

HMS Colossus

SEDIMENT LEVEL MONITORING 2014

EH6935



Project Report

Kevin Camidge

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Cover photograph: Composite image of the upper deck guns from the south (Photo by Peter Menear)

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3H Consulting



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Otter Watersports

The Team



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Project Name

Colossus Sediment Level Monitoring

Background

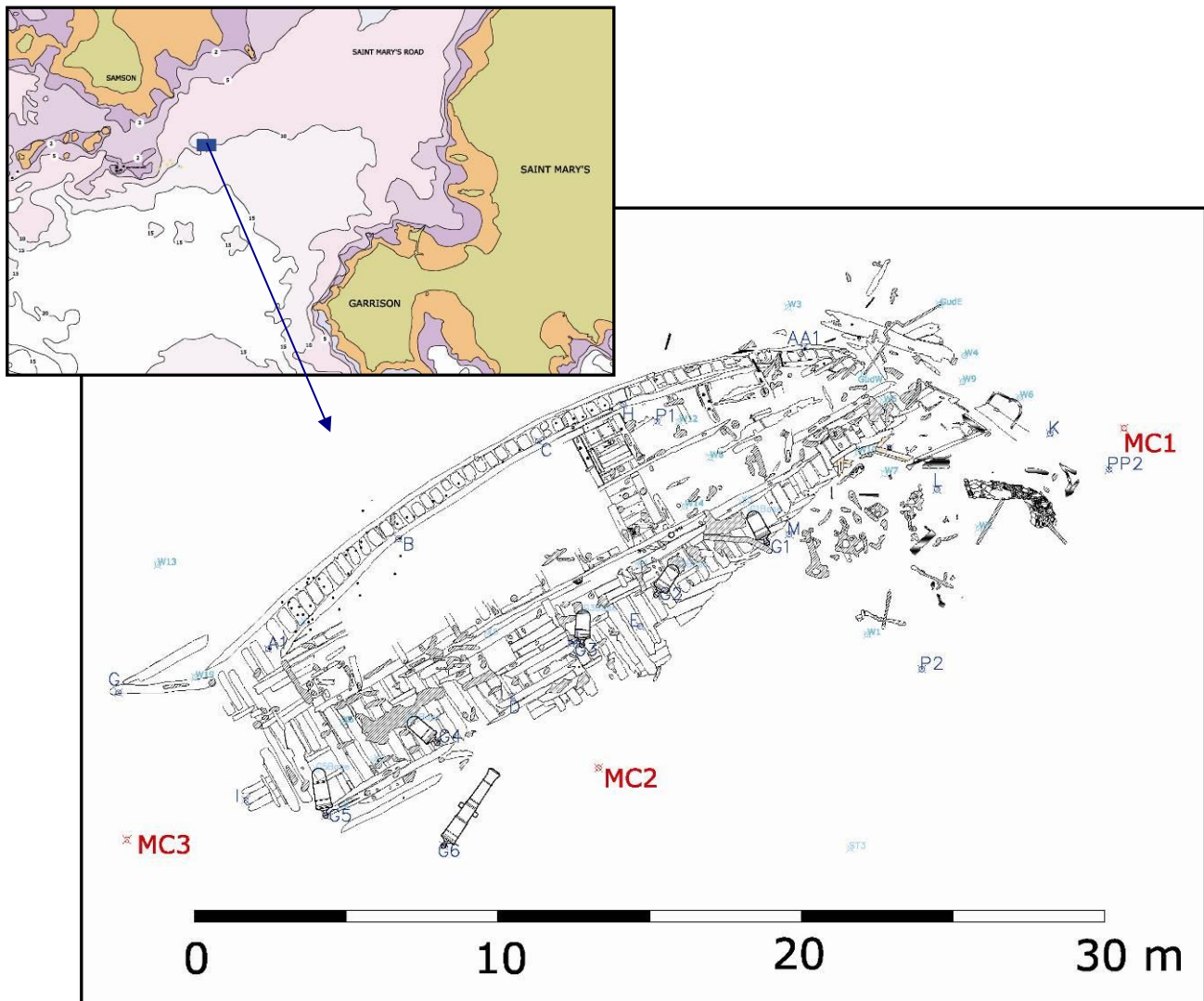


Fig 1. The stern of Colossus as drawn in 2003. The inset shows the location in St Mary's Roads, Scilly.

The Ship

HMS Colossus was a 74 gun warship built in 1787 at Gravesend and wrecked off Samson in the Scillies in 1798. These 74 gun ships were one of the most successful types of the period. They were typically about 51m (170 feet) in length and had a crew of over 600. During her relatively short working life (eleven years) *Colossus* saw action at Toulon, Groix, Cape St Vincent and Cadiz. She also took part in the capture of two enemy ships in 1793: *Le Vanneau*, a French 6-gun ship; and *Vrai Patriot*. She had no less than nine different captains during her relatively short career. She had a complete refit, which took six months, in 1796.

In December 1798 *Colossus* was on her way home to England with wounded from the Battle of the Nile and with cargo including part of Sir William Hamilton's second collection of Greek pottery. She was sheltering from a gale in St Mary's Roads when the anchor cable parted and she was driven aground to the south of Samson. All but one member of the crew were taken off safely before *Colossus* turned onto her beam ends and proceeded to break up.

Vital Statistics

Length (MGD)	172' 3" (52.5m)
Breadth	47' 9" (14.6m)
Tonnage	1703 tons
Draught (hold)	20' 9½" (6.3m)
Standard armament	28 x 32lb main gun deck 28 x 18lb upper gun deck 14 x 9lb quarter deck 4 x 9lb forecastle
Ballast	110 tons of iron ballast and 250 tons of shingle
Ordered	13 th December 1781
Laid down	October 1782
Launched	4 th April 1787

The Site

The wreck of HMS *Colossus* lies to the south of Samson in the Isles of Scilly. To date, two main areas of wreckage have been identified - the bow and the stern. In 1975 part of the wreck (probably the bow) was designated under the Protection of Wrecks Act. This designation was revoked in 1984. The current site, the stern, was designated in 2001, and is located at Latitude 49° 55'.471N, Longitude 006° 20'.505W (260154.906E 5535593.077N UTM zone 30, WGS84).

Previous work

Salvage work took place on *Colossus* from the time of her loss until the early part of last century. Work included Braithwaite and Tonkin 1803-1806, the Dean Brothers in the 1830s and possibly Western Marine Salvage in the early part of last century.

Roland Morris, a marine salvager and proprietor of the Penzance Maritime Museum, began searching for the wreck of *Colossus* in 1967 using a small team of divers. In August 1974 they located material relating to *Colossus*. The site was designated in 1975 under the Protection of Wrecks Act 1973. A large quantity of pottery, remains of Hamilton's second collection of pottery, was recovered and deposited in the British Museum – where at least one of these reconstructed pots is now on public display. Once Morris' team had finished their work, the site was de-designated in 1984. The current whereabouts of the other material removed from the site by Morris is for the most part unknown.

Areas of exposed timber and iron guns were discovered by local divers in 2001. This material was some distance to the east of the area worked by Morris and turned out to be part of the stern of *Colossus*. This was designated in July 2001. Late in 2001 the Archaeological Diving Unit (ADU) excavated at the stern of *Colossus* as well as around a piece of carved timber, which turned out to be one of the stern quarter-pieces of the vessel.

In 2002 a quarter-piece, part of the stern decoration of the vessel, was recovered from the site. This was conserved at the Mary Rose Trust, and has now been returned to Scilly for display on Tresco. Later that year a small, limited excavation was undertaken on the site to establish the nature and extent of the structural remains.

In 2003, a two-year site stabilisation trial was commissioned by English Heritage, to determine the most effective method of slowing down the deterioration of the exposed timbers on the seabed. This determined that on this site the most effective form of stabilization is a layer of Terram 4000 (Camidge, 2009).

In 2004 and 2005 the Cornwall and Isles of Scilly Maritime Archaeology Society (CISMAS) carried out a survey of the debris field surrounding the wreck of *Colossus*. This demonstrated the presence of large quantities of material from *Colossus* extending beyond the area covered by the current designation.

Between 2002 and 2012 the author carried out monitoring of the sediment levels on the site. This work has demonstrated that the sediment levels around the stern section of *Colossus* have continued to fall throughout this period.

In 2008 a small area at the stern of the wreck was protected with a geotextile covering of Terram 4000. The efficacy of this type of protection on this site was established in the stabilisation trials commissioned by English Heritage (Camidge, 2009). Timber sample blocks were installed beneath the Terram mat and on the seabed. A small seabed sign was also installed to inform visiting divers of the function of the Terram protection. Before the Terram was installed, the area to be covered was recorded in detail along with a control area, so that the long term effects of the stabilisation could be determined. The same year a diver trail was installed on the site and an underwater guide book produced, copies of which are held by the local dive charter boats for the use of visiting divers. This work was commissioned by English Heritage.

In 2010, a monitoring survey of the small objects exposed on the seabed around the exposed timbers of the wreck was undertaken. The aim of this survey was to allow the amount of object mobility, loss and deterioration to be determined in subsequent monitoring surveys.

The most recent work on this site was in 2012 when a small excavation was undertaken on the stern section of the site. There were a number of reasons for this undertaking: investigation of the main gun deck ordnance, recording of a main gun-deck port, and detailed recording of the post-wrecking stratigraphy present on the wreck. Recording of newly exposed wreck material was also undertaken in phase two of the project, along with monitoring of mobile surface artefacts. The on-going recording of the sediment levels on the site was continued. In addition to these site specific enquiries, a number of more general aims were achieved. These included investigation and appraisal of different excavation methods and recording regimes, and the initiation of a long-term reburial trial on the site using real archaeological objects rather than modern tokens. Finally, an opportunity to gain experience in underwater excavation was offered to two separate 'trainees', who were able to use this experience towards their NAS part II and III qualifications.

All the reports relating to the CISMAS work on *Colossus* can be downloaded at www.cismas.org.uk

Project Aims and Objectives

Renew Sediment Level Monitoring Points

The principal aim of this project was to renew the sediment level monitoring points around the wreckage exposed on the seabed. Sediment level monitoring began on the site in 2003 as part of the *Colossus* site stabilisation trials commissioned by English Heritage (EH 3593). A copy of the full stabilisation report can be downloaded at www.cismas.org.uk. (Camidge, 2005) The fluctuating sediment levels around the site have been recorded each year relative to fourteen fixed points (M1-M8 and M10-M15) – these are positioned as shown on the location plan below. The results of the sediment level monitoring have been presented each year in the annual licensee’s report submitted to English Heritage.

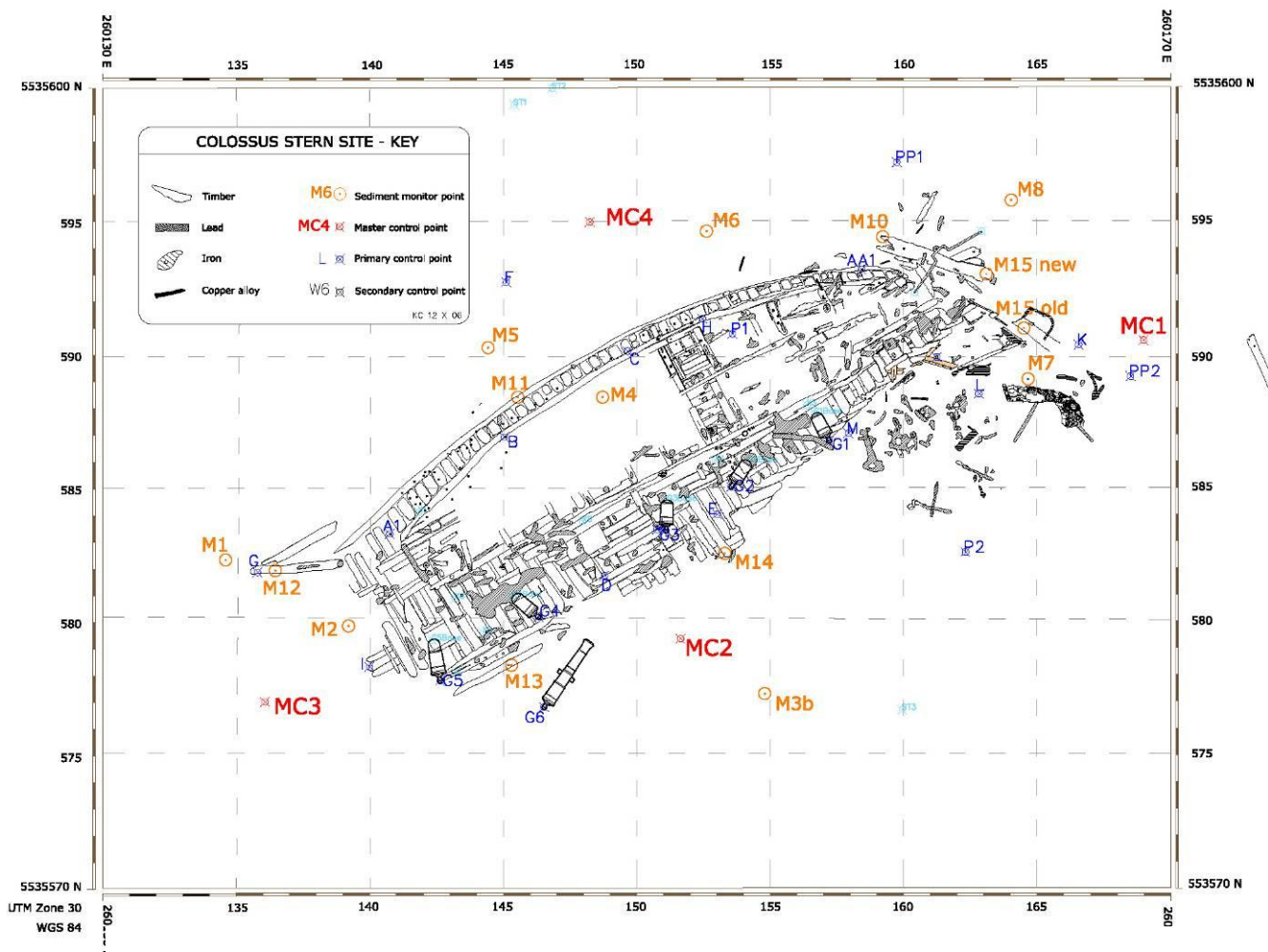


Fig 2. Plan showing the locations of the sediment monitoring points M1-M15 (pre July 2014)

Sediment level measurements had been last taken on 13th October 2013. It was then noted that three of the sediment monitoring points (M10, M11 and M12) were missing as the timbers they were attached to no longer survived. Several other monitoring points were in a precarious state and were deemed unlikely to survive much longer.

Maintenance of the Dive Trail

The dive station marker floats become fouled with marine growth, making it difficult to read the station number. New numbered station markers treated with anti-foul paint were installed. At the same time new rope risers (used to attach the numbered floats to the concrete blocks) were also installed. This should extend the life of the dive trail for several more years.

Extending the Dive Trail

One of the lower gun deck 32lb guns lies some 30m to the south-east of the last station (number 11) on the current dive trail. As none of the lower deck guns survive on the site it was decided to add this to the existing dive trail. The dive trail underwater guide was updated to take account of this addition.

Peripheral Survey

A search of the area to the immediate south-west of the wreck was made.

Permissions

A licence from the Marine Management Organisation was not required for this project. The project was discussed with Joanna Woolef of the MMO and was deemed to be exempt from the requirement for an MMO licence.

The project was also discussed with Michael Bapty of Knight Frank (acting for the Crown Estate) and it was confirmed that a licence for this project is not required from the Crown Estate.

A survey licence under the Protection of Wrecks Act is already held by the author. As the only intrusive activity anticipated was the placing of the sediment monitoring pins – which are physically identical to survey control points – the survey licence was deemed sufficient.

Stakeholders

The following are the main stakeholders associated with this project.

English Heritage

The Colossus site is designated under the Protection of Wrecks Act.

CISMAS

The Cornwall and Isles of Scilly Maritime Archaeology Society have undertaken a number of projects on this site. They will also undertake the fieldwork associated with this project.

The Isles of Scilly diving community

This includes the three dive charter boat skippers on Scilly: Tim Alsop, Jo Williams and Dave McBride; they regularly take divers to the dive trail on this site. Todd Stevens (one of the other licensees on the designated wreck site of *HMS Colossus*) is also a very active historic wreck excavator in Scilly.

The Crown Estate

The seabed within 12 nautical miles is largely owned by the Crown and managed by the Crown Estate.

The Duchy of Cornwall

The Duchy of Cornwall owns and operates the harbour at St Mary's. They are always informed of CISMAS maritime projects in Scilly.

Isles of Scilly Museum (St Mary's)

The Isles of Scilly Museum has taken the archive and artefacts from previous projects on this site. They have agreed to take the objects recovered during this project.

Marine Management Organisation

A licence from the MMO was not required for this project. The project was however discussed with the MMO prior to commencement of the project.

The Receiver of Wreck (MCA)

All finds recovered were reported to the Receiver of Wreck.

Results

Sediment Monitoring

All fourteen sediment monitoring points were renewed. The sediment monitoring points (SMP) now consist of one metre long 10mm diameter stainless steel rods. Each rod has a 25mm stainless steel ring welded to its top end to allow for easy attachment of labelling tags (using heavy duty cable ties). In addition, each of these rings has the number of the SMP stamped into its surface – to ensure easy identification even if the plastic tags become detached. The new, one metre rods have been driven into the seabed to a uniform depth; each has exactly 0.15m of its length protruding above the seabed as it existed in July 2014. To maintain consistency with previous results the levels will still be reported relative to those existing in 2003.



Fig 3. Detail of sediment monitoring pins showing the attached rings with identity stamps



Fig 4. Sediment monitoring pin M7 installed on the seabed (July 2014)

The majority of the points were placed in exactly the same location as their predecessors. The points which were previously attached to the timber of the wreck (M10 to M15) have been installed in locations very close to those previously used (usually within 0.05m). The new locations are shown in fig 7 below. The sediment levels were recorded before the new monitoring points were installed. This data shows that there has been a significant fall in the sediment levels on the site since the levels were last measured in October 2013. This may be due to the series of severe storms which occurred in January and February of this year.

This series of severe storms affected Cornwall in the early part of 2014. Severe damage was caused to the coastal defences of Devon and Cornwall, including the severing of the main rail line at Dawlish and at Penzance. The storms also caused exceptional movement of sediments in Mount's Bay, which exposed the 'submerged forest' for the first time in living memory. The Met Office described these storms as follows:

Around 6 major storms hit through this period, separated by intervals of 2 to 3 days. The sequence of storms followed an earlier stormy period from mid-December 2013 to early January 2014. Taken individually, the first two storms were notable but not exceptional for the winter period. However, the later storms from early to mid-February were much more severe. Overall, the period from mid-December 2013 to mid-February 2014 saw at least 12 major winter storms, and, when considered overall, this was the stormiest period of weather the UK has experienced for at least 20 years. (Met_Office, 2014)

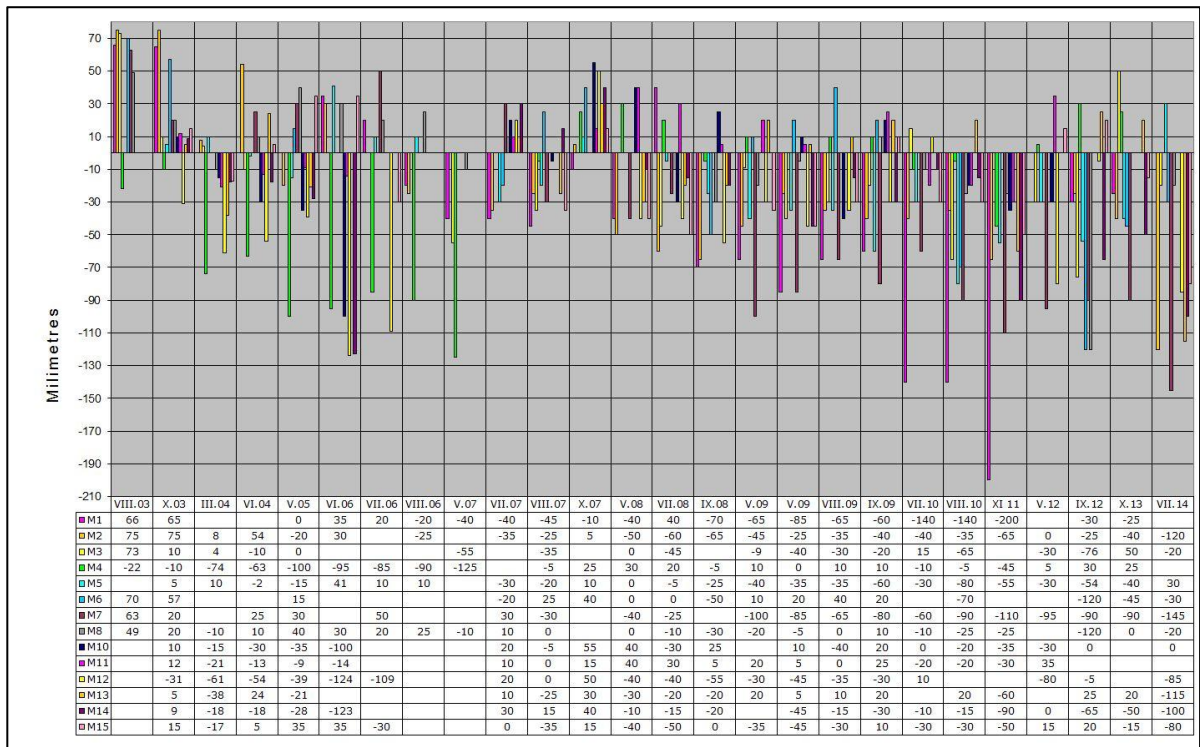


Fig 5. Chart of sediment level changes relative to levels as they were in May 2003 for M1 to M8; August 2003 for M10 to M15. Values shown are in millimetres; positive values denote a rise in seabed level (relative to 2003) while negative values denote a fall in seabed levels (relative to 2003). A blank entry in the table indicates that the diver was unable to locate the monitor point or that the point was missing

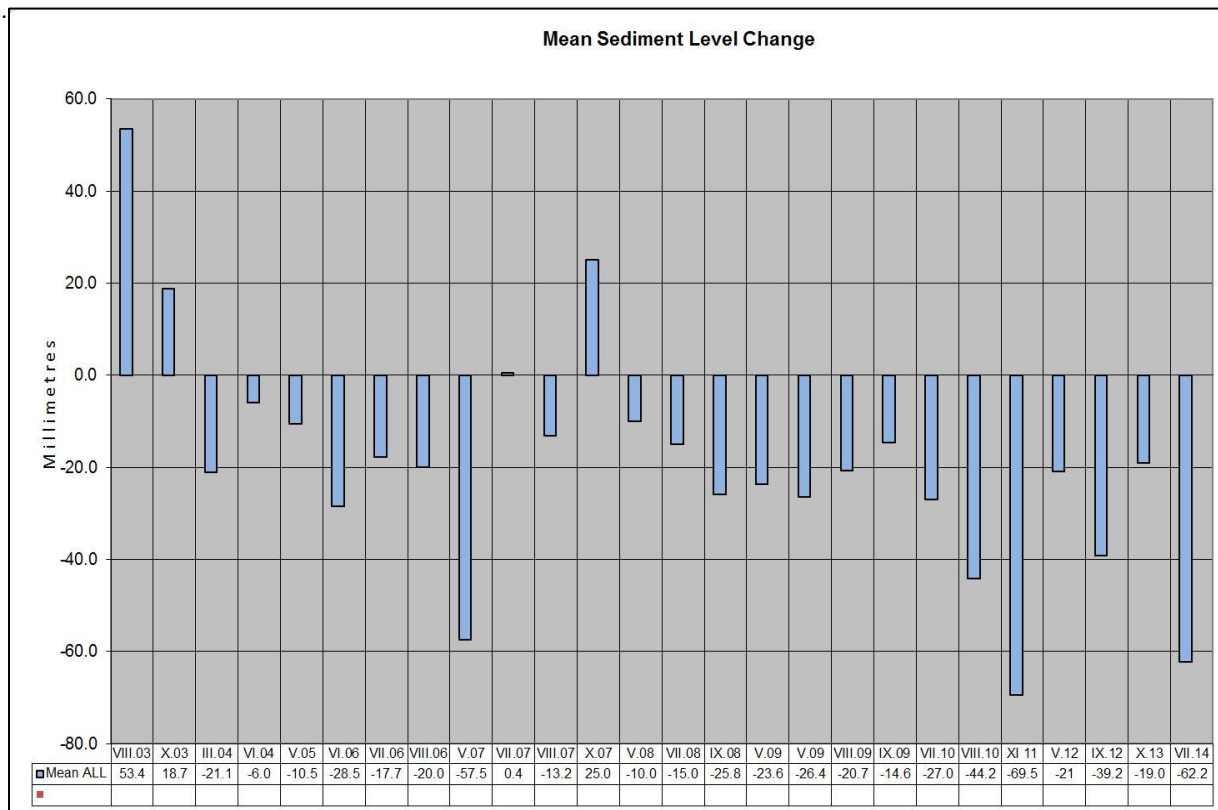


Fig 6. Bar chart showing the mean overall change in seabed sediment level (relative to the level in 2003) for all monitor points. All values are in millimetres. Zero represents the seabed level in 2003; negative values denote a mean fall in sediment level, and positive values a mean rise in sediment level

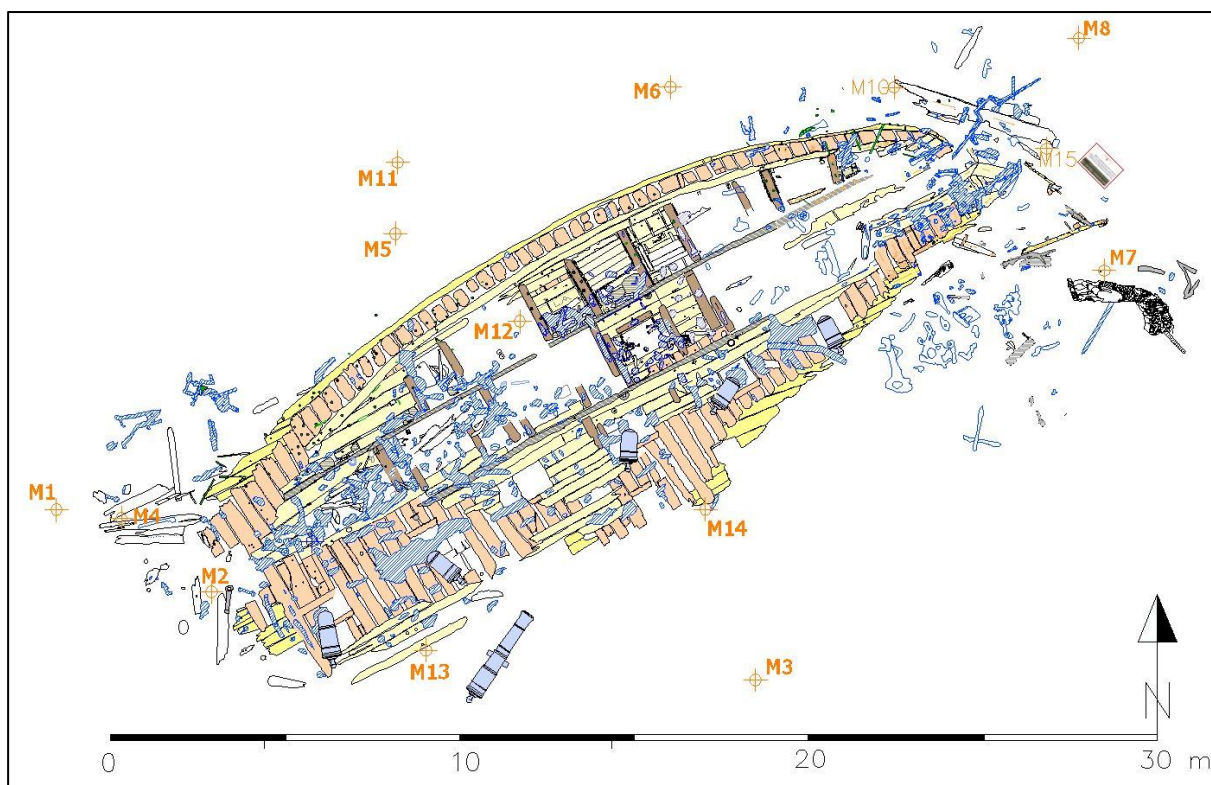


Fig 7. Plan showing the locations of the new Sediment Monitoring Points installed in July 2014. The new points are shown in green M1-M8 and M10-M15.

The mean sediment levels on the site have fallen by 62.2 millimetres relative to the levels pertaining in 2003. This is the second lowest sediment level ever recorded on the site. The lowest mean level recorded was in November 2011 (69.5mm) - see fig 6. The recorded level at each individual monitoring point is shown in fig 5. This illustrates how the levels vary around the site; a uniform change across the site has never been recorded.

The sediment monitoring on this site has now been in place since 2003, renewal of the SLM points should ensure that this valuable indicator of the sediment levels on the site can continue in the future. The sediment levels on the site are a good measure of the level of vulnerability of the timber and other organic material of the wreck.

Positions of SMP July 2014 UTM Zone 30 WGS84		
No	Easting	Northing
M1	260134.68	5535582.21
M2	260139.13	5535579.86
M3	260154.75	5535577.32
M4	260136.54	5535581.97
M5	260144.41	5535590.13
M6	260152.30	5535594.34
M7	260164.76	5535589.08
M8	260164.03	5535595.75
M9	NOT USED	
M10	260158.72	5535594.33
M11	260144.48	5535592.18
M12	260147.98	5535587.62
M13	260145.29	5535578.18
M14	260153.31	5535582.22
M15	260163.11	5535592.58

Dive Trail Maintenance

The dive trail station markers consist of small numbered hard-plastic wash-buoys attached to concrete sinkers on the seabed by short lengths of synthetic rope. When the trail was set up the local dive boat skippers agreed to remove these floats at the end of each season and replace them each spring. Apparently this was not possible last winter and the markers remained on the seabed throughout the winter. Despite a series of severe storms in January and February 2014 the only observed damage to the station markers was that several had dragged their concrete sinkers – this was easy and quick to rectify.

The station markers were all replaced as part of this project. One of the new station markers (station 12) is shown installed on the seabed in fig 8. Previously the floats had been painted with marine anti-foul paint, but this had not proved very effective at deterring build-up of weed and algae. The current floats have now been painted with high quality paint with a generous addition of specialist paint fungicide. It will be instructive to observe whether this fares any better than the marine anti-foul paint used previously.

The dive trail will continue to need periodic maintenance if it is to continue in use. Past experience suggests that the floats and rope risers will need to be renewed roughly every five years. The floats may need cleaning at more frequent intervals to ensure that the numbers are legible as the floats tend to become covered with algae and weed.



*Fig 8.
Dive trail station marker 12
Showing one of the main gun deck
32lb Blomefield guns (G10).*

Dive Trail Extension

The dive trail was extended to include one of the main gun deck 32lb Blomefield guns lying on the seabed some 60m to the south-east of the main area of exposed wreckage. The new dive station is number 12 and is shown on fig 9 below. The original dive trail was a circular tour of the main area of exposed wreckage and comprised stations 1 to 9; this was installed in 2009. This was extended by two stations (10 and 11) in 2012. The two stations added in 2012 are in an area to the south east of the main wreckage and take in a large iron spar (probably part of the steering gear) and one of the upper deck 9lb Armstrong guns (probably from the quarterdeck).

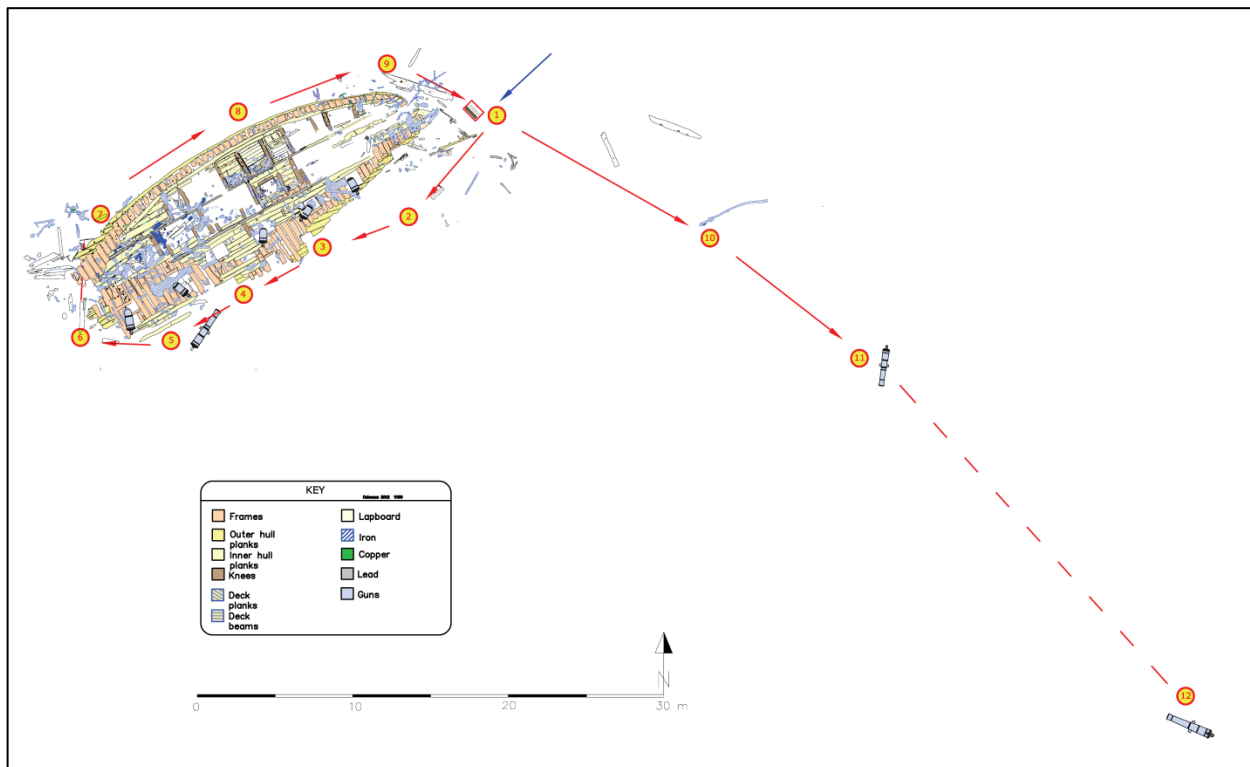


Fig 9. The extended dive trail. Station 12 was added to the trail in July 2014. The position of the new leaded line is indicated by the dashed line.

The new station installed this year (station 12) lies almost 30m from the preceding dive station (station 11). For this reason a length of leaded line has been laid on the seabed between stations 11 and 12 – this should ensure that divers do not get lost when proceeding from station 11 to 12. The leaded line has been secured to the seabed using iron staples constructed from 12mm steel reinforcing rod – see fig 10.

The dive trail guide book has been updated to include the new dive station; a copy of the updated guide is included on the DVD ROM which accompanies this report. Copies of the new guide will be forwarded to the dive boat skippers on Scilly.



Fig 10. Steel staples used to secure the lead-line between dive stations 11 and 12

Peripheral Searches

A number of searches around the exposed wreckage were undertaken to determine whether any new material had been exposed by the recent winter storms. These searches were conducted using circular searches undertaken by a pair of divers. The centre point of the search was established from a known point, such as one of the existing control points around the wreck. A distance line was attached to the central point and the divers then conducted a circular search with the divers spaced along the distance line within sight of each other. Any objects located were positioned by measuring the distance along the line (which was marked in metres) and the compass bearing back along the line to the centre of the search. This method does not give an exact position for the object, but previous work with this technique has shown that it gives a good approximation.

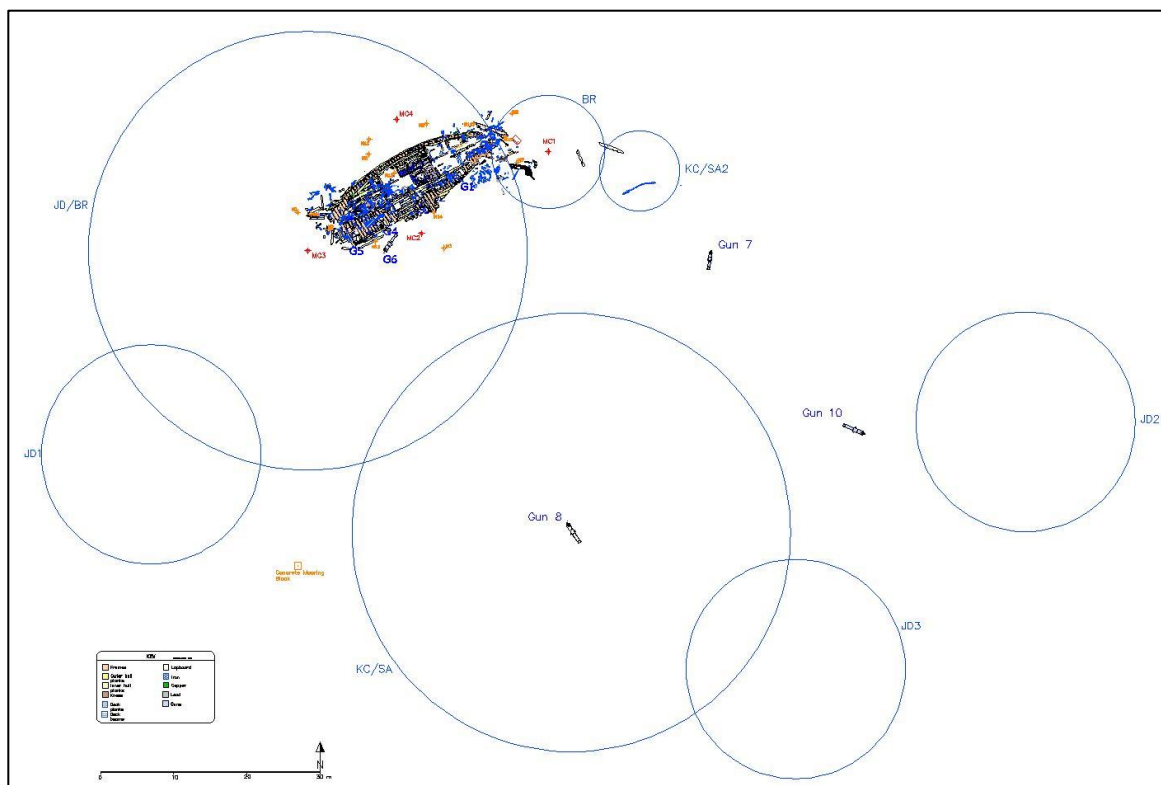


Fig 11. Plan showing the circular searches undertaken in July 2014.

Seven circular searches were completed, covering a total area of just over 8000 square metres. Four of these searches JD1, JD2, JD3 and KC/SA did not locate any artefacts (fig 11).

Search BR/JD

The main search to the west of the wreck (BR/JD in fig 11) was completed out to a radius of 30m from control point MC3. A total of eleven objects were found in this area, most of them fairly close to the known wreckage. The majority of the objects found were unidentifiable pieces of iron concretion (a total of six were found). One piece of timber, two fragments of copper hull sheathing, a lead scupper and the upper link and strap of part of a chain plate were found – see fig 12 for a more detailed description of these objects. This material is typical of the objects found in the debris field between the bow and stern sections of the wreck (Camidge, 2005) and probably does not warrant any further investigation at this stage.

Peripheral Searches July 2014

Search Area	ID	Object	Dimensions (mm)	Easting	Northing
BR/JD	S1	Timber (beam)	100x120x230	260132.06	5535575.94
BR/JD	S2	Iron concretion	250x150x100	260135.56	5535582.62
BR/JD	S3	Copper sheathing nail	30	260135.56	5535582.62
BR/JD	S4	Iron concretion	340x130x150	260136.48	5535583.21
BR/JD	S5	Iron chain plate fragment – includes the eye (strap) where the upper link enclosed the wooden deadeye (now missing)	1000x300x170	260136.07	5535584.34
BR/JD	S6	Lead scupper pipe including waterway flange	260x180x100ø	260133.90	5535588.84
BR/JD	S7	Iron concretion	320x160ø	260125.21	5535571.89
BR/JD	S8	Area of iron concretions	800x200	260146.87	5535578.79
BR/JD	S9	Iron concretion	400x300	260147.23	5535592.98
BR/JD	S10	Iron concretion T-shaped	150x70x50	260158.17	5535582.73
BR/JD	S11	Copper sheathing with nail holes	240x150x2	260158.56	5535582.75
KC/SA_2	Musket 1	Wood stock and part of iron barrel of a musket, includes copper alloy trigger guard and butt plate	950 long	260178.27	5535586.98
KC/SA_2	Musket 2	Part of an iron musket barrel - broken	800 long	260179.09	5535583.37
KC/SA_2	Musket 3	Wood stock and iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy trigger guard and butt plate	820 long	260176.20	5535582.60
BR	Musket 4	Iron barrel and part of the wood stock	520 long	260171.36	5535585.91
BR	Musket 5	Wood stock and iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy butt plate	1310 long	260162.96	5535582.55
BR	Musket 6	Wood stock and iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy trigger guard and butt plate	1410 long	260163.39	5535585.36
BR	Musket 7	Wood stock (part) and iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy trigger guard and butt plate	1230 long	260163.30	5535585.23
BR	Musket 8	Iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy trigger guard and butt plate	640 long	260165.43	5535583.59
BR	Musket 9	Wood stock (part) and iron barrel of a musket, remains of the flint-lock visible. Includes copper alloy trigger guard and butt plate. One of the 'crossed muskets' at station 2 of the dive trail.	1300 long	260161.17	5535584.68

Peripheral Searches July 2014					
Search Area	ID	Object	Dimensions (mm)	Easting	Northing
BR	Musket 10	Iron barrel and small part of wood stock. One of the 'crossed muskets' at station 2 of the dive trail.	1070 long	260161.35	5535584.15
KC/SA_2	Deadeye	Wood deadeye, has three oval sectioned holes (with rope still in holes) and length of rope wrapped around about half of its circumference. Wood and rope in very good condition	570 ϕ	260185.39	5535591.17
KC/SA_2	Fe1	Substantial, slightly curved iron rod, partly buried in the seabed.	2380x350x300	260181.83	5535589.46
KC/SA_2	Fe2	Two concreted iron rods with large (220) diameter 'eyelets'. Probably the upper links and straps from shroud chains.	1050x100 ϕ and 1400x100 ϕ	260179.06	5535586.55
BR	Fe3	Complex iron structure with at least two iron bolts evident.	1200x260x100	260170.23	5535584.04
KC/SA_2	Timber 1	Two short planks each with an iron fastening bolt embedded.	420x100x80 580x100x80	260179.41	5535589.12
KC/SA_2	Timber 2	Length of oak planking, has two iron fastening bolts	3650x350	260179.41	5535590.48
KC/SA_2	Timber 3	Partly exposed length of timber with iron fastening bolt – possibly gun carriage part? Close to pewter buttons and leather shoe	410x100	260186.30	5535589.70
KC/SA_2	Timber 4	Length of wood with radiused tennon at one end	720x130x100	260172.15	5535587.85
KC/SA_2	Timber 5	Four pieces of timber, one very similar to T3 with iron fastening. Also a length of rope.	300x120x100	260185.94	5535586.64
KC/SA_2	Timber 6	Two eroded fragments of timber sticking out of the seabed. Also a length of rope	220x50x50	260185.36	5535587.02
KC/SA_2	Bone 1	Bone brush handle, one end shaped as a shoe horn. Recovered [F1100]	182x33x1.9 to 6.4	260186.15	5535589.90
KC/SA_2	Leather 1	Leather sole of a shoe or boot	310x95	260186.47	5535590.06
KC/SA_2	Pewter 1	53 pewter buttons. Recovered finds [F1101-F1152]	17 ϕ and 23 ϕ	260186.34	5535589.92
KC/SA_2	Fabric 1	Area of Fabric associated with the buttons and shoe sole. Sampled [F1153]	50x50	260186.38	5535590.11

Fig 12. Table of objects found, dimensions and positions – searches undertaken in July 2014

Muskets

The area to the east of the wreck was also searched with some surprising results. The search located a number of muskets exposed on the seabed. A pair of muskets (muskets 9 and 10 on fig 13) have always been visible at the south-east end of the wreck, these being the main feature of interest at dive station 2 on the dive trail.

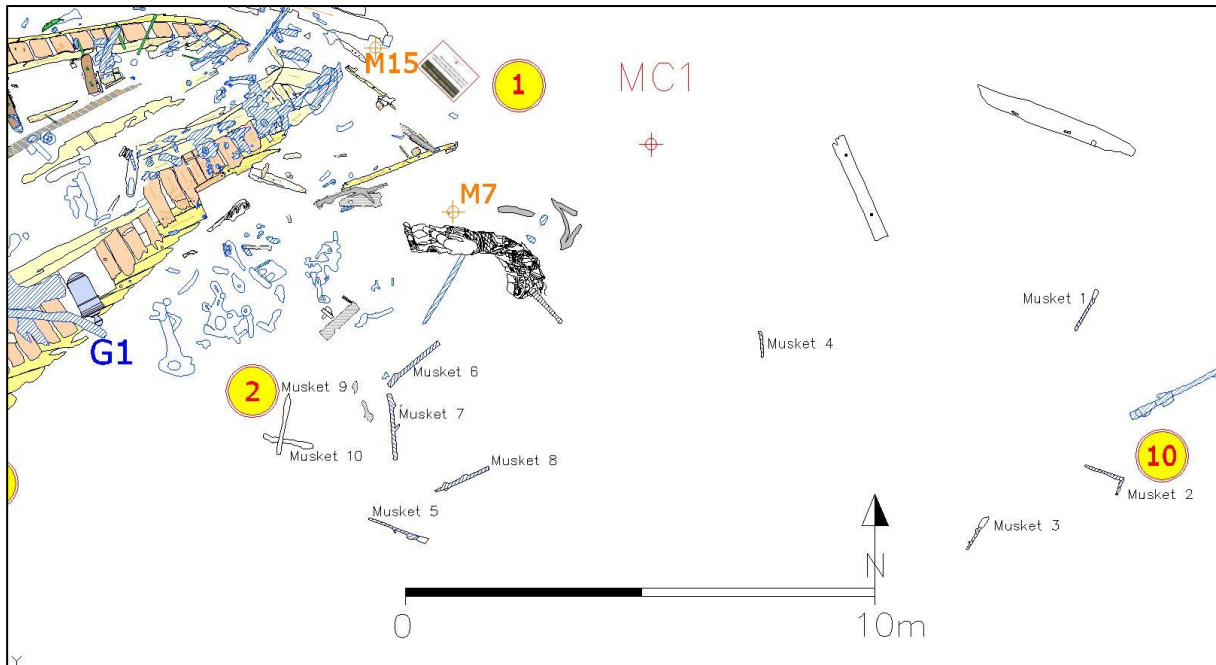


Fig 13. Plan showing the distribution of the muskets exposed on the seabed. The yellow circles indicate dive trail stations.

The searches revealed a number of previously unseen muskets exposed on the seabed. In total ten muskets were recorded, all situated to the south-east of the wreck and seeming to form a debris trail extending eastwards from dive station 2 for some 18m. The muskets consist of an iron barrel, often with the wooden stock still intact. Many of them exhibit evidence of the flint-lock, and some still have the copper alloy trigger guard and butt plate still in place. For a more detailed description of each musket see fig 12.

Muskets have only been found in this area to the south-east of the wreck, probably indicating proximity to the place on the wreck where the muskets were originally stored. It is interesting to speculate what mechanism caused these relatively heavy objects to be dispersed to the east of the wreck. Any future work on the site should monitor this area in case further muskets become exposed. Consideration should also be given to perhaps raising one of these for further study - for example establishing exactly which of the numerous models of musket of this period they are.

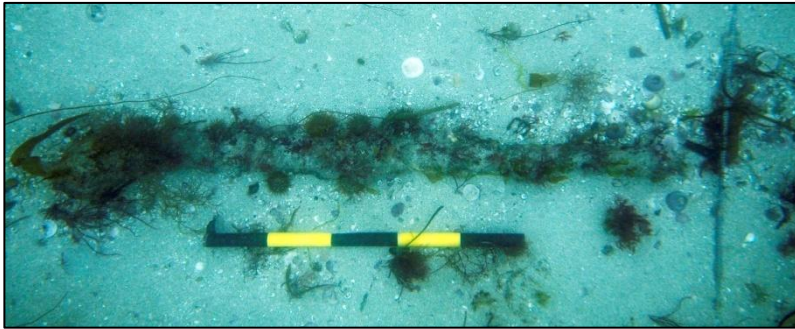


Fig 14
Musket 1
(scale = 0.5m)



Fig 15
Musket 2
(scale = 0.5m)



Fig 16
Musket 3
(scale = 0.5m)



Fig 16 (left)
Musket 4
(scale = 0.5m)



Fig 17 (below)
Musket 5 and detail showing the
trigger guard
(scale = 0.30m)



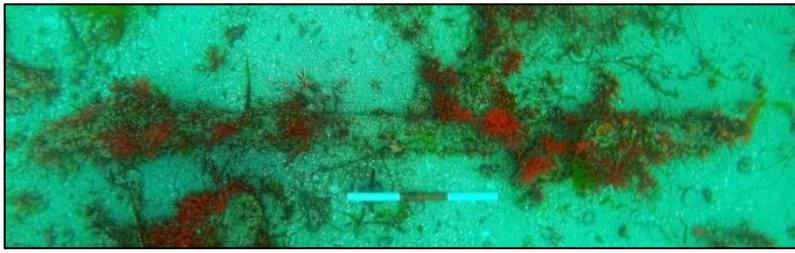


Fig 18
Musket 6
(scale = 0.3m)



Fig 19
Musket 7
(scale = 0.3m)



Fig 20
Musket 7
Detail showing the trigger guard

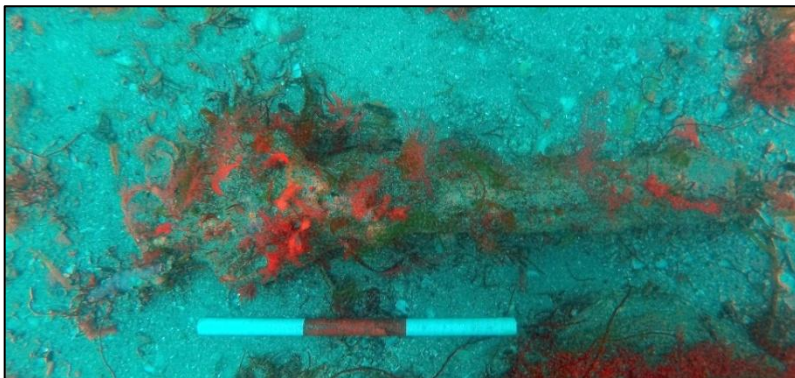


Fig 21
Musket 8
(scale = 0.3m)



Fig 22
Muskets 9 & 10
(scale = 0.3m)

Rigging material

A number of items originating from the rigging of the vessel were also found in the area to the south-east of the wreck. These include [Fe2], a pair of iron rods with eyelets (figs 12, 23 and 25). These would have formed the upper links and straps of the chains. These are part of the mechanism to secure and tension the mast shrouds - they hold the lower deadeyes and connect them to the hull of the vessel. As these lie some 20m from the remains of the hull of *Colossus* there is a possibility that they may originate in the (until now) missing starboard side of the ship. The main area of exposed wreckage represents the port side of the vessel from stern to mainmast.

A large timber deadeye was also located (fig 23 and 24). This was 0.57m (22") in diameter and seems unusually large, even for a mainmast deadeye. By comparison, the largest deadeye recovered from *Invincible* was 0.45m (18") in diameter (Bingeman, 2010) while the *Seventy-four Gun Ship* lists the mainmast deadeye as 0.38m (15") (Boudriot, 1986). It is in very good condition with only slight traces of gribble on one edge – suggesting that this item has until recently been buried within the seabed sediments. It has three 'eye' holes, each with remains of rope within them (the remains of the lanyard - used to tension the shrouds). A length of more substantial rope still wrapped around the outside circumference of the block attests to its identification as the upper deadeye of the pair (the lower block being secured with an iron loop). The rope (see fig 24) is cable-laid, consisting of three strands of conventional hawser-laid rope. It is approximately 0.06m in diameter (0.188m or 7 inches in circumference).

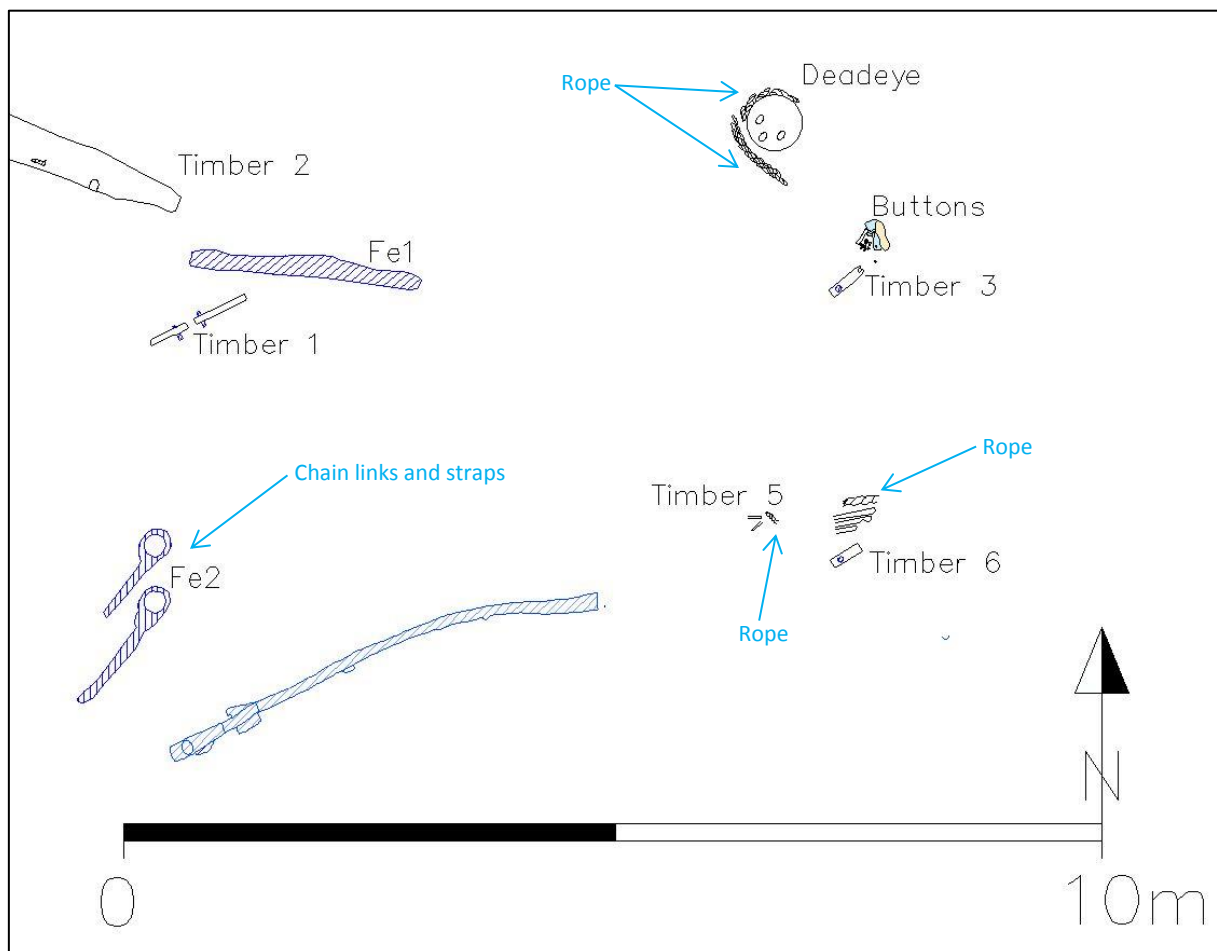


Fig 23. Rigging elements found to the south-east of the main area of the wreck

Two areas of rope were also found (figs 23 and 26), and were associated with timbers 5 and 6. The rope associated with timber 5 was hawser-laid, and about 0.04m in diameter. The rope associated with timber 6 was cable-laid and about 0.06m in diameter. Although this rope was in very good condition no further investigation of it was made as it is very soft and fragile. Taken together, these objects suggest that well preserved parts of the rigging of *Colossus* have been recently exposed in this area. Further investigation should be considered to establish the nature and extent of these remains.

All these items were found on the penultimate and last day of the project. They were buried with sediment (by hand fanning) and the sediment was secured using small rocks. As long as these items are not interfered with they should survive until more extensive investigation of this area can be undertaken.

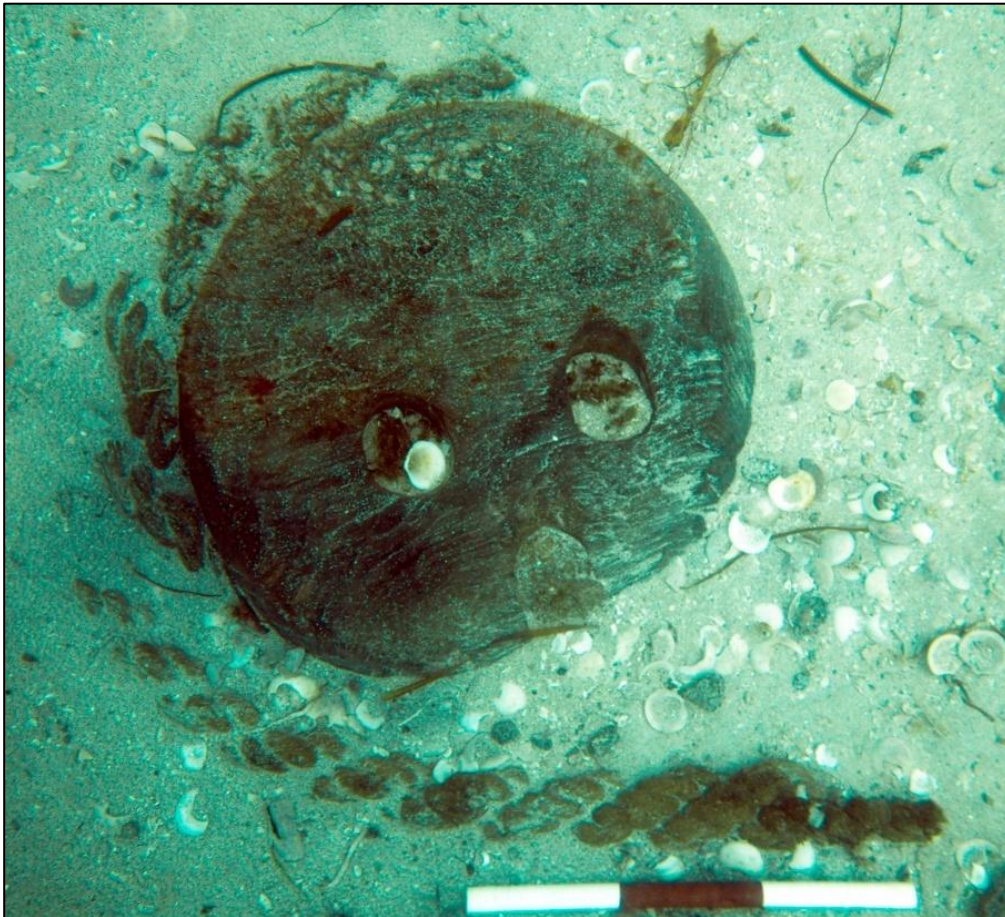


Fig 24
Deadeye and
remains of rope
Scale = 0.3m



Fig 25. Iron object [Fe2], one of the eyelets or straps of the shroud chains. Scale = 0.3m

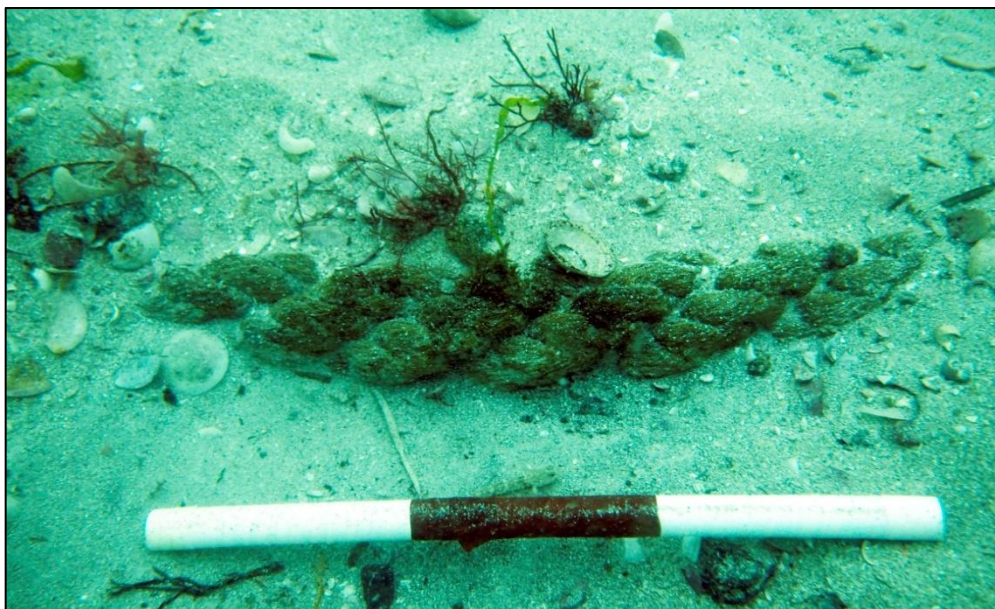


Fig 26. Cable-laid rope found in association with timber 6. Scale = 0.3m

Timber

Several partly exposed timbers were also found in the area to the south-east of the wreck. These include timbers 1, 3, 4, 5 and 6 on fig 23 – timber 2 was located in 2005 during the debris field survey. Mostly, only small parts of these timbers were exposed above the seabed - so it is difficult to make an identification of the timbers without further investigation. However many of the timbers have iron fastenings and are in good condition, suggesting that they have been buried until relatively recently. A more detailed description of each timber appears in fig 12 above. This newly exposed material should be investigated to establish its nature and extent.



Fig 27 – Timber 1. Scale = 0.3m



Fig 28 – Timber 2. Scale = 0.3m



Fig 29 – Timber 3. Scale = 0.3m



Fig 30 – Timber 4. Scale = 0.3m

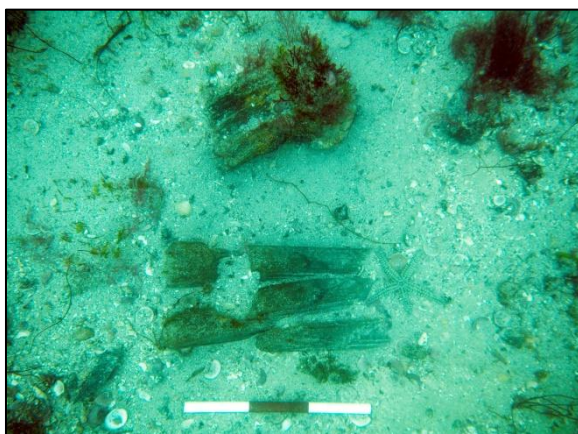


Fig 31 – Timber 5. Scale = 0.3m



Fig 32 – Timber 6 and associated rope. Scale = 0.3m

Personal items

A small collection of personal items was located one metre to the south-east of the large deadeye already described. The personal items consisted of a bone brush with a shoe horn incorporated into the handle [F1100], a leather shoe sole, an area of fabric [F1153] and a collection of 53 pewter uniform buttons {F1101-F1152}. The items were all found within close proximity to each other (fig 33) and as such may well have been constrained by a small container such as a bag.

The leather shoe sole was 0.31m long x 0.095m wide. It appeared to sit on an area of fabric, the fabric being composed of fairly coarse fibres and seemed to include strands with metallic threads – possibly braid. The fabric may represent the remains of a uniform jacket or other item of clothing. A small sample [F1053], 0.05m square was taken for further study (figs 33 and 34).

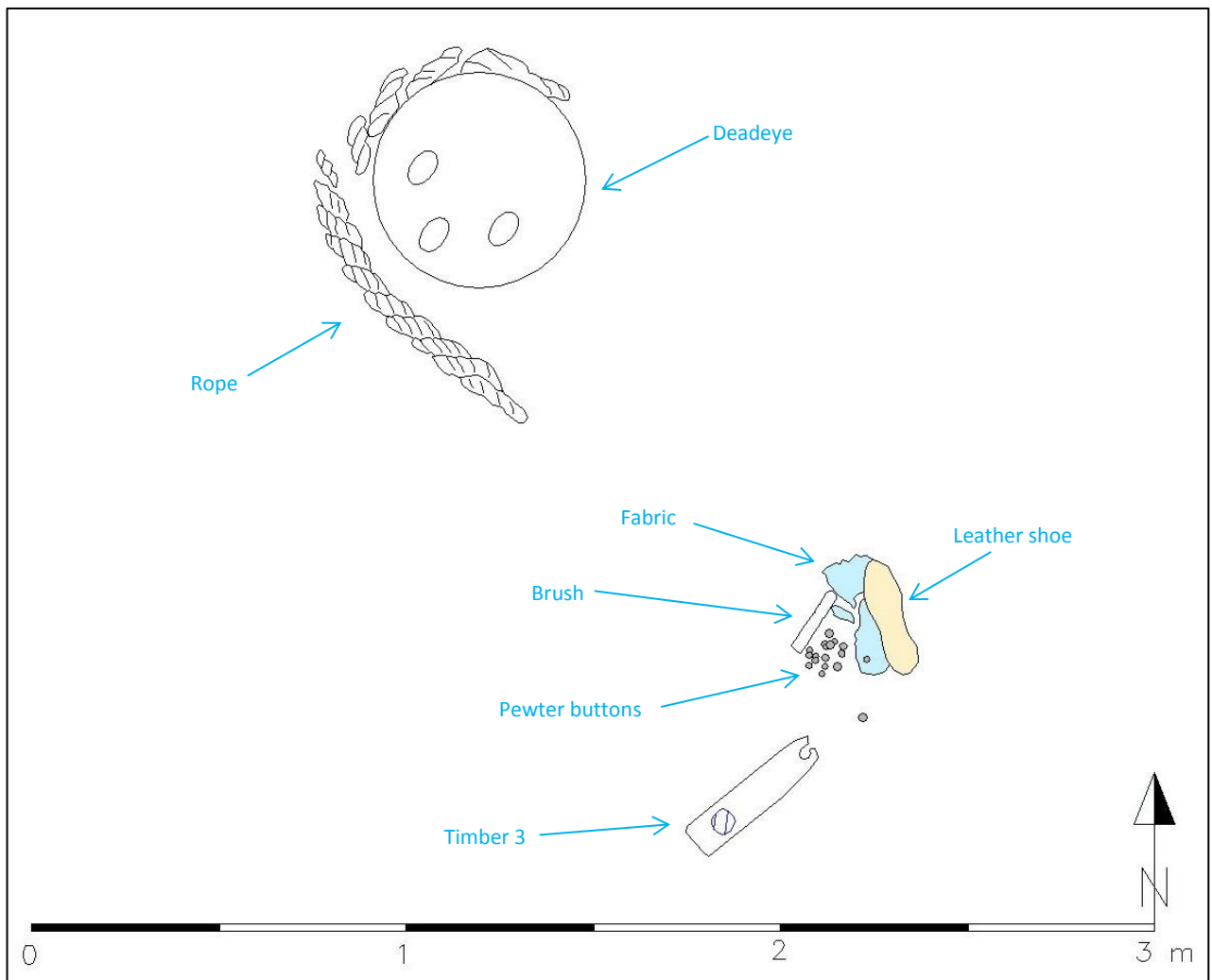


Fig 33. Plan showing the personal items (brush/shoehorn, shoe and buttons) relative to the deadeye and timber 3.

These items were found just below the seabed surface; part of the leather sole had been recently exposed and adverted us to the presence of the artefacts. The brush [F1100], the pewter uniform buttons [F1101-F1152] and a fabric sample [F1153] were recovered and are currently undergoing further study at EH by Angela Middleton. The leather sole and most of the fabric were left *in situ* and have been protected by placing a sand bag and sediment over them.



Fig 34. Collection of personal items found next to timber 3 (bottom right). Leather shoe sole (next to scale), area of fabric (below the shoe), bone brush/shoe horn and a group of 53 pewter buttons.

The bone brush handle consists of a flat piece of animal bone with a bristle plate at one end and incorporates a shoe horn at the other end. It is 0.18m long, 0.033m wide and varies in thickness between 6.4mm at the bristle plate and 1.9mm at the end of the shoe horn. Small copper-alloy wires are visible in the bristle holes – probably used to secure the bristle bundles (these can be seen in figs 36 and 37). A very similar fragment of a combined shoe horn and bone brush was found on *Invincible* (Inv/88/315) (Bingeman, 2010).

The pewter buttons were all found in close proximity to the fabric remains. Indeed some of the buttons appeared to be incorporated within the fabric – three additional buttons were found to be within the fabric sample [F1153] when this was x-rayed (fig 35). In total, 53 buttons were recovered and these fall into four distinct types. The first of these consists of 14 larger (23mm diameter) buttons with a fouled anchor design impressed onto the face (fig 38). A full description and dimensions of these appears in the finds list which is on the DVD ROM which accompanies this report. An almost identical pewter button (In/85/005) was recovered from the wreck of *Invincible* (Bingeman, 2010).

The second and most numerous type of button recovered was 35 smaller pewter buttons (17mm diameter) again with a fouled anchor design on the face. The majority (30) of these have a maker's name stamped on the reverse 'I NUTTING COVENT GARDEN' (Figs 39 and 40). Joseph Nutting is a

known military button maker working in Covent Garden, London in the 18th and 19th centuries (Nayler, 1993).

By the time of a 1791 directory, it was Joseph Nutting "army button maker". The "J" was shown in the Roman form "I" on the backs of buttons (Dorgan, 2014).

A similar 17mm fouled anchor button was found on *Invincible* (Inv/83/0124) – but in that example the maker's mark reads 'I NUTTING **AND SON** COVENT GARDEN' (Bingeman, 2010).

The third type of button found consisted of only two smaller pewter buttons [F1149 and F1150]. These are marked on the face with '25 SUSSEX REG^T' (Fig 41). The 25th regiment were renamed the 25th (Sussex) regiment of foot in 1782. A clue to how these came to be on *Colossus* is given by the following – taken from the Kings Own Scottish Borderers Association web site:

At the outbreak of the French Revolutionary War the 25th was in Plymouth, and between 1793 and 1797 supplied marine parties for service aboard warships in the Mediterranean, the English Channel and the North Sea. (KOSBA, 2014)

The final type of button consists of two small (14mm diameter) plain flat cast disks, with an attachment hoop on the rear (bottom right fig 42).

The buttons, brush and fabric sample (currently at EH) will be the subject of a separate report by Angela Middleton. The shoe sole and fabric are still on the seabed, and there is likely to be further material associated which is still buried within the seabed sediments. It seems likely that these items were contained in a bag and that they were probably someone's personal possessions. A collection of material of this type is worthy of further investigation, especially as the falling sediment levels on the site are likely to expose them, leading to dispersal and decay.

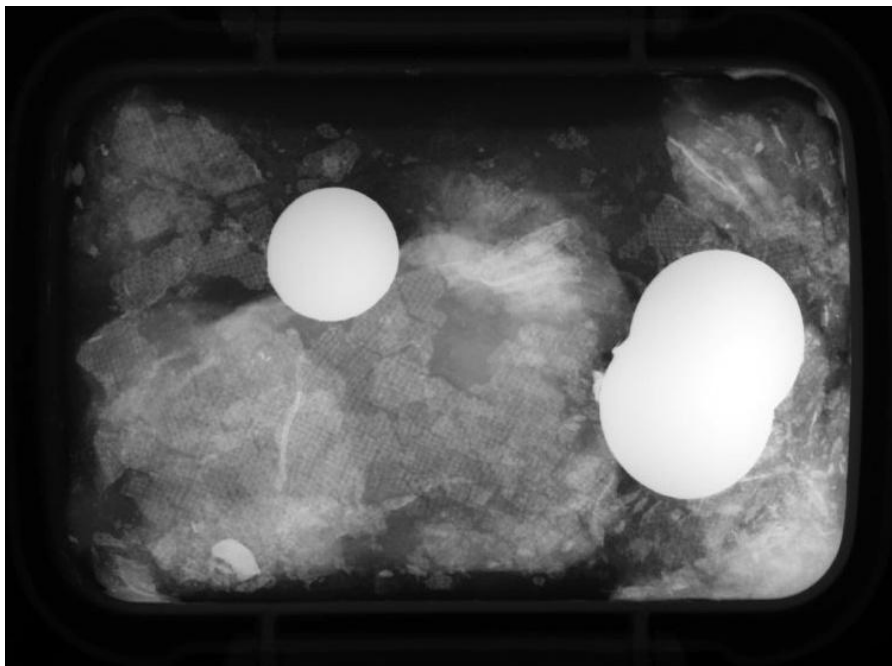


Fig 35
X-Ray of fabric sample F1153
Note the three pewter
buttons contained within the
fabric sample
(EH Angela Middleton)

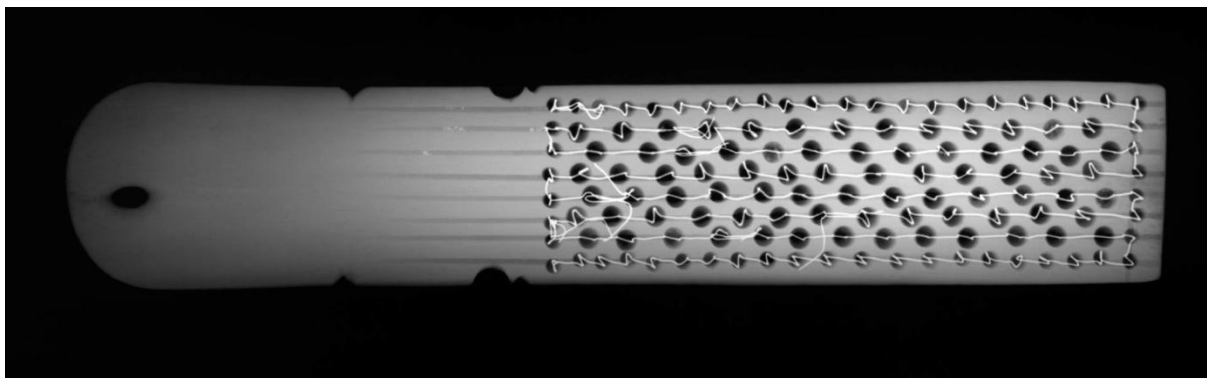


Fig 36. X-Ray of F1100, bone combined brush/shoehorn. Note the copper alloy wire used to secure the bristle bundles.
(EH Angela Middleton)



Fig 37. Bone brush / shoehorn F1100. Note the copper alloy wire used to secure the bristle bundles



*Fig 38
Large pewter uniform button
with fouled anchor design,
23mm diameter [F1101]*



*Fig 39
Pewter uniform button with
fouled anchor design, 17mm
diameter [F1128]*



*Fig 40
The reverse of [F1128] –for
the face see fig 39 above.
Inscribed 'I NUTTING
COVENT GARDEN'
17mm diameter*



Fig 41
Pewter uniform button
[F1150] marked '25
SUSSEX REGT.'



Fig 42. The 53 pewter buttons recovered in July 2014 [F1101 to F1152]

3D Photogrammetric Recording of Guns 7 and 10

Recent publications have referred to the use of 3D photogrammetry recording on underwater sites. The technique seems promising, but published data on its accuracy looks disappointing (McCarthy & Benjamin, 2014). We decided to do a small trial of the technique on two of the outlying guns on the site of *Colossus*. Guns 7 and 10 were chosen as they both include complex elements difficult to record using traditional tape and planning frame methods. Gun 7 has the remains of ironwork attached which formed part of the gun carriage fastenings while gun 10 has chain associated – possibly from its use as a boat mooring at some point in the past.

Drumbeg Cannons		
Difference between tape and Photoscan model		
Object	Mean difference %	Greatest difference %
Cannon 1	6.9	30
Cannon 2	11.2	23.3
Cannon 3	40.1	133

Fig 43
Table showing a summary of the differences between Photoscan measurements and diver measurements for three 'cannon' at Drumbeg, Scotland (McCarthy & Benjamin, 2014, p.108)

We decided to use the same software as used on the *Invincible* (Pascoe, 2014) and at Drumbeg (McCarthy & Benjamin, 2014). This is Agisoft Photoscan which uses a set of overlapping photographs taken from a variety of viewpoints to create a scalable 3D model from which measurements can be taken. We tried the technique first on land, using as a subject an 18lb Armstrong gun now in Morrab Gardens, Penzance allegedly donated by Roland Morris – so quite possibly one of the guns removed from the bow site of *Colossus* by him. The results were encouraging, with the difference between tape and Photoscan measurements averaging 1.6%, the greatest difference being 3.8% (fig 45). These figures suggest that the technique is viable as an archaeological record. We decided to see whether we could achieve similar levels of accuracy underwater.



Fig 44. Photoscan textured model of the Morrab Gardens Gun. Scales = 0.5m

Morrab Gun				
Photographed on land (Fuji X100 23mm lens)				
Gun part	Tape	Photoscan	Difference (m)	Difference (%)
Length - overall	3.030	3.031	0.001	0.03
Length – BR to MF	2.750	2.731	-0.019	0.7
BR diameter	0.485	0.491	0.006	1.2
MF diameter	0.390	0.375	-0.015	3.8
Trunnion to BR	1.210	1.208	-0.002	0.2
Bore	0.132	0.136	0.004	2.9
Trunnion diameter	0.136	0.133	-0.003	2.2
Trunnion width	0.675	0.663	-0.012	1.7
Trunnion offset	0.121			
Mean difference			-0.009m	1.6%
Greatest difference			-0.019m	3.8%

Fig 45
Table showing the differences between Photoscan measurements and tape measurements for the 18lb gun in Morrab Gardens, Penzance

The guns on the seabed near Colossus had a covering of weed growth. We knew from previous trials of the technique (*Royal Anne Galley, 2014*) that this would hinder the alignment of the photographs as it moves between photographs and confuses Photoscan. The weed was removed by hand from each gun prior to photography. This is time-consuming and must be taken into account when considering use of this technique as a recording method. In this case, it took a pair of divers just under an hour to remove the weed from each gun. The underwater photographs were taken using an Olympus EPL1 camera with 9mm lens in an underwater housing with a 100mm Zen dome port. In total, 91 photographs were taken of the gun, at three different elevations radiating around the gun.



Fig 46
Photoscan dense point cloud model of gun 7. Note the upstanding iron work around the trunnions – probably the remains of the gun carriage fastening bolts. The gun is lying upside down. The dense point cloud model is more granular than a textured model but shows relief detail more clearly. Scale = 0.5m



Fig 47

Photoscan textured model of gun 7. Note the upstanding iron work around the trunnions – probably the remains of the gun carriage fastening bolts. The gun is lying upside down. The textured model is less granular than the dense point cloud. Scale = 0.5m

The photoscan textured model is included on the DVD ROM which accompanies this report. This is in PDF format and can be viewed, zoomed, panned and rotated using the ordinary Adobe PDF reader which is widely available and free.

Colossus Gun 7				
Photographed underwater Olympus EPL1 9mm, Zen 100mm dome port				
Gun part	Tape	Photoscan (EPL1)	Difference (m)	Difference (%)
Scale bar	0.500	0.501	+0.001	0.2
Length - overall	2.600	2.570	-0.030	1.2
Length – BR to MF	2.325	2.325	Reference	
BR diameter	0.465	0.463	-0.002	0.4
MF diameter	0.375	0.361	-0.014	3.7
Bore	0.082	0.087	+0.005	5.7
Trunnion diameter	0.145	0.143	-0.002	1.3
Trunnion width	0.580	0.569	-0.011	1.9
Trunnion offset	0.121			
Mean difference			0.009m	2.04%
Greatest difference			0.030m	5.7%

Fig 48

Table showing the differences between Photoscan measurements and tape measurements for Gun 7 on the Colossus dive trail

The differences between the tape measurements (taken by divers) and the Photoscan measurements (taken from the Photoscan model) can be seen in fig 48. The accuracy seems to be only slightly worse than that achieved with the Morrab gun on land. The largest actual difference was 30mm, which is well within the tolerances expected if two different divers were to measure the same heavily concreted gun.

The final gun recorded during this project was Gun 10, the most recent addition to the dive trail. This is one of the main gun-deck 32lb Blomefield guns. It has a length of chain wrapped around the barrel and also in a pile on the seabed next to the gun (figs 49 and 50).



Fig 49
Photocan dense point cloud model of gun 10. Note the chain wrapped around the gun and lying on the seabed next to the gun. The gun is lying upside down. The dense point cloud model is more granular than a textured model but shows relief detail more clearly. Scale = 0.5m and 1m



Fig 50
Photocan textured model of gun 10. Note the chain wrapped around the gun and lying on the seabed next to the gun. The gun is lying upside down. The textured model is less granular than the dense point cloud model but shows relief detail less clearly. Scales = 0.5m and 1m

Colossus Gun 10				
Photographed underwater Olympus EPL1 9mm, Zen 100mm dome port				
Gun part	Tape	Photoscan (EPL1)	Difference (m)	Difference (%)
Scale bar	0.500	0.510	+0.010	1.9
Length - overall	3.260	3.255	-0.005	0.2
Length – BR to MF	2.920	2.920	Reference	
BR diameter	0.615	0.619	+0.004	0.6
MF diameter	0.450	0.433	-0.017	3.7
Trun to BR	1.240	1.216	-0.024	1.9
Bore	0.132	Not clear		
Trunnion diameter	0.200	0.192	-0.008	4.0
Trunnion width	0.855	0.809	-0.024	1.9
Trunnion offset	0.121			
Mean difference			0.013m	2.02%
Greatest difference			0.024m	4.0%

*Fig 51
Table showing the differences between Photoscan measurements and tape measurements for Gun 10 on the Colossus dive trail*

The same camera equipment was used for this gun as was used for gun 7 (see above). In this case 99 photographs were taken, but Photoscan only managed to align 86 of them. The rejected photographs all had conspicuous weed in the water column, which is probably why they failed to align. Despite the missing photographs – mainly around the muzzle of the gun – an acceptable model was still generated. The accuracy of the measurements obtained for this gun from the Photoscan model were broadly similar to those obtained from gun 7. In this case the largest difference between the tape measurements and the Photoscan measurements was 24mm. This is a very good result when considering the nature of the object being measured – a heavily concreted gun. The textured model for this gun has also been provided as a PDF file on the DVD ROM accompanying this report. This will allow the reader to explore the Photoscan model of gun 10 from all angles.

In conclusion, the technique can be accurate enough for detailed archaeological recording underwater. However there are a number of factors which need to be considered when deciding whether to use 3D photogrammetry or more traditional techniques for underwater recording. If the objects to be recorded are covered in weed this will need to be removed if photogrammetry is to be successful – this can be time-consuming and is often not necessary when using tapes or planning frames. The post-processing is also quite time consuming, often taking several hours (the actual time depends on the power of the computer used). Moreover, factors such as weed in the water column (a particular problem on *Colossus*) can hinder proper alignment of photographs. The files generated by Photoscan are very large – in PLY format the file for the Morrab gun is 950 megabytes - which could have serious implications for archiving (not least of which would be the cost). A further drawback is that you do not know whether the recording has been successful until many hours after the dive is over, whereas with a paper drawing you know what you have before you leave the water. Where the technique excels is when complex 3D objects – such as the upstanding ironwork on gun 7 – need to be recorded. These are often difficult to record traditionally and require a high degree of skill from the drawist to achieve good results. CISMAS will continue to experiment with this recording technique. Our next aim is to determine the optimum combination of dome port and lens focal length to optimise image quality and reduce distortion.

Conclusions

A collaboration has been instigated between the author and the licensee of the protected wreck site *HMS Invincible*. The *Invincible* was a French 74 gun ship built at Rochefort in 1744 and captured by the British Navy in 1747. She then served as a British warship until wrecked in the Solent in 1758. Extensive excavation of the wreck has taken place since 1978.

The idea of this collaboration is to exchange information between the teams working on the two wreck sites. This process has only just begun but already some interesting concordances and differences have been noted. The current licensee of *Invincible*, Dan Pascoe, dived with us on *Colossus* during this project to view at first hand the wreck. It is hoped that members of the CISMAS dive team will also have the chance to dive on *Invincible* at some future date.

Monitoring of the sediment levels on the site this year has shown that the levels have fallen to the second lowest level ever recorded on the site. This may be due to the severe storms experienced in the early part of this year. Whatever the cause, the continued diminution of sediment cover on the site will put archaeological material at risk on the site – as clearly demonstrated by the newly exposed material recorded in July this year.

The sediment monitoring points installed on the site in 2003 were being compromised by the falling sediment levels and loss of timbers to which they were attached. For this reason, all fourteen points were replaced with more robust, 1m long stainless steel rods. This will facilitate sediment level monitoring for some years to come.

The dive trail on the site underwent maintenance this year to ensure its future survival. All the dive station markers were replaced with newly painted floats with new rope risers. A new type of anti-foul paint was applied to the floats, which will hopefully minimise weed and algal growth on the floats. An extra dive station (station 12) was added to the dive trail to help maintain the interest of returning divers and to enhance the experience for all those using the trail. The dive trail guide book has been updated to include the additional dive station and some of the recently-exposed muskets.

Newly exposed archaeological material has been found to the south-east of the wreck. This includes a number of muskets, bringing the total number of muskets exposed on the seabed to ten. Serious consideration should be given to raising one of these muskets for study and identification. Several items of rigging have also been exposed (rope, shroud chains and a large deadeye). Several new areas of timber are evidently starting to emerge from the sediment in this area. At this stage it is only speculation, but it is possible that we may have material from the missing starboard side of the vessel lying to the south-east of the existing remains. Finally a small collection of personal items was found in the same area, very closely associated, suggesting that they may have originally been contained by a fabric bag. These items consisted of a leather shoe, a bone combined brush/shoehorn, the remains of fabric – possibly a jacket, and 53 pewter uniform buttons. The brush and buttons were recovered for further study (Angela Middleton, EH). Given the very good state of preservation of the newly exposed material, further investigation of these items should be undertaken as soon as possible. The logistics of operating in Scilly probably mean that this could not be organised sooner than spring 2015.

Contents of the DVD ROM

Finds

Finds database (Microsoft Excel XLSX file)

Finds Photographs (JPEG)

Finds X-rays (JPEG)

3D Photogrammetry

Morrab Gun (PDF)

Colossus Gun 7 (PDF)

Colossus Gun 10 (PDF)

Note that these files can be viewed, rotated, panned and zoomed using the standard Adobe reader

Dive Trail

Updated dive trail guide (PDF)

Dive Trail Video (MP4)

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