THE "BARREL WRECK": A PRELIMINARY ASSESSMENT OF ITS HULL REMAINS

By Wendy van Duivenvoorde

Report—Department of Maritime Archaeology, Western Australian Museum, No. 288

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Cover photo: Looking at Table Mountain from Robben Island, South Africa.
Photograph: Jon Carpenter.

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Introduction

The “Barrel Wreck” names an unidentified ship that sank off Robben Island near Cape of Good Hope in South Africa. Located in the shallow waters of Table Bay, the wreckage known as the Barrel Wreck consists of a partially intact wooden vessel, an anchor, cannon and other ship’s fittings. It carried a cargo in barrels, possibly of goods such as spices, tar, beer and wine.

The wreck has yet to be positively identified, but preliminary archival research by Vanessa Maitland narrowed the list to six possible vessels known to have sunk in this area—all dating to the 1800s. The most likely contender was a 19th-century German vessel with a cargo of glass plates. Although archaeologists observed such glass cargo, more recent archaeological work seems to be pointing towards two French ships dating to 1756 and 1786. Dendrochronological investigations discussed in this report confirm that the ship was built after 1754 and, therefore, may support the latter theory. The ship hull remains on the site, however, can be easily mistaken for a construction method more typical of northwest European shipbuilding of early 17th century.

Nautical Archaeology Society students surveyed the site in February 2011 and January 2012 (Sharfman, 2011: 9–10). During the 2011 and 2012 conservation field schools, Jon Carpenter and Vicki Richards from the Western Australian Museum, photographed the ship’s exposed structural elements and collected timber and hair samples—mixed with a resinous substance—from the ship’s hull. The timber samples were taken on 10 February 2011 from the sacrificial planking (or wooden sheathing), two layers of hull planking (outer and inner layer of hull planking), a treenail from the inner layer of hull planking, a frame, ceiling planking, possibly an inner floor or cargo floor to protect ceiling planking, and the keel. In January 2012, Jon Carpenter and Vicki Richards set out to take an additional timber sample for dendrochronology from the hull structure investigated in the previous year. However, sediments had covered up areas of the shipwreck site exposed in 2011, and they were unable to access the previously visible timber structure. The timber for dendrochronological investigation came from hull planking that was easily accessible for sampling.

Archaeological investigation of the wood and hair species

Dr Wendy van Duivenvoorde (Flinders University, WA Museum) assessed the timber photographs and facilitated the analyses of the ship remains, i.e. Professor Nili Liphschitz (The Botanical Laboratories, Tel Aviv University, Israel) identified the wood species of the timber samples, Dr Henk Haaster (Biax Consult, Netherlands) worked on the hair remains, and Marta Domínguez Delmás (RING laboratories, Netherlands) performed the dendrochronology of a hull planking timber (Appendix 1). All samples were kept in water until their examination in the laboratory; none of the wood and hair samples were conserved, nor treated with chemicals.

Fig. 1 Wood, resinous substance, and hair samples taken from the Barrel Wreck. Photograph: Jon Carpenter.

Wood species identification

Prof. Liphschitz made cross sections and longitudinal tangential, as well as radial, sections for each samples with a sharp razor blade. She identified the wood microscopically up to the tree species, based on the three-dimensional structure from these sections. Comparison was made with reference sections prepared from systematically identified recent trees and shrubs and with anatomical atlases.

The results show that the keel, two layers of hull planking, the outer layer of ceiling planking, a treenail fastening a frame to the inner layer of hull planking, and a frame were all made of *Quercus robur* (English oak). The wooden sheathing, inner floor planking (cargo floor), and wood from the starboard side were all made of *Pinus sylvestris* (Scots pine) (Table 1).

Quercus robur grows up to 45m tall and is widespread throughout Europe except in the extreme north. It is widely planted for timber. *Pinus sylvestris* can attain heights up to 35–50m and is common throughout Europe, having the widest distribution of all pines. These two tree species have similar patterns of distribution in Europe.

Table 1: Trees used in the construction of the Barrel Wreck.

No.	Catalogue No.	Description of the Sample	Rough dimensions of the timbers	Tree species
1	BW-4	Sheathing (sacrificial planking)	Th. 2.5 cm	*Pinus sylvestris*
2	BW-H	Outer layer of hull planking	Th. 9 cm	*Quercus robur*
3	BW-C	Inner layer of hull planking	Th. 11 cm	*Quercus robur*
4	BW-D	Treenail from inner hull planking BW-C	-	*Quercus robur*
5	BW-F	Frame	Sided 33 cm and molded 44.5 cm	*Quercus robur*
6	BW-G	Outer layer of ceiling planking	Th. 12 cm	*Quercus robur*
7	BW-E	Inner floor (cargo floor) planking	Th. 25 cm	*Pinus sylvestris*
8	BW-P	Keel	-	*Quercus robur*
9	BW-8	Unidentified timber on starboard side, near 85 (on plan)	-	*Pinus sylvestris*

Photographic assessment

The sketch and photographs made by Jon Carpenter and the results of the wood species identification seemed to show resemblances in construction and materials to VOC ships *Mauritius* (1609), *Batavia* (1629) and the Dutch-built Christianshavn B&W 2 ship (Van Duivenvoorde, 2008; Lemée, 2006; L'Hour et. al., 1990; 1989). The rough dimensions of the Barrel Wreck's timbers, as recorded by Carpenter, are listed in Table 1. Large, ocean-going ships destined to sail to the Americas or Indies in the early 17th century, such as Dutch East India Company ships, were constructed using a bottom-based construction method with two thick layers of oak hull planking below their waterline. This method entailed assembly of the ship's bottom planking first, before the frames were inserted. After the frame floors and first futtocks were fastened to the bottom planking, the second futtocks of the ship's sides were erected. Hull planks were then nailed to the latter above the ship's bottom in a plank–on–frame fashion (Van Duivenvoorde, 2009: 61–62).

Although no assertions can be made on the Barrel Wreck's construction method, its hull remains seem to indicate that the ship was built with two thick layers of oak hull planking (Table 1); the outer layer measuring 9 cm and the inner layer 11 cm in thickness (Fig. 2).

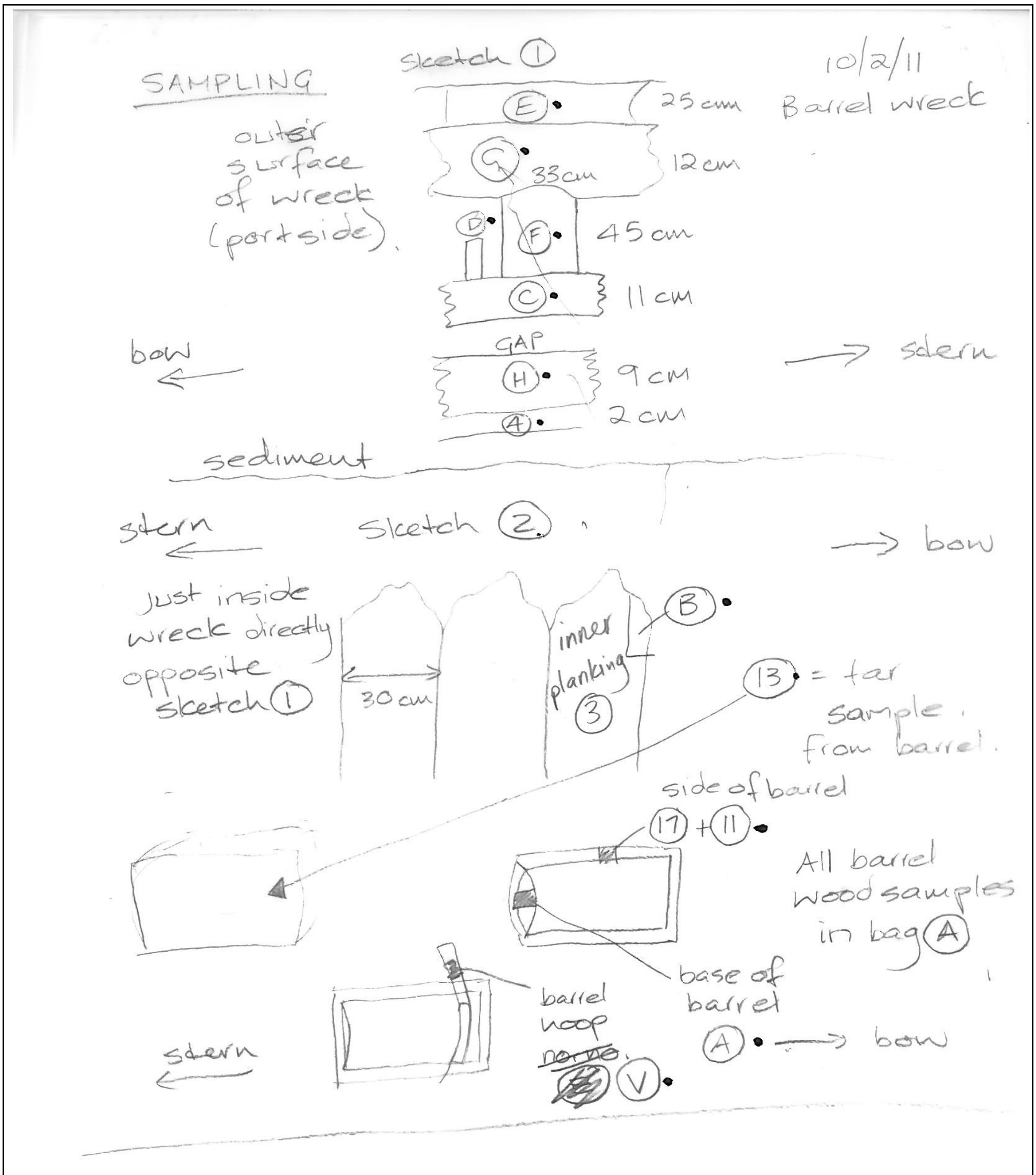

Fig. 2 Location of wood samples taken from exposed timbers. Sketch: Vicki Richards.

Double hull planking was used as early as 1595 in Dutch shipbuilding for the construction of large ocean-going vessels. This construction technique, however, was short lived; sometime after the 1650s, double hull planking was no longer employed in the construction of large merchantmen and warships, with the exception of whaling vessels (Van Duivenvoorde, 2008: 442). The first example of a Dutch East India Company ship with a single layer of hull planking is *Vergulde Draak,* which sank off the Western Australian coast in 1656. It must be noted that not only Dutch-built ocean going vessels were built with two excessively thick layers of oak hull planking. Recent work on the Virginia Company ship *Warwick*, which sank off Bermuda in 1619, has shown a similar construction with two thick layers of oak hull planking (Custer Bojakowski and Bojakowski, 2010: 50–51). However, the Dutch were exporting large numbers of seagoing ships to other European countries in the 17th century, in particular in the first half of the 17th century (Van Duivenvoorde 2008: 16).

In addition to double planking the hulls, the Dutch East India Company—and India company shipbuilders in other European nations, such as England, Denmark, and Sweden—often outfitted its ships with an additional layer of pine sheathing to protect the hull from the ravages of marine borers. This sacrificial sheathing was fastened with iron nails to the outer layer of hull planking, with the nails closely spaced in order to create a layer of iron rust to provide additional protection against marine organisms. This method became a standard worm-protection measure throughout the 17th and 18th centuries.

The archaeological remains of all VOC ships, such as *Mauritius* (1613), *Batavia* (1629), *Vergulde Draak* (1656), *Avondster* (1659), *Kennermerland* (1664), *Risdam* (1727), *Zuiddorp* (1712), *Zeewijk* (1727), *Buitenzorg* (1760), and *Nieuwe Rhoon* (1776), and many other European ships, in particular English and French, from this period have provided evidence for such protection (Van Duivenvoorde, 2008: 351). Pine sheathing generally varies in thickness between 2.5 and 5 cm depending on its location on the hull and the date of the vessel.

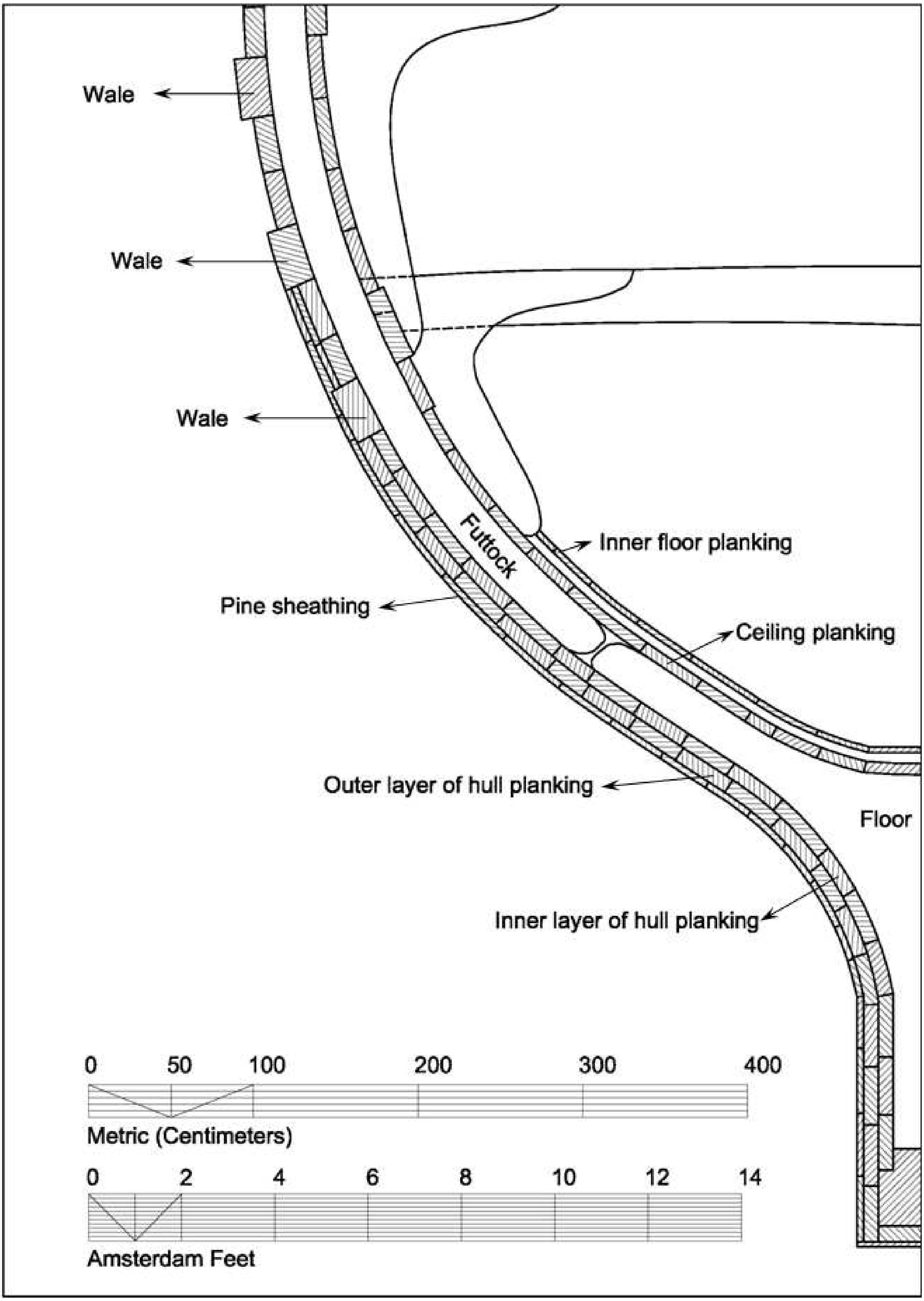

Fig. 3 Cross-section of *Batavia*'s hull showing all layers of planking and frame timbers.
Illustration: Wendy van Duivenvoorde.

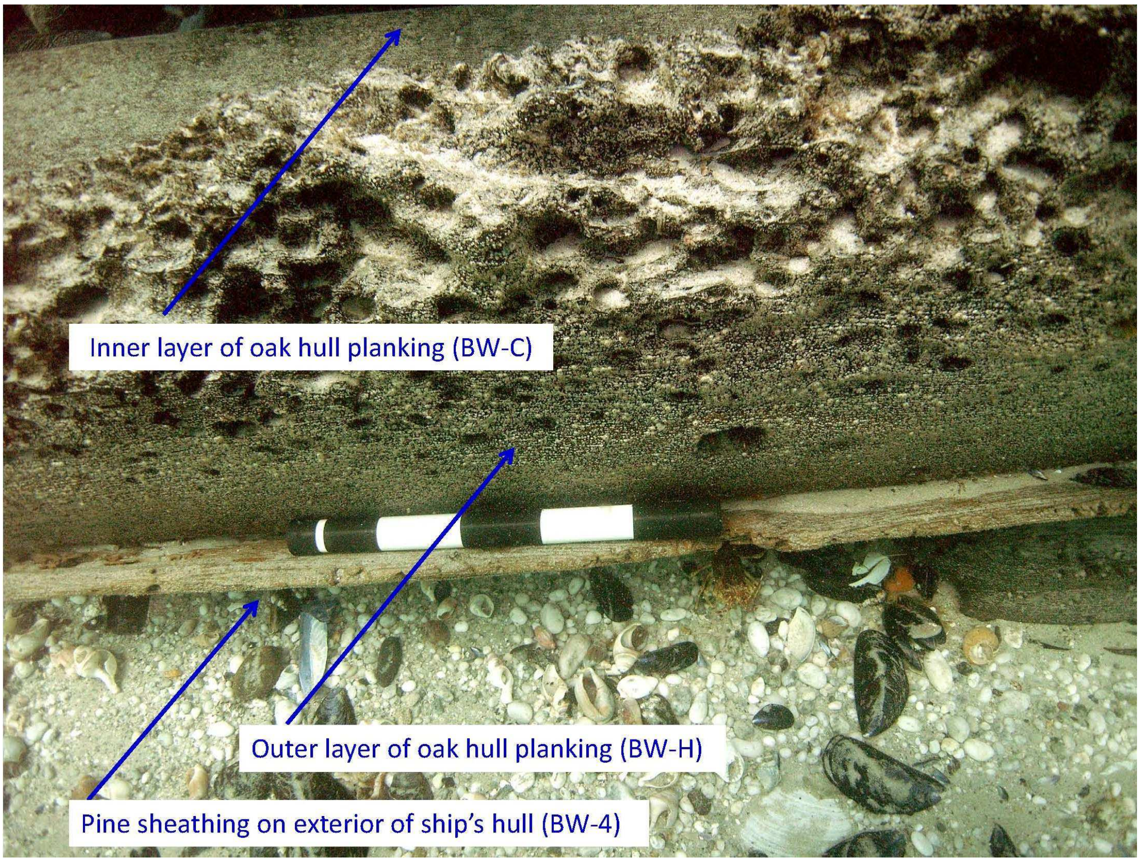

Fig. 4 Two layers of oak hull planking and a sacrificial layer of pine sheathing, Barrel Wreck. Photograph: Jon Carpenter.

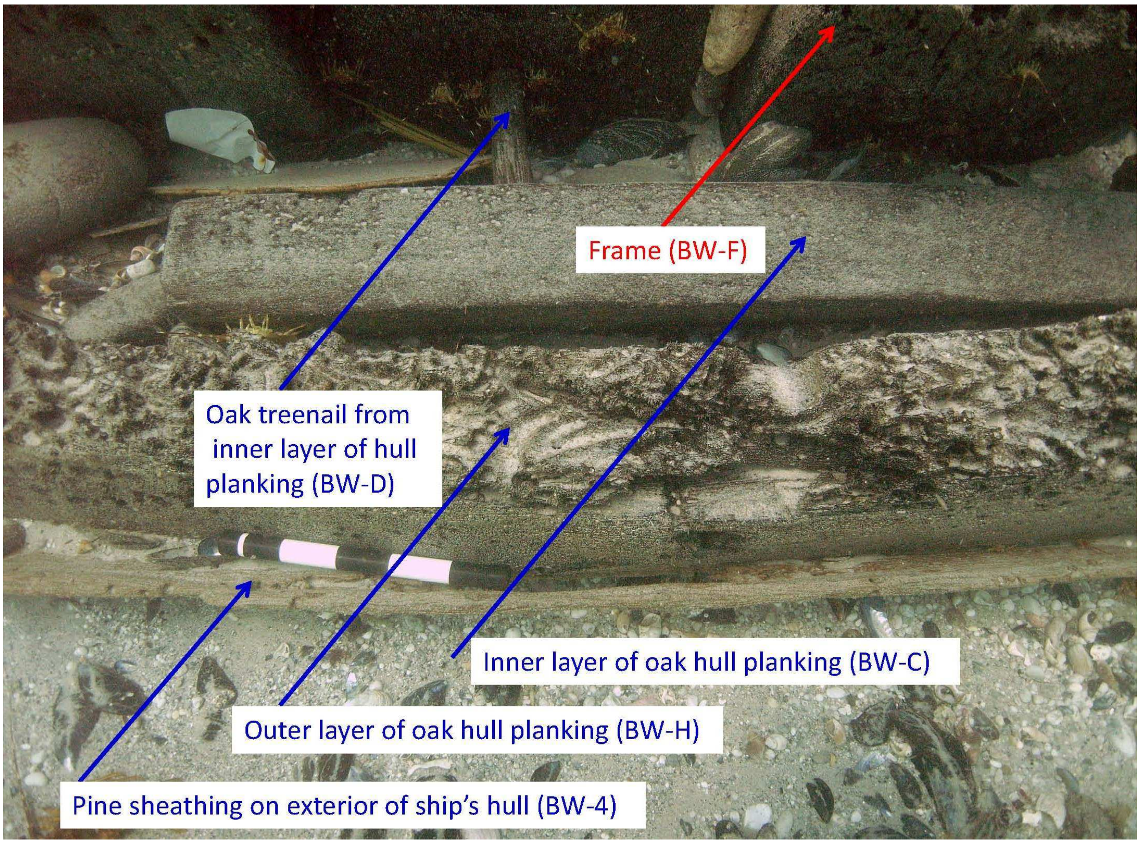

Fig. 5 Two layers of oak hull planking and a sacrificial layer of pine sheathing, Barrel Wreck. Photograph: Jon Carpenter.

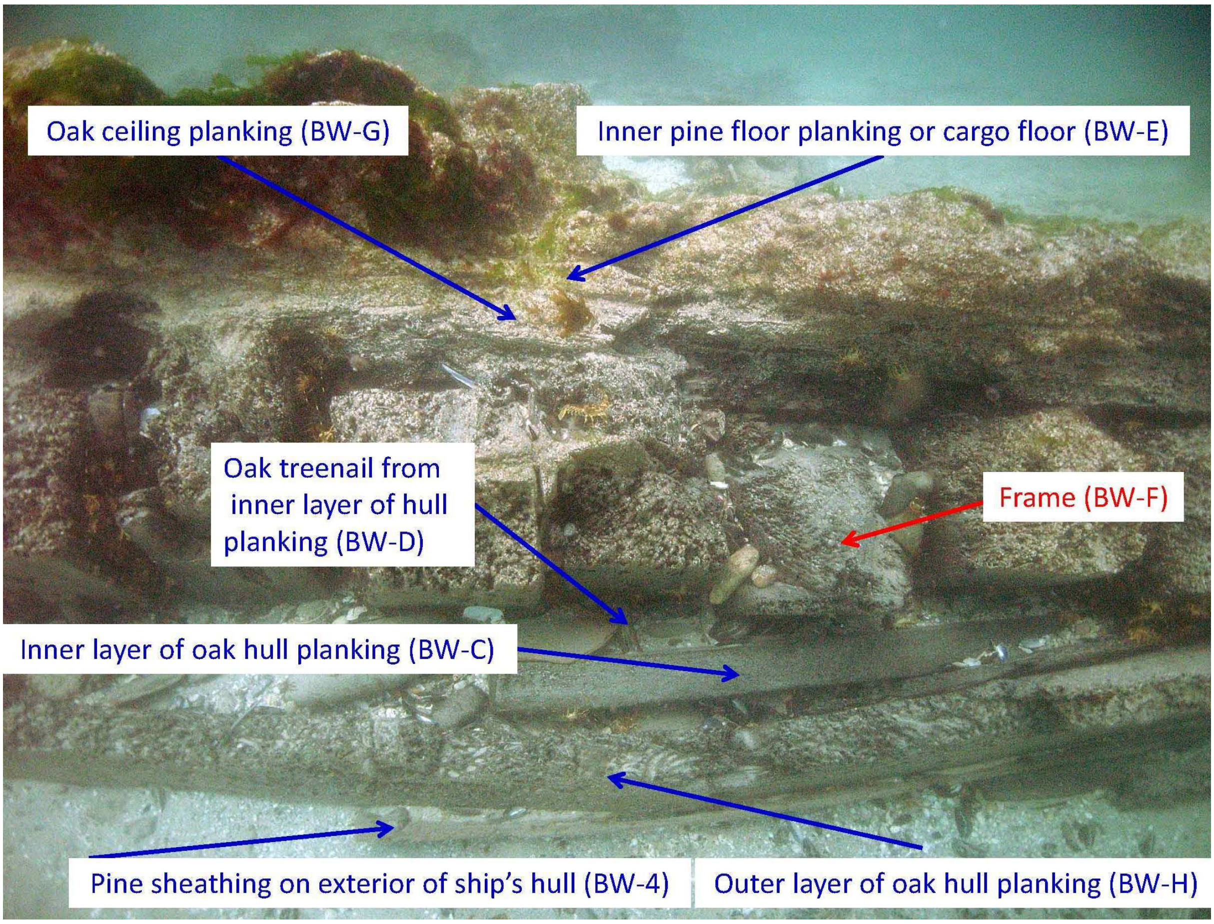

Fig. 6 Two layers of oak hull planking and a sacrificial layer of pine sheathing, Barrel Wreck. Photograph: Jon Carpenter.

Lead sheathing on stems and sternposts

Archaeological and historical evidence indicate that the stems, keels, and sternposts of ships were sheathed with copper or lead as early as the late 16th and early 17th centuries. For example, the sternposts of VOC ships, such as *Nassau* (1606), *Batavia (1629)*, *Vergulde Draak* (1656) and the Christianshavn B&W 2 ship were all sheathed with copper; a practice continued on VOC ships, as evidenced by the archaeological remains of VOC ship *Buitenzorg*, built at the Amsterdam shipyard in 1753. Archaeological evidence has shown that it was standard VOC practice to sheath the sternposts of its ships with copper sheets (fastened with copper sheathing tacks) throughout the Company's existence. In the case of *Batavia*, the preserved sheathing on the sternpost consists of one layer of copper sheets, whereas *Vergulde Draak*'s sternpost was covered with multiple layers of copper with lead sheathing in between.

No archaeological evidence has been found to date to confirm copper or lead sheathing of the stem on 17th- or 18th-century VOC ships, but Company archives often refer to sheathing of the stem, keel, and sternpost with lead or copper (Van Duivenvoorde, 2008: 444). Other European countries undoubtedly took similar measures to protect the back bones of their ships with lead and copper sheathing.

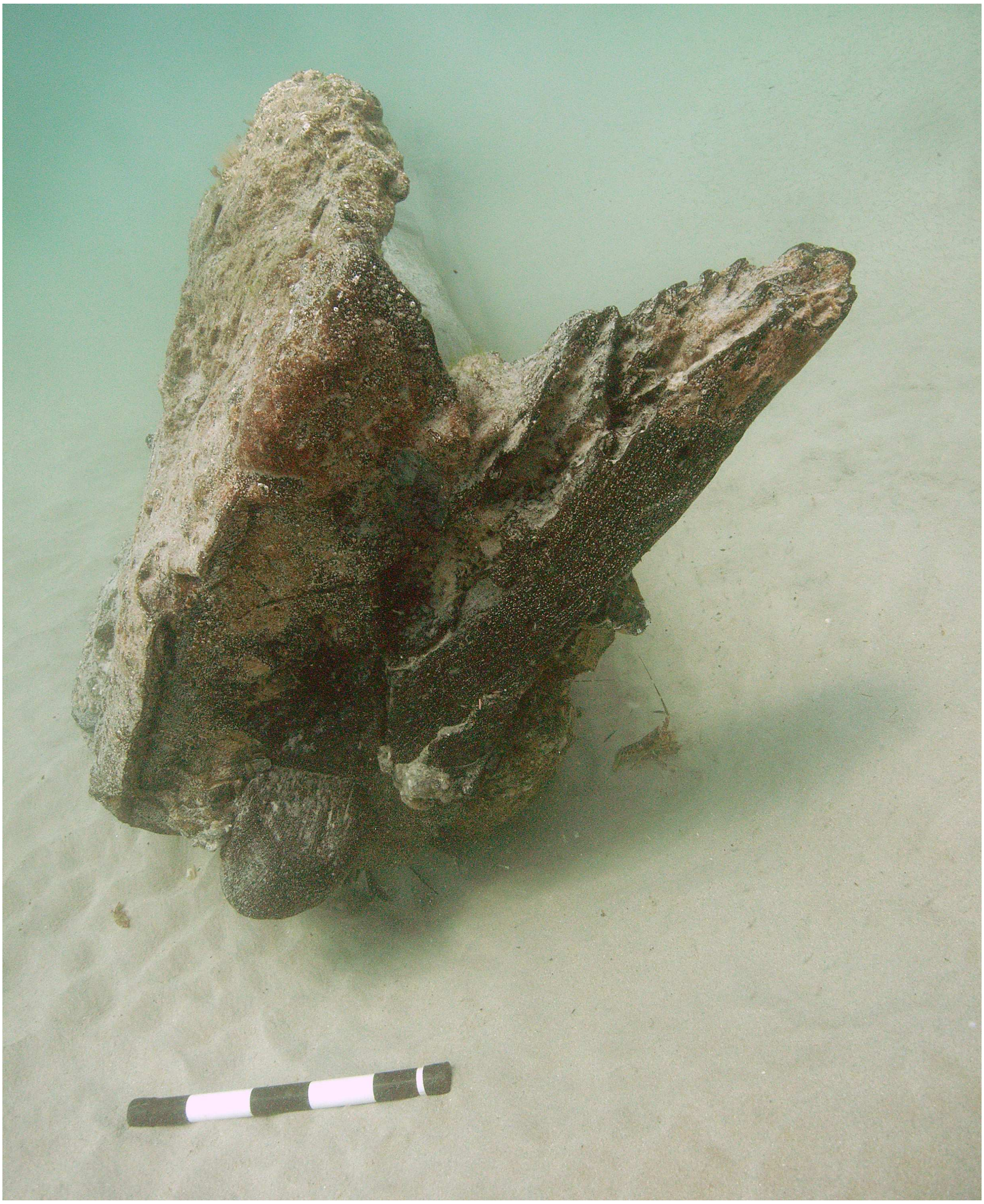

Fig. 7 Lead sheathing at aftermost end of the sternpost, Barrel Wreck. Photograph: Jon Carpenter.


Fig. 8 Lead sheathing on the stem, Barrel Wreck. Photograph: Jon Carpenter.

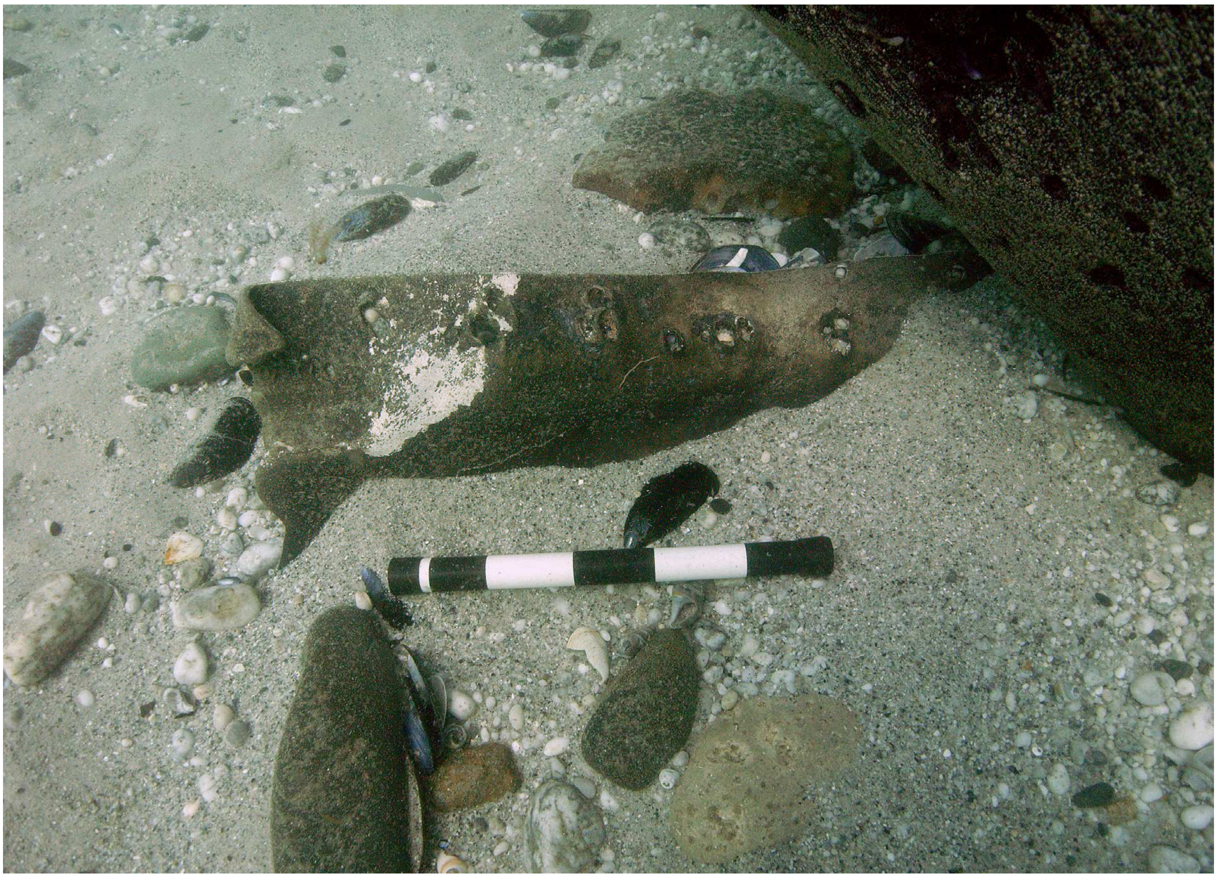
Fig. 9 Metal sheathing detached from the ship's hull, Barrel Wreck. Photograph: Jon Carpenter.

Animal hair and resinous substance

A very thin layer of animal hair was applied the Barrel Wreck's hull with a resinous substance. Two sample of hair were sent to Henk Haaster, a specialist in archaeological animal hair identification. Dr Haaster noted that both samples are poorly preserved and he could not make a positive identification. The hair in one sample seemed to have a structure similar to cattle hair, and the other sample had one root similar to that of cattle. However, more samples are needed to make a positive identification. Like pine sheathing, layers of animal hair have been observed in many shipwrecks between the hull planking and sacrificial planking, but little scientific study has been conducted on this material type to identify it properly. An overview of hair identification studies can be found in Van Duivenvoorde 2008, pages 179–187.

For Dutch ships, cattle hair seems to be the material assumed based on historical research, as seen in the early publications of the *Batavia* ship itself and, more recently, VOC ships *Mauritius*, *Kampen* (1627), and *Buitenzorg* (1760). This assumption probably follows Witsen and Van IJk, who both mention explicitly the use of cattle hair in the 17th century. The earliest VOC shipbuilding charter of 1603 simply refers to hair, not the hair of any specific animal (Van Duivenvoorde, 2008: 483).

Thin layers of animal hair (approximately 0.005 m thick) were applied between the hull and sacrificial planking of *Batavia*, *Vergulde Draak*, *Zeewijk* (1727) and *Zuiddorp* (1712). Research into the actual animal hair, applied to the hulls of these four VOC ships provided some unexpected results: Seven hair samples from *Batavia*, five from *Vergulde Draak*, and one from *Zeewijk* were positively identified as goat. However, a sixth sample from *Vergulde Draak* and one from *Zuiddorp* were identified as being from cattle and comprised of primary guard hairs, which clearly show the diagnostic marker for cattle hair, the so-called globular vacuoles (Van Duivenvoorde, 2008: 179–187, 302– 305). Cattle and goat were the largest populations in Dutch animal husbandry since the early medieval period, which, for example, is demonstrated by the leather used to manufacture shoes from the eleventh century onwards. Leather shoe remnants found in archaeological contexts in the Netherlands are made primarily from cattle or goat hides.

The resinous substance from the Barrel Wreck is currently being analyzed by Ian Godfrey from the Department of Materials Conservation of the Western Australian Museum.

Dendrochronology: Dating the ship's construction and provenance its timber

The most important results in this preliminary report are those of the dendrochronological investigation performed by Marta Domínguez Delmás from RING laboratories in the Netherlands (see for full report in Appendix 1). Study of the hull planking sample shows that the timber came from a tree that grew somewhere in the North of Germany and was felled sometime after AD 1754. Unfortunately, the sample did not provide a specific date range in which the tree could have been felled due to the absence of sapwood.

The results, however, are concomitant with the historic research conducted by Vanessa Maitland, the recent confirmation of the origin and date of the lead ingots from the shipwreck site, and it supports the theory that the shipwreck is that of a late 18th-century French shipwreck (Email correspondence Bill Jeffery and Gwen Smart, 2 February 2012).

Preliminary conclusion and recommendations

The hull remains on the Barrel Wreck site seem to display features typical for early 17th-century northwestern European ship construction, i.e. double hull planking with a layer of pine sheathing. However, the dendrochronological assessment clearly indicates that the ship was built after 1754. Although timber identified came from a tree felled in northern Germany, this data does not provide any clues on the origin of the ship, i.e. where it was built, nor under which flag it sailed, as European nations all imported their shipbuilding timber.

Therefore the following recommendation should be taken into consideration: Have a specialist in northwestern European shipbuilding, with experience in the study of archaeological ship timbers dating to the late 18th century, conduct a proper preliminary assessment of the ship's hull construction. Especially, if the Barrel Wreck was planked with two layers of hull planking and a third layer of pine sheathing below the waterline—i.e. the two layers of oak hull planking are not localized repairs or the result of visual illusion due to a post-deposition process—, it would make an excellent wreck for the study of ships' hull construction as only few examples with such construction features are known from this period other than whaling vessels.

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Appendix 1: Report on dendrochronology by Marta Domínguez Delmás, RING.

ring
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Mrs. dr. W. van Duivenvoorde
Flinders University
GPO Box 2100
Adelaide SA 5001
Australia

Subject: dendrochronological research of a sample from an unidentified shipwreck found in South Africa

RING's quotation number: O2012008
***RING* report number: 2012020**

Amersfoort, 15 March 2012

Dear Mrs. Van Duivenvoorde,

Hereby we inform you about the results of the dendrochronological research performed on a sample from an unidentified timber element pertaining to an unidentified shipwreck found in South Africa. The definitions of the terms used in the report, as well as several figures and additional information are included in Appendix 3.

The wood species corresponds to some deciduous oak species (*Quercus* subg. *Quercus)*. The oaks included in this subgenus cannot be differentiated from each other by their wood anatomy (Schweingruber, 1990), therefore an identification down to the species level cannot be provided.

After cleaning several rays in the transversal surface of the sample (from the pith to the outermost visible ring as indicated in Figure 1, Appendix 1), we obtained a continuous tree-ring series containing 130 rings. The comparison of this tree-ring series with the master chronologies of oak available at the Ring Foundation (see http://www.noaa.nl/content/hst03/h3.1.4.2.htm#143) resulted in the absolute dating of the sample, with the most recent ring dating in AD 1742 (see Table 1 in Appendix 2, and Figure 2 in Appendix 3).

The tree from were the timber originates grew somewhere in the North of Germany and was felled after AD 1754. The fact that there is no sapwood present in the sample hampers any possibility to provide an interval of dates in which the tree could have been felled.

Yours sincerely,

Marta Domínguez Delmás.
Dendrochronologist, RING Foundation – Dutch Centre for Dendrochronological Research.

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 1. Transversal section of the sample

Figure 1. Transversal surface of the sample, showing the cleaned areas where the ring-widths have been measured. The red arrows point at the direction of the measurements, from the inner to the outer rings.

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 2. Statistical results of the dendrochronological research

Table 1. Statistical results of the sample with the master chronology

Description sample	Wood species	RING's Dendro-code	N	Pith	Sapwood	Bark edge	Begin year	Last year	Felling date*	*t*	%PV	*p*	Master chronology
Sample from unknown element	Oak (*Quercus* sp.)	SAS00010	130	+1	-	>12	1613	1742	After AD 1754	7,84	70,8	0,0001	NLNSA502

* Felling date estimated according to Jansma (2007).

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 3. Visual synchronisation of the tree-ring series with the master chronology

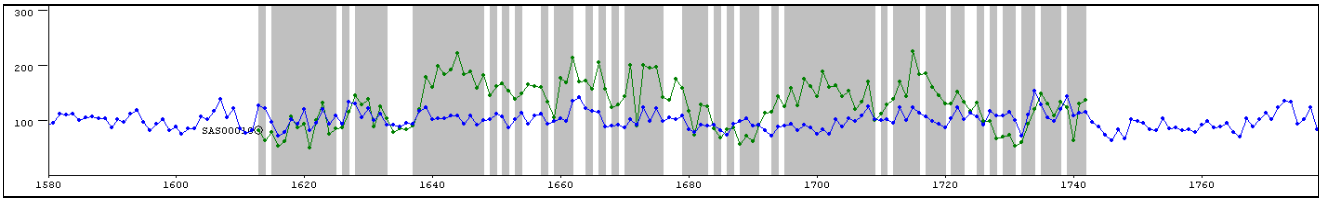

Figure 2. Green: tree-ring series from the sample SAS00010 (the circle indicates that the pith is present in the sample); blue: master chronology NLNSA502. Y-axes: tree-ring widths in mm*10^{-2}; X-axis: calendar year. The grey area indicates the percentage of parallel variation (%PV) between the overlapping part of the sample and the master chronology.

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 4. Glossary

RING's dendro-code	=	Code assigned by the Ring Foundation to the measurement of a sample.
N	=	Total number of measured rings in the sample;
Pith	=	Centre of the tree; +1/-: pith present/absent;
Sapwood	=	Number of sapwood rings measured. According to Hollstein (1980), oaks in Germany show an average number of sapwood rings of 16±5 in trees up to 100 years old, 20±6 rings in trees between 100 to 200 years old, and 26±8 in trees older than 200 years. At the Ring Foundation we use a new, revised calculation for sapwood archaeological / historic timber dating back to Dutch and German chronologies (Jansma 2007).
Bark edge	=	Boundary between the last ring and the bark; WK: bark edge present; when absent, an estimation of the number of rings to the bark edge might be given (depending on the wood species);
Begin year	=	Date of the first ring (closest to the pith of the tree) measured in the sample;
Last year	=	Date of the last ring (most recent ring, closest to the bark of the tree) measured in the sample;
Felling date	=	Date of the last ring plus the estimated mean number of rings to the bark edge when the WK is not present;
Overlap	=	Number of overlapping rings between two curves in the matching position;
t	=	Student's *t*-value after normalization of the data using Hollstein's (1980) algorithme; this value is used to identify the match between two tree-ring series for which the correlation reaches its highest value. Student t-values over 5 for an overlap of 100 rings are likely to indicate a match;
%PV	=	Percentage of parallel variation; this value indicates, for the overlapping period between two tree-ring series, the percentage of years in which the ring-widths increase or decrease similarly. Values higher than 70%, for an overlap of 100 rings are highly significant and indicate a match. The significance of this value is directly related tot he length of the overlapping period;
p	=	Significance of %PV;
Master chronology	=	Chronology that served to date the sample.

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 5. Master chronology used to date the sample

NLNSA502 Cluster 5 (Van Daalen, 2003).

RING-report 2012020, Sample from an unidentified shipwreck found in South Africa

Appendix 6. References

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