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The *London* protected wreck, The Nore, off Southend-on-Sea, Thames Estuary, Essex: Wood identifications and recording of wooden remains recovered between 2014 and 2016

Zoë Hazell and Emma Aitken

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SUMMARY
Nearly 300 wood identifications were carried out on wooden artefacts recovered from the wreck of the *London* during phases of surface recovery and archaeological excavation between 2014 and 2016. A total of 16 wood (/wood group) types were identified, of which 14 were hardwoods and two were softwoods. Patterns of wood selection preferences for some of the artefact types have been recognised, in particular for the handspikes and pulley blocks. Wood choices likely reflect characteristics of the wood types themselves (for example, ease of working, comfort in use) as well as their availability.

ACKNOWLEDGEMENTS
Many thanks to A. Middleton for her assistance with – and valuable discussions about – the artefacts, and to G. Campbell for her help confirming some of the identifications. Thanks to Historic England for the funding and to Cotswold Archaeology for managing the project. Thanks also to Cotswold Archaeology for allowing E. Aitken the time spent as a work-based training placement with Z. Hazell at Fort Cumberland.

ARCHIVE LOCATION
The archive will be deposited with Southend Museum Services. Please note that at the time of writing (Autumn 2018), the assemblage was still being worked on and held at Historic England, Fort Cumberland, Portsmouth and – in the case of the gun carriage – at York Archaeological Trust, York; so has not yet been deposited.

DATE OF RESEARCH
2016 to 2018

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1 INTRODUCTION

The wreck of the *London* is fully submerged in the greater Thames Estuary, off Southend-on-Sea, Essex. It sank in AD1665 following an explosion, and was designated in 2008 under the Protection of Wrecks Act (site ref. 1000088). It is at on-going risk of loss through erosion, and so to mitigate for this, a programme of surface recovery (by the licensing team) and limited excavations (led by Cotswold Archaeology and funded by Historic England) took place from 2014–2016.

A total of around 700 small finds (SFs) have been recovered so far, of which almost half are made of wood. These were first examined and described by Allen (2016a and b) at York Archaeological Trust. Since then, samples have been stored at Fort Cumberland, Portsmouth under the care of A. Middleton (Archaeological Conservator, Historic England) and Eric Nordgren (former Archaeological Conservation Assistant, Historic England).

2 SAMPLE SELECTION

Work on the material took place in phases, starting with those remains/artefacts identified as a priority for analysis. The decision was made for some particularly good examples not to be sub-sampled (i.e. complete, undamaged artefacts), including handspikes: SF3333 and SF3559, and two of the four concreted handspikes comprising SF3558. In addition, SF3469, SF3472, SF3526, SF3527, SF3581 and SF3601 (powder bottles), SF3730 (tuning peg), and SF3342 (pipe stopper) were examined under low power magnification only because they were such good and/or rare examples.

For artefacts that consisted of multiple components – the single and double blocks (with the cheek, sheave(s) and peg) and any paired bodies and lids of powder bottles – the wood of each separate component was examined.

3 SUB-SAMPLING AND IDENTIFICATION METHODS

3.1 Sub-sampling methods

Wood identifications of the artefacts were carried out at Fort Cumberland, Portsmouth. All artefacts were examined initially under low power magnification (x6.3 to x40) using a Leica MS5 microscope. Where possible, thin sections were then taken by hand, using a double-edged razor blade. Care was taken to remove the minimal sample necessary for identification, and as far as possible, samples were taken from discreet and/or already-damaged areas of the artefacts. Ideally, thin sections were taken from the three planes of wood required for secure identifications; the transverse section (TS), radial section

(RS) and the tangential longitudinal section (TLS). Sometimes this was not possible, particularly for the pegs in the pulley blocks. Where no areas conducive to thin section sampling were present, identifications were made from low magnification observations. The thin sections were examined under high power magnification (x100 to x400) using a Leica DM2500.

3.2 Taxonomic identifications

The wood identifications were made using a combination of the texts and keys by Schweingruber (1982) and Gale and Cutler (2000) and the reference material from Historic England's *Wood and Charcoal Reference Collection* (held at Fort Cumberland, Portsmouth, England). As far as possible, identifications were made to genus level, as is standard practice for identifications made on the basis of microscopic anatomical features. Exceptions to this are as follows:

- The wood taxonomy type *Populus/Salix* (poplar/willow) was used as it is not possible to reliably distinguish between these two genera on the basis of their microscopic wood anatomical features.
- The Maloideae (Pomoideae) group consists of the Pomaceous fruits, and includes: *Crataegus* (hawthorn), *Cotoneaster* (Cotoneasters), *Pyrus* (pears), *Malus* (apples) and *Sorbus* (whitebeams); these cannot be readily distinguished on the basis of their wood anatomy.
- Betulaceae: this refers to the Birch family, which includes *Betula* (birch), *Alnus* (alder), *Corylus* (hazel) and *Carpinus* (hornbeam). Some could not be identified to genus level, but depending on the selection of taxonomic features visible, it was possible to narrow down some identifications to:
  a) Betulaceae Group 1 (*Alnus*/*Betula*/*Carpinus*/*Corylus*) where no aggregate rays nor perforation plates were seen/present/preserved,
  b) Betulaceae Group 2 (*Alnus*, *Corylus* or *Carpinus*, but not *Betula*) where aggregate rays were seen/present, but no perforation plates were seen
  c) *Alnus* or *Betula*; this applied to a single artefact, where only limited wood anatomical features were visible (including a diffuse porous structure, and scalariform perforation plates with multiple, narrowly-spaced bars bars) but it was otherwise too poorly preserved, in particular to be able to count the cell width of the rays.
- Where some of the vessel pattern was visible in the TS, but it was not possible to identify even to family level (for example, if destructive sampling was not appropriate), this is noted; in particular, 'diffuse porous' or 'ring porous' hardwood.

Where a wood identification could not be made with absolute certainty, but it was considered most likely (for example, if most but not all of the diagnostic features could be seen), the result is reported as: cf [taxon].

3.3 Floristic interpretations

Given that the artefacts were recovered from a shipwreck, no inferences about probable species (based on those known to be native to the British Isles) have been made. In terms of the *Castanea* sp. there are no chestnuts native to the British Isles, and the only species native to Europe is *C. sativa* (sweet chestnut). *Juglans* sp. (walnut) is also not native to the British Isles.

4 ADDITIONAL RECORDING OF THE POWDER BOTTLES

4.1 Condition assessment of the powder bottles

A condition assessment was carried out on all the powder bottle[1] remains by A. Middleton and Z. Hazell (see results in Table A1). The categories used are defined in Table 1. The three spouts were classified as Category 2 in order to ensure that they were not omitted from later analyses; despite being only a small part of an artefact, they were a relatively rare find. Where broken-off necks were present within a lid, these have been (re)categorised as Category 3 (i.e. a fragment of a body), having initially been categorised based on the lid's condition (i.e. Category 2). Examples of remains from each of the condition categories are shown in Figure A1 (a to f).

Table 1. Category name and definitions used for the condition assessment of the powder bottles.

Category name	**Definition**
Category 1	Complete powder bottle (body and lid)
Category 2 - body	(Near) complete
Category 2 - lid	(Near) complete
Category 2 - spout	(Near) complete
Category 3 - body	Fragment
Category 3 - lid	Fragment

4.2 Volumes of the powder bottles

Prior to any conservation, the volume (internal capacity) of the powder bottle bodies was also measured where possible (by E. Aitken)[2]. Only Category 1 and 2 bodies were suitable for this. Broken and incomplete bodies were recorded as such, and for those, volumes are therefore minimum values. In total, volumes of 72 powder bottles were recorded.

[1] Also sometimes known as cartridge or 'Apostle' bottles; used to store the gunpowder for muskets.
[2] The volume of SF3601 was recorded post-conservation (by A. Middleton) as it had not been available at the initial time of recording; it was undergoing analysis at the University of Southampton.

The carrying capacity was measured by filling the powder bottle body with water, and then measuring the volume of water held, by transferring it into a measuring cylinder. Volumes were recorded to the nearest 1 ml.

5 RESULTS

5.1 Wood identification results

A total of 307 wood identifications were carried out on the material[3], of which:

- 7 were duplicates between analysts or sampling phases (either inadvertently, or revising the decision to then destructively sample something that had previously been examined non-destructively);
- 25 identifications – or attempts at identifications – were carried out macroscopically as they could not be destructively sampled. Although sometimes it was not possible to produce a wood identification in this way, it does not preclude successful identifications in the future using alternative methods (e.g. micro-CT scanning);
- the remaining (282) identifications were done using destructive sampling i.e. by removing thin-sections.

In total, 14 hardwood (deciduous) and two softwood (coniferous) taxa/taxonomic groups were recorded (see Table 2).

[3] This number does not equate to SF numbers, for reasons explained below.

*Table 2. A list of the wood types identified. Details follow Stace (2010). * = genera not native to the British Isles.*

	Family	**Genus**	**Common name**
Angiosperms (hardwoods)	Aquifoliaceae	*Ilex* sp.	holly
	Betulaceae	*Alnus* sp.	alder
		Betula sp.	birch
		Carpinus sp.	hornbeam
		Corylus sp.	hazel
	Fagaceae	*Castanea* sp.*	sweet chestnut
		Fagus sp.	beech
		Quercus sp.	oak
	Juglandaceae	*Juglans* sp.*	walnut
	Oleaceae	*Fraxinus* sp.	ash
	Rosaceae	Maloideae/Pomoideae	Pomaceous fruits (incl. hawthorn, apple, pear, whitebeam)
	Salicaceae	*Populus/Salix* spp.	poplar/willow
	Sapindaceae	*Acer* sp.	maple
	Ulmaceae	*Ulmus* sp.	elm
Gymnosperms (softwoods)	Pinaceae	*Pinus* sp.	pine
	Taxaceae	*Taxus* sp.	yew

A summary of the results are presented in Table 3, where they are grouped into the following four artefact categories: Gunners' equipment, Small arms, Rigging, and Other. Details of all the characteristics recorded are presented in the Appendix (Table A2).

The detailed results are shown as graphs in Figures 1, 2, 3, 4 and 6: Gunners' equipment (Figure 1), Small arms (Figure 2 and 3), Rigging (Figure 4), and Other (Figure 6). However, it should be noted that the number of 'small find' records does not necessarily represent the number of artefacts [i.e. a 'minimum number of individuals']. Usually, there was one wood identification result for each allocated small find (number), however:

- some artefacts had multiple component parts, yet a single SF number – for example pulley blocks (each with the cheek, sheave(s) and peg);
- SF3655 was a group of multiple lids together with a flask spout;
- occasionally, when SFs that consisted of multiple fragments were examined closely, it became clear that they were not the same woods, and therefore not from the same individual artefact or component. In such cases, it was necessary to carry out multiple identifications from a single SF number. This was the case for some of the powder bottles, where fragments were grouped together;
- some separate small find numbers could be refitted;
- not all SF numbers represented complete artefacts, meaning that there is likely an over representation where partial remains could not be refitted. This is especially in the case of the powder bottles and the handspikes.

*Table 3. Summary of the wood identifications. The indeterminate results for artefacts that were not destructively sampled, are excluded. Artefacts have been grouped into the following four categories: Gunners' equipment, Small arms, Rigging, and Other. [a] = includes both secure and 'cf' identifications, and excludes any duplications in determining the wood type that occurred during the multiple phases of analysis. [b] = minimum number of wood types (taking into consideration the possibilities in the grouped Betulaceae). * = identification has since been refined by micro-CT scanning. The total number of identifications for the powder bottles includes all the identifications (i.e. condition categories 1, 2 and 3).*

Artefact type	**Wood types present**																						
		Betulaceae																					
	cf / *Acer*	cf / Betulaceae (undiff.) Group 1	Betulaceae (not *Betula*) Group 2	Betulaceae (*Alnus*/*Betula*)	cf / *Alnus*	cf / *Betula*	cf / *Carpinus*	cf / *Corylus*	cf / *Castanea*	cf / *Fagus*	cf / *Fraxinus*	cf / *Ilex*	cf / *Juglans*	cf / Maloideae	cf / *Pinus sylvestris* group	cf / *Populus*/*Salix*	cf / *Quercus*	cf / *Taxus*	cf / *Ulmus*	Ring porous wood type	Diffuse porous wood type	Total number of wood types	Total number of identifications [a]
Gunners' equipment																							
Flexible rammer					2											1						2	3
Gun carriage truck																			1			1	1
Handspike (incl handspike part)						4				1	38											3	43
Linstock				1	1	14			2		9					1	1					6 [b]	29
Ram rod shaft											1											1	1
Total																							77

Artefact type	**Wood types present**																						
		Betulaceae																					
	cf / *Acer*	cf / Betulaceae (undiff.) Group 1	Betulaceae (not *Betula*) Group 2	Betulaceae (*Alnus/Betula*)	cf / *Alnus*	cf / *Betula*	cf / *Carpinus*	cf / *Corylus*	cf / *Castanea*	cf / *Fagus*	cf / *Fraxinus*	cf / *Ilex*	cf / *Juglans*	cf / Maloideae	cf / *Pinus sylvestris* group	cf / *Populus/Salix*	cf / *Quercus*	cf / *Taxus*	cf / *Ulmus*	Ring porous wood type	Diffuse porous wood type	Total number of wood types	Total number of identifications [a]
Small arms																							
Powder bottle body	6	1	2		1	4	16			26	39		1	1		14					2	9 [b]	113
Powder bottle lid	2		1		2	3	9			13	17									1	1	8 [b]	49
'Flask' stopper/spout											3											1	3
Pistol grip handle													1									1	1
Total																							166
Rigging																							
Pulley double block: cheek																			2			1	2
Pulley double block: sheave											2								2			2	4
Pulley double block: peg												1		1								2	2
Pulley single block: cheek																			3			1	3

Artefact type	**Wood types present**																						
		Betulaceae																					
	cf / *Acer*	cf / Betulaceae (undiff.) Group 1	Betulaceae (not *Betula*) Group 2	Betulaceae (*Alnus/Betula*)	cf / *Alnus*	cf / *Betula*	cf / *Carpinus*	cf / *Corylus*	cf / *Castanea*	cf / *Fagus*	cf / *Fraxinus*	cf / *Ilex*	cf / *Juglans*	cf / Maloideae	cf / *Pinus sylvestris* group	cf / *Populus/Salix*	cf / *Quercus*	cf / *Taxus*	cf / *Ulmus*	Ring porous wood type	Diffuse porous wood type	Total number of wood types	Total number of identifications [a]
Pulley single block: sheave																			3			1	3
Pulley single block: peg										1		1									1	3	3
Total																							17
Other																							
'Fire log'						1												1				2	2
Bar											1											1	1
Branch wood					1																	1	1
Bung											1											1	1
Cask: cant stave																	1					1	1
Cask: hoop								1														1	1
Cask: stave																	7					1	7
Hammer handle/shaft		1																				1	1

Artefact type	**Wood types present**																						
		Betulaceae																					
	cf / *Acer*	cf / Betulaceae (undiff.) Group 1	Betulaceae (not *Betula*) Group 2	Betulaceae (*Alnus/Betula*)	cf / *Alnus*	cf / *Betula*	cf / *Carpinus*	cf / *Corylus*	cf / *Castanea*	cf / *Fagus*	cf / *Fraxinus*	cf / *Ilex*	cf / *Juglans*	cf / Maloideae	cf / *Pinus sylvestris* group	cf / *Populus/Salix*	cf / *Quercus*	cf / *Taxus*	cf / *Ulmus*	Ring porous wood type	Diffuse porous wood type	Total number of wood types	Total number of identifications [a]
Handle											2											1	2
Moulded strip															1							1	1
Pipe stopper		1*																				1	1
Plank																	1		1			2	2
Plank - ?box edge													1									1	1
Shaft (incl shaft part)						1				1	1											3	3
Shaft/handle											1											1	1
Spade handle										1												1	1
Timber with notch															1							1	1
Total																							28
Grand total																							**288**

In the following text, where multiple identifications were made for an artefact, and where both secure and insecure (i.e. cf) identifications were made within an artefact type these are discussed as "(cf) [taxon]". Where either secure or insecure identifications were made, but not both, these are reported as "[taxon]" or "cf [taxon]", respectively.

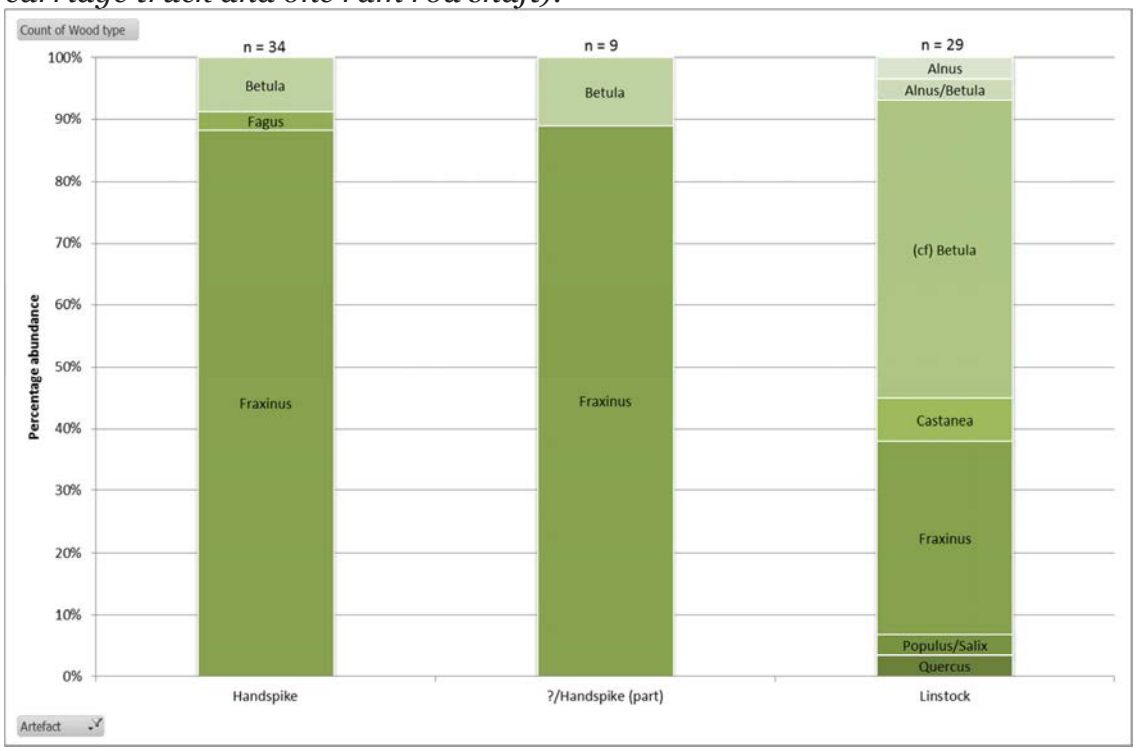
Note that many of the interpretations of the finds were assigned during the excavation; some may subsequently be revised during the course of the project.

5.1.1 Gunners' equipment

Most of the remains examined within this category were from handspikes and linstocks, although three flexible rammers (2 *Alnus*, 1 *Populus/Salix*), a ram rod shaft (1 *Fraxinus*) and one of the gun carriage trucks (wheels) (1 *Ulmus*) were also included.

Figure 1 shows the wood types identified from the gunners' equipment. The **handspikes** were made mostly from *Fraxinus* but with a few from *Betula* and a single example from *Fagus*. A range of wood types was used for the **linstocks** – mostly (cf) *Betula* and *Fraxinus*, but with single occurrences each of *Populus/Salix*, *Alnus*, *Quercus* and *Alnus/Betula*. Two were made of *Castanea*.

Figure 1. Wood identification results of the Gunners' equipment artefacts, shown as percentages of each artefact category. Not showing artefact types with five or fewer identifications (i.e. the three flexible rammers, one gun carriage truck and one ram rod shaft).



Whilst handling the handspikes it was possible to refit some of the fragments (Table A4).

5.1.2 Small arms

The small arms examined consisted almost entirely of **powder bottles**, together with a few flask spouts (3 (cf) *Fraxinus*) and a single **pistol handle** (1 *Juglans*). Whilst handling the artefacts, the following additional information was recorded:

- six were complete powder bottles (i.e. a paired lid and body) of which four had their lids still *in situ* on the body[4]. These were: SF3469, SF3472, SF3526, SF3527, SF3581 and SF3601;
- six powder bottle lids still had the broken-off neck associated them; some of the necks remained inside their lid. These were: SF3506, SF3587, SF3656, SF3657, SF3658 and SF3700. Note that the neck for SF3587 was not analysed as it was not possible to get access to the fragment to sample (without removing it from inside the lid).

Figure 2 shows the wood identifications associated with the small arms. The powder bottles were made using a variety of wood types: (cf) *Acer*, (cf) Betulaceae Groups 1 and 2, *Alnus*, (cf) *Betula*, (cf) *Carpinus*, (cf) *Fagus*, (cf) *Fraxinus*, *Juglans*, Maloideae and (cf) *Populus*/*Salix*. Some diffuse and ring porous hardwoods (which could not be resolved further) were also recorded.

[4] As well as the six examined, there is an additional paired powder bottle lid and body; SF3470.

Figure 2. Wood identification results of the Small arms artefacts, shown as percentages of each component. Not showing artefact types with five or fewer identifications (i.e. the three flask spouts and the single pistol grip handle).

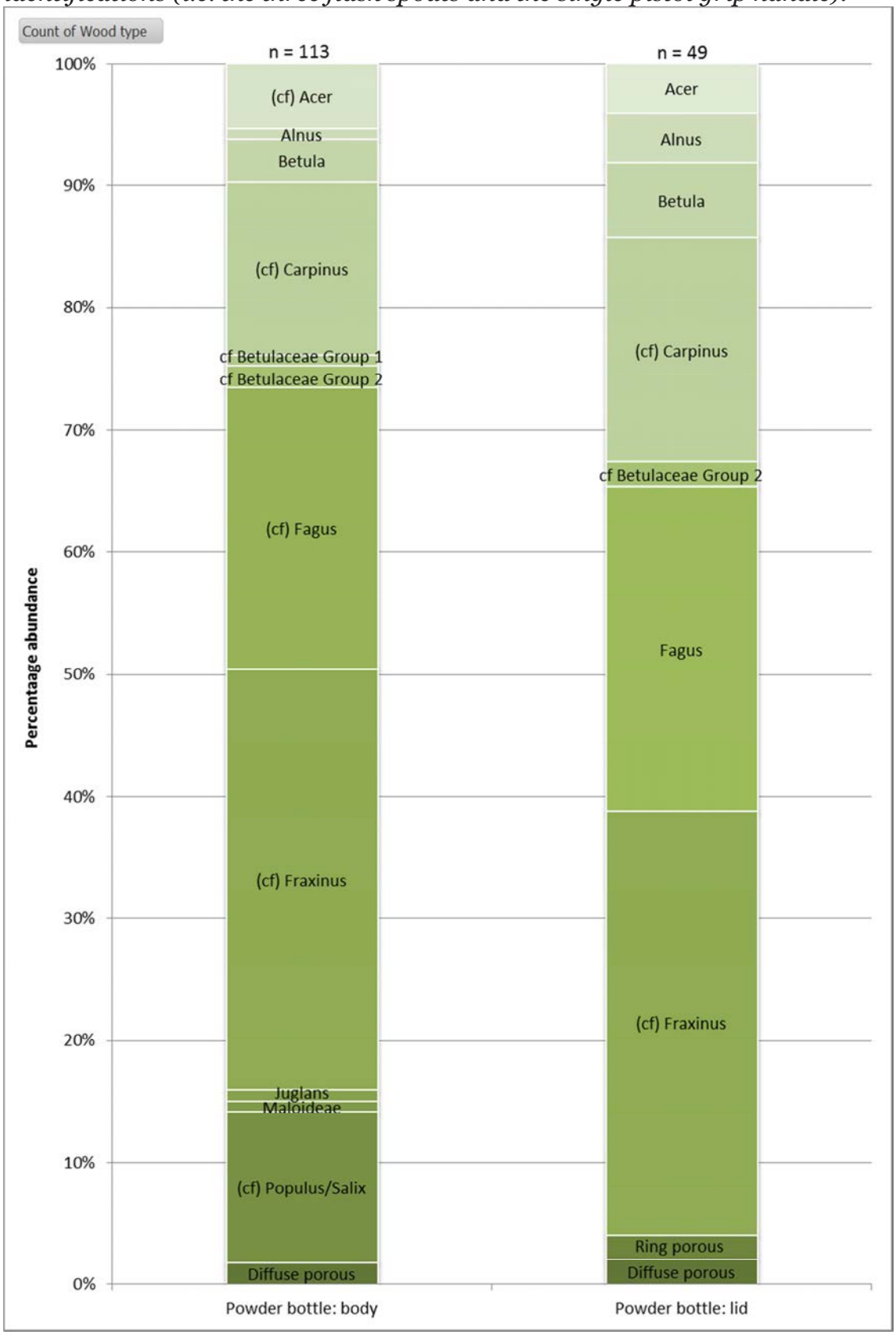
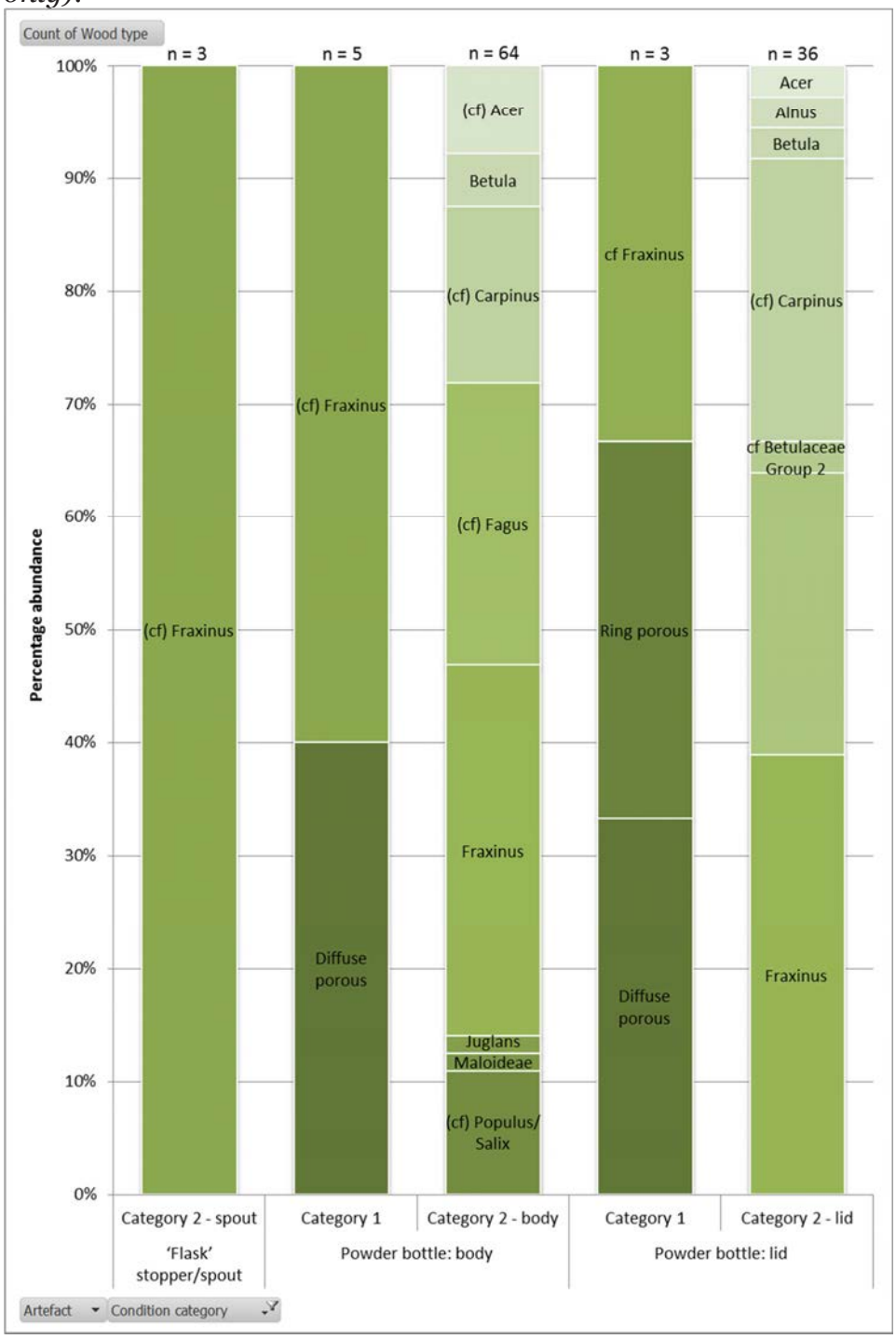


Figure 3 shows the powder bottle identifications, but only of condition Category 1 and 2 (see Table A1). Omitting the Category 3 remains, which are generally very fragmentary, aims to try and minimise over-counting. Overall, the majority of the remains were made from (cf) *Fraxinus*, (cf) *Fagus* and Betulaceae taxa (although no identifications of *Corylus* were made). In addition to these, there were some examples of (cf) *Populus/Salix* and (cf) *Acer*, and single examples each of *Juglans* and Maloideae.

Figure 3. Wood identifications of the powder bottles (condition categories 1 and 2 only).



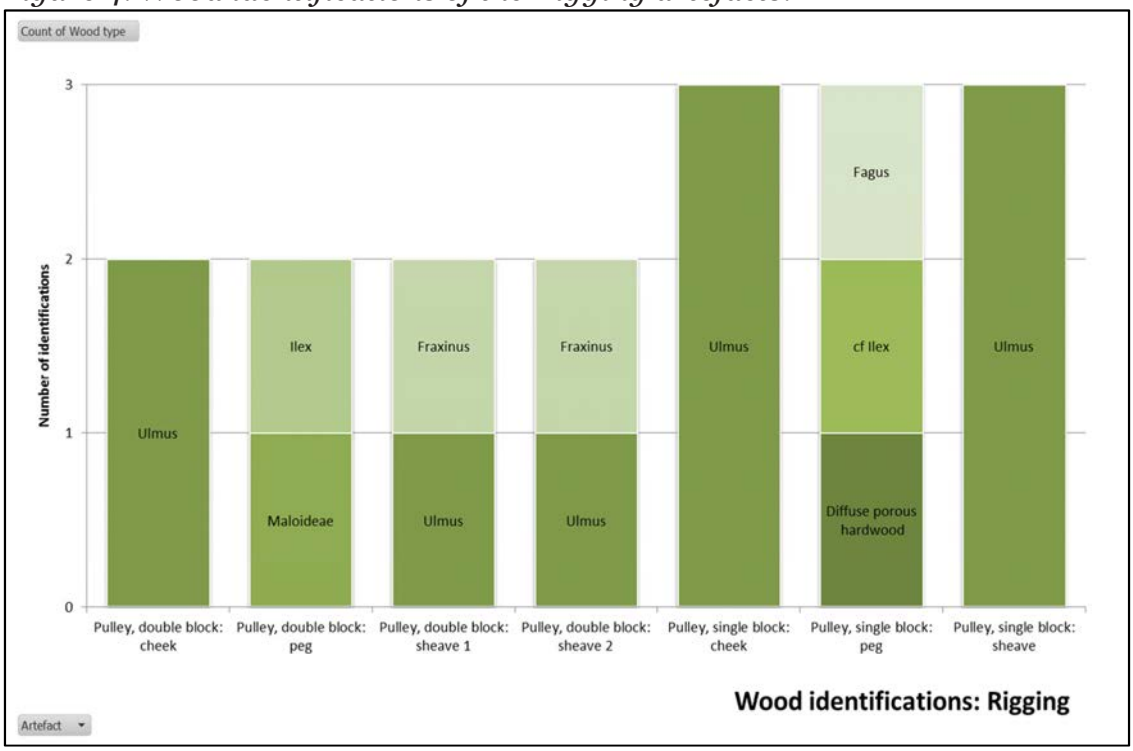
Of the powder bottles with paired lids and bodies – where it was possible to determine the wood type sufficiently – the same wood types are used for the separate components; for example SF3472 – cf *Fraxinus*, SF3656 – *Fagus*, and both SF3506 and SF3658 – (cf) *Carpinus*. An exception is SF3469 which consists of a *Fraxinus* body and a diffuse porous wood lid (although both were examined macroscopically).

The three flask spouts were made from (cf) *Fraxinus*, and the pistol handle was made from *Juglans*.

5.1.3 Rigging

The rigging components made of wood consisted only of **pulley blocks;** three single blocks, and two double blocks. Every pulley block had three different elements; the cheek (the main body of the pulley block), the sheave(s) (the moving disc(s)) and the peg (to hold each pulley together). Figure 4 shows the wood identifications associated with these; *Fagus*, *Fraxinus*, (cf) *Ilex*, Maloideae and *Ulmus*. A diffuse porous hardwood (which could not be resolved further) was also recorded.

Figure 4. Wood identifications of the Rigging artefacts.



All the cheeks were made of *Ulmus*, and both *Ulmus* and *Fraxinus* were used to make the sheaves. For the double pulley blocks, each pair of sheaves was always made of the same wood, likely to ensure even wear and function; both *Fraxinus* and both *Ulmus*. A mix of woods was used for the pegs: (cf) *Ilex* (two), Maloideae (one), *Fagus* (one) and a wood type that could not be identified, but which had a diffuse porous structure (one). Two of the pegs (one of cf *Ilex* and

that of Maloideae) were almost complete small diameter roundwoods, with bark still intact around some/most of their outer edge (Figure 5).

Figure 5. Pulley block SF3052 (cf Ilex) showing bark around part of the peg's outer edge (highlighted in the close-up by the dashed white line).

5.1.4 Other

The remainder of the artefacts examined here were all included in this category. They consisted of: '**fire logs**', a **bar**, **branch wood**, a **bung**, **cask** elements (cant stave, hoop and stave), a **hammer handle**/shaft, various other **shafts and handles**, a piece of **moulded strip**, a **pipe stopper**, a **plank**, a piece of plank thought to be a **box edge**, a D-shaped **spade handle** and a piece of **timber with notch**.

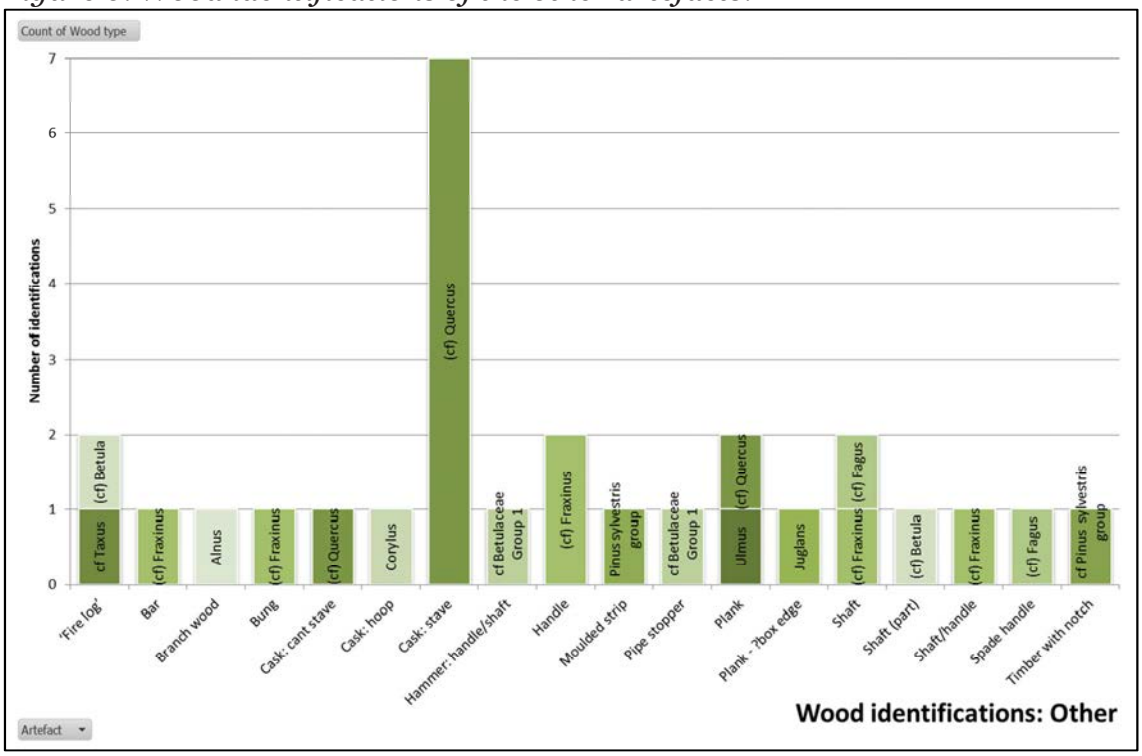
Figure 6 shows the wood identifications of this 'Other' category of finds. In particular, the cask consists of multiple elements – the staves were (cf) *Quercus* and the hoop around it was *Corylus*. The possible box edge was *Juglans*. The assemblage also included multiple tool handles: the hammer handle was cf Betulaceae Group 1, and a D-shaped handle (from a spade, for example) was made of cf *Fagus*. Pieces of branchwood that are thought to have been for firewood[5] were cf *Taxus* and *Betula*. The pipe stopper could not be sampled, but by examining it under low power magnification, it was possible to identify it as one of the Betulaceae family (i.e. *Alnus*/*Betula*/*Carpinus*/*Corylus*). Subsequent analysis and investigation of the artefact, using micro-CT scanning[6],

[5] Although these were recorded as possible firewood at the time of excavation, other uses, such as running repairs, cannot be discounted.

[6] This work with the 'µ-VIS X-Ray Imaging Centre' at the University of Southampton is currently in progress.

has meant that it has since been possible to refine the identification. The detailed methods and results of this investigation will be reported separately.

Figure 6. Wood identifications of the other artefacts.



5.2 Other wood characteristics

Indications of wood maturity were possible from the presence[heartwood]/ absence[sapwood] of tyloses in the long-lived tree types *Quercus*, *Castanea* and *Fraxinus*, and the curvature of the growth rings (at least in the areas of artefact sub-sampled for thin sections):

- For the linstocks, from the presence and absence of tyloses it seems that both *Fraxinus* and *Castanea* heartwood and sapwood were used. Some of the *Fraxinus* linstocks were made from the central part of the tree element used, seen from presence of the pith and the associated strong growth ring curvatures.
- In terms of the hand spikes, most of those examined had weak ring curvatures, indicating that they were made from larger tree elements. An exception was the handspike made from *Betula* (SF3439) (refitted with other fragments, see Table A4) – a central piece of wood with strong growth ring curvature.
- The (cf) *Quercus* cask components had tyloses present too, indicative of heartwood.
- The only sample of *Ulmus* where the presence/absence of tyloses was recorded (most of the artefacts had been examined at low power magnification), was for the plank (SF3138), where the presence of tyloses suggests heartwood was used. If this was a structural element of the ship, then heartwood could have been favoured since deposits within the heartwood make it more durable (Ridout 2000, 15).

The observations indicating that the larger sized equipment (notably the handspikes) used bigger tree/wood elements, and that smaller artefacts were fashioned from smaller sized elements, represent logical and efficient use of the wood; multiple large objects could be made from a single larger tree element, and using smaller diameter wood elements for smaller objects (eg the powder bottles) would require minimal working and less wood wastage.

Where ring widths were recorded, there seems to be a mix of both wide and narrow growth rings, indicating fast and slow growth, respectively. The handspikes included a mix of ring widths, but most were wide rings (i.e. fast growing). The linstocks, in comparison, although mixed, were mostly narrow ring widths (slow growing).

Most of the remains were not suitable for determining the season of felling, primarily because they did not contain the real outermost growth ring. Of the exceptions that did still have bark attached (two of the pulley block pegs, the cask hoop and the branch wood), all were taxa that do not have readily-distinguishable early- and late-wood vessel patterns.

Generally, the condition of the wood itself was good enough to allow wood identifications to some level; in terms of samples that were destructively sampled, none were completely unidentifiable due to poor preservation. Again, for sub-sampled artefacts, in only a few examples were identifications only possible to family level; notably the cf Betulaceae level identifications of, for example, the handle hammer (SF3732) and part of a powder bottle (SF3690c).

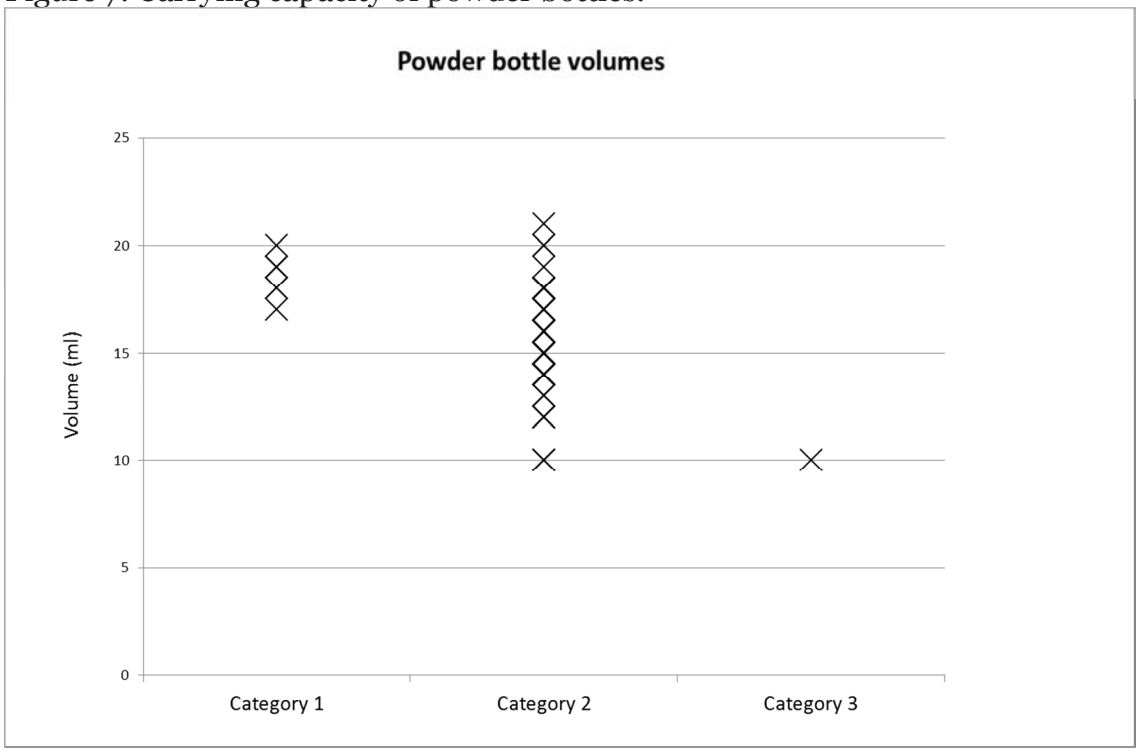
During sampling and examination under the microscope, three fragments were recorded as having evidence of possible insect damage: the moulded strip (SF3144) and two fragments of handspikes (SF3449 and SF3716). The evidence on the sub-sampled thin sections from the handspikes consisted of a circular hole on one (*c* 1mm diameter), and an oval hole on the other (as possibly it was compressed). Whilst refitting handspike fragments, macroscopic insect damage to fragments SF3176, SF3253, SF3293 and SF3439 was also recorded. Of these, only SF3253 was not examined microscopically. The fact that no insect damage was recorded from the microscopic examination of the others simply reflects the limited area of the thin-sectioned sample.

The *Ulmus* gun carriage truck had multiple knots, visible macroscopically.

5.3 Powder bottle volume results

The volumes of the powder bottles are presented in Figure 7 and Table A3, together with details on conditions of the bottles, that are relevant to the volumes recorded. The majority of the volumes are between 10–20 ml, with the volumes of the best condition bottles (Category 1) in the upper end of that range, from 17–20 ml.

Figure 7. Carrying capacity of powder bottles.



6 DISCUSSION

6.1 Wood type and characteristics

A range of wood types was used throughout the ship, although very much dominated by hardwood types, including both short- and long-lived taxa. In this section probable reasons for any preferential selection of wood types are discussed; other than where specific artefacts are referred to by SF number, the named genera are mentioned generally (with no consideration as to whether identifications of artefacts at this site were secure, insecure, or both).

For the majority of artefact types with multiple individuals, a mix of wood types was used; an exception is that of the pulley block cheeks, which were all made from *Ulmus* (elm). In terms of wood diversity for artefact types with the greatest number of individuals, the powder bottles (bodies and lids) showed the most diversity (9) (not including the Betulaceae groups for which an individual genus could not be differentiated), followed by the linstocks (6) and then the handspikes (3).

There are multiple reasons for the wood types used and selected for different uses throughout the ship; both practical and/or aesthetic:

- durability: all the cheeks, and some of the sheaves, of the **pulley blocks** were made of elm, as it copes well with repeated wetting and drying (oak would crack and

likely fail if subjected to the same conditions). Elm was also used for the **gun carriage truck** (wheel), likely for similar reasons. Although Cutler and Gale (2000, 139) state that *Ilex* (holly) is 'rather perishable', it is also slow-growing and a close-grained wood – therefore dense and hard, and suitable for a **pulley block peg**. *Fagus* (beech) (used for one of the handspikes, a peg of one of the pulley blocks, and the D-shaped handle, as well as for the powder bottles) is a stable, strong wood (Gale and Cutler: 110).

- handling comfort: many of the **handles/shafts** were made from *Fraxinus* (ash) whose "resilience and resistance to stress produces an ideal medium for tool handles" (Gale and Cutler, 2000: 120); in particular, the **handspikes** were made from ash – the large vessels in the earlywood, together with relatively narrow rays, help make it flexible and absorb impact/stresses, and therefore make it comfortable to use. *Juglans* sp. (walnut) was used for the **pistol handle**, agreeing with Gale and Cutler (2000: 146) that: "It [walnut] is shock-resistant and resilient, and is one of the foremost woods for gunstocks". Walnut was also used for one of the **powder bottle** bodies.
- attractiveness of the wood grain: walnut was used for the **pistol handle**. It was also used for the (?)**box panel**. It is also a durable wood;
- ease of working: the **linstocks** were each individually turned, with great detail, and many of the wood types selected for them were easy to work (eg ash, *Populus*/*Salix* (poplar/willow)). Beech can be split even when seasoned, and it "has a straight, even grain" (Gale and Cutler, 2000: 110) – characteristics which would make it amenable for working. What is thought to be the **cask's hoop** was made of *Corylus* (hazel), a flexible wood;
- availability: *Quercus* (oak) (with tyloses present, indicating oak heartwood) was used for the body of the **cask**. This is a wood commonly used for such objects, due to its strength and widespread availability; it is also noted by Gale and Cutler (2000: 205) that the presence of tyloses makes it nearly impermeable. The **pulley block pegs** of cf holly (SF3052) and Maloideae (SF3358) both had bark attached; these could be running repairs, in which case whatever was suitable (the right size and diameter, requiring no/minimal working) and easily obtainable would have been used. The pieces of branch wood (possibly used for **firewood** (fire logs) or running repairs) were also probably sourced from what was around when needed.

Two types of wood were identified which are not native to the British Isles; *Juglans* (walnut) and *Castanea* (sweet chestnut). Given the sea-faring history of the ship, and that both would have been growing in the British Isles by this time, it was not possible as part of this investigation to determine whether these artefacts were made from wood that had been grown in Britain or abroad.

6.2 Further work

Whilst the selection of wood types have been discussed here in terms of their artefact use, it will be of interest to compare wood selection as evidenced from the *London* with information derived from comparable sites (age and military

use); such an inter-site comparison will be done as part of subsequent project reporting.

It should be noted here that further analysis, using other investigative techniques, for example micro-CT scanning, could result in identifications for artefacts that cannot be sampled destructively; as well as those already mentioned within this report (namely the pipe stopper and tuning peg) other suitable candidates could be the small wooden pegs used to hold the leather shoe heels and soles together.

Other wooden items listed in the original project finds list, but could not be located for this analysis, are SF3019 to SF3023 – listed as parts of a small rope-handled wood box. Their location remains unknown, never having been passed to Fort Cumberland for conservation.

7 CONCLUSIONS

Around 300 wood identifications were carried out on wooden artefacts recovered from the wreck of the *London*. The remains were dominated by artefacts associated with warfare; notably gunners' equipment (mostly handspikes and linstocks) and small arms (dominated by powder bottles). 16 wood (/wood group) types were identified; dominated by hardwood types *Ilex* sp. (holly), *Alnus* sp. (alder), *Betula* sp. (birch), *Carpinus* sp. (hornbeam), *Corylus* sp. (hazel), *Castanea* sp. (sweet chestnut), *Fagus* sp. (beech), *Quercus* sp. (oak), *Juglans* sp. (walnut), *Fraxinus* sp. (ash), Maloideae/Pomoideae (Pomaceous fruits incl. hawthorn, apple, pear, whitebeam), *Populus*/*Salix* spp. (poplar/willow), *Acer* sp. (maple) and *Ulmus* sp. (elm), together with two softwoods *Pinus* sp. (pine) and *Taxus* sp. (yew). Two of the taxa are not native to the British Isles; *Juglans* and *Castanea*.

The patterns of wood selection for the main artefact types are:

- *Fraxinus* (ash); for the handspikes and many of the shafts/handles
- *Ulmus* (elm); for pulley blocks
- *Quercus* (oak); cask

Wood selection was likely influenced by the characteristics of the wood types themselves (for example, ease of working, comfort in use) – in turn affected by the anatomical structure of the woods – as well as their availability.

The pulley blocks also show evidence of possible running repairs; the wood used for two of the pulley block pegs still had some bark attached.

This analysis has demonstrated the wealth of information that can be obtained from identifying the woods from which the artefacts were made. Where identifications were not possible (on artefacts that were not destructively subsampled) further analysis with alternative methods can be considered.

8 REFERENCES

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9 APPENDIX

Table A1. Results of the powder bottle condition assessment; categorisations made by A. Middleton and Z. Hazell, with additional notes by Z. Hazell. [a] = information from the finds photograph. [b] = where it was initially categorised as Category 2 (based on the lid's condition) but has since been re-categorised as Category 3 (because the neck is the only remaining fragment of its body). [c] = where the neck was not analysed. For category definitions see Table 1 in this report's main text.

SF number	Category	Notes
3469	Category 1	
3470	Category 1	
3471	Category 2 - body	Most present; all neck missing
3472	Category 1	Body still has fibres in (?)both lug holes
3473	Category 3 - body	Most missing. Only 1 lug attached to a small fragment remains
3474	Category 2 - body	Most present; all neck missing
3475	Category 3 - body	Missing bottom half; most of neck and both lugs present
3504	Category 2 - body	Most present; missing part of neck
3505	Category 3 - body	Top half only present, with some of neck missing. Both lugs present
3506a	Category 2 - lid	Complete; with neck that had been inside. Additional fragment in bag - unclear if related to lid/neck
3506b	Category 3[b] - body	Neck only; 2 refitted fragments, formerly inside lid
3507	Category 2 - lid	Complete
3508	Category 2 - lid	Complete
3509	Category 2 - lid	Complete
3510	Category 2 - lid	Complete
3511	Category 2 - lid	Nearly complete
3512	Category 2 - lid	Complete
3513	Category 3 - body	Most missing; only a third of the neck present
3514	Category 2 - body	Most present, all neck missing. Some damage to top edge of bottle
3515	Category 2 - body	Most present, neck nearly all missing. Bottom half of body is squashed to an oval shape
3516	Category 2 - body	Most present; top damaged. Most of neck missing
3517	Category 2 - body	Most present, all neck missing
3518	Category 2 - body	Most present, nearly all neck and one lug missing
3519	Category 2 - body	Most present, all neck and one lug missing. Top of remaining bottle has some missing
3520	Category 2 - body	Most present; all neck missing
3521	Category 2 - body	Most present; missing more than half of neck
3522	Category 2 - body	Most present; all neck missing
3523	Category 2 - lid	Complete

SF number	Category	Notes
3524	Category 2 - lid	Complete
3525	Category 2 - body	Most present, neck mostly missing
3526	Category 1	Lid has fibres present in one lug hole
3527	Category 1	
3528	Category 3 - body	Most present; neck and base missing
3538	Category 3 - body	Most missing; base only
3566	Category 3 - lid	Very damaged; missing lugs and most of neck column.
3567	Category 2 - body	Mostly complete; one lug broken. Neck broken, missing more than half
3572	Category 2 - body	Most present, only neck missing
3573	Category 2 - body	Most present; top damaged. Neck and top edge missing
3574	Category 2 - body	Most present, all neck missing
3575	Category 2 - body	Mostly complete, most of neck missing
3576	Category 2 - body	Most present, neck missing, some damage to top of remaining bottle
3577	Category 2 - body	Complete
3578	Category 2 - body	Complete
3579	Category 2 - body	Mostly complete, about half the neck missing
3580	Category 2 - body	Complete
3581	Category 1	
3582	Category 2 - body	Most present, more than half neck missing, lots of iron deposit
3583	Category 2 - body	Mostly complete, most of neck missing
3584	Category 2 - body	Mostly present. Neck broken, most missing. Some small fragments in the bag have broken off the neck.
3585	Category 2 - body	Mostly complete, all of neck missing
3586	Category 2 - body	Mostly complete, most of neck missing, some damage to top of remaining body
3587	Category 2 - lid	Complete [with some of the neck still inside it[c]]
3588	Category 2 - lid	Most present, part of bottom edge broken off
3599	Category 2 - lid	Complete, from 3 refitted fragments
3601	Category 1	
3602	Category 2 - body	Most present; more than half neck missing
3603	Category 2 - body	Complete
3604	Category 2 - body	Mostly complete; neck broken, missing just under half. A small fragment in the bag has broken off the neck
3606	Category 2 - body	Complete
3607	Category 2 - body	Most present; all neck missing
3608	Category 3 - body	About a third present lengthways; 1 lug present. Neck missing
3609	Category 2 - lid	Mostly complete, from 3 refitted fragments
3610	Category 2 - lid	Complete
3611	Category 2 - lid	Complete

SF number	Category	Notes
3612	Category 3 - body	Most present; both lugs and most of neck present; missing base
3613	Category 3 - body	Missing bottom half; top half present (including neck and both lugs)
3614	Category 2 - lid	Complete
3615	Category 3 - body	Most missing; base only
3616	Category 2 - body	Most present; all neck missing
3617	Category 3 - body	Bottom half missing; neck and both lugs present
3618	Category 2 – spout	Spout only
3619	Category 3 - body	Most missing; base only
3620	Category 3 - body	Bottom half missing; most of neck and both lugs present
3621	Category 3 - body	Most missing; both lugs and some side of body present, (from 3 refitted fragments). Also in the bag were 7 fragments too fragmented to ID, and 1 fragment that did not look like part of a powder bottle
3622	Category 2 - lid	Mostly complete, from 2 refitted fragments
3630	Category 2 - lid	Complete
3635	Category 2 - body	Mostly complete, neck damaged with about half missing
3636	Category 3 - body	Mostly complete. Missing top section (neck and both lugs)
3637	Category 2 - body	All present, except neck
3638	Category 2 - body	Mostly complete, over half neck missing
3639	Category 2 - body	Mostly complete, all neck missing, one lug broken
3640	Category 2 - body	Mostly complete, one lug broken, all neck missing, some damage to top of remaining body
3641	Category 2 - body	Mostly complete, most of neck missing
3642	Category 2 - body	Mostly complete, over half neck missing
3643	Category 2 - body	Mostly present, one lug broken, no neck present
3644	Category 2 - body	Most present, all neck missing, some damage to top of remaining body
3645	Category 2 - body	Mostly complete, all neck missing
3646	Category 3 - body	Bottom half including the base present. Upper half and lugs missing
3647	Category 3 - body	Half present lengthways; 1 lug and all base present; neck missing
3648	Category 3 - body	Most missing; base and small part of side present
3649	Category 2 - lid	Mostly complete, damage to bottom of edge of lid - some missing
3650	Category 2 - body	Mostly complete, neck missing, damage to top of remaining body
3651	Category 2 - body	Mostly complete, hole in side of body, a little loss/damage to neck

SF number	Category	Notes
3652	Category 3 - body	Missing neck and bottom half of bottle
3653[7]	Category 2 - body	Mostly complete, with both lugs present. Neck missing.
3654a	Category 3 - body	Most missing; one lug and some side present as 2 refitted fragments
3654b	Category 3 - body	Most missing; only part of side, lengthways, present
3654c	Category 3 - body	Most missing; only part of side and part of base present
3654d	Category 3 - body	Most missing; only fragment with part of lug on it present
3654e	Category 3 - body	Most missing; only fragment of side, lengthways, present
3654f	Category 3 - body	Most missing; only fragment of side, lengthways, with part of a lug, present
3654g	Category 3 - body	Most missing; 2 refitted fragments, each with a lug present
3655a	Category 2 – spout	Spout only
3655b	Category 3 - lid	More than half the lid missing, widthways. 1 lug missing
3655c	Category 3 - lid	Most of neck missing. Both lugs present
3655d	Category 3 - lid	More than half the neck missing, widthways. Both lugs present
3655e	Category 3 - lid	Most of neck missing. Both lugs present
3655f	Category 3 - lid	All of neck missing. Both lugs present
3655g	Category 3 - lid	Most/all neck missing. 1 lug missing
3655h	Category 3 - lid	Most of neck missing. Both lugs present
3655i	Category 3 - lid	Most/all neck missing. 1 lug missing
3655j	Category 3 - lid	Most/all of neck missing. Both lugs present
3655k	Category 3 - lid	Half the neck missing, widthways. 1 lug missing
3656a	Category 2 - lid	Complete (slightly damaged); with neck still inside
3656b	Category 3[b] - body	Neck only, inside lid
3657a	Category 2 - lid	Complete; with neck still inside
3657b	Category 3[b] - body	Neck only, inside lid
3658a	Category 2 - lid	Complete; with neck still inside
3658b	Category 3[b] - body	Neck only, inside lid
3659	Category 2 - lid	Complete
3660	Category 2 - lid	Complete
3661	Category 2 - lid	Complete
3662	Category 2 - lid	Complete
3664	Category 2 - body	Mostly complete, most of neck missing, some damage to top of remaining body
3665	Category 2 - body	Mostly complete, most of neck missing
3666	Category 2 - body	Mostly complete, one lug broken, all neck missing, damage to top of remaining body
3667	Category 2 - body	Mostly complete, all of neck missing
3668	Category 2 - body	Mostly complete, neck mostly missing, both lugs damaged
3669	Category 2 - body	Mostly complete, all neck missing

[7] Some of the early project documentation refers to this as SF3563. SF3563 is a handspike (fragment).

SF number	Category	Notes	
3670	Category 2 - body	Mostly present, no neck present	
3671	Category 2 - body	Most present, missing from above lugs, both lugs present but one damaged	
3672	Category 3 - body	Missing neck and bottom half; both lugs present	
3673d	Category 3 - body	Small fragment with 1 lug	
3673a	Category 3 - body	Small fragment with part of a lug. Smallest of the 3 fragments	The 3 fragments seem to refit, but not with absolute certainty.
3673b	Category 3 - body	Small fragment with 1 lug. The middle-sized of the 3 fragments.	
3673c	Category 3 - body	Side half of body, including part of a lug and part of the base. Largest of the 3 fragments.	
3673e	Category 3 - body	Base only	
3674	Category 2 - lid	Complete	
3675	Category 2 - lid	Complete	
3676	Category 2 - lid	Complete	
3678	Category 2 - body	Most present; top damaged. Neck present but damaged, with more than half missing. 1 small fragment has broken off, but refits	
3679	Category 3 - body	Top with both lugs and 1 side present. Neck, base and rest of body missing	
3680	Category 2 - body	Mostly complete, most of neck missing	
3681	Category 2 - body	Mostly complete, one lug missing, some damage to top of remaining body	
3682	Category 2 - body	Mostly complete, all of neck missing	
3683	Category 2 - body	Mostly complete, all neck missing	
3684	Category 2 - body	Mostly complete, all neck missing	
3685	Category 2 - body	Mostly complete, neck missing	
3686	Category 3 - body	Top half only present (including both lugs and most of neck)[a]	
3687	Category 3 - body	2 fragments refit to form most of the top half; missing bottom half, base and most of neck too	
3688	Category 3 - body	Bottom half only present	
3689	Category 3 - body	Missing most of top half; some upper side present (but lug missing)	
3690a (=3690b)	Category 3 - body	2 fragments refit to form incomplete body (part of side missing); no neck or base. Both fragments have 1 lug present	
3690b (=3690a)	Category 3 - body		
3690c	Category 3 - body	Most missing; 1 lug present	
3696	Category 2 - lid	Complete	
3697	Category 2 - lid	Complete	
3698	Category 2 - lid	Complete	
3699	Category 2 - lid	Complete	

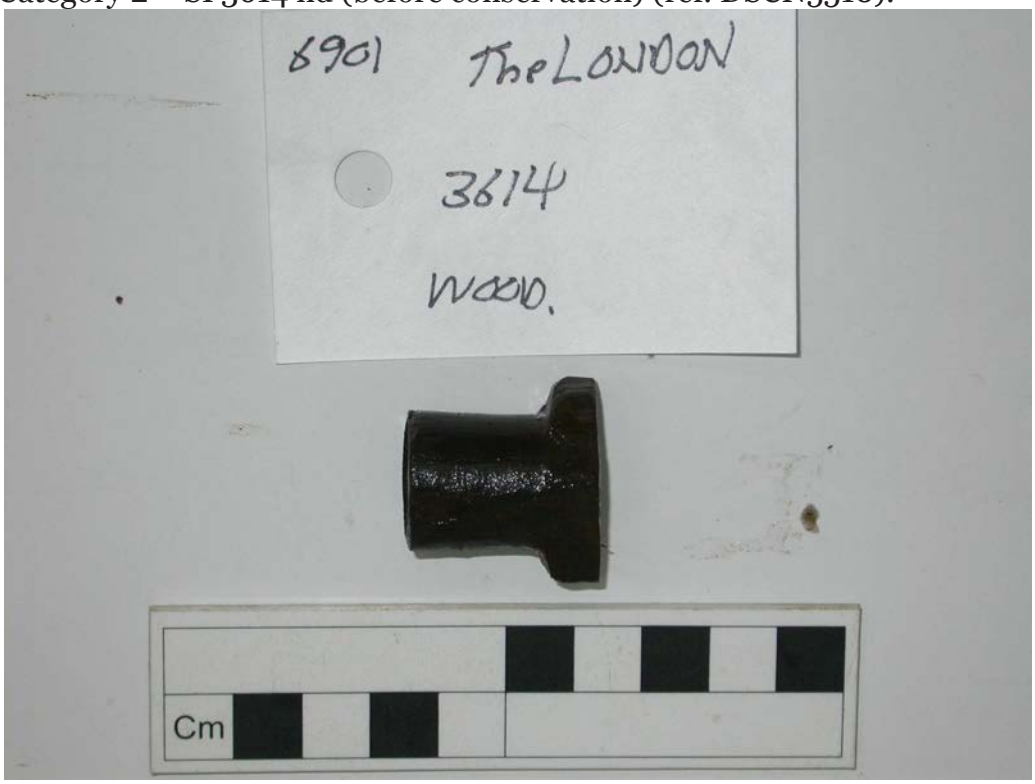
SF number	Category	Notes
3700a	Category 2 - lid	Mostly complete, one lug mostly missing. Neck inside lid
3700b	Category 3[b] - body	Neck only, inside lid
3702	Category 2 - body	Mostly complete, all of neck missing
3703	Category 2 – spout	Spout only. Rest of body missing
3712	Category 2 - lid	Complete
3737	Category 2 - body	Most present; top damaged. Most of neck missing
3794	Category 2 - lid	Complete
3795	Category 3 - body	Most missing; only part of neck remains. Multiple fragments were in the bag (x4); only the neck fragment was analysed as the others were too small

Figure A1. Examples of remains from each of the powder bottle condition categories; 1, 2 and 3.

(a) Category 1 – SF3469 body and lid (before conservation) (ref. DSCN5476).

(b) Category 2 – SF3567 body (before conservation) (ref. DSCN5361).

(c) Category 2 – SF3614 lid (before conservation) (ref. DSCN5510).



(d) Category 2 – SF3703 spout (before conservation) (ref. DSCN6333).

(e) Category 3 – SF3620 body (before conservation) (ref. DSCN5492).

(f) Category 3 – SF3655 multiple lids (before conservation) (ref. DSCN6377).

Table A2. Wood identifications carried out on the London Wreck wooden artefacts. Results are listed in Small Find numerical order. cf = possible; Indet = indeterminate (unidentifiable); n/r = not relevant. The presence of tyloses usually indicates the presence of heartwood, although they can also occur in damaged wood. Samples in [...] are fragments refitted based on macroscopic characteristics (and not sub-sampled/identified). [a] = not sub-sampled, examined at low magnification; [b] = the identification has since been refined by micro-CT scanning.
2016 = August 2016 (all Z. Hazell), 2017i = Dec 2016–Jan 2017 (all Z. Hazell), 2017ii = May 2017 (Z. Hazell and E. Aitken), 2018i = May 2018 (Z. Hazell and E. Aitken), 2018ii = June 2018 (Z. Hazell and E. Aitken).
See reports Hazell (2016, 2017) and Aitken and Hazell (2017).
Duplicate identifications have been paired and highlighted in the table with a bold boxed outline.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2016	SF3052 (already conserved)	Single block	Cheek	*Ulmus*[a]	
			Sheave	*Ulmus*[a]	
			Peg	cf *Ilex*[a]	Small diameter roundwood with bark still present (visible around c. 1/3 of the peg hole). Damage by marine borers revealed the internal wood structure.
2016	SF3120	Single block	Cheek	*Ulmus*	
			Sheave	*Ulmus*[a]	Based on comparison with the cheek, when examined at low magnification.
			Peg	*Fagus*	
2016	SF3127	Double block	Cheek	*Ulmus*	
			Sheave 1	*Ulmus*	
			Sheave 2	*Ulmus*	
			Peg	*Ilex*	
2016	SF3132	Branch wood	n/r	*Alnus*	A branching branch. Near-complete bark present.
2018i	SF3133	Ram rod shaft	n/r	*Fraxinus*	Wide rings. Tyloses present.
2018i	SF3138	Plank	n/r	*Ulmus*	Tyloses present. Narrow rings. Poorly preserved.
2016	SF3144	Moulded strip	n/r	*Pinus sylvestris* group	Insect damaged

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017ii	SF3149	Gun carriage truck	Main wheel (part)	*Ulmus*	Multiple knots in the artefact.
			Separate fragment	*Ulmus*	Occasional tyloses.
2017ii	SF3159	Tail end of handspike?	n/r	*Fraxinus*	Weak ring curvature. Wide rings. Tyloses present.
2017ii	SF3160	Tail end of handspike	n/r	*Fraxinus*	Weak ring curvature. Wide rings. Tyloses present.
2017ii	SF3164 [=SF3217, SF3193]	Linstock	n/r	*Betula*	Additional characteristics Indet.
2017ii	SF3174	Part of handspike	n/r	*Fraxinus*	Weak ring curvature. Mixed ring widths, with some very narrow. Tyloses present.
2017ii	SF3175	Part of tapering wooden shaft	n/r	*Betula*	Weak ring curvature.
2018i	SF3176	Handspike	n/r	*Betula*	Possible roundwood.
2017ii	SF3184	Linstock	n/r	cf *Betula*	Narrow ring growth.
2016	SF3186	Linstock	n/r	*Betula*	Red iron stain in cells. Silver grey deposit (lead) on outside of artefact.
2017ii	SF3187 [=SF3189]	Linstock	n/r	*Fraxinus*	Pith present. Strong ring curvature. Narrow ring growth. Occasional tyloses.
2017ii	SF3188a [=SF3188b]	Linstock	(Examined the fragment with the taper hole).	cf *Betula*	Not a roundwood.
2017ii	SF3190 [=SF3183]	Linstock	n/r	*Betula*	Narrow ring growth. Red/brown iron deposit in vessels.
2017ii	SF3191 [=SF3181, SF3185]	Linstock	*n/r*	*Betula*	Not a roundwood.
2017ii	SF3192 [=SF3268, SF3245]	Linstock	n/r	*Fraxinus*	Narrow ring growth. Occasional tyloses.
2018i	SF3196	Handspike	n/r	*Fagus*	Medium ring width.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017ii	SF3197 [=SF3202]	Linstock	n/r	*Fraxinus*	Pith present. Strong curvature. Medium ring width.
2017ii	SF3198b [=SF3198a]	Linstock	(Examined the fragment with the taper hole).	cf *Betula*	Not a roundwood.
2016	SF3199	Linstock	n/r	*Castanea*	Tyloses present in the subsample examined.
2016	SF3200	Linstock	n/r	*Betula*	Very degraded (in sampled section). Some iron staining.
2016	SF3201	Linstock	n/r	*Castanea*	Tyloses present in some of the subsample fragments.
2017ii	SF3203 [=SF3195]	Linstock	n/r	cf *Betula*	Moderate ring curvature, narrow ring width. Not a roundwood.
2017ii	SF3204	Part of handspike	n/r	*Fraxinus*	Weak ring curvature. Wide rings. Tyloses present.
2017ii	SF3205	Part of handspike	n/r	*Betula*	Indet. ring curvature.
2016	SF3206	Flexible rammer	n/r	*Populus/Salix*	Pale grey/cream coloured wood where not oxidised.
2016	SF3207	Flexible rammer	n/r	*Alnus*	Wide growth rings. Iron stain in cells.
2016	SF3213 [=SF3310]	Linstock	n/r	*Betula*	
2017ii	SF3216	Linstock	n/r	*Fraxinus*	Weak ring curvature. Narrow rings. Tyloses present.
2017ii	SF3218 [=SF3170]	Linstock	n/r	*Betula*	Not a roundwood.
2017ii	SF3219 [=SF3270]	Linstock	n/r	*Fraxinus*	Pith present. Strong ring curvature. No tyloses. Wide rings (fast growing).
2017ii	SF3221	Linstock	n/r	*Betula*	Wide growth rings.
2017ii	SF3223 [=SF3215]	Linstock	n/r	*Betula*	Moderate ring curvature. Narrow growth rings.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017ii	SF3226 [=SF3263, SF3277] SF3279	Linstock	n/r	*Fraxinus*	Weak ring curvature. Medium ring width. Occasional tyloses. Iron concretion.
			n/r	*Fraxinus*	Pith present. Moderate-strong ring curvature. Narrow rings. Identified separately.
2017ii	SF3229 [=SF3225, SF3262]	Linstock	n/r	*Fraxinus*	Weak ring curvature. Wide growth ring. Not a roundwood. Tyloses present.
2017ii	SF3233	Spade handle	n/r	cf *Fagus*	
2016	SF3234	Bar	n/r	*Fraxinus*	Sampled.
2017ii	SF3234	Bar	n/r	cf *Fraxinus*[a]	Ring curvature weak-moderate. Mostly narrow growth rings. Duplicate identification, not sampled.
2016	SF3235	Handspike	n/r	*Fraxinus*	Tyloses present
2016	SF3236	Handspike	n/r	*Fraxinus*	
2016	SF3237	Handspike	n/r	*Fraxinus*	Tyloses present in places
2017ii	SF3252	Linstock	n/r	*Alnus*	Compressed and poorly preserved.
2016	SF3257	Single block	Cheek	*Ulmus*	
			Sheave	*Ulmus*	
			Peg	Indet.[a]	Not possible to sample. A diffuse porous hardwood
2017ii	SF3259 [=SF3287]	Linstock	n/r	*Fraxinus*	Strong ring curvature. Narrow growth rings. Occasional tyloses present. Pith present.
2017ii	SF3267 [=SF3288, SF3265, SF3247]	Linstock	n/r	*Fraxinus*	Strong ring curvature. Medium ring width. Occasional tyloses. SF3247 has since broken into two fragments
2017ii	SF3273 [=SF3258, SF3246, SF3275]	Linstock	n/r	*Alnus/Betula*	Narrow ring growth. Very poor preservation.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017ii	SF3282 [=SF3280, SF3264, SF3261]	Linstock	n/r	*Populus/Salix*	No pith. Moderate ring curvature. Medium and wide rings present.
2018i	SF3293	Handspike	n/r	*Betula*	Roundwood, with possible pith. Strong ring curvature. Medium width rings.
2017ii	SF3305	Part of handspike	n/r	*Fraxinus*	Weak ring curvature. Wide rings. Tyloses present.
2017ii	SF3306	Part of handspike	n/r	*Fraxinus*	Weak ring curvature. Mixed ring widths. Tyloses present.
2016	SF3307	Handspike	n/r	*Fraxinus*	Tyloses present
2018i	SF3308	Handspike	n/r	*Fraxinus*	Weak-no ring curvature. Tyloses present. Narrow rings.
2016	SF3309	Linstock	n/r	*Quercus*	Very degraded (in sampled section). Some iron staining.
2016	SF3311	Handspike	n/r	*Fraxinus*	
2017ii	SF3312	Linstock	n/r	cf *Betula*	Not a roundwood. Knot present.
2016	SF3324	Flexible rammer	n/r	*Alnus*	Lots of iron deposit in cells.
2016	SF3327	Handspike	n/r	*Fraxinus*	
2016	SF3333	Handspike	n/r	n/r	Not sampled – a complete, good example.
2017i	SF3342	Pipe stopper	n/r	cf *Betulaceae* Group 1[a,b]	Wide growth rings, with weak curvature.
2016	SF3358	Double block	Cheek	*Ulmus*	Red iron deposit in cells.
			Sheave 1	*Fraxinus*	Tyloses present
			Sheave 2	*Fraxinus*[a]	Based on comparison with the other sheave, when examined at low magnification.
			Peg	Maloideae	Pith present, off centre. Near complete roundwood cross-section; bark present for 5/6 of the circumference.
2017ii	SF3389	Plank - ?box edge	n/r	*Juglans*	Tyloses present.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018i	SF3399	Plank	n/r	*Quercus*	Tyloses present.
2017i	SF3431	Shaft	n/r	*Fraxinus*	Very wide growth rings, with weak/no curvature. Tyloses present.
2017i	SF3435	Handspike	n/r	*Fraxinus*	Wide growth rings, with no curvature. Tyloses present.
2017i	SF3437	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
2017ii	SF3437	Part of ?handspike	n/r	*Fraxinus*	Weak ring curvature. Wide rings. Tyloses present. Duplicate identification.
2017i	SF3438	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak/no curvature. Occasional tyloses.
2018i	SF3439	Handspike	n/r	*Betula*	Roundwood. Strong ring curvature.
2017i	SF3443	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak/no curvature. Tyloses present.
2017i	SF3448	Handspike	n/r	*Fraxinus*	Wide growth rings. Tyloses present.
2017i	SF3449	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Occasional tyloses. ?insect hole (circular, 1mm diameter).
2018i	SF3459	Handspike	n/r	*Fraxinus*	Occasional tyloses. Heavily concreted with iron.
2017i	SF3463	'Fire log'	n/r	*Betula*	Moderate ring curvature. Some distinctive bark still attached.
2017i	SF3465	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
2018i	SF3466	Wooden shaft (possible tool/implement)	n/r	cf *Fagus*	Poorly preserved.
2017i	SF3469	Powder bottle	Lid in situ	Indet.[a]	Not a roundwood. [?Betulaceae type vessel pattern: diffuse porous, aggregate rays?]
			Body	*Fraxinus*[a]	Not a roundwood.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3471	Powder Bottle	Body	*Fraxinus*	Narrow-medium rings. Weak curvature. Tyloses present.
2017i	SF3472	Powder bottle	Lid in situ	cf *Fraxinus*[a]	Not a roundwood.
			Body (hole in side)	cf *Fraxinus*[a]	Fibres still present in one (probably both) of the holes.
2018i	SF3473	Powder bottle	Body	*Fraxinus*	Narrow-medium ring widths. Tyloses present.
2018ii	SF3474	Powder Bottle	Body	*Fraxinus*	Very narrow rings. Tyloses present
2018i	SF3475	Powder bottle	Body	*Alnus*	Medium width rings.
2017i	SF3487	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
2018i	SF3489	Handspike	n/r	*Fraxinus*	Weak curvature.
2018i	SF3490	Handspike	n/r	*Fraxinus*	Weak-no ring curvature. Tyloses present.
2018ii	SF3504	Powder Bottle	Body	*Populus/Salix*	
2017i	SF3505	Powder bottle	Body	*Fagus*	Not a roundwood. Weak/none ring curvature.
2018i	SF3505	Powder bottle	Body	*Fagus*	Narrow rings. Occasional tyloses present. Duplicate identification.
2018ii	SF3506a	Powder Bottle	Lid (complete; with neck that had been inside).	*Carpinus*	Weak curvature
2018ii	SF3506b	Powder Bottle	Body (neck only, formerly inside lid)	cf *Carpinus*	Moderate curvature
2018ii	SF3507	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Wide rings. Indet. curvature
2018ii	SF3508	Powder Bottle	Lid	*Carpinus*	
2018ii	SF3509	Powder Bottle	Lid	*Fraxinus*	Narrow rings. Degraded
2018ii	SF3510	Powder Bottle	Lid	*Carpinus*	Weak curvature
2017i	SF3511	Powder bottle	Lid	*Fraxinus*[a]	Not a roundwood. Ring curvature weak/none.
2018ii	SF3512	Powder Bottle	Lid	*Fraxinus*	Tyloses. Narrow ring. Weak curvature

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3513	Powder Bottle	Body	*Populus/Salix*	
2018ii	SF3514	Powder Bottle	Body	*Populus/Salix*	Medium-large rings. Weak curvature.
2017i	SF3515	Powder bottle	Body	cf *Populus/Salix*	Not a roundwood. Weak ring curvature. Dark stain around outer edge of rim where the closed lid would have been in contact with the body. Compressed (oval).
2018ii	SF3516	Powder Bottle	Body	*Fraxinus*	Tyloses present.
2017i	SF3517	Powder bottle	Body	*Fraxinus*	Not a roundwood. Weak/none ring curvature. Tyloses present. Dark stain around outer edge of rim where the closed lid would have been in contact with the body.
2017i	SF3518	Powder bottle	Body	*Fraxinus*	Not a roundwood. Weak ring curvature. Dark stain around outer edge of rim where the closed lid would have been in contact with the body. Tyloses present.
2017i	SF3519	Powder bottle	Body	*Juglans*	Not a roundwood. Hard wood. ?Weak ring curvature (growth ring boundaries were undulating). Dark stain around outer edge of rim where the closed lid would have been in contact with the body.
2018ii	SF3520	Powder Bottle	Body	*Populus/Salix*	Medium-wide rings.
2018ii	SF3521	Powder Bottle	Body	*Fagus*	
2018ii	SF3522	Powder Bottle	Body	*Fraxinus*	Tyloses present. Narrow rings. Weak/no curvature
2018ii	SF3523	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Narrow rings. Weak/no curvature
2018ii	SF3524	Powder Bottle	Lid	*Fraxinus*	Tyloses present
2017i	SF3525	Powder bottle	Body	*Carpinus*	Not a roundwood. Weak/none ring curvature.
2017i	SF3526	Powder bottle	Lid (not *in situ*)	Indet.[a]	Fibres still present in one of the holes.
			Body	Indet.[a]	Not a roundwood. Wide ring. [Diffuse porous hardwood]

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017i	SF3527	Powder bottle	Lid (not *in situ*)	Indet.[a]	
			Body	Indet.[a]	Not a roundwood. Wide ring. [Diffuse porous hardwood]
2017i	SF3528	Powder bottle	Body	*Fraxinus*	Not a roundwood. Weak/none ring curvature. Some very slow growing rings.
2018i	SF3528	Powder bottle	Body	*Fraxinus*	Narrow rings. Tyloses present. Duplicate identification.
2018i	SF3533	Handspike	n/r	*Fraxinus*	Weak-no ring curvature. Medium ring width. Tyloses present.
2018i	SF3536	Handspike	n/r	*Fraxinus*	Weak-no curvature.
2017i	SF3537	'Fire log'	n/r	cf *Taxus*	Branch (c. 30cm long) with (broken off) side branches.
2017i	SF3538	Powder bottle	?Base only	*Fraxinus*	Not a roundwood. Moderate ring curvature. Occasional tyloses. Black, circular stain in centre of base (where would have been in contact with gunpowder stored inside).
2018i	SF3538	Powder bottle	Body	*Fraxinus*	Occasional tyloses. [Only TS used for ID, as fragment small]. Duplicate identification.
2017i	SF3551	Shaft or handle	n/r	*Fraxinus*	Very wide growth rings, with weak ring curvature. Occasional tyloses.
2017ii	SF3555	Part of ?handspike	n/r	*Fraxinus*	Tyloses present.
2018i	SF3556	Handspike	n/r	*Fraxinus*	Tyloses present.
2017i	SF3558 (four concreted together)	Handspike (a)	Longest fragment	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
		Handspike (b)	Shortest fragment	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
		Handspike	n/r	Not sampled	(Complete)
		Handspike	n/r	Not sampled	(Complete)

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017i	SF3559	Handspike	n/r	Not sampled	(Complete)
2017i	SF3561	Handspike	n/r	*Fraxinus*	Wide growth rings. Tyloses present.
2018i	SF3562	Handspike	n/r	*Fraxinus*	Weak curvature. Tyloses present.
2017i	SF3563	Handspike	n/r	*Fraxinus*	Wide growth rings. Tyloses present. Lots of iron deposition.
2018i	SF3564	Handspike	n/r	*Fraxinus*	Weak-no ring curvature. Tyloses present. Wide rings.
2017i	SF3566	Powder bottle	Lid only	*Fagus*	Not a roundwood. Weak/none ring curvature.
2018ii	SF3567	Powder Bottle	Body	*Fagus*	Narrow rings. Weak curvature.
2017i	SF3569	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Tyloses present.
2018i	SF3570 (fragment 2 of 2)	Handspike	n/r	*Fraxinus*	Tyloses present.
2017i	SF3571	Handspike	n/r	*Fraxinus*	Weak/no growth ring curvature. Occasional tyloses.
2018ii	SF3572	Powder Bottle	Body	*Fagus*	Medium-wide rings. Weak/no curvature. Occasional tyloses
2018ii	SF3573	Powder Bottle	Body	*Fraxinus*	Tyloses present. Medium rings
2018ii	SF3574	Powder Bottle	Body	Maloideae	Narrow rings. Weak curvature.
2018ii	SF3575	Powder Bottle	Body	cf *Populus/Salix*	Weak curvature
2018ii	SF3576	Powder Bottle	Body	*Populus/Salix*	Wide rings. Weak/no curvature.
2018ii	SF3577	Powder Bottle	Body	*Fraxinus*	Moderate curvature. Medium ring width. No tyloses
2018ii	SF3578	Powder Bottle	Body	*Fraxinus*	Tyloses present
2018ii	SF3579	Powder Bottle	Body	*Acer*	Medium rings. Weak/no curvature.
2018ii	SF3580	Powder Bottle	Body	*Fagus*	Narrow rings. Weak/no curvature.
2017i	SF3581	Powder bottle	Lid *in situ*	Indet.[a]	[No wood structure visible due to sediment cover]
			Body	Indet.[a]	[TLS: wide rays]
2018ii	SF3582	Powder Bottle	Body	*Carpinus*	Medium-wide rings. Weak curvature.

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3583	Powder Bottle	Body	*Fagus*	Narrow ring. Moderate curvature. Occasional tyloses
2018ii	SF3584	Powder Bottle	Body	*Betula*	Weak curvature
2018ii	SF3585	Powder Bottle	Body	*Carpinus*	Weak curvature.
2018ii	SF3586	Powder Bottle	Body	*Carpinus*	Medium rings. Weak/no curvature.
2018i	SF3587	Powder bottle	Lid	*Fagus*	Tyloses present.
2018ii	SF3588	Powder Bottle	Lid	*Fraxinus*	Narrow rings. Weak curvature. Tyloses present
2018ii	SF3599	Powder Bottle	Lid	*Fagus*	Wide ring. Indet curvature
2017i	SF3601	Powder bottle	Lid *in situ*	Indet.[a]	[TS: looks ring porous]
			Body	cf *Fraxinus*[a]	Not a roundwood. Weak/no ring curvature.
2018ii	SF3602	Powder Bottle	Body	*Fraxinus*	Very narrow rings. Tyloses present. Weak/no curvature
2018ii	SF3603	Powder Bottle	Body	*Fraxinus*	Tyloses present. Narrow-medium rings.
2018ii	SF3604	Powder Bottle	Body	*Carpinus*	Very narrow rings. Weak curvature.
2018ii	SF3606	Powder Bottle	Body	*Fraxinus*	Tyloses present. Narrow rings. Weak/no curvature
2018ii	SF3607	Powder Bottle	Body	cf *Acer*	Narrow rings. Weak/no curvature.
2018i	SF3608	Powder bottle	Body	*Fraxinus*	Narrow rings. Tyloses present.
2018ii	SF3609	Powder Bottle	Lid	cf *Carpinus*	Poor preservation
2018ii	SF3610	Powder Bottle	Lid	*Fraxinus*	Narrow rings. Weak curvature. Tyloses present
2018ii	SF3611	Powder Bottle	Lid	*Betula*	Indet. curvature and ring width
2018i	SF3612	Powder bottle	Body	*Populus/Salix*	Medium-large ring widths.
2018i	SF3613	Powder bottle	Body	*Betula*	Wide rings.
2018ii	SF3614	Powder Bottle	Lid	cf *Carpinus*	Degraded
2018ii	SF3615	Powder Bottle	Body	*Populus/Salix*	
2018ii	SF3616	Powder Bottle	Body	cf *Fagus*	Indet. curvature (cannot get good sections of other planes for a secure identification)

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018i	SF3617	Powder bottle	Body	*Fraxinus*	Narrow growth ring. Tyloses present.
2017i	SF3618	'Flask' stopper/spout	Pointed spout/tip only	*Fraxinus*[a]	Not a roundwood. Weak/no ring curvature. Very wide rings i.e. fast growth.
2018ii	SF3618	Powder Bottle	Body (spout only)	*Fraxinus*	Indet. tyloses (degraded). Indet. ring curvature. Duplicate identification, here sampled.
2018i	SF3619	Powder bottle	Body	*Fraxinus*	Narrow-medium ring widths. Tyloses present.
2018ii	SF3620	Powder Bottle	Body	*Fagus*	Wide ring. Indet curvature
2018ii	SF3621	Powder Bottle	Body	*Fraxinus*	Tyloses present
2018ii	SF3622	Powder Bottle	Lid	*Alnus*	Medium rings. Weak curve
2018ii	SF3630	Powder Bottle	Lid	*Fagus*	
2018i	SF3631	Timber with notch; and SF3632 (cordage)	n/r	cf *Pinus sylvestris* group	Wood degraded.
2017i	SF3634	Pistol grip handle	Handle	*Juglans*	Tyloses present. Hard to sample.
2018ii	SF3635	Powder Bottle	Body	*Fraxinus*	Tyloses present. Weak ring curvature. Medium ring widths
2018ii	SF3636	Powder Bottle	Body	*Fraxinus*	Tyloses present. Weak curvature. Medium rings
2018ii	SF3637	Powder Bottle	Body	cf *Fagus*	Occasional tyloses
2018ii	SF3638	Powder Bottle	Body	*Fagus*	Occasional tyloses
2018ii	SF3639	Powder Bottle	Body	*Fraxinus*	Medium ring width. Weak/no curvature. Tyloses present
2018ii	SF3640	Powder Bottle	Body	*Fraxinus*	Narrow-medium ring. Weak/no curvature. Tyloses present
2018ii	SF3641	Powder Bottle	Body	*Fagus*	Weak curvature. Occasional tyloses
2018ii	SF3642	Powder Bottle	Body	*Fraxinus*	Very narrow-medium ring width. Weak curvature. Tyloses present
2018ii	SF3643	Powder Bottle	Body	cf *Acer*	

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3644	Powder Bottle	Body	*Fagus*	Medium ring width. Weak/no curvature. Occasional tyloses
2018ii	SF3645	Powder Bottle	Body	*Betula*	Weak curvature. Wide rings
2018i	SF3646	Powder bottle	Body	*Populus/Salix*	
2018i	SF3647	Powder bottle	Body	cf *Fagus*	
2018i	SF3648	Powder bottle	Body	*Fraxinus*	Narrow growth ring. Occasional tyloses present. Moderate ring curvature (not from a roundwood piece).
2018ii	SF3649	Powder Bottle	Lid	*Carpinus*	Medium rings. Weak curvature.
2018ii	SF3650	Powder Bottle	Body	*Fagus*	Medium ring width. Weak/no curvature. Occasional tyloses
2018ii	SF3651	Powder Bottle	Body	*Acer*	
2018i	SF3652	Powder bottle	Body	*Acer*	
2018i	SF3653	Powder bottle	Body	cf *Carpinus*	
2018ii	SF3654a	Powder Bottle	Body	*Fraxinus*	Tyloses present
2018ii	SF3654b	Powder Bottle	Body	*Fraxinus*	Tyloses present
2018ii	SF3654c	Powder Bottle	Body	*Fraxinus*	Tyloses present
2018ii	SF3654d	Powder Bottle	Body	*Populus/Salix*	
2018ii	SF3654e	Powder Bottle	Body	*Fraxinus*	Tyloses present. Medium width rings.
2018ii	SF3654f	Powder Bottle	Body	*Fagus*	Occasional tyloses
2018ii	SF3654g	Powder Bottle	Body	cf *Fagus*	Occasional tyloses
2018ii	SF3655a	Powder Bottle	Body	*Fraxinus*	Narrow rings. Tyloses present.
2018ii	SF3655b	Powder Bottle	Lid	*Fraxinus*	Narrow rings. Tyloses present. Weak/no ring curvature
2018ii	SF3655c	Powder Bottle	Lid	*Acer*	Wide ring
2018ii	SF3655d	Powder Bottle	Lid	*Betula*	

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3655e	Powder Bottle	Lid	*Alnus*	
2018ii	SF3655f	Powder Bottle	Lid	*Fagus*	
2018ii	SF3655g	Powder Bottle	Lid	*Fagus*	Narrow rings. Tyloses present
2018ii	SF3655h	Powder Bottle	Lid	*Betula*	
2018ii	SF3655i	Powder Bottle	Lid	*Fraxinus*	
2018ii	SF3655j	Powder Bottle	Lid	*Fagus*	Narrow rings
2018ii	SF3655k	Powder Bottle	Body	*Populus/Salix*	
2018ii	SF3656a	Powder Bottle	Lid	*Fagus*	Medium ring width. Weak curvature. Occasional tyloses
2018ii	SF3656b	Powder Bottle	Body	*Fagus*	Medium-large ring. Occasional tyloses. Weak/no curvature
2018ii	SF3657a	Powder Bottle	Lid	*Carpinus*	Narrow rings. Moderate ring curvature
2018ii	SF3657b	Powder Bottle	Body	Betulaceae Group 2	Wide rings. Indet. ring curvature.
2018ii	SF3658a	Powder Bottle	Lid (complete, with neck inside)	*Carpinus*	Narrow ring
2018ii	SF3658b	Powder Bottle	Body (neck only, inside lid)	*Carpinus*	Poor preservation
2018ii	SF3659	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Narrow rings. Weak curvature
2018ii	SF3660	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Very narrow rings. Weak curvature
2018ii	SF3661	Powder Bottle	Lid (complete)	*Acer*	Weak curvature.
2018ii	SF3662	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Medium ring width. Weak/no curvature.
2018ii	SF3664	Powder Bottle	Body	*Acer*	Wide-medium rings. Weak/no ring curvature.
2018ii	SF3665	Powder Bottle	Body	*Fagus*	Weak curvature. Occasional tyloses
2018ii	SF3666	Powder Bottle	Body	*Fraxinus*	Very wide ring. Weak curvature. Tyloses present

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3667	Powder Bottle	Body	*Fraxinus*	Tyloses present. Weak/no ring curvature. Narrow-medium rings
2018ii	SF3668	Powder Bottle	Body	*Fagus*	Tyloses present. Weak/no ring curvature. Medium-wide rings.
2018ii	SF3669	Powder Bottle	Body	*Fagus*	Weak/no ring curvature. Occasional tyloses
2018ii	SF3670	Powder Bottle	Body	cf *Carpinus*	Weak/moderate ring curvature. Medium ring widths.
2018ii	SF3671	Powder Bottle	Body	*Betula*	Narrow-medium rings. Weak ring curvature
2018i	SF3672	Powder bottle	Body	*Fagus*	
2018i	SF3673a [?=3673b, 3673c]	Powder bottle	Body	*Fraxinus*	Tyloses present.
2018i	SF3673b [?=3673a, 3673c]	Powder bottle	Body	*Fraxinus*	Narrow rings. Tyloses present.
2018i	SF3673c [?=3673a, 3673b]	Powder bottle	Body	*Fraxinus*	Tyloses present.
2018i	SF3673d	Powder bottle	Body	cf *Carpinus*	
2018i	SF3673e	Powder bottle	Body	*Fagus*	
2018ii	SF3674	Powder Bottle	Lid	*Fagus*	Narrow rings. Weak curvature. Tyloses present
2018ii	SF3675	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Narrow-medium rings. Weak-moderate curvature
2018ii	SF3676	Powder Bottle	Lid	*Fagus*	Weak curvature. Occasional tyloses
2018ii	SF3678	Powder Bottle	Body	*Fagus*	
2018i	SF3679	Powder bottle	Body	*Populus/Salix*	
2018ii	SF3680	Powder Bottle	Body	*Fraxinus*	Medium curvature. Narrow-medium rings. Tyloses present
2018ii	SF3681	Powder Bottle	Body	*Populus/Salix*	Weak/no curvature. Medium rings
2018ii	SF3682	Powder Bottle	Body	*Carpinus*	Medium-wide rings. Weak curvature.
2018ii	SF3683	Powder Bottle	Body	cf *Carpinus*	Medium-large ring. Weak/no curvature

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2018ii	SF3684	Powder Bottle	Body	*Fraxinus*	Weak curvature. Tyloses present. Very narrow rings
2018ii	SF3685	Powder Bottle	Body	*Carpinus*	Medium ring width. Weak curvature
2018i	SF3686	Powder bottle	Body	cf *Carpinus*	
2018i	SF3687	Powder bottle	Body	cf *Carpinus*	
2018i	SF3688	Powder bottle	Body	*Fagus*	Narrow-medium ring widths.
2018i	SF3689	Powder bottle	Body	cf *Carpinus*	
2018i	SF3690a (piece with smaller lug) [=3690b]	Powder bottle	Body	*Fagus*	Wide rings.
2018i	SF3690b (piece with larger lug) [=3690a]	Powder bottle	Body	*Fagus*	
2018i	SF3690c	Powder bottle	Body [not part of 3690a and b].	cf Betulaceae Group 1	Very poorly preserved. Compressed wood structure.
2018ii	SF3696	Powder Bottle	Lid	*Fagus*	Weak curvature
2018ii	SF3697	Powder Bottle	Lid	*Fagus*	Narrow-medium rings. Weak-moderate curvature.
2018ii	SF3698	Powder Bottle	Lid	*Fraxinus*	Tyloses present. Moderate ring curvature
2018ii	SF3699	Powder Bottle	Lid	*Fraxinus*	No tyloses. Indet. ring width and curvature (poor condition).
2018ii	SF3700a	Powder Bottle	Lid	cf *Carpinus*	Medium ring width. Weak curvature
2018ii	SF3700b	Powder Bottle	Body	cf Betulaceae Group 2	
2018ii	SF3702	Powder Bottle	Body	cf *Fagus*	Weak curvature. Poor preservation.
2017i	SF3703	'Flask' stopper/spout	Pointed spout/tip only	cf *Fraxinus*[a]	Not a roundwood. Weak/no ring curvature.
2017i	SF3705	Handle	n/r	*Fraxinus*	Not a roundwood. Moderate ring curvature. Some very wide rings i.e. very fast growth.
2018ii	SF3712	Powder Bottle	Lid	*Fagus*	Wide rings.
2017i	SF3716	Handspike	n/r	*Fraxinus*	Wide growth rings, with weak curvature. Occasional tyloses. ?insect hole (oval - ?compressed).

Analysed	Small find number	Artefact	Sub-component	Wood type	Notes
2017i	SF3730	Tuning peg	Peg body	Indet.[a]	Dark reddy/brown wood.
			Circular insert	Indet.[a]	Paler wood (decoration?).
2017i	SF3732	Hammer	Handle/shaft	cf Betulaceae Group 1	Hard to sample.
2017i	SF3733	Bung	n/r	cf *Fraxinus*[a]	Weak curvature growth rings. Wide growth rings. Iron deposit.
2018i	SF3733	Bung	n/r	cf *Fraxinus*	Tyloses present. Very degraded. Iron deposit present. Moderate-weakly curved growth rings. Duplicate identification, but here, sampled.
2018ii	SF3737	Powder Bottle	Body	*Fraxinus*	Tyloses present. Weak curvature
2018i	SF3764	Wooden handle	n/r	cf *Fraxinus*	Very poorly preserved
2018i	SF3781	Cask	Stave	*Quercus*	Narrow rings. Tyloses present.
2018i	SF3782	Cask	Stave	*Quercus*	Narrow rings. Tyloses present.
2018i	SF3783	Cask	Stave	cf *Quercus*[a]	Narrow rings.
2018i	SF3784	Cask	Stave	*Quercus*	Narrow rings. Tyloses present.
2018i	SF3785	Cask	Stave	*Quercus*	Medium width rings. Tyloses present.
2017i	SF3786	Cask	Stave	*Quercus*	Narrow growth rings, with weak/no curvature. Tyloses present.
2018i	SF3787	Cask	Stave	cf *Quercus*[a]	Narrow rings.
2017i	SF3788	Cask	Cant stave (curved head piece)	*Quercus*	Narrow growth rings, with weak/no curvature. Tyloses present throughout.
2017i	SF3789	Cask	Hoop	*Corylus*	Some bark attached. Pith present. Half section of a small diameter roundwood. Strong ring curvature (≥9 rings based on those counted in the sampled section).
2018ii	SF3794	Powder Bottle	Lid	cf Betulaceae Group 2	
2018ii	SF3795	Powder Bottle	Body	*Fraxinus*	

*Table A3. Powder bottle body volume results (Categories 1 and 2 only). * = volume was measured post-conservation.*

Small Find number	Condition category	Volume (ml)	Notes on completeness relevant to capacity
3469	Category 1	18	
3470	Category 1	17	
3471	Category 2	16	Neck broken
3472	Category 1	18	
3474	Category 2	c10	Body broken, neck broken
3504	Category 2	15	
3514	Category 2	16	Neck broken
3515	Category 2	c10	Bottom cracked [water escaped]
3516	Category 2	18	Neck broken
3517	Category 2	17	Neck broken
3518	Category 2	17	Neck broken
3519	Category 2	14	Neck broken
3520	Category 2	16	Neck broken
3521	Category 2	18	Neck broken
3522	Category 2	19	Neck broken
3525	Category 2	14	Neck broken
3526	Category 1	19	
3527	Category 1	19	
3567	Category 2	14	Neck broken
3572	Category 2	16	Neck broken
3573	Category 2	14	Neck broken
3574	Category 2	18	Neck broken
3575	Category 2	15	Neck broken
3576	Category 2	14	Neck broken
3577	Category 2	18	Neck broken
3578	Category 2	17	
3579	Category 2	13	Neck broken
3580	Category 2	16	
3581	Category 1	19	
3582	Category 2	17	Neck broken
3583	Category 2	18	Neck broken
3584	Category 2	18	Neck broken
3585	Category 2	c12	Body broken, neck broken
3586	Category 2	15	Neck broken
3601	Category 1	20*	
3602	Category 2	18	Bottom and neck broken
3603	Category 2	15	
3604	Category 2	14	Neck broken
3606	Category 2	17	

Small Find number	Condition category	Volume (ml)	Notes on completeness relevant to capacity
3607	Category 2	16	Neck broken
3616	Category 2	14	Neck broken
3635	Category 2	20	Neck broken
3637	Category 2	17	Neck broken
3638	Category 2	15	Neck broken
3639	Category 2	15	Neck broken
3640	Category 2	17	Neck broken
3641	Category 2	c14	Body and neck broken
3642	Category 2	15	Neck broken
3643	Category 2	18	Neck and body broken
3644	Category 2	16	Neck broken
3645	Category 2	12	Neck broken
3650	Category 2	16	Neck broken
3651	Category 2	c12	Body broken
3664	Category 2	18	Neck broken
3665	Category 2	13	Neck broken
3666	Category 2	15	Neck broken
3667	Category 2	14	Neck broken
3668	Category 2	15	Neck broken
3669	Category 2	20	Neck broken
3670	Category 2	13	Neck broken
3671	Category 2	16	Neck broken
3678	Category 2	15	Neck broken
3680	Category 2	15	Neck broken
3681	Category 2	12	Neck broken
3682	Category 2	16	Neck broken
3683	Category 2	14	Neck broken
3684	Category 2	14	Neck broken
3685	Category 2	14	Neck broken
3689	Category 2	c10	Broken in half
3702	Category 2	21	Neck broken
3737	Category 2	15	Neck broken

Table A4. Refitted handspike fragments (by Z. Hazell and E. Aitken, June 2018)

Refitted handspike fragments	**Details of refitting**
SF3555 SF3489	Do not physically join. Tentative match based on growth rings.
SF3570 [fragment 1 of 2] SF3570 [fragment 2 of 2] SF3465 SF3438	Physical match. Growth ring match.
SF3205 SF3175	Physical match Growth ring match
SF3305 SF3307	Physical match
SF3174 SF3716	Tentative physical match Growth ring match
SF3490 SF3557	Physical match Growth ring match
SF3253 SF3293 SF3439	Physical match
SF3176	Tentative match with other three fragments, based on: from a roundwood (centre), and same woodworm damage.
SF3532 SF3535 SF3536	Physical match Growth ring match

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