

SS RICHARD MONTGOMERY SURVEY REPORT 2011



Maritime and Coastguard Agency
October 2012

1. EXECUTIVE SUMMARY

1.1 The 2011 survey of the SS Richard Montgomery took place on the 10th and 11th November 2011 and employed the same survey and data processing techniques as used in previous surveys of the wreck. The objectives of the survey were to gather physical data on the wreck and its environment in order to determine its current condition, to compare these results with previous survey data and to identify any changes or deterioration. The survey was conducted by NetSurvey Ltd using the Port of London Authority (PLA) survey vessel Yantlet and a Reson 8125H high definition multibeam sonar unit. The resulting data was processed and reported on by NetSurvey Ltd and a fully rendered three dimensional point cloud of the wreck was scrutinised against data from the 2009 and 2010 surveys.

1.2 By using a survey platform which had previously been used to survey the wreck, the XYZ position corresponded well with data collected in 2009 and 2010. This allowed for accurate comparisons of survey data despite the fact that, for reasons outlined below, the data collected in 2011 was of lower definition than data from 2009 and 2010.

1.3 The results of the 2011 survey indicate that the wreck of the SS Richard Montgomery remains in a similar condition to that found in 2009 and 2010, with the wreck structure appearing to be stable but with some signs of deterioration.

1.4 The key points from the 2011 survey include:

- The orientation and inclination of the wreck remain unchanged from 2009 and 2010.
- The crack at Hold 2 appears to have lengthened by 27cm when compared with 2010 survey data.
- A minor decrease in height of deck plating above Hold 2 was noted but could not be accurately measured.
- Small-scale removal of sediment from around the bow area was noted, as was a build-up of sediment on the port side.
- Using a slightly larger vessel to survey the wreck itself resulted in a lower definition data than in 2009 and 2010.
- Over much of the wreck no changes were noted.
- No evidence was found of cargo escaping from the wreck.

1.5 The key recommendation for future surveying of the SS Richard Montgomery is that work is carried out on a vessel that allows survey lines to be run directly over the top of the wreck, or as close as is reasonable given the nature of the wreck structure. This will ensure that all key features of the wreck are ensonified and will result in data of improved clarity. The overarching effect of having data of high clarity is that the interpretation of how the wreck is changing will be straightforward and less open to interpretation.

2. BACKGROUND

2.1 The SS Richard Montgomery was a US Liberty Ship built by the St. John's River Shipbuilding Company, Jacksonville, USA in 1943. In August 1944, the ship left the US with a cargo of munitions bound for the UK and then on to France. After arriving in the Thames Estuary, the SS Richard Montgomery was ordered to anchor off Great Nore. However, the vessel dragged anchor and, on the falling tide, foundered on Sheerness Middle Sand, a sand bank running east from the Isle of Grain, to the north of the Medway Approach Channel. Almost immediately, the vessel hogged and the hull plates forward of the bridge began to split. An operation began to discharge the cargo. However, the ship broke its back, the forward section became completely flooded and, eventually, in September 1944, the vessel sank and the salvage operation was abandoned.

2.2 Although the stern section of the wreck was cleared during the salvage operation, approximately 1400 tons (NEQ)¹ of munitions remain in the forward section of the wreck. The wreck lies in two sections across the tide and close to the Medway Approach Channel. Her masts are clearly visible above the water at all states of the tide and the seabed around the wreck has gradually scoured away to leave the wreck sitting on a bedrock which is believed to be London Clay.

2.3 The wreck is designated under section 2 of the Protection of Wrecks Act 1973². There is a prohibited area around the wreck and it is an offence to enter within this area without the written permission of the Secretary of State. The wreck is clearly marked on the relevant Admiralty charts, the prohibited area around the wreck is ringed with four cardinal buoys and twelve red danger buoys, and the wreck is under 24 hour surveillance by Medway Ports (under contract to the Maritime and Coastguard Agency).

2.4 Whilst the risk of explosion is considered to be low, the wreck is regularly monitored. Surveys of the wreck are undertaken in order to provide information on its condition, identify any changes and to help inform future management strategy. Since 2002, multibeam sonar technology has been utilised for these surveys. Multibeam sonar is used because it is faster and provides a greater level of detail, accuracy and repeatability than could be achieved through a diving survey. This is in part due to the very poor visibility and high tidal range in the Thames Estuary.

¹ Net Explosive Quantity

² Text of the Protection of Wrecks Act 1973 [Protection of Wrecks Act 1973](#)

3. THE SURVEY

3.1 NetSurvey Ltd was contracted by the Maritime & Coastguard Agency (MCA) to acquire, process and report on multibeam sonar survey data from the wreck of the SS Richard Montgomery. The survey was undertaken on the 10th and 11th of November 2011.

3.2 The survey included full coverage of the wreck and the surrounding seabed out to a distance of approximately 400m. Specific attention was paid to detailing the hull areas where deterioration has been noted in past surveys and also to the masts, overhanging debris, the debris between the two sections of the wreck and any cracks, apertures or anomalies that were not present in previous surveys. The objective of the seabed survey was to identify any loose or isolated wreckage and show any sediment build up or scouring adjacent to the wreck.

3.3 NetSurvey was required to process the raw survey data and compare it to previous survey data in order to ascertain whether any changes in the wreck structure and surrounding seabed had occurred.

3.4 The survey was conducted from the PLA survey vessel Yantlet. Yantlet is fitted with a Reson Seabat 8125H multibeam echo sounder, Applanix POS-MV 320 inertial system and OS Net network RTK positioning. The 8125H combines the sonar head of an 8125 with the data processor unit of a 7125. The results are maximised data coverage, roll stabilisation and high density footprints which are suited to wreck investigations. The survey was conducted over two days, during which multiple passes of the wreck were made in order to ensure that full coverage was achieved. The surrounding seabed survey was performed using a survey line spacing of 20 metres.

3.5 During the survey, water column data was logged at selected locations along the wreck structure. The purpose of this was to capture data on finer detail that may otherwise be missed by the multibeam digitisation process.

3.6 An Applanix POS-MV 320 inertial system was used to output real-time position, attitude and heading data. This sensor outputs heading and attitude to an accuracy of 0.02° and 0.01° respectively. The POS-MV is a tightly-coupled system which uses Inertially-Aided Real-Time Kinematic (IARTK) technology. The POS-MV is integrated with the Reson 8125 to apply time stamp information to the swath data. As well as real-time data, the raw inertial and GPS data was recorded as a raw sensor file. This means that the data could then be post-processed using POSPAC MMS software and imported into the multibeam data at a later stage.

3.7 HYPACK was used to collect, display and edit data from the multibeam echosounder systems and was integrated with the Reson 8125 processing unit on board the Yantlet. Multibeam data collection was performed by the HYSWEEP® SURVEY program. This program combines the multibeam data with heave-pitch-roll sensors and outputs them into one file.

3.8 Although Yantlet has been used for previous SS Richard Montgomery surveys, it was not used for the 2010 survey. Therefore, some small differences in positioning within the dataset were anticipated. In some previous surveys, two survey vessels have been used with the smaller vessel passing directly over the wreck in order to collect as much data as possible. Although the Yantlet is not a large vessel (13.4m in length) and has a draught of only 1m, it was considered that the risk of collision with upstanding structures on the deck of the Montgomery was higher and, therefore, the Yantlet did not pass directly over the wreck during the survey. It was concluded that similar data coverage could be achieved using the sonar head in tilt mode close to the hull. However, Yantlet was able to pass between the two sections of the wreck in order to maximise data coverage.

3.9 For data processing, a combination of POSPac MMS, CARIS HIPS and QPS Fledermaus was used. The raw logged HSX files derived from Hypack were imported into CARIS HIPS. A post-processed Smoothed Best Estimate of Trajectory (SBET) file was then applied in order to update the ship's navigation and GPS height. Following Sound Velocity (SV) application, a GPS tide was derived and the data was then merged and TPU (total propagated uncertainty) calculated. The swath data was examined in CARIS HIPS in the form of a BASE surface for any systematic errors such as tide or sound velocity artefacts which could be picked up using standard deviation colour maps.

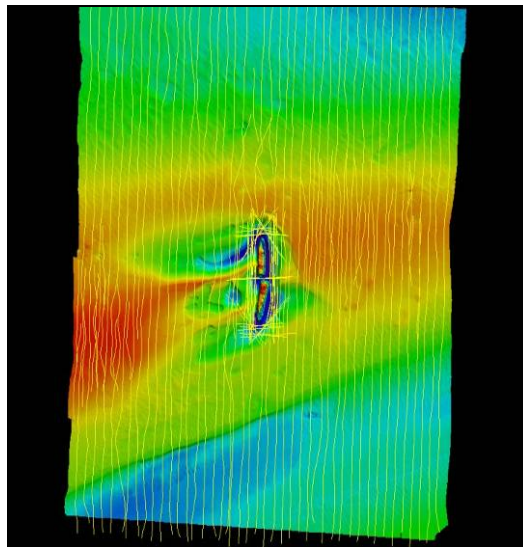


Fig. 1 - CARIS BASE Surface with navigation lines

3.10 The HIPS multibeam data was then passed into the QPS program Dmagic where it was processed into a PFM. Once in Fledermaus PFM format, the point cloud could be cleaned and processed so that only valid points of the wreck remained. Once data cleaning was completed, the finalised point cloud was exported and surface DTMs (digital terrain model) generated. The resulting surfaces were output into a variety of models which include surface difference, profiles and surface statistics.

3.11 The end result is a fully rendered 3-D point cloud which can then be compared with existing data sets to identify any signs of deterioration or changes to the structure of the vessel.

4. SURVEY RESULTS

4.1 As outlined above, survey lines were planned so that maximum coverage of the wreck could be achieved. Also during the planning stage, it was concluded that using the 8125H multibeam unit in its titled mode (40 degrees) would compensate for the survey vessel not passing directly over the wreck. Although sufficient data was collected to visualise the wreck and to enable comparisons with previous data sets, the resulting noise generated in the water column diluted the effect of the bottom tracking and led to a poorer digitisation of the wreck than had been anticipated. Evidence of this can be seen in some of the images below.

4.2 The survey gathered detailed information about both sections of the wreck and the surrounding seabed, with attention particularly focused on areas where previous surveys have identified corrosion, apertures, cracks or buckling. The stern section of the wreck is known to have been salvaged immediately after the vessel grounded and, for this reason, the areas of specific focus are mostly on the forward section of the wreck where the remaining cargo is situated.

4.3 Key Areas Highlighted in Previous Survey

4.3.1 During previous surveys, four specific areas of the wreck have received particular attention. These are the areas where the most pronounced changes or deterioration have been noted in the past. These areas are indicated in the image below.

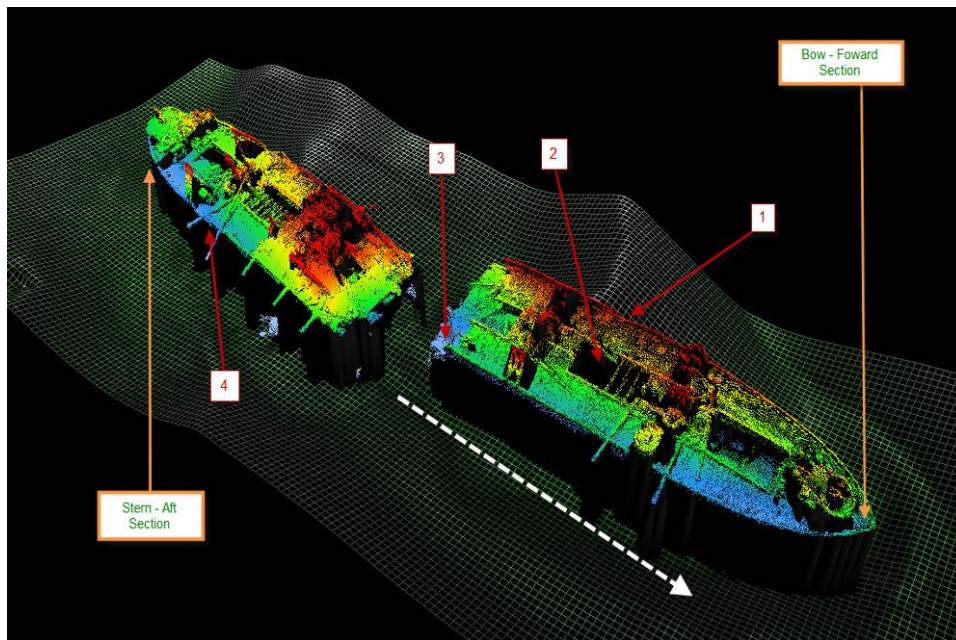


Fig. 2 - SS Richard Montgomery Overview with location of key areas

- Area 1) Crack and split in hull plating at Hold 2
- Area 2) Partial collapse of deck plating above Hold 2
- Area 3) Aperture in the bulkhead aft of the forward section
- Area 4) Vertical split in hull plating in the stern section

4.4 Area 1 – Crack and split in hull plating at Hold 2

4.4.1 The crack in the hull plating on the forward port side of the wreck has been noted in surveys since at least the 1970s. When the 2010 survey data was compared with that collected in 2009, no apparent change in the size of this crack was noted. The crack measured approximately 1.27m by 2.20cm. Data collected in 2011 suggests that the width of the crack has not changed, but the vertical length of the crack may be approximately 27cm longer than in 2010.

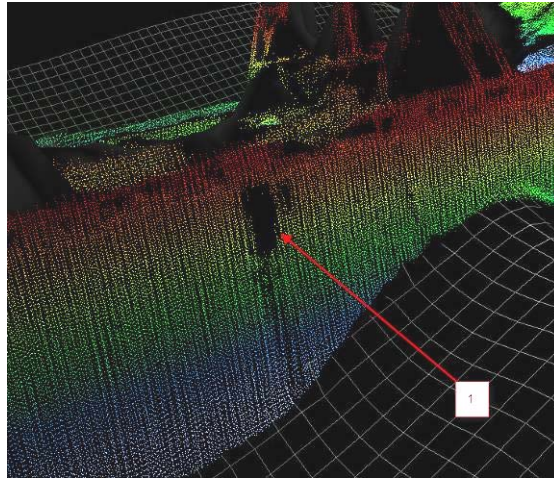


Fig. 3, 4 & 5 Area 1) Crack in hull plating at Hold 2, point cloud data of crack from 2011.

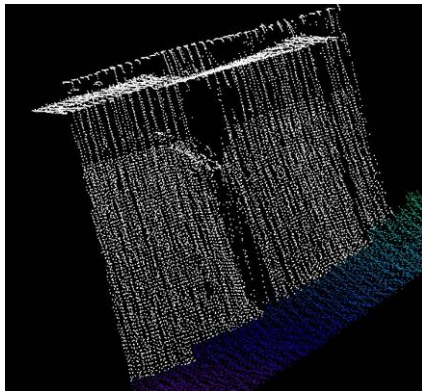


Fig. 4 – 2010

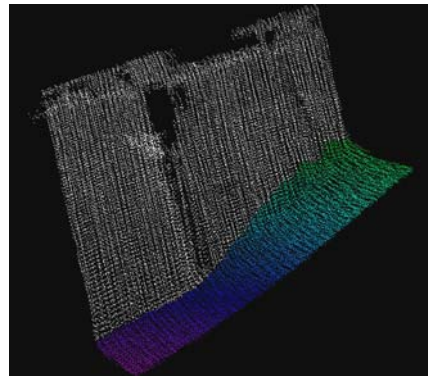


Fig. 5 - 2011

4.5 Area 2 – Partial Collapse of Deck Plating at Hold 2

4.5.1 This section of the hull has shown the greatest change over time. Measurements taken as part of the 2006 data set showed the difference between deck levels to be 0.35m. This difference increased to 0.5m in 2008 and effectively doubled to 1.10m in 2009. The results from the 2010 data set showed that the rate of collapse had slowed with the difference being just a few centimetres increase from the previous year. The data from 2011 measured the height difference to be 1.41m, which is a change of 23cm from 2010. However, there was a low density of data collected from this area of the wreck during the 2011 survey so it is not as easy to visually note any changes as it has been in previous years.

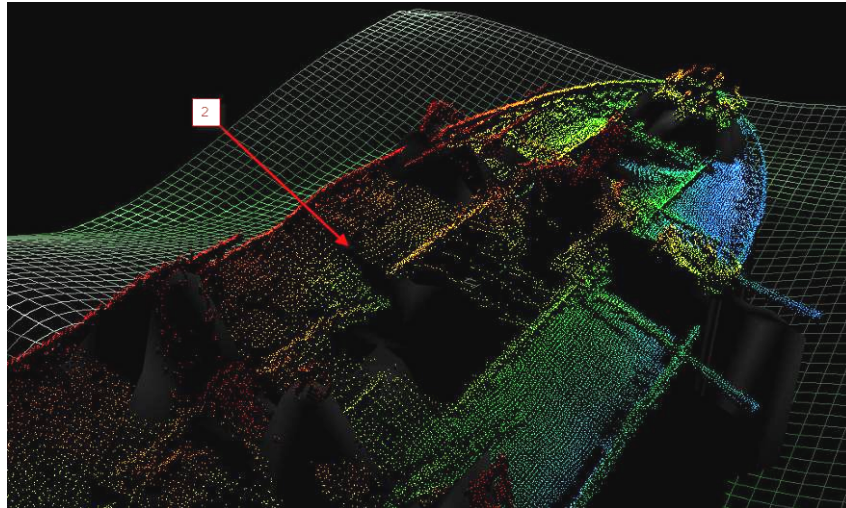


Fig. 6, Deck plating at Hold 2, 2011

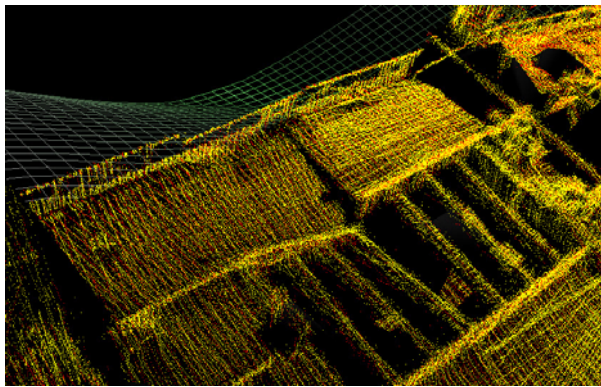


Fig. 7 Hold 2 2009 (Yellow) – 2010 (Red)

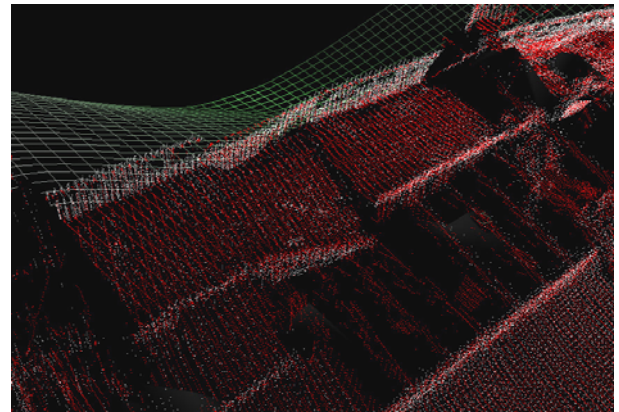


Fig. 8 Hold 2 2010 (Red) – 2011 (Grey)

4.6 Area 3 – Aperture in the bulkhead aft of the forward section

4.6.1 The aperture in the bulkhead at Hold 3 is highlighted as an area that should be monitored as a key feature of the wreck structure. Out of the 4 areas highlighted, this remains the most stable as, over a number of surveys, there has been no noticeable change in the size or shape of the opening.

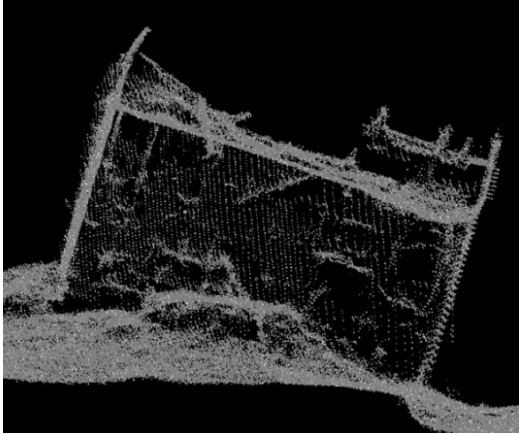


Fig. 9 Bulkhead Hold 3, 2010

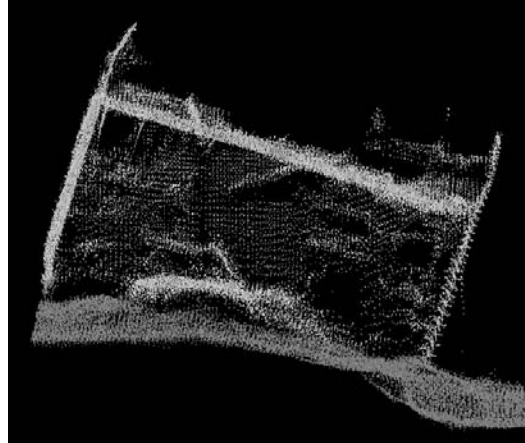


Fig. 10 Bulkhead Hold 3, 2011

4.7 Area 4 – Vertical split in hull plating in the stern section

4.7.1 Using the multibeam unit in tilted mode during the 2009 survey, a crack in the hull on the starboard side of the stern section was noted. Survey data from 2010 showed no evidence of this crack. It was thought that this feature may not have been insonified in 2010 due to the lack of a tilted function on the multibeam unit. However, the data collected in 2011, using the tilted head mode, also shows no indication of a crack at this location. It is therefore likely that this was a misinterpretation of the 2009 data set caused by shadowing of the multibeam swath by overhanging debris.

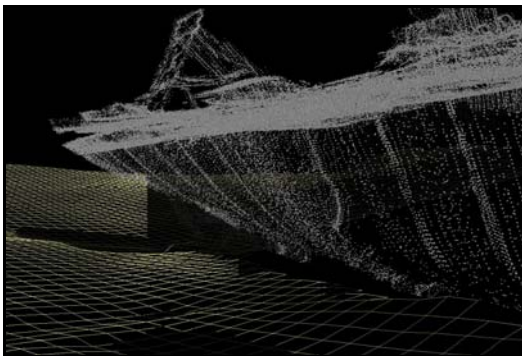


Fig. 11 Hull plating stern section, 2009

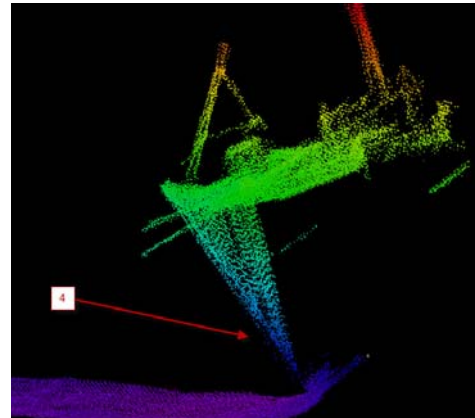


Fig. 12 Hull plating stern section, 2011

4.8 The Masts

4.8.1 All three of the vessel's masts are still standing and extend up through the water line at all states of the tide. There are two masts on the bow section of the wreck and one mast on the stern section. Because of their exposure to wind and tide, an assessment of the condition of the masts is included in the survey. All three masts appear to be in place and near vertical in relation to the hull section. The 2010 survey did not note any changes to the masts when

compared with 2009 survey data. Similarly, data gathered in the 2011 survey did not note any changes, indicating that the masts have so far remained structurally stable. It should be noted that using the multibeam unit in tilted mode allows more of the mast structure to be ensonified. The multibeam data clearly identifies the masts below the water level and a photographic survey shows the masts above the water. There was no laser scanning as part of the 2011 survey.



Fig. 13 The masts at low tide, 2011

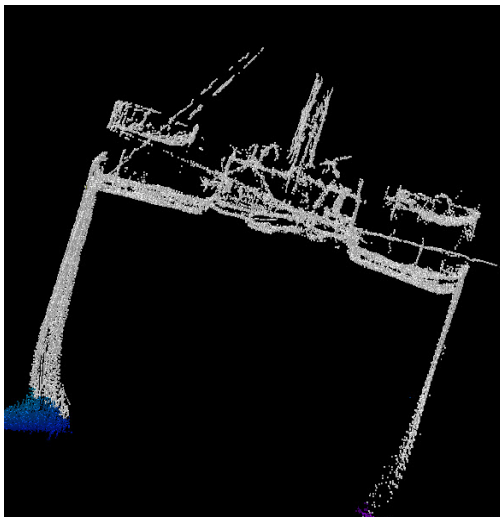


Fig. 14 Mast, bow section, 2010

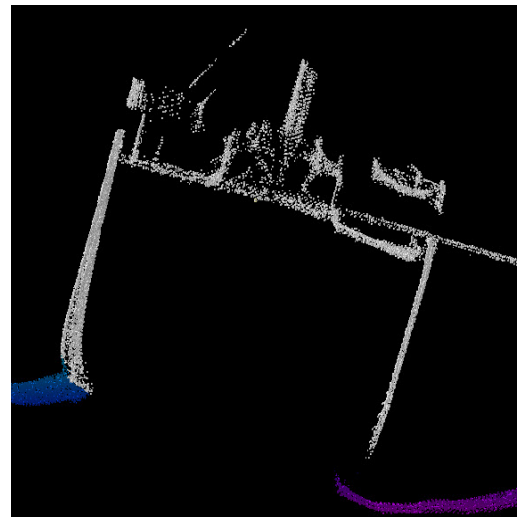


Fig. 15 Mast, bow section, 2011

4.9 Deformation of the hull

4.9.1 Multibeam data sets show that there is some deformation of the hull, particularly in the area around Hold 2. In fact, the vessel showed signs of hogging when it first went aground in 1944 and, over time, this has become evident in the survey data. This deformation takes the shape of bulging and

buckling in the hull plating and is probably due to weakening of the hull structure and stresses such as the weight of the cargo and possibly the weight of sediment build-up on the port side of the wreck.

4.9.2 Data gathered from the port side of Hold 2 in 2010 did not show any measurable change in the bulging of the hull plating since 2009. However, it is acknowledged that this bulging can be difficult to accurately measure. In order to quantify any changes evident in the 2011 data set, the point cloud was extracted and gridded at 5cm. The profiling tool was then run over the surface to show the extent of the buckling on the side of the hull. This shows that the hull is buckling outwards by approximately 15cm closer to deck level and by almost 40cm closer to the seabed.

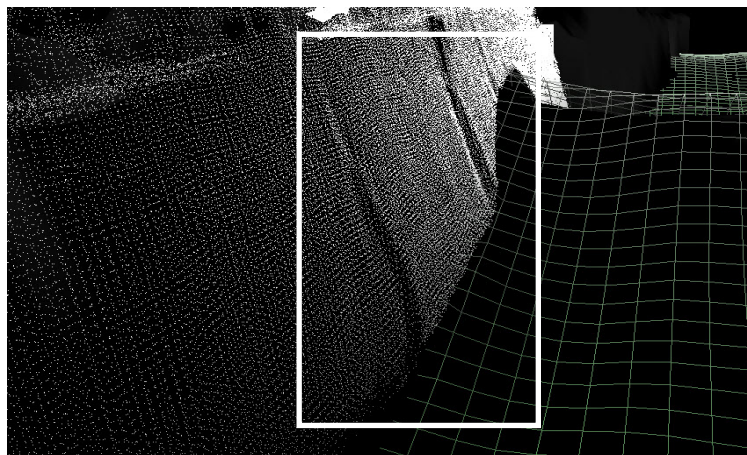


Fig. 16 Hull deformation port side bow section, 2011

4.9.3 As noted in previous surveys, below the crack in the hull plating at Hold 2 (area 1), a split runs from the bottom of the crack down the length of the hull plating to the seabed. Previous multibeam data indicates that there is a deformity in the hull plating directly beneath the crack (highlighted in orange in fig. 17). Using the point cloud data from this area it was possible to produce a surface gridded at 5cm which shows this area of deformity. This data indicates that the hull is bending inwards by approximately 15-20cm.

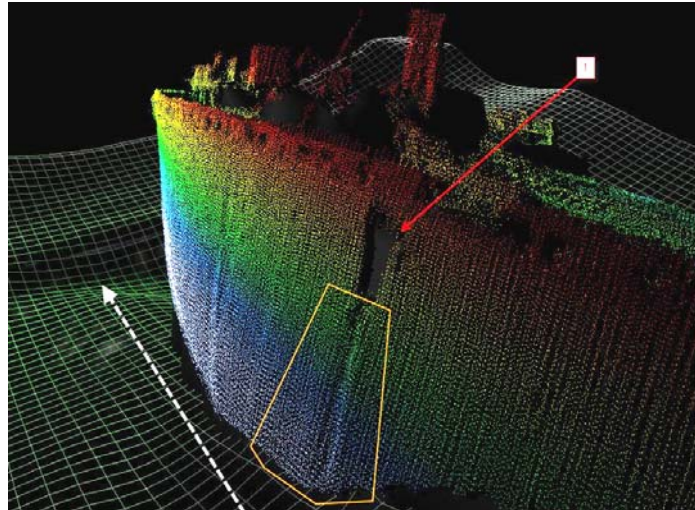


Fig. 17 – Deformity in hull at Hold 2

4.9.4 In order to assess whether the hull forward of the crack at Hold 2 is at a different orientation to the hull aft of the crack, vertical angles of the hull on either side were measured. These same calculations were also carried out in 2009 and 2010. These measurements were conducted on a single line basis so that the angles obtained would not be affected by any minor positioning errors coming from different lines and causing the results to be skewed.

4.9.5 Two measurements were taken either side of the crack at Hold 2 at locations A and B (see fig. 18). The results show that, during the course of this three year time period, the angle of the hull either side of the crack has not changed significantly. Two measurements were also taken on the aft section of the wreck at locations C and D (see fig. 19).

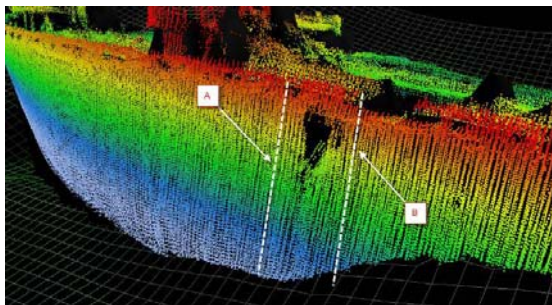


Fig. 18 – A & B measurements, bow section

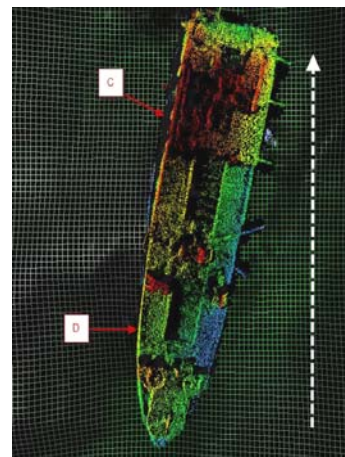


Fig 19 – C & D measurements, stern

4.10 Seabed Survey and Water Column Data

4.10.1 The objectives of the survey include an assessment of the seabed around the wreck and out to approximately 400m distant from the wreck. The purpose of this seabed survey is to assist in determining the level of seabed support particularly around the bow of the vessel, to identify any build-up or scouring of seabed sediment adjacent to the wreck, to determine whether any cargo material has escaped from the wreck and to locate and identify any other debris within the prohibited area.

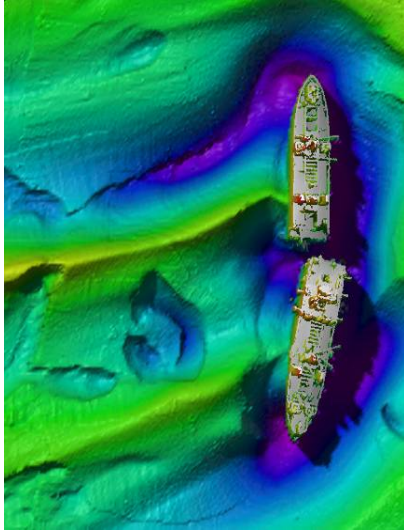


Fig. 20 Seabed survey 2010

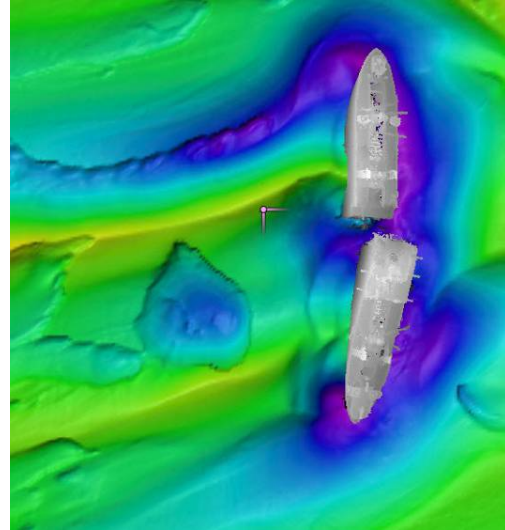


Fig. 21 Seabed survey 2011

4.10.2 Across the rest of the prohibited area, a total of 38 seabed contacts were recorded, as in previous years. These range from 20cm high pieces of debris to the wreck of a possible Thames barge measuring 16.5m x 5.5m x 2.5m.

4.10.3 The results of the seabed survey showed no change in the seabed dynamics around the foot of the bow. Overall, the scour pattern around the wreck remains similar with the distinct horseshoe shape evident in 2009, 2010 and 2011. A number of variances were observed. The scour pattern to the west of the wreck is still present and its general shape and position remain the same, however, the depth and dimensions have increased and the scour now measures 48m x 40m (dimensions in 2010 being 45m x 35m). The sand waves directly to the north showed signs of erosion in 2010 and this appears to have continued, with the 2011 data showing the sand wave to have a depth of 4.96m when compared to 4.62m in 2010.

4.10.4 As was highlighted in previous reports, it is likely that the scouring of the sand around the wreck, caused by the increased speed of water as it flows around the vessel, has gradually allowed the structure to settle onto the bedrock of London Clay; and it is now likely that there is no significant quantity of sand under the wreck itself. Both sections of the wreck list to starboard

which means that much of the wreck's weight is unsupported. The sandbanks that are continuing to form on its port side are adding to the weight of the structure and are probably contributing to some of the deformation seen in both the bow and stern sections of the wreck. In both the bow and stern section the main cracks and hull deformation are approximately in-line with the crest of the sandbanks.

4.11 Water column processing

4.11.1 Water column data was collected during the course of the 2011 survey at strategic points over the wreck. These lines were run to ensure data was collected from the finer wreck structures, such as chains and cables, which might not show up in the bottom-tracked sonar data. Water column data is a relatively new field in hydrographics and one that is becoming more widespread.

4.11.2 For the 2011 survey, the raw water column data was taken into the program FM Midwater. There it was combined with navigation files derived from the SBET used for the positioning of the multibeam data. These two files were then combined to form a generic water column (GWC) file which contains all the information from the water column.

4.11.3 The result of this processing was that no new information regarding the state of the wreck was revealed. When compared to the multibeam data, it showed the same strong returns along the side of the wreck superstructure with no additional significant information.

4.12 Survey Results Over the Rest of the Wreck

4.12.1 Over the rest of the wreck and the surrounding seabed, in general terms, few areas of change were noted. The following is a list of various other areas of the wreck and details what changes, if any, were noted in the 2011 survey.

1. Hole in lower hold cover of Hold 2 – this is not evident in the 2011 survey data and it may be that there was insufficient beam coverage in this area to visualise the hole.
2. Indications of 'tween deck cargo – this has been variously interpreted as indications of the cargo inside the wreck or as part of the hull plating.

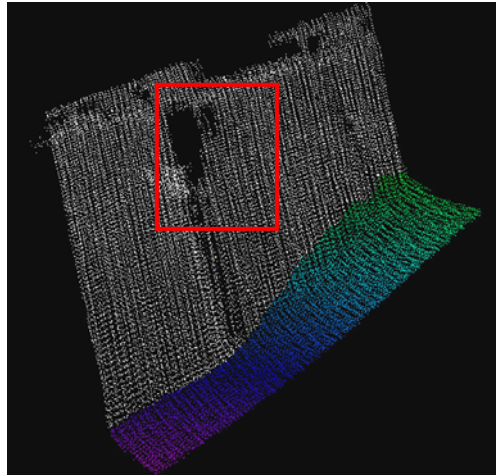


Fig. 22 2011, 'tween deck cargo (?), port side

3. A-frame on the stern section starboard side, no sign of deterioration when compared to 2010 survey data.
4. Deck and hatch coaming at Hatch 3 - the 2011 data shows no additional signs of collapse in this section.
5. Hole in hull plating on the starboard side of Hold 2 - this has been previously identified as a hole and the the data from the 2011 survey shows that at this location there is a hole in the hull, with elements bending both in and outward from the structure and the hole has not grown since 2010.
6. Split in deck plating on the stern section, starboard side - a split in the deck plating that was described as a hole in 2008, next to a fallen piece of debris that had sagged down 0.30m. There is no change in the data set from 2011 when compared to that collected in 2010.
7. Holes in boat deck, stern section, port side - In 2009 the holes were 0.7m in diameter; in 2011 there is not enough coverage to clearly determine the dimensions of the holes however, the measuring tool in FM indicates that the diameters are now 0.8m.
8. Collapse of lower hold cover, Hold 3 - this area is described as a sagging of the cover and overall collapse of the lower hold. The 2011 data does indicate the starboard side is lower than the port but it has not changed in height relative to previous survey data.
9. Indications of 'tween deck cargo, Hold 1 - the 2011 data set shows little change of the tween deck cargo. Evidence of it still being in place remains clear in the point cloud.
10. Indications of 'tween deck cargo, Hold 3 - comparing the 2011 data to that captured in previous years shows no sign of deterioration or change in the state of the tween deck cargo.

11. Boiler room casing - the 2011 data set seems to confirm that this area is still intact, although it is a difficult area to check because of the complex surroundings.
12. Stern gun - the stern gun and gun tub look to be in a similar condition to that observed in the 2010 survey. The shape and location of the gun remain constant with the barrel of the gun pointing upwards at an angle of 17°.

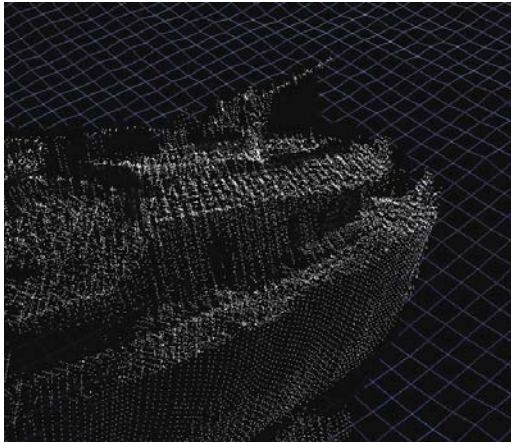


Fig. 23 Stern gun 2010

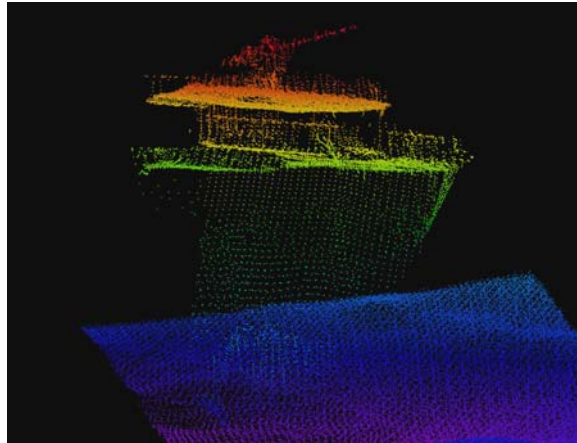


Fig. 24 Stern gun 2011

Across most of the rest of the wreck, little or no changes were noted.

5. CONCLUSIONS & RECOMMENDATIONS

The results of the 2011 data show the wreck of the SS Richard Montgomery remains in a condition similar to those observed in 2010. The list and orientation of the wreck remains the same whilst small changes have occurred to the structure of the wreck and the surrounding seabed. Highlighted in the 2009 report were three key factors that would affect the future stability and deterioration of the site. These were the strength of the hull structure, the local environment around the wreck site and the condition of the munitions within the forward section.

5.1 Structural Changes

The results of the 2011 data show that the orientation and inclination of the SS Richard Montgomery remain the same as those reported in 2010 and 2009. Observations of point cloud data from the last 3 years of survey supports the conclusion that, in terms of its position, the SS Richard Montgomery continues to remain stable. The key features that were identified in the 2009 survey and re-examined during 2010 were again subjected to close examination to ensure that any changes found could be emphasised and brought to the attention of the MCA. As outlined above, the crack in the hull on the forward port side at Hold 2 does show change since 2010. The

hold area which sits directly behind this also shows a minor decrease in height. Excluding the key areas, the wreck structure appears stable with negligible signs of deterioration evident.

5.2 Seabed Movement

The area which immediately surrounds the wreck shows small signs of change from the 2010 survey. The level of deposition and removal of sediment remains minimal around the wreck, but is most notable in and around the bow and stern sections. The scour that appears to the west of the vessel shows only small changes in its dimensions and characteristics. The entire surrounding seabed surveyed shows only small changes from the previous year's data as shown by the contours.

5.3 Munitions

The surveying techniques used to collect data cannot be used to accurately predict the amount and condition of the cargo that remains in the vessel. The survey does demonstrate that, where cargo material can be visualised by the multibeam data, no changes have occurred and also that there is no evidence of cargo material escaping from inside the wreck. The 2009 survey report conducted by NetSurvey includes a more in-depth analysis of the munitions which was provided by Wessex Archaeology.

5.4 Recommendations

The key recommendation for future surveying of the SS Richard Montgomery is that work is carried out on a suitable vessel that allows the survey to be run directly over the top of the wreck, or as close as is reasonable given the nature of the wreck structure. This will ensure that all key features of the wreck are insonified and will result in data of improved clarity. The overarching effect of having data of high clarity will mean that interpreting how the wreck is changing will become more straightforward and less open to interpretation.