruas 1989). Unfortunately dunnage was not present so comparisons could not be made with the Newport Ship dunnage, perhaps for reasons of taphonomy or because this type of packaging was not needed on the Aber Wrac'h. Plant macrofossil analysis is still underway, so the author is very grateful to Marie-Pierre Ruas for access to the unpublished results.

Although not a trading ship and slightly later in date, the Tudor warship, *Mary Rose*, provides a wide range of samples with which to make comparisons. This wreck, excavated in 1979-82 in the Solent, was one of the first British wrecks to be extensively sampled for environmental remains. The quantities and variety of food and dunnage remains were not as great in samples from the *Mary Rose* as in the Newport Ship, though the sample size was similar (mainly 1 to 2 litres) and plant macrofossil preservation was usually very good (Smith and Green 2005, 591). From the 112 samples fully analysed 5833 identifications were made (average of 52 items per sample). This can be compared to the 3798 identifications from the 25 fully analysed Newport Ship samples (152 items per sample on average). On the *Mary Rose* most of the samples were taken from (or near) to containers such as casks and sacks on the ship prior to lifting the hull in 1982. Samples close to specific items such as bowls, cordage or tools were also often selected for full analysis. The time delay between sampling and analysis was greater than with the Newport Ship (around 20 rather than 10 years) but the generally good state of preservation suggests that this was not a major factor. Differences in the construction and use of these vessels were probably the main factor.

The history behind the *Mary Rose* is well documented and sources of foods and dunnage much more likely to have been primarily British. The baskets and chests of plums/greengages, for example, were probably grown in local orchards, since these fruits would not have had a long 'shelf-life'. However, plums/greengages may have been dried and stored as prunes. In addition, a ship of this status and date clearly had access to exotic imports, as demonstrated by the basket of peppercorns and two half coconut shells recovered from the ship. Other exotic fruit and nut remains similar to those present on the Newport Ship were recovered, but not in notable quantities in any of the samples. For example, only two fragments of walnut shell are listed in Appendix 3, along with three grape pips and two grape skins. No fig seeds were recovered, suggesting either that sewage was not present in the samples or that this imported fruit that was widely available by the later medieval and post-medieval periods had not been brought on board. As with the Newport Ship, cereal remains were scarce, with the majority consisting of chaff, and with rye being the most frequent cereal. Bran was not found and it was presumed that most grain-based foods would have been brought on board as fully prepared products, in particular ships biscuits. In contrast to the Newport Ship most of the chaff occurred at the bow of the ship. It is likely that some of the differences between the foods were due to the fact that the Newport Ship food evidence was primarily derived from sewage, so fruits with larger stones such as plums were not well-represented, small-seeded fruits were abundant and some foods and flavourings would have been ground up prior to eating, such as pepper and grain, so were not preserved in a recognisable form. For the *Mary Rose*, on the other hand, most of the evidence came from containers of whole stored fruits and flavourings such as plums and peppercorns. In addition, one ship was at the start of its voyage whilst the other was probably close to the end of this particular crossing and almost certainly contained accumulated waste from many such journeys. Despite the different taphonomies, it is clear that there were also differences in diet between the ships, as food remains such as walnut shell are not derived from sewage, and they preserve well so that even small fragments are recognisable. On board a cargo ship the diet may have been quite varied, depending on what was being carried, whilst on a heavily crewed warship rations mainly consisted of beer, biscuit, peas and pork, according to documentary sources (Smith and Green 2005, 601). No evidence for peas or biscuit were found on the *Mary Rose*, perhaps because of preservation biases if the peas had been stored whole. There was a small amount of evidence for peas on the Newport Ship, but if pulses had been a major component of the diet they were as 'invisible' as the cereals in the sewage deposits.

The differences in origins were also seen in the dunnage, or 'bedding, packing and stuffing' described by Smith and Green (2005, 601). As with the Newport Ship, the bow and stern of the ship's decks contained the highest concentrations of these materials, which may be due to the way that the bilge water flowed towards the centre of the boat, leaving a 'tide mark' of waste at either end. Concentrations at the stern of the *Mary Rose* may also be due to the probable location of living quarters on the upper deck, underneath the sterncastle, though the toilets were probably located at the bow. Some plant material in the fore of the main deck may have been used as wadding for cannons. The main materials present were broom leaves and stems (*Cytisus* sp.), cereal chaff and bracken. On the Newport Ship juniper leaves, heathers and smaller amounts of broom, and bracken were used to pack the cargo safely, as described above.

Slightly further afield and later in date, two post-medieval wrecks of merchant vessels excavated near the Island of Texel, the Netherlands, produced remarkable cargos. Texel served as a transhipping point, where goods were moved from large merchant vessels to smaller boats that could cope with the shallow waters around Amsterdam. The eighteenth-century Burgzand Noord 4 wreck produced barrels of unroasted coffee beans, probably originating from the Dominican Republic (Kuijper and Manders, 2009). The ship may have carried around 100 barrels of coffee beans amounting to c. 22000kg of cargo. Traces of cocoa bean, buckwheat and peanut pod were also found. Sugar cane stalks had been used as pressure release valves in the barrels. Blocks of wood were used to secure the barrels, the species of which are mostly found in the northern Amazon basin.

The Burgzand Noord 14 wreck sunk in the seventeenth-century (Moolhuizen, 2009). The vessel was one of the Dutch East India Company trading ships which traded between Amsterdam and the East Indies, West Indies and Baltic. The diet of the crew was a monotonous mix of rye bread, buckwheat porridge, beans and salted meat, and as a result health problems caused many deaths, according to documentary sources. Samples were taken from six barrels and from areas near the barrels and in the stern. The most abundant items of food found on board were thousands of black peppercorns, cereal grains (rye with rye brome contamination) and peas/beans (a dense mass identified from hilums). Buckwheat, rice, cucumber and a variety of weed seeds were recovered in smaller quantities. The trading route and cargos (as opposed to food for the crew) of this ship were less easy to determine, though the black pepper (probably from SW India) peas/beans and rye were the likely cargos. Crop weed distribution could not provide a definite origin for the cereals, except that it was probably European, but not Spain or the British Isles. It is interesting to see that small amounts of heathers, black mustard and traces of hemp and flax were present in the samples, as on the Newport Ship.

Documentary evidence for Christopher Columbus' ships sailing from Spain in 1492 indicated that food and drink carried on board comprised water, vinegar, wine, olive oil, molasses, cheese, honey, raisins, rice, garlic, almonds, salted flour, sea biscuits, dry pulses (chickpeas, lentils, beans), salted sardines, dry salt cod and pickled or salted meats (www.christopher-columbus.eu/food.htm). The only plant remains likely to have been recovered in archaeobotanical samples from the bilges of his ships would have been grape pips from the raisins, perhaps olive stone fragments from the oil, almond shell fragments, rice grains if still in their husks, and pulse hila. Clearly, this ship would have had very different provisioning requirements from the Newport Ship, whose voyage would probably have lasted only a few days or weeks in contrast with Columbus' seven month trans-Atlantic expedition.

Unfortunately plant macrofossil studies from wrecks in the Mediterranean are harder to find. Haldane summarised the evidence from shipwreck archaeobotany in 1990, including details of the Late Bronze Age wreck at Ulu Burun, Turkey (Haldane 1990). At Ulu Burun over 100 shipping jars were excavated, including jars of terebinth resin probably used in making perfumes and incense. Other goods being traded included coriander seeds that had probably been stored in baskets or woven bags, and pomegranates, figs and olives that had been transported in storage jars. Studies of leaves and twigs used for dunnage are still underway. This ancient trading ship is thought to have travelled a circular route around the Eastern Mediterranean. Although the Iberian Peninsula may not have been included, it does demonstrate that coriander, pomegranates and olives have a very long history of being traded in the Mediterranean. Haldane (1990, 59) notes that Columella describes how pomegranates can be stored for up to a year, a property that would make them a valuable source of vitamins for crews of trading ships undergoing long journeys.

CONCLUSIONS

The plant remains recovered from the bilges of the ship primarily represent accumulations of food remains from sewage and discarded food waste, plus frequent fragments of dunnage that had fallen through gaps in the cargo deck. The food remains indicate that a varied diet was enjoyed judging from the fruit, nut and flavourings present, though this may not be totally representative of the main foods being consumed. Few cereal remains were present, but this is probably a taphonomic problem, with cereal-based foods being brought on board already prepared and processed cereals not surviving well in waterlogged deposits. Millet was the main cereal identified – a small grain that can be boiled like rice or milled into flour. Rivet/hard wheat, rye and oats were also present as chaff fragments. Peas and beans may also have been part of the diet, but these remains were greatly outnumbered by abundant fig, grape, walnut and hazelnut remains. Other, less frequent fruits and nuts included pine nuts, almond, pomegranate, peaches, plums, cherries, apples, and possibly olives. Flavourings included coriander, black mustard, fennel, and flax, hemp and hop could have been used for a variety of purposes.

The diet was far more southern European in character than British and it contrasts with sixteenth-century documentary records of the daily rations of members of the crew on the Spanish armada. Theirs consisted of a very monotonous, scurvy-inducing diet of biscuits, wine, chick peas, horse beans, salted fish, salted meat, cheese, oil and vinegar (Pérez-Mallaina 2005, 141). Either merchant ship crews enjoyed a more varied diet, or there was a relaxed attitude to crew members occasionally supplementing their diet from the cargo. It is also possible that the more exotic sewage components in the bilges were primarily deposited by the higher ranks amongst the crew.

Heathland or garigue-type vegetation appears to have been used as dunnage, the main shrubs being heathers and a species of juniper that occurs in southern Europe but not in the British Isles. The vegetation was probably collected from coastal areas of dry, sandy soils on the Iberian Peninsula during the late summer, since heather flowers were abundant. In the light of information by W.R.Childs (1978) concerning the seasonal nature of Anglo-Castillian trade in fruits and nuts, a very tentative suggestion can be made that perhaps the last voyage of the Newport Ship took place prior to Christmas, since fruits and nuts were more profitable at this time, and even poorer households treated themselves to imported figs and raisins. Childs quotes a Moses Conterin who was refusing to accept a return cargo of figs and raisins from Andalusia because the ship had been delayed by storms and they would arrive too late to be sold profitably. More profitable imports to Britain such as wine and oil would have been the main cargos for this route, with wool and cloth being the main British exports.

It is hoped that when future wrecks of this type are excavated, either around the coast of the British Isles or the Iberian Peninsula, samples will be taken from the bilges so that comparisons can be made with the Newport Ship.

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Figure 1: Juniper leaf dimensions

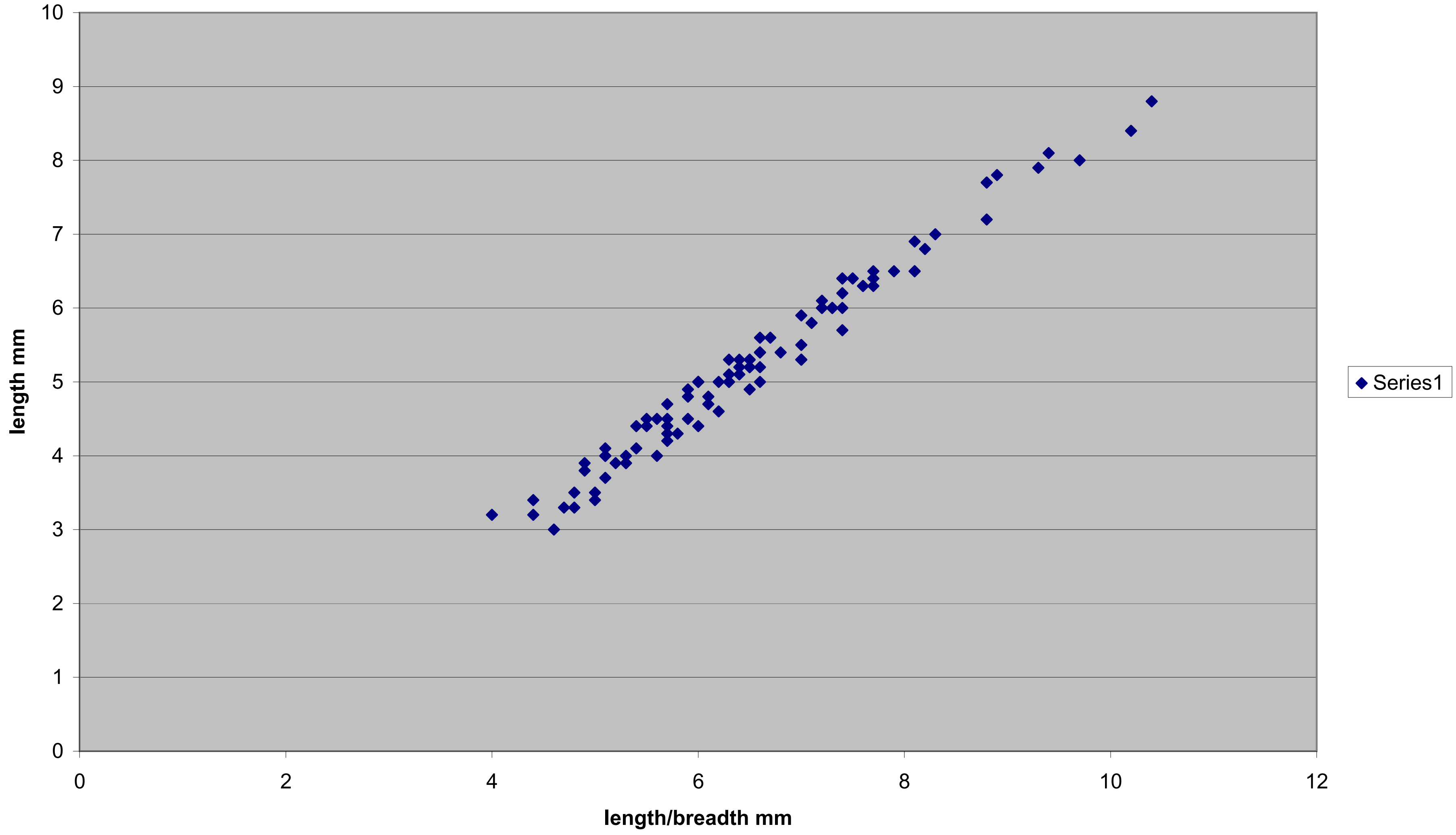
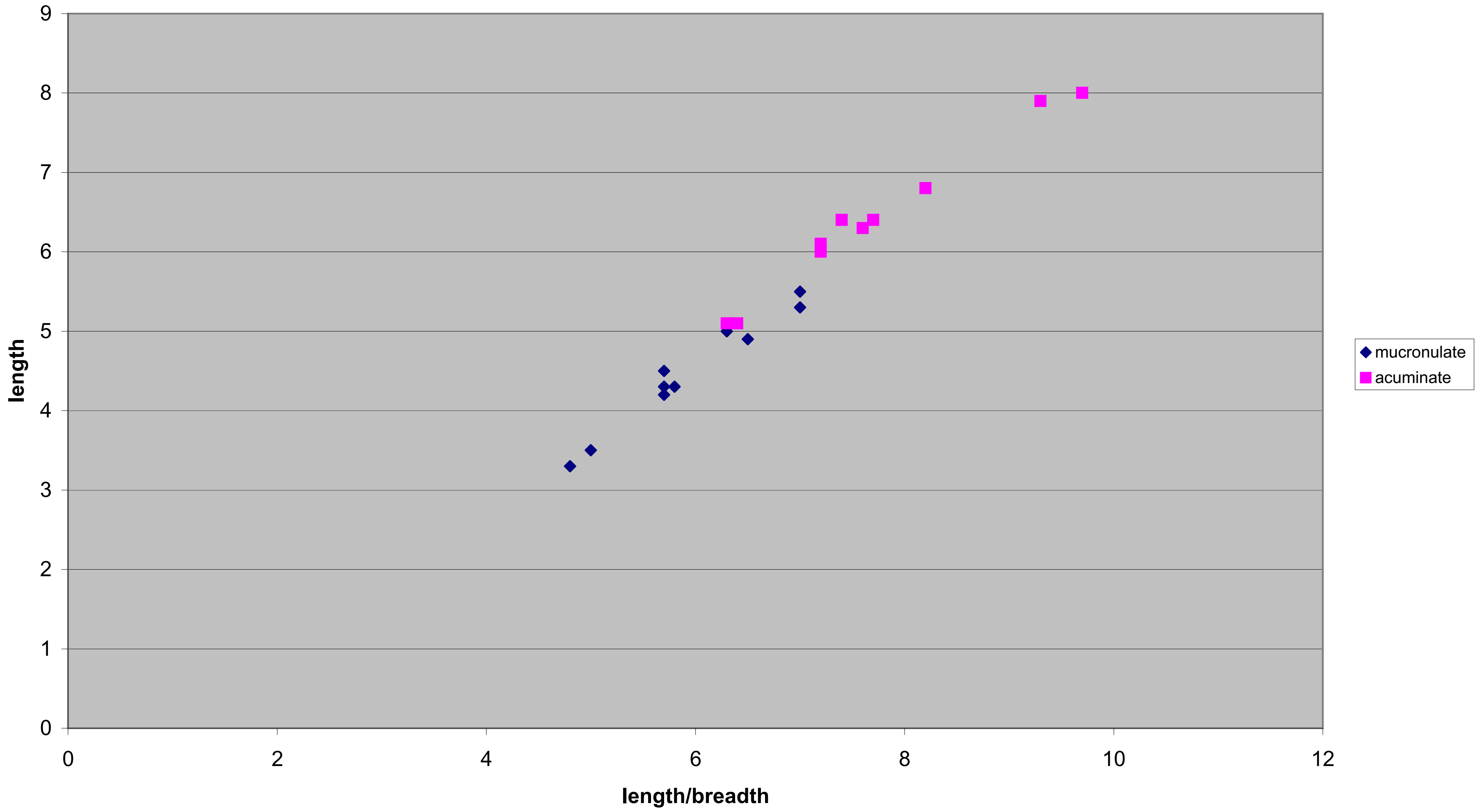


Figure 2: Juniper leaf apex comparison



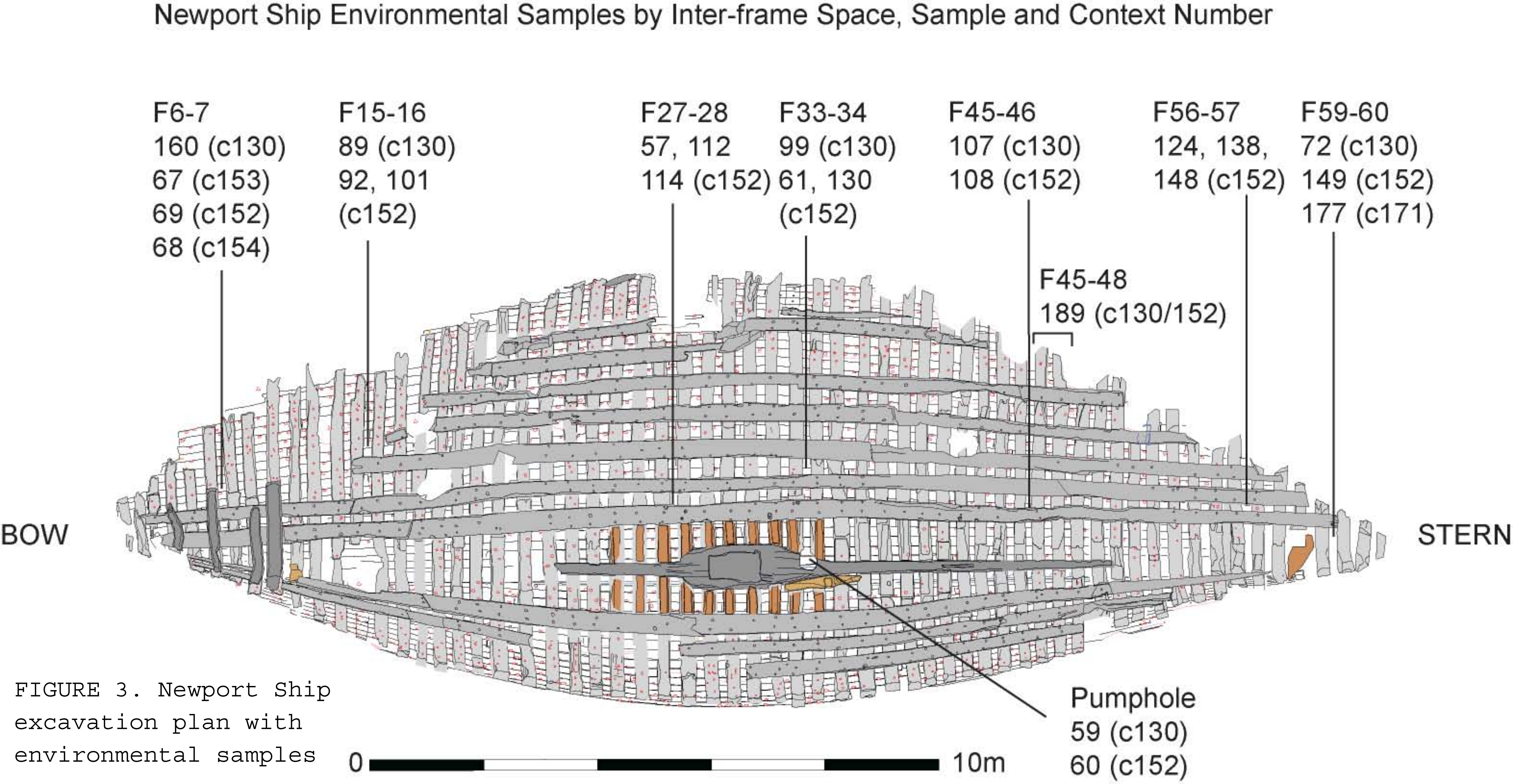
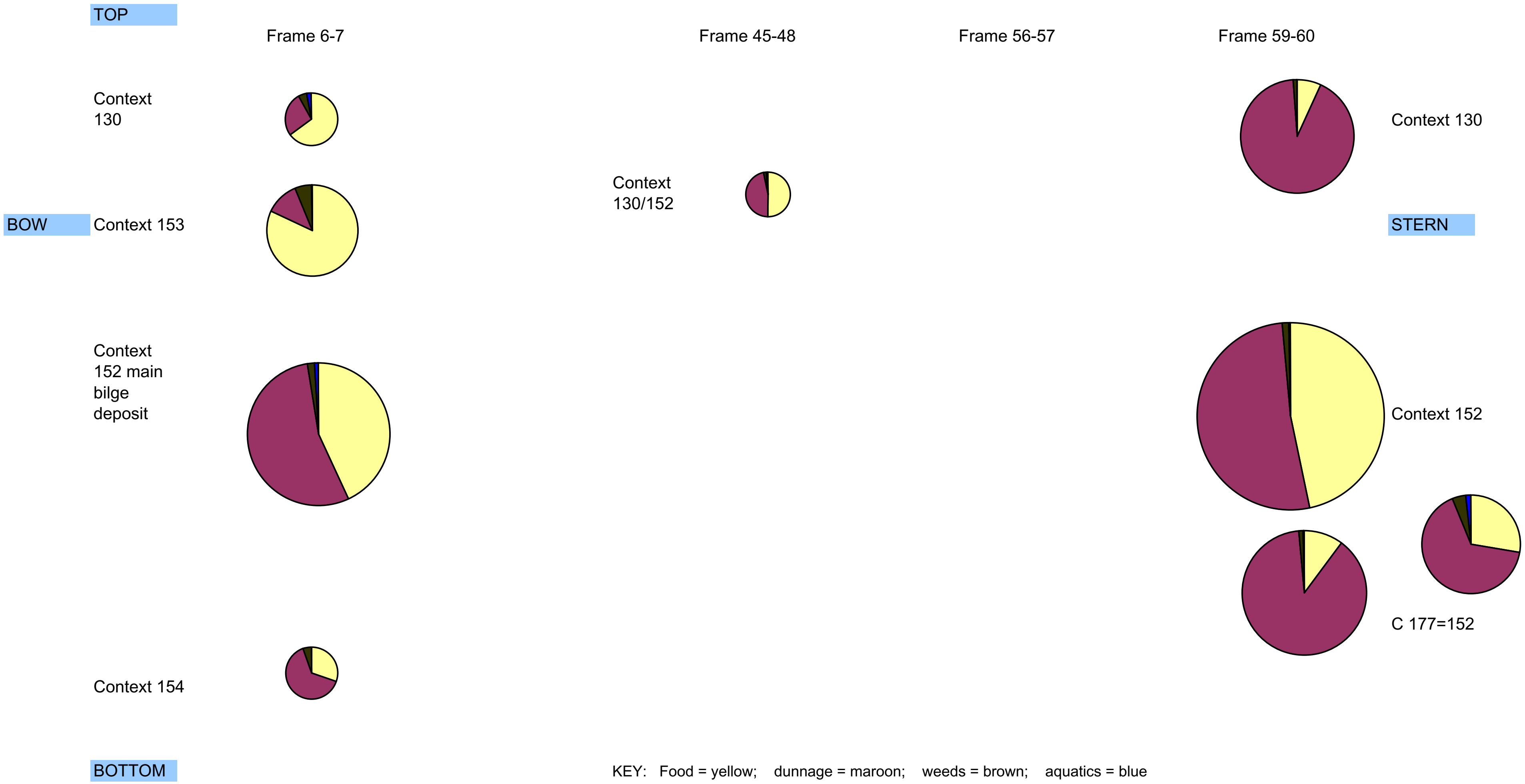


FIGURE 3. Newport Ship excavation plan with environmental samples

FIGURE 4

Schematic diagram of plant macrofossil distribution through the Newport Ship



KEY: Food = yellow; dunnage = maroon; weeds = brown; aquatics = blue

PLATE 1: MILLET

PLATE 2: ALMONDS

PLATE 3 POMEGRANATE SEEDS

PLATE 4: JUNIPER LEAVES


1 mm

Table 1: Plant remains from Newport Ship (467)

Frame no.	F6-7	F6-7	F6-7	F6-7	F5-14 SMALL FINDS (ID by A.Hall)	F15-16	F15-16	F15-16	F15-16 SMALL FINDS (ID by A.Hall)	F27-28	F27-28	F27-28	F33-34	F33-34	F33-34	Pump Hole F33-34	Pump Hole F33-34	F29-35 SMALL FINDS (ID by A.Hall)
Context	130	153	152	154	120; 130	130	152	152	130; 152; 254; 1015	152	152	152	130	152	152	130	152	120; 130; 152
Sample no.	160	67	69	68	MSG	89	92	101	MSG	112	114	57	99	61	130	59	60	MSG
Sample volume (litres sediment)	5.5	2	0.4	2	-	?	0.7	0.15	-	1	2	0.5	1	0.3	0.5	?	5	-
Flot / Residue analysed	FR	FR	FR	FR	-	FR	F	FR	-	FR	FR	FR	FR	F	F	FR	FR	-
Cereals / cereal chaff																		
Panicum miliaceum L. (millet palea and lemma)		10	3											1	1			
Triticum turgidum/durum (rivet/hard wheat rachis frag.)																		
Triticum sp. (free-threshing wheat rachis fragment)																		
Secale cereale L. (rye rachis fragment)																		
Avena sp. (oat glume)																		
Cereal grain or large grass caryopsis																		
cereal-sized culm node																		
cereal-sized culm fragment																		
Small-seeded fruits and pulses (from faeces or cargo)																		
Malus sylvestris (L.) Mill. (crab apple pip)	2	1+4f	3f															
cf. *Pisum sativum* L. (pea-type hilum)		2	1															
Vicia faba L. (broad bean, charred cotyledon fragment)																		
Vitis vinifera L. (grape pip)	6+21f	2+96f	20f	1+14f		1+2f				2f						2f		
Ficus carica L. (fig seed)	38	46	10	7		12				16	23	1				3	3	
Rubus sect. *Glandulosus* Wimm. & Grab.(blackberry seed) DHSW	1	1						1										
Punica granatum L. (pomegranate seed)	2	1+18f	cf.2f			cf. 1f					2f							
Larger fruit stones and nut shells (discarded food waste or cargo)																		
Prunus domestica ssp. *insititia* (damson type stone)									1									
Prunus cf. *mahaleb/lusitanica* (cf. St Lucie Cherry/Portugal Laurel)					4													
Prunus Section *Cerasus* (cherry-type stone)																		1
Prunus sp. (cherry/damson/plum stone frag.)				cf.1	1f													
Prunus persica (L.) Batsch (peach stone)					2 halves													
Prunus dulcis (Mill.) D.A.Webb (almond nutshell frag)	1																	
Pinus pinea (stone pine nutshell frag.)						1										2		
Juglans regia L. (walnut shell fragment)	5	53	2	13	9	5			1	2	2					1	1	2
Corylus avellana L. (hazelnut shell frag.)	16	58	4	4	10	1			5	12							1	4
cf. *Olea europea* (cf. olive stone, smooth)	1f*																	
Fibre plants, flavourings and possible medicinal herbs																		
Cannabis sativa L. (hemp achene)						cf.1f												
Humulus lupulus L. (hop seed) FHS											1							
Linum usitatissimum L. (cultivated flax seed)	1	cf.1f	1									1+cf.5f						
Linum usitatissimum L. (cultivated flax capsule)												cf.1f						
Brassica nigra- type (cf. black mustard seed)	2	12				3				1	1					1		
Brassica/Sinapis sp. (mustards, charlock, turnip etc. seed)	1		2							2								
Coriandrum sativum L. (coriander mericarp)																		
Foeniculum vulgare Mill. (fennel mericarp)	1																cf.1f	
Apium graveolens L. (wild celery mericarp)				1														
Daucus carota L. (carrot mericarp) Gc		1	1f															
Dipsacus sp. (teasel fruit)			1f															
Unidentified long-seeded Apiaceae			1f															
Probable Dunnage																		
Pteridium aquilinum (L.)Kuhn (bracken pinnule fragment)	1			1								cf.1					3	
Pinus sp(p). pine needle fragment	1		1															
Juniperus oxycedrus/navicularis (detached leaves)	4	2	5	3				1			1			24				
Juniperus oxycedrus/navicularis (stem fragments with leaves)	1													1				
Unidentified capsule A- possibly Juniper female cone scales	2	4	3f															
cf.*Genista/Cytisus sp.* (cf. broom leaf fragment) Es			2	10										2				
cf. Genista/Cytisus sp. (cf. broom spine) GE																		
Ulex sp. (gorse spine) GEWs			1															
Crataegus sp. (hawthorn fruit stone) HSW					1													
cf. *Quercus* sp. (cf. immature acorn) HSW																		
cf. *Quercus* sp. (cf. oak leaf frag.) HSW																		
cf. *Quercus coccifera* (spiny leaf fragment cf.Kermes oak) HSW																		
Betula pendula Roth (silver birch seed) WaE	1						1											
Alnus glutinosa L. (alder seed) WSF	2	1																
Salix sp. (willow bud scales) HSWw	1															1	21	
Calluna vulgaris (L.) Hull (heather shoot tip) Esp	3	1	7	8							2			2				
Calluna vulgaris (L.) Hull (heather flower/fruit) Esp			1	1		1												
Calluna vulgaris (L.)Hull (detached heather leaves) Esp			4	2														
Calluna vulgaris (L.)Hull (heather stem frags with leaves) Esp																		
Erica tetralix L. (cross-leaved heath leaf) Ew			1	15										1				
E. cinerea L. (bell heather leaf) Ed	7	8	10	2		6		2		1	2			2			1	
E. arborea/lusitanica/australis- type (long thin heather leaf) E																		
Erica sp.unknown d) (glaucous wide veined leaf)		3	11	11		7					2			2				
Ericaceae NFI flowers	11	22	16	29				1		1	3			2				
Ericaceae NFI stems	1	3																
Sambucus nigra L. (elder seed) DHSW	1																	

Table 1: Plant remains from Newport Ship (467)

Frame no	F45-46	F45-46	?F45-46	F45-48	F45-46 SMALL FINDS (ID by A.Hall)	F56-57	F56-57	F56-57	F56-57 SMALL FINDS (ID by A.Hall)	F59-60	F59-60	F59-60	F58-61 SMALL FINDS (ID by A.Hall)	Present in Assess Samples
Context	130	152	152	130/152	1006	152	152	152	1007	130	152	171	1087; 1089; 1090	128; 130; 152; 153; 171
Sample no.	107	108	108?	189	MSG	124	138	148	MSG	72	149	177	MSG	-
Sample volume (litres sediment)	0.4	0.4	?	6	-		0.4	1	-	1	1	7.6	-	-
Flot / Residue analysed	FR	FR	FR	FR	-	F	F	FR	-	FR	FR	FR	-	-
Cereals / cereal chaff						NIL	NIL					subsamp		
Panicum miliaceum L. (millet palea and lemma)			1	2							1	5		Y
Triticum turgidum/durum (rivet/hard wheat rachis frag.)										cf.1	cf.1	cf.2		
Triticum sp. (free-threshing wheat rachis fragment)										1				
Secale cereale L. (rye rachis fragment)										2				
Avena sp. (oat glume)											cf.1	cf.1		
Cereal grain or large grass caryopsis								1f		1		2		Y
cereal-sized culm node								2		2	1	8		
cereal-sized culm fragment												1		
Small-seeded fruits and pulses (from faeces or cargo)														
Malus sylvestris (L.) Mill. (crab apple pip)														
cf. *Pisum sativum* L. (pea-type hilum)												1		
Vicia faba L. (broad bean, charred cotyledon fragment)									1 char f					
Vitis vinifera L. (grape pip)			36f	1+14f				1+4f		2+3f	2+7f	6+5f		
Ficus carica L. (fig seed)			4	16				18		3	154	69		Y
Rubus sect. *Glandulosus* Wimm. & Grab.(blackberry seed) DHSW														
Punica granatum L. (pomegranate seed)										cf.1f		5+9f		
Larger fruit stones and nut shells (discarded food waste or cargo)														
Prunus domestica ssp. *insititia* (damson type stone)											1			Y
Prunus cf. *mahaleb/lusitanica* (cf. St Lucie Cherry/Portugal Laurel)														Y
Prunus Section *Cerasus* (cherry-type stone)														
Prunus sp. (cherry/damson/plum stone frag.)														Y
Prunus persica (L.) Batsch (peach stone)														
Prunus dulcis (Mill.) D.A.Webb (almond nutshell frag)														
Pinus pinea (stone pine nutshell frag.)				3								4		Y
Juglans regia L. (walnut shell fragment)				3				4		1	4	24	3	Y
Corylus avellana L. (hazelnut shell frag.)		cf.1	1		1			3		1	1	13	1	Y
cf. *Olea europea* (cf. olive stone, smooth)												1+6f	2	
Fibre plants, flavourings and possible medicinal herbs														
Cannabis sativa L. (hemp achene)			1	2				2		cf. 1f	2	2		
Humulus lupulus L. (hop seed) FHS								1			2	11		
Linum usitatissimum L. (cultivated flax seed)												1		
Linum usitatissimum L. (cultivated flax capsule)														
Brassica nigra- type (cf. black mustard seed)				7				1		2				
Brassica/Sinapis sp. (mustards, charlock, turnip etc. seed)												3		Y
Coriandrum sativum L. (coriander mericarp)								1f				1		
Foeniculum vulgare Mill. (fennel mericarp)														
Apium graveolens L. (wild celery mericarp)														
Daucus carota L. (carrot mericarp) Gc														
Dipsacus sp. (teasel fruit)														
Unidentified long-seeded Apiaceae														
Probable Dunnage														
Pteridium aquilinum (L.)Kuhn (bracken pinnule fragment)								1		4		4		Y
Pinus sp(p). pine needle fragment										1		18		
Juniperus oxycedrus/navicularis (detached leaves)				13				43		93	105	650+		
Juniperus oxycedrus/navicularis (stem fragments with leaves)				1				2		1		17+		
Unidentified capsule A- possibly Juniper female cone scales				3				9		1f	1f	25+12f		
cf.*Genista/Cytisus sp.* (cf. broom leaf fragment) Es	1			6						39	5	69		
cf. Genista/Cytisus sp. (cf. broom spine) GE														
Ulex sp. (gorse spine) GEWs				1							1	2		
Crataegus sp. (hawthorn fruit stone) HSW												1		
cf. *Quercus* sp. (cf. immature acorn) HSW												cf.1		Y
cf. *Quercus* sp. (cf. oak leaf frag.) HSW												cf.1		
cf. *Quercus coccifera* (spiny leaf fragment cf.Kermes oak) HSW				2										
Betula pendula Roth (silver birch seed) WaE												Y		
Alnus glutinosa L. (alder seed) WSF				1								2		Y
Salix sp. (willow bud scales) HSWw								11						
Calluna vulgaris (L.) Hull (heather shoot tip) Esp				6				2		17	15	65+		Y
Calluna vulgaris (L.) Hull (heather flower/fruit) Esp				3				3		23		12+		Y
Calluna vulgaris (L.)Hull (detached heather leaves) Esp								3		3				Y
Calluna vulgaris (L.)Hull (heather stem frags with leaves) Esp														
Erica tetralix L. (cross-leaved heath leaf) Ew												13+		Y
E. cinerea L. (bell heather leaf) Ed	1		2	1				12		85	29	319+		
E. arborea/lusitanica/australis- type (long thin heather leaf) E												1+		Y
Erica sp.unknown d) (glaucous wide veined leaf)				1				2			1	8+		
Ericaceae NFI flowers	1			9				7		1	26	255+		
Ericaceae NFI stems				1						2		10+		
Sambucus nigra L. (elder seed) DHSW	1													Y

Table 1: Plant remains from Newport Ship (467)

Frame no.	F6-7	F6-7	F6-7	F6-7	F5-14 SMALL FINDS (ID by A.Hall)	F15-16	F15-16	F15-16	F15-16 SMALL FINDS (ID by A.Hall)	F27-28	F27-28	F27-28	F33-34	F33-34	F33-34	Pump Hole F33-34	Pump Hole F33-34	F29-35 SMALL FINDS (ID by A.Hall)
Context	130	153	152	154	120; 130	130	152	152	130; 152; 254; 1015	152	152	152	130	152	152	130	152	120; 130; 152
Sample no.	160	67	69	68	MSG	89	92	101	MSG	112	114	57	99	61	130	59	60	MSG
Unidentified woody seed B		1																
Unidentified ridged stems C		1		3														
Disturbed/cultivated ground and grassland plants																		
Ranunculus acris/bulbosus/repens (buttercup achene) DG		8				2		1										
Trifolium/Medicago/Lotus sp. (clover-type seed) CDG								1										
cf. *Trifolium*- type (clover-type calyx) CDG								12										
Urtica dioica L. (stinging nettle achene) CDn	1																	
U. urens L. (small nettle achene) CD																		
Raphanus sp. (wild radish? mericarp) CD	1																	
Polygonum aviculare (knotgrass achene) CD		1																
Rumex acetosella L. (sheep's sorrel achene) EoGCas	1	1																
Rumex sp. (dock achene) CDG	1	1		1														
Stellaria media (L.) Vill. (common chickweed seed) Cno				1														
Spergula arvensis L. (corn spurrey seed) Ca																		
Agrostemma githago L. (corn cockle seed) A																		
Silene spp (campion seed) CDG	1	2																
Chenopodium album L. (fat-hen seed) CDn		3	1	1												Y		
Atriplex patula/prostrata (orache seed) CDn		2		cf.2f														
Indeterminate Primulaceae																		
Coronopus squamatus (Forssk.) Asch. (swine-cress half-fruit) D																		
Solanum nigrum L. (black nightshade seed) CD											1							
Plantago major L. (greater plantain seed) Cgo		cf.1		1														
Galeopsis tetrahit L. (common hemp-nettle nutlet) ADWod	1																	
Prunella vulgaris L. (selfheal nutlet) GDWo																		
Verbena officinalis L. (vervian nutlet) Go																		
Carduus/Cirsium sp. (thistle achene) GDY	1																	
Leontodon autumnalis L. (autumn hawkbit achene) G		1																
Sonchus asper (L.)Hill (prickly sow-thistle achene) CDY																		
Anthemis cotula L. (stinking chamomile achene) Adhw													1					
Chrysanthemum segetum L. (corn marigold achene) AD	1																	
Indeterminate Asteraceae																		
Poaceae (indeterminate grass caryopsis) CDG		2	1	1		1												
Plants of marsh, wetlands and water bodies																		
Nymphaea alba L. (white water lily seed) P																		
Ranunculus sceleratus L. (celery-leaved buttercup achene) MP																		
Rorippa nasturtium-aquaticum (L.)Hayek (water cress seed) MP																		
cf. *Suaeda maritima* (L.)Dumort (annual sea blite seed) saltmarsh	3					1										1		
Mentha sp. (mint nutlet) MPGw																		
Menyanthes trifoliata L. (bogbean seed) M																		
Hydrocotyle vulgaris L. (marsh pennywort fruit) M																		
Triglochin maritimum L. (sea arrowgrass seed) coastal																		
Potamogeton sp. (pondweed fruit) MP																		
Typha sp. (bulrush) MP																Y		
Juncus sp. (rush seed) MPw																		
Schoenoplectus lacustris (L.)Palla (common club-rush nutlet) M																		
Eleocharis subg. *Palustres* (spike-rush nutlet) MPw	1																	
Carex sp. (trigonous sedge nutlet) MPw																		
Carex sp. (lenticular sedge nutlet) MPw																		
Cyperaceae NFI (various lenticular sedge nutlets) MPGw		1	1			1												
Phragmites australis (Cav.) Trin.ex Steud. (common reed)																		
moss	+++	+++	++	++		++	+	++		++	++	+	+	+	+	+	++	
wood fragments	+++	++++	++++	+++		++++	+++	+++		+++	+++	++	+++	+++	++	+++	++	
charcoal	+					+	+			+	+++				+	++	+	
coal	+	+				+		+++								++		
insects	+		++			++	+	+			++					+	+	
fly puparia	+++	+	+++	+		+				++	++	+	+++		+	+	+	
feathers																+		
molluscs											++					+		
bone/fish scales	++	++	++	++		++					++					+		
caulking/luting	+++			++		+		+		++		+		+		+		
TOTAL	150	375	116	135		47	1	19		32	39	9	1	37	1	9	31	
fragments per litre	27.3	187.5	290	67.5		?	1.4	126.7		32	19.5	18	1	123.3	2	?	6.2	

Table 1: Plant remains from Newport Ship (467)

Frame no.	F45-46	F45-46	?F45-46	F45-48	F45-46 SMALL FINDS (ID by A.Hall)	F56-57	F56-57	F56-57	F56-57 SMALL FINDS (ID by A.Hall)	F59-60	F59-60	F59-60	F58-61 SMALL FINDS (ID by A.Hall)	Present in Assess Samples
Context	130	152	152	130/152	1006	152	152	152	1007	130	152	171	1087; 1089; 1090	128; 130; 152; 153; 171
Sample no.	107	108	108?	189	MSG	124	138	148	MSG	72	149	177	MSG	-
Unidentified woody seed B												10		
Unidentified ridged stems C				1						8	15	54		
Disturbed/cultivated ground and grassland plants														
Ranunculus acris/bulbosus/repens (buttercup achene) DG												5		Y
Trifolium/Medicago/Lotus sp. (clover-type seed) CDG														
cf. *Trifolium*- type (clover-type calyx) CDG														
Urtica dioica L. (stinging nettle achene) CDn														
U. urens L. (small nettle achene) CD											Y	Y		
Raphanus sp. (wild radish? mericarp) CD														
Polygonum aviculare (knotgrass achene) CD			1					1				2		Y
Rumex acetosella L. (sheep's sorrel achene) EoGCas														
Rumex sp. (dock achene) CDG	1			1				2			1			Y
Stellaria media (L.) Vill. (common chickweed seed) Cno								1						Y
Spergula arvensis L. (corn spurrey seed) Ca														Y
Agrostemma githago L. (corn cockle seed) A														Y
Silene spp (campion seed) CDG														
Chenopodium album L. (fat-hen seed) CDn												1		Y
Atriplex patula/prostrata (orache seed) CDn												5		Y
Indeterminate Primulaceae				1										
Coronopus squamatus (Forssk.) Asch. (swine-cress half-fruit) D		1												
Solanum nigrum L. (black nightshade seed) CD														
Plantago major L. (greater plantain seed) Cgo												Y		Y
Galeopsis tetrahit L. (common hemp-nettle nutlet) ADWod														Y
Prunella vulgaris L. (selfheal nutlet) GDWo								1				3		Y
Verbena officinalis L. (vervian nutlet) Go										1				
Carduus/Cirsium sp. (thistle achene) GDY			1									1		
Leontodon autumnalis L. (autumn hawkbit achene) G										1		Y		Y
Sonchus asper (L.)Hill (prickly sow-thistle achene) CDY											1			Y
Anthemis cotula L. (stinking chamomile achene) Adhw										1		Y		Y
Chrysanthemum segetum L. (corn marigold achene) AD												1		Y
Indeterminate Asteraceae												Y		Y
Poaceae (indeterminate grass caryopsis) CDG								1			1	Y		Y
Plants of marsh, wetlands and water bodies														
Nymphaea alba L. (white water lily seed) P														Y
Ranunculus sceleratus L. (celery-leaved buttercup achene) MP												Y		Y
Rorippa nasturtium-aquaticum (L.)Hayek (water cress seed) MP												Y		Y
cf. *Suaeda maritima* (L.)Dumort (annual sea blite seed) saltmarsh														
Mentha sp. (mint nutlet) MPGw												Y		Y
Menyanthes trifoliata L. (bogbean seed) M														
Hydrocotyle vulgaris L. (marsh pennywort fruit) M														
Triglochin maritimum L. (sea arrowgrass seed) coastal												Y		Y
Potamogeton sp. (pondweed fruit) MP														Y
Typha sp. (bulrush) MP														Y
Juncus sp. (rush seed) MPw												Y		
Schoenoplectus lacustris (L.)Palla (common club-rush nutlet) M								2			1	1		
Eleocharis subg. *Palustres* (spike-rush nutlet) MPw														
Carex sp. (trigonous sedge nutlet) MPw			1											Y
Carex sp. (lenticular sedge nutlet) MPw														Y
Cyperaceae NFI (various lenticular sedge nutlets) MPGw				1								2		
Phragmites australis (Cav.) Trin.ex Steud. (common reed)												Y		Y
moss	+		+	++				+++		+++	+++	++++		
wood fragments	++	+++	+++	+++		+++	++	++++		++++	+++	++++		
charcoal			+								+	+		
coal				+				++		+	+			
insects	+	+	+	+						+		++		
fly puparia		++	++	++		+++	++	+++		+++	++	++++		
feathers				+				++		++	+++	+++		
molluscs										+	+	++		
bone/fish scales			++	+				++		++	+++	+++		
caulking/luting	++			+++						+++	+	++		
TOTAL	5	2	49	99		0	0	141		303	380	1815		
fragments per litre	12.5	5	?	16.5				141		303	380	238.8		

TABLE 2: ID AND DISTRIBUTION OF FOOD REMAINS PER LITRE OF SEDIMENT FOUND ON THE NEWPORT MEDIEVAL SHIP.

Frame no.	Pump Hole	F6-7	F6-7	F6-7	F6-7	F15-16	F15-16	F27-28	F27-28	F27-28	F33-34	F33-34	F33-34	F45-46	F45-46	F45-48	F59-60	F56-57	F59-60	F59-60
Context	152	130	153	152	154	152	152	152	152	152	130	152	152	130	152	130/152	130	152	152	171
Sample no.	60	160	67	69	68	92	101	112	114	57	99	61	130	107	108	189	72	148	149	177
Sample volume (litres sediment)	5	5.5	2	0.4	2	0.7	0.15	1	2	0.5	1	0.3	0.5	0.4	0.4	6	1	1	1	7.6
Cereals, pulses, fruits and nuts																				sub-sample
TOTAL CEREAL CHAFF (excluding millet)																	7	3	3	2.6
cf. Pisum sativum (pea-type hilum plus testa fragment, dark brown)			1	2.5																0.1
Prunus spp. (all plums and cherries)					0.5														1	
Prunus persica (L.) Batsch (peach stone)		SF																		
cf. Olea (cf. olive stone fragments)																				0.9
Malus sylvestris (apple pip)		0.4	2.5	7.5																
Rubus sect. *Glandulosus* (blackberry seed)		0.2	0.5				6.7													
Punica granatum (pomegranate seed)		0.4	9.5	5					1								1			1.8
Prunus dulcis (Mill.)D.A.Webb (almond nutshell frag)		0.2																		
Juglans regia L. (walnut shell fragment)	0.2	0.9	26.5	5	6.5			2	1							0.5	1	4	4	3.2
Corylus avellana L. (hazelnut shell frag.)	0.2	2.9	29	10	2			12							2.5		1	3	1	1.7
Pinus pinea (stone pine nutshell frag.)																0.5				0.5
Ficus carica L. (fig seed)	0.6	6.9	23	25	3.5			16	11.5	2						2.7	3	18	154	9.1
Vitis vinifera L. (grape pip)		4.9	49	50	7.5			2								2.5	5	5	9	1.4
Panicum miliaceum (millet grain)			5	7.5								3.3	2			0.3			1	0.7
TOTAL FOOD REMAINS PER LITRE	1	16.8	146	112.5	23	0	6,7	32	13.5	2	0	3.3	2	0	2.5	6.5	25	36	176	23.9

FOOD REMAINS PER LITRE OF SEDIMENT OMITTING SAMPLES WITH NO SAMPLE VOLUME DATA [SF = small find]

Concentrations =>5 items per litre marked pink

TABLE 3: Imported Foods Found on the Newport Medieval Ship

Imported foods	Common name	Newport Ship record (25 samples in total)	British Medieval archaeobotanical records (from York Archaeobotanical Database)	Sites	Medieval records from Western Europe (from Hopf 1991 and Kroll database)	Listed in C13th to C16th British Customs Records (Gras 1918)
Panicum miliaceum L.	common or broomcorn millet florets	24 florets in 8 samples	2 florets from 1 site	Norwich Waterfront	North Portugal ; France; Germany; Italy; Netherlands	no
Punica granatum L.	pomegranate seeds	8 + 33 frags in 7 samples	0		Portugal; Netherlands	C15th & C16th
Prunus persica (L.) Batsch	peach stone fragments	2 halves in smallfinds	2 frags from 2 sites	Bristol Dundas wharf; Beverley Eastgate	Portugal ; Netherlands	no
Prunus dulcis (Mill.) D.A.Webb	almond nutshell frag	1 basal fragment	5 frags from 4 sites	Bristol Dundas wharf; Plymouth sewer; Oxford Dominican Priory; Shrewsbury Abbey	Spain (charcoal only)	C14th
Juglans regia L.	walnut shell fragments	135 fragments in 14 samples plus smallfinds	several urban sites but rarely more than a few fragments	variety of waterlogged and occasionally charred deposits	widespread	C16th
Ficus carica L.	fig seeds	423 seeds in 16 samples	relatively common on medieval urban sites	mainly waterlogged and mineralised, especially latrine deposits	widespread	C14th to C16th
Vitis vinifera L.	grape pips	22 whole and 226 frags in 13 samples	relatively common on medieval urban sites	mainly waterlogged and mineralised, especially latrine deposits	widespread	C14th to C16th

Comments on identifications of plant materials associated with the Newport Ship: archive report

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A wide variety of botanical specimens was examined by the author, primarily to provide an identification. The samples ranged from artefacts (mainly cordage and basketry) to isolated 'spot finds' (mainly nutshell and fruitstones, and some small plant fragments associated with (but not always necessarily part of) artefacts of various kinds. The following comments are intended to amplify the identifications in order to draw attention to the interpretative significance of selected remains. They are grouped by artefact or plant material type.

Cordage

The unconserved, wet cordage samples fell into two types. On the one hand there were some (usually quite large) fragments of rope which were firm to the touch, retaining their three-dimensional shape well (though at least three of the samples examined were part of the same rope, A). These were invariably of one or more kinds of grass, clearly identified as such by the epidermal cell patterns visible in some fragments with characteristic long and short cells, the former with sinuous margins. Sometimes the architecture of the grass stem or leaf was visible with strong parallel ribs formed by the vascular strands visible through the tissues. Occasionally grass was identified amongst some samples of cordage which had become very decayed (e.g. MSG855). The identity of this material remains uncertain. It has not been possible to match it with esparto (*Stipa tenacissima*), but deeper investigation of the literature reveals that a second grass, *Lygeum spartum*, also (confusingly) called esparto, or sometimes false esparto (as well as alvarde and albardine), has also been used for cordage in western Europe in the past. Modern reference material of this grass is being sought.

The other type of cordage tended to consist of much softer, usually rather 'collapsed' fragments. The material here consisted of rather decayed plant stems, often breaking into characteristic short, square-ended fragments a few millimetres long. Diagnostic epidermis and clear fibre bundles were usually lacking but the presence of reddish to orange coloured linear strands interpreted as resin ducts is taken to indicate that these are partly-processed stems of hemp (*Cannabis sativa* L.). In conventional stem-bast fibre production the mature stems of hemp (or flax) are steeped in water (or left in the open for dew to form on them) for some days till the softer tissues decay to the point where the bundles of fibres within the outer parts of the stems are released after the stems are dried and beaten. The latter stages of fibre extraction do not seem to have occurred in the case of the hemp rope fragments from this ship, the ropes being made from stems which had received little treatment other than the initial soaking ('retting') and the pulling of the outer layers from the woody 'core' so that the fibres were still accompanied by the softer tissues which surrounded them.

In one case (MSG1297), an area of epidermis was preserved and this bore the characteristic pattern of cells associated with one of the glandular hairs which are present across the surface of the aerial parts of the hemp plant (and which furnish the narcotic resin).

In another case, some largely intact hemp stem fragments were noted: MSG828 comprised more or less whole peeled stem strips to about 120 x 5 mm—the kind of raw material used to make all these other hemp ropes (and also noted by the author from cordage samples from two Norwegian boats of the early and late 16th centuries, respectively).

Similar material, identified by the resin ducts, was noted amongst the samples of possible thread taken during conservation from stitch holes from leather artefacts, e.g. MSG083, as well as from some samples designated as 'unidentified organic' where the small patches of decayed hemp may simply have been fragments of cordage no longer bearing any characteristics enabling them to be classified as such.

Basketry

All of the samples designated as basketry were formed of young willow (*Salix*) twigs up to about 4-5 mm in maximum dimension (and likely to be from stems 1-2 years old).

Mosses from shoes and boots

Mosses associated with various leather shoes were examined. Material from MSG092 weas mainly *Dicranum* sp(p)., *Hylocomium splendens*, and *Neckera complanata*, with some *Pleurozium schreberi*, though none of the shoots was larger than 10 mm. They are most likely to have been collected from an area of heathland or moorland, the last species being distinctly calcifuges (lime-avoiding).

The moss from MSG557 (separately numbered as MSG1274) consisted of several 10-20 mm long shoots, and included *Pseudoscleropodium purum*, *Thuidium tamariscinum* and *Hylocomium splendens*, which as a group also seem likely to have originated in heathland, or grassland on acid soils.

From MSG1279 the moss identified comprised fragments of *Thuidium* cf. *tamariscinum*, whilst that from MSG559, the toe of fragment 1, MSG 1280, yielded shoots of *Hylocomium* sp. (probably *H. splendens*) and perhaps another hypnoid species. The moss from toe stuffing MSG1246 from MSG1272 was too decayed to identify beyond 'moss'; there were no complete leaves.

Other mosses

The largest collection was MSG829, a concentration of mosses which seemed to be primarily *Hylocomium splendens* and *Thuidium tamariscinum*, of which there were several cunic centimeters of material.

Fruits and nuts

The great majority of the specimens recorded during excavation and conservation as nutshell were hazel (*Corylus avellana* L.), present in 32 separately numbered samples as whole nuts or fragments of various sizes. A good proportion of the shell fragments proved to be walnut (*Juglans regia* L.), present in 18 samples, amongst which there were several 'half-nutshells' in very good condition, retaining their characteristic reticulate surface ornamentation, but, more unusually, some of the softer tissue forming the internal protection for the edible nut.

Amongst the nutshells were a very few other taxa: a single fruitstone of sloe/blackthorn (*Prunus spinosa* L.), a single cherry (*Prunus* Section *Cerasus*) stone fragment, one small cultivated plum (*P. domestica* ssp.*insititia* (L.) C. K. Schneider, ovoid, approx. 18 x 11 x 6 mm), two peach (*P. persica*) stones or half-stones, a single half-achene of hemp and three grape pips (*Vitis vinifera* L.). (Fruits and seeds of the size of grape pips would, in any case, be expected to be recovered from sieving of sediment samples, so these can hardly be seen as representative.)

Two groups of fruitstones currently elude identification:

(i) four stones from MSG1085, one holed by ?rodent, with kernel testa showing; they have an unusual 'drop' shape, widest towards the bottom, with a 'cherry' like smooth surface and suture; they are about 12x 7 x 5 mm and the nearest match so far is *Prunus mahaleb* (St Lucie cherry), whose nearest natural occurrence is C and S Europe

(ii) two stones from MSG1088: these are superficially similar to *Cornus mas* (cornelian cherry, another C European species) in size and shape, but lack any of the surface striations and grooves of that species and currently defy identification.

Other plant materials

Bracken (*Pteridium aquilinum* (L.) Kuhn)

A few samples proved to contain remains of the large common fern bracken:

MSG1248 (from a stitching hole) a ?bracken rachis fragment where the pinnule tissue had almost all decayed, leaving the midrib; it was clearly not used for stitching!

MSG819: impression of part of a frond to a max of about 160 mm with a few fragments of organic material preserved in places, where inrolled margins and sporangia within the margins, could easily be observed.

MSG1252 (sample 1/2 examined): plant stem to 30mm by 5 mm, lacking stomata, and regular, narrow, rather smooth-walled linear-rectangular cells characteristic of bracken stalk.

Heather (*Calluna vulgaris* (L.) Hull)

A single example of heather was recorded—a long branching stem to 270mm (MSG1309). It was of the size which suggests it might have been used in a heather broom or besom.

Newport Ship: plant identifications by Allan R. Hall

(sample number will usually be MSG number, but context is not always known

- for which 888, 9999, have been used)

Context	Alpnum SN	Taxon		
109	75	Cannabis sativa (st fgts)		
120	1002	Corylus avellana		
120	1004	Corylus avellana		
120	1006	wood fgts		
120	1006	Corylus avellana		
120	1007	Cannabis sativa		
120	1008	Corylus avellana		
120	1009	Prunus persica		
120	1010	Corylus avellana		
120	1012	Corylus avellana		
120	1013	Corylus avellana		
120	1014	Prunus Section Cerasus		
120	1014	Corylus avellana		
120	1015	Corylus avellana		
120	1017	Corylus avellana		
120	1018	Juglans regia		
120	1019	Juglans regia		
120	1022	Corylus avellana		
120	29	Corylus avellana		
120	565	Alnus (wood)		
120	565	Salix sp(p). (tw fgts)		
128	1284	woody root fgts		
128	1286	cf. Alnus glutinosa		
128	20	Prunus spinosa		
128	62	Cannabis sativa (st fgts)		
130	1016	Corylus avellana		
130	1021	Corylus avellana		
130	1085	Corylus avellana		
130	1085	Prunus sp(p).		
130	1085	Juglans regia		
130	1282	cf. Salix sp(p). (b)		
130	21	Prunus persica		
130	22	Juglans regia		
130	23	Juglans regia		
130	24	Corylus avellana		
130	26	Corylus avellana		
130	26	wood chips		
130	26	Juglans regia		
130	263	Prunus domestica ssp. insititia		
130	264	Corylus avellana		
130	267	cf. Crataegus monogyna		
130	27	Juglans regia		
130	28	marine mollusc shell fgts		
130	28	?bark fgts		
130	28	Coniferae (wood chips)		
130	28	Juglans regia		
130	28	Corylus avellana		
130	30	Juglans regia		

Context	Alpnum SN	Taxon		
130	32	Juglans regia		
130	32	Corylus avellana		
130	33	Corylus avellana		
130	36	Juglans regia		
130	564	twig fgts		
130	70	Salix sp(p). (tw fgts)		
130	834	Cannabis sativa (st fgts)		
130	89	Salix sp(p). (tw fgts)		
133	828	Cannabis sativa (st fgts)		
133	833	Cannabis sativa (st fgts)		
133	835	Cannabis sativa (st fgts)		
146	857	wood fgts		
149	59	Cannabis sativa (st fgts)		
149	61	Cannabis sativa (st fgts)		
152	1003	Corylus avellana		
152	1020	cf. Vicia faba (ch cot)		
152	1023	Corylus avellana		
152	25	Corylus avellana		
152	254	Juglans regia		
152	31	Corylus avellana		
171	1011	Juglans regia		
171	1086	Corylus avellana		
171	1086	Juglans regia		
171	1087	Juglans regia		
171	1088	indet. seed(s)		
171	1089	Juglans regia		
171	1089	Corylus avellana		
171	1090	Juglans regia		
172	807	Gramineae (culm fgts)		
172	855	Gramineae (culm fgts)		
467	79	Cannabis sativa (st fgts)		
467	809	Cannabis sativa (st fgts)		
467	85	indet. plant structure		
467	858	Castanea/Quercus (wood)		
467	858	Salix sp(p). (tw fgts)		
467	86	plant fibres		
467	87	cf. Cannabis sativa (st fgts)		
467	92	Pleurozium schreberi		
467	92	Potentilla cf. erecta		
467	92	Prunella vulgaris		
467	92	Neckera complanata		
467	92	Dicranum sp(p).		
467	92	Hylocomium splendens		
888	1083	worked wood fgts		
888	112	prickles		
888	1183	Vitis vinifera		
888	1184	Corylus avellana		
888	1185	Corylus avellana		
888	1186	Corylus avellana		
888	1187	Juglans regia		
888	1219	?wood chips		

Context	Alpnum SN	Taxon		
888	1222	root/rhizome fgts		
888	1222	colonial hydroid		
888	1223	stem fgts		
888	1223	colonial hydroid		
888	1225	root/rhizome fgts		
888	1229	stem fgts		
888	1231	wood fgts		
888	1231	herbaceous detritus		
888	1235	cf. Cannabis sativa (st fgts)		
888	1243	indet. plant structure		
888	1248	cf. Pteridium aquilinum (pinn fgts)		
888	1248	cf. Linum usitatissimum (stem fgts)		
888	1250	stem fgts		
888	1252	Pteridium aquilinum (stalk fgts)		
888	1274	Thuidium tamariscinum		
888	1274	Hylocomium splendens		
888	1274	Pseudoscleropodium purum		
888	1275	animal hairs		
888	1275	moss (lfless stems)		
888	1276	stem fgts		
888	1277	stem fgts		
888	1279	Thuidium cf. tamariscinum		
888	1280	moss		
888	1280	Hylocomium cf. splendens		
888	1281	moss		
888	1293	Gramineae (culm fgts)		
888	1294	Gramineae (culm fgts)		
888	1295	Gramineae (culm fgts)		
888	1297	Cannabis sativa (st fgts)		
888	1299	Gramineae (culm fgts)		
888	13	cf. Fagus sylvatica (lf/lvs)		
888	1301	Cannabis sativa (st fgts)		
888	1304	Cannabis sativa (st fgts)		
888	1310	cf. Cannabis sativa (st fgts)		
888	1310	Thuidium cf. tamariscinum		
888	1311	cf. Cannabis sativa (st fgts)		
888	14	bark fgts		
888	14	Neckera crispa		
888	14	cf. Pteridium aquilinum (stalk fgts)		
888	15	concretions		
888	1619	animal hairs		
888	1619	Gramineae (culm fgts)		
888	1619	stem fgts		
888	2504	animal hairs		
888	2504	cf. Cannabis sativa (st fgts)		
888	2504	stem fgts		
888	252	Pinus sylvestris (cone fgts)		
888	34	fly puparia		
888	51	herbaceous detritus		
888	52	cf. Fagus sylvatica (lf/lvs)		
888	526	wood chips		

Context	Alpnum SN	Taxon		
888	526	Salix sp(p). (wood)		
888	63	animal hairs		
888	63	stem fgts		
888	64	Cannabis sativa (st fgts)		
888	80	stem fgts		
888	808	Neckera complanata		
888	815	Gramineae/Cerealia (culm fgts)		
888	819	Pteridium aquilinum (pinn fgts)		
888	820	stem fgts		
888	820	Urtica dioica		
888	828	Cannabis sativa (st fgts)		
888	829	Thuidium tamariscinum		
888	829	Hylocomium splendens		
888	83	cf. Cannabis sativa (st fgts)		
888	84	animal hairs		
888	847	?bark fgts		
888	874	Salix sp(p). (tw fgts)		
888	88	Cannabis sativa (st fgts)		
888	90	animal hairs		
888	90	Cannabis sativa (st fgts)		
888	94	herbaceous detritus		
888	97	moss		
888	1309	Calluna vulgaris (tw fgts)		
999	1263	Salix sp(p). (tw fgts)		
999	1267	Salix sp(p). (tw fgts)		
999	1308	Salix sp(p). (tw fgts)		
999	547	bark fgts		
999	547	cf. Castanea sativa (wood)		
999	547	Salix sp(p). (tw fgts)		
1001	1231	fly puparia		
1001	837	Corylus avellana		
1002	1247	barnacle shell fgts		
1013	1015	Corylus avellana		
1027	849	Cannabis sativa (st fgts)		
9999	1272	Cirriphyllum piliferum		
9999	1272	cf. Eurhynchium sp(p).		
9999	1272	Rhytidiadelphus cf. triquetrus		
9999	1293/4	Gramineae (culm fgts)		
9999	1298	Gramineae (culm fgts)		
9999	1299	Gramineae (culm fgts)		
9999	811	Cannabis sativa (st fgts)		
9999	842	Gramineae (culm fgts)		
9999	845	Gramineae (culm fgts)		
9999	846	Gramineae (culm fgts)		
9999	848	Gramineae (culm fgts)		
9999	850	Gramineae (culm fgts)		
9999	851/856	Gramineae (culm fgts)		
9999	853	Gramineae (culm fgts)		