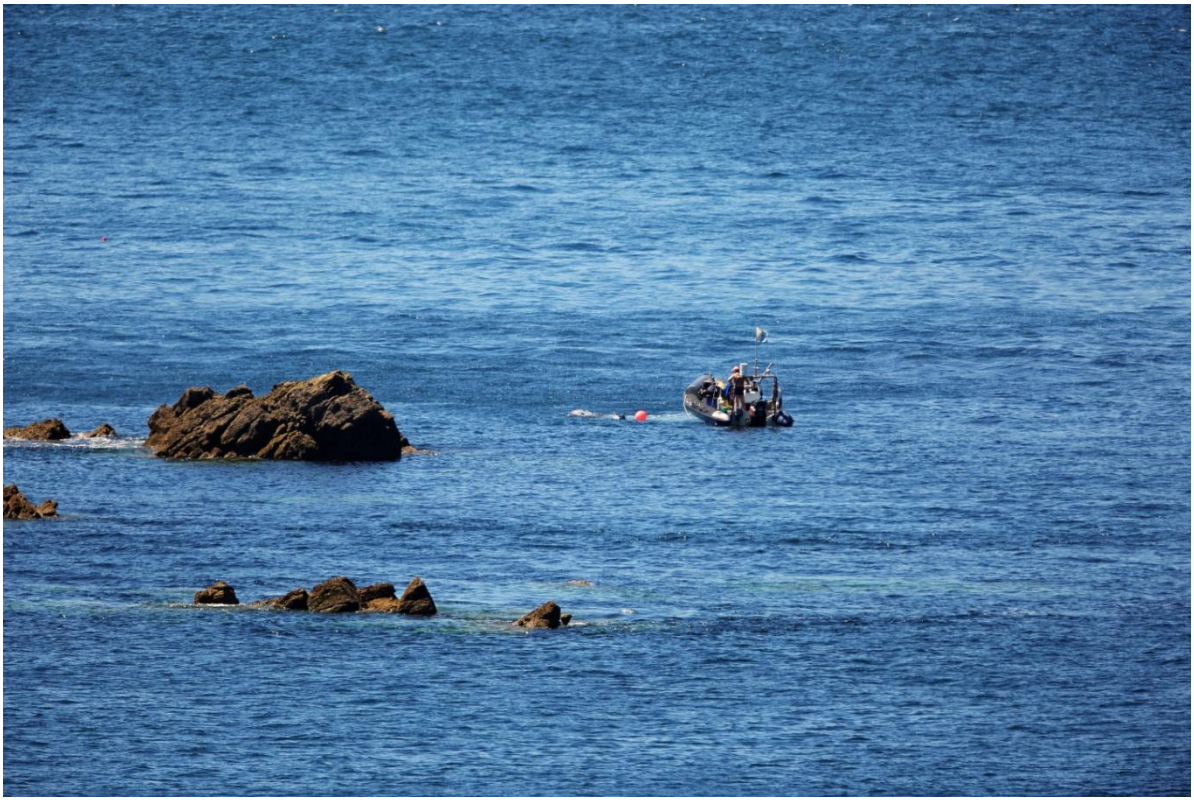
Report No: 2014R052

Royal Anne Galley
Marine Environmental Assessment
The Lizard, Cornwall

Phase 4: Inspection and Monitoring



Cornwall Archaeological Unit and CISMAS

Royal Anne Galley

Marine Environmental Assessment
The Lizard, Cornwall

Phase 4: Inspection and Monitoring

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Acknowledgements

This study was commissioned by English Heritage and carried out by the Cornwall and Isles of Scilly Maritime Archaeology Society and Historic Environment Projects, Cornwall Council.

The Project Manager was Charles Johns; the CISMAS dive team was Kevin Camidge, Peter Menear, David Roberts and Des Glover. The dive boat skipper was Steve McEwen.

The views and recommendations expressed in this report are those of the Cornwall Archaeological Unit and CISMAS and are presented in good faith on the basis of professional judgement and on information currently available.

Freedom of Information Act

As Cornwall Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.

Cornwall Archaeological Unit is a Registered Organisation with the Institute for Archaeologists

Cover illustration

Diving on the *Royal Anne* Galley, 19 June 2014 (photograph by Terence Thirlaway)

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Abbreviations

CAU Cornwall Archaeological Unit
CISMAS Cornwall and Isles of Scilly Maritime Archaeological Society
EH English Heritage
MEA Marine Environmental Assessment

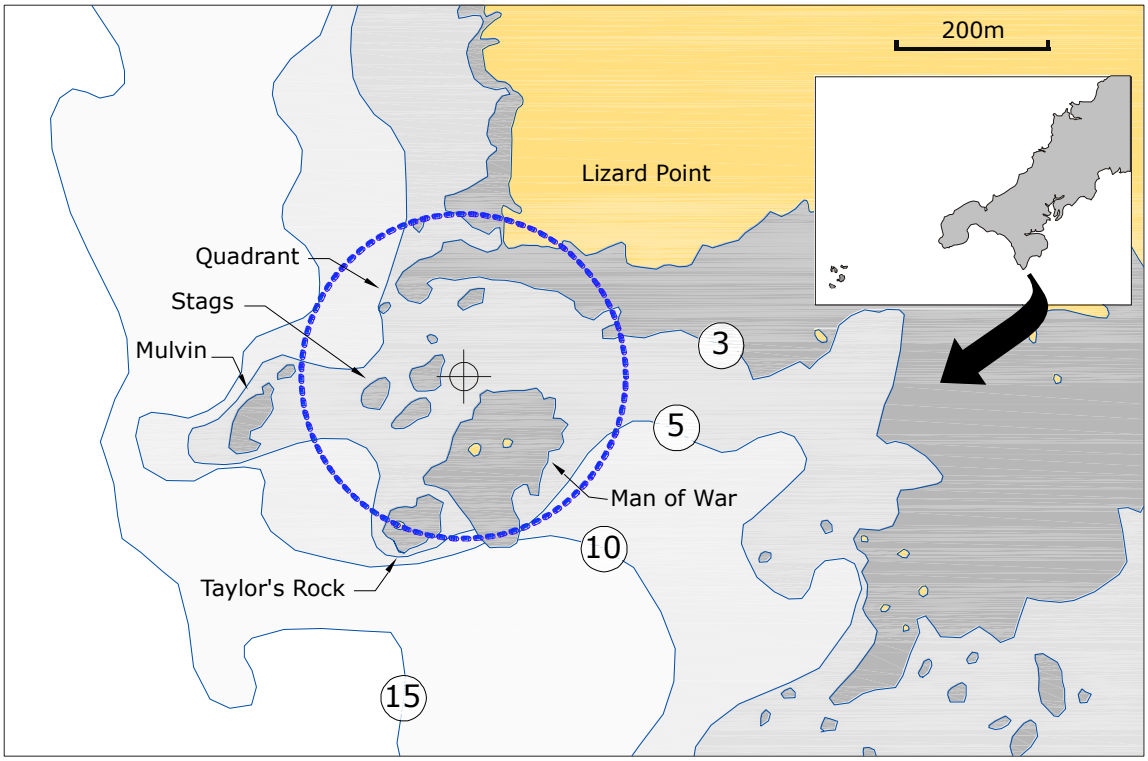


Fig 1 Location of the Royal Anne Galley designated wreck site off Lizard Point

1 Summary

This report describes the results of the Phase 4 inspection and monitoring of the *Royal Anne* Galley, a protected wreck site lying off the Lizard Point, carried out for English Heritage as part of the Marine Environmental Assessment of the site by the Cornwall Archaeological Unit (CAU—formerly Historic Environment Projects, Cornwall Council) and maritime archaeologist Kevin Camidge, with members of the Cornwall and Isles of Scilly Maritime Archaeological Society (CISMAS).

The objectives of the Phase 4 fieldwork were to:

- record the positions of the dispersal objects placed on the seabed in 2009;
- record the two iron guns (G1 and G2); and
- install new survey control points.

The fieldwork had been delayed since 2011/2012 by adverse sea conditions and then illness of the key member of the project team, but successful dives were made at last on 19 and 20 June 2014.

The site had changed considerably since the Phase 3 monitoring in October 2010, although the seabed conditions here are very dynamic, the storms of early 2014 had probably caused the extensive displacement of large rocks and also movement of the two iron guns. Some artefacts— cannon balls, etc.—had also been exposed on the seabed. It was also noted that the flora on the site seemed to have changed. Previously the site was characterised by an unusually tall and dense cover of kelp. The kelp on the site now is much smaller and sparser with much lower level, fine-filament 'sea weeds' having taken over.

The two guns were relocated, planned and photographed. Of the dispersal trials objects —20 bricks and 20 steatite spheres placed on the seabed in April 2010—only three spheres were located, in contrast to the eight spheres and 13 brick recorded in October 2010. None of the existing control points were intact and three new survey control points were established.

It is recommended that monitoring at two-year intervals of the site should be considered and that the newly exposed artefacts should be planned and recorded. Because so few dispersal objects were found this year it is probably not worth continuing monitoring them, although any future work or survey on the site should keep a look out in case any become visible in the future.

2 Introduction

2.1 Project background

The *Royal Anne* Galley was a galley frigate, a type of small, fast warship, combining sail with oar propulsion. Built at Woolwich Dockyard, she was wrecked off the Lizard Point (Fig 1) on 10 November 1721; about two hundred crew and passengers were lost including John, 3rd Lord Belhaven, who was en voyage to take up a new post as the Governor of Barbados.

The wreck site was rediscovered in 1991 when a large sounding lead was found adjacent to two iron guns by local diver Robert Sherratt. Subsequently numerous objects were recovered from the seabed in the vicinity of the iron guns, including items of cutlery bearing the Belhaven crest, which led to the identification of the wreck. The wreck was designated under the Protection of Wrecks Act (1973) as the *Royal Anne* Galley in 1993. The designation extends for a radius of 200m from position Latitude 49° 57'.48N, Longitude 05° 12'.99W (datum unknown).

Although the *Royal Anne* Galley lies close inshore in about 6m of seawater, the area is surrounded by rocks and large Atlantic swells make access difficult. The rocky seabed is a very dynamic environment with deep gullies and crevices normally obscured by thick kelp.

In 2005 English Heritage commissioned Historic Environment Projects, Cornwall Council and Penzance-based maritime archaeologist Kevin Camidge to undertake a desk-based assessment of the *Royal Anne* Galley — the first phase of a Marine Environmental Assessment (MEA) of the site. The purpose of the MEA is to allow English Heritage to make an informed judgment on best practice for field assessment and therefore to establish site stability and preservation potential.

Following completion of the Phase 1 report, which outlined a strategy for field assessment and monitoring of the site (Camidge *et al* 2006), English Heritage commissioned a Phase 2 field assessment. This was carried out during 2008 and 2009 when the following objectives were successfully accomplished:

- A bathymetric survey was undertaken;
- A marine biological assessment was undertaken;
- A water sample was collected and analysed;
- Sediment samples were collected and analysed;
- Objects for monitoring dispersal (bricks and spheres) were installed on the site;
- Objects to monitor the biological degradation of timber were installed on the site.

The Phase 2 field assessment report recommended that at least one recovery/inspection should be undertaken in 2010; the results from this would inform whether any further monitoring was required (Camidge *et al* 2009).

In 2009 English Heritage audited all designated wreck sites to better understand their condition and vulnerability. As a result, nine sites were deemed to be most at risk and were included on the National Heritage at Risk register; the *Royal Anne* Galley was one of these sites (English Heritage 2009, 13). In 2010, as result of the MEA, the *Royal Anne* Galley was removed from the register following the implementation of an improved management regime (English Heritage 2010), and the site remains off the register.

The Phase 3 monitoring was carried out in 2010 and made an inspection of the site and to recover the oak sample blocks for analysis and locate the tracer objects, spheres and bricks (Fig 5), which had been placed on and below the seabed. In total, 21 of the original 40 objects were located and recorded (8 spheres and 13 bricks), the objects

having been moved on the seabed by an average of 5.15m (spheres) and 4.89m (bricks). With a single exception the objects had been 'sorted' by the environmental forces acting on the site.

Analysis of the oak blocks exposed on the seabed of this site showed they are subject to attack by wood-boring organisms and that survival of any timber from the wreck of the *Royal Anne* Galley is unlikely.

Following the recommendations of the Phase 3 report (Camidge *et al* 2011) a further stage of inspection and monitoring (Phase 4) was commissioned by English Heritage in 2011 for continued observation and study of the disposition of the dispersal objects, renewal of the control point network on the site and detailed recording of the two iron guns.

2.2 Objectives of the Phase 4 Fieldwork

The objectives of the Phase 4 fieldwork as outlined in the project design (Camidge and Johns 2011) were to:

- record the positions of the dispersal objects;
- record the two iron guns (G1 and G2); and
- install new survey control points

It was envisaged that this work would be undertaken in the autumn of 2011 or the spring of 2012. Diving on this site has always been difficult due to the exposed position of the wreck. Even when the sea is flat calm elsewhere, it is often not possible to dive at this site due to ground swell from the west. No suitably settled weather conditions coincided with the availability of CISMAS divers during this period. Work during much of 2013 was not possible due to the illness of Kevin Camidge. It was fortunate, therefore, that a protracted spell of very settled weather in June 2014 allowed this work to proceed at last.

2.3 Logistics

The diving was undertaken from the MCA coded 8.5m RIB *Cornish Diver* which operates out of Falmouth. The diving took place on the 19 and 20 of June 2014. A team of four CISMAS divers undertook the fieldwork: Kevin Camidge, Peter Menear, David Roberts and Des Glover. The dive boat skipper was Steve McEwen. The journey from Falmouth to the site (Lizard Point) was undertaken each day — a distance of 33km (about 18 nautical miles) each way, which took just over an hour each way.

2.4 General Observations

It has been almost four years since the last dive on the Royal Anne Galley site; what was immediately apparent was just how much the site had changed in that time. It was obvious that the guns had changed position relative to each other and the surrounding rocks and gullies. It also seemed that some of the larger rocks and gullies had moved or been altered by the action of the sea. Finally, it was noticed that the flora on the site seemed to have changed. Previously the site was characterised by an unusually tall and dense cover of kelp. The kelp on the site now is much smaller and sparser with much lower level, fine-filament 'sea weeds' having taken over.

The most likely cause of these changes is the series of exceptional storms experienced in south west England during January and February 2014 (Table 1 and Fig 2). 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. Indeed, the whole region suffered the effects of these storms and exceptional sediment movements have been noted at a number of sites around much of Cornwall's coast, exposing palaeosols with 'submerged forest' at Daymer Bay on the north coast, at Millendraeth in the south east, and removing overlying sand from the 1917 wreck of the *SS Carl* on the middle shore of Booby's Bay,

north coast, and the late 17th century protected wreck of the *Coronation*, inshore off Rame Head in Plymouth Sound. 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).

These storms have probably contributed to the movement of objects observed on the site during the June 2014 fieldwork. Although movement of large rocks on the site has been previously noted the changes seen in June are by far the most extensive to date. More changes to the site were noted at this inspection than had been previously observed since systematic work on the site began in 1993. This is the first time that movement of the two iron guns (G1 and G2) has been observed. Some artefacts (cannon balls, etc.) had also been exposed on the seabed by the storms.

Date	Max Wind Speed	
	Knots	M.P.H.
25–26 Jan 2014	51	59
31–1 Feb 2014	53	61
4–5 Feb 2014	66	76
8–9 Feb 2014	62	71
12 Feb 2014	66	76
14–15 Feb 2014	67	77

Table 1 Maximum wind speeds recorded at RNAS Culdrose (about 16km north of the site) during the winter storms of early 2014 (Met_Office 2014)

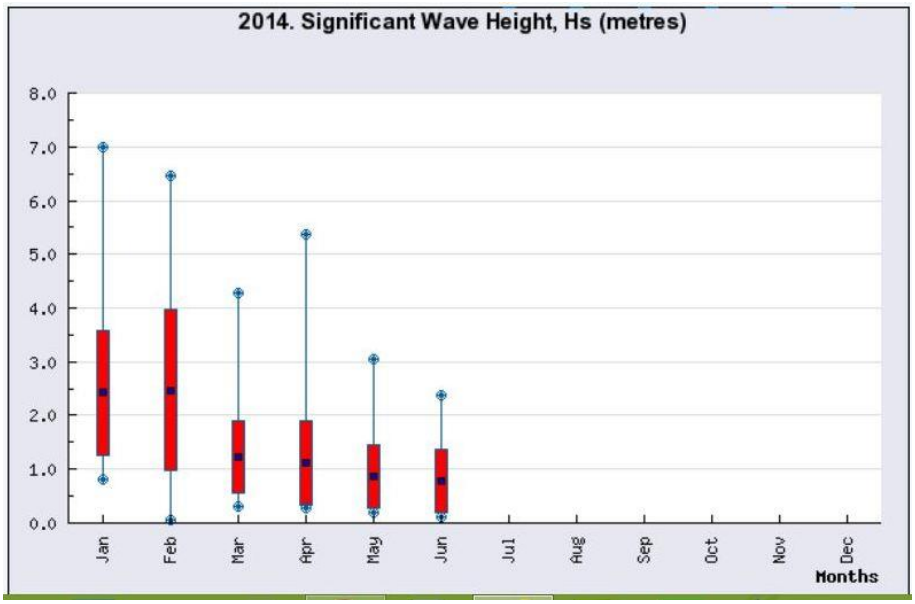


Fig 2 Graph of significant wave heights recorded by the Porthleven wave buoy operated by the Channel Coastal Observatory. This wave buoy is situated approximately 16.5km NNW of the site (Channel Coastal Observatory 2014)

3 Fieldwork results

3.1 The Guns

As soon as the two iron guns (G1 and G2) were relocated in June this year it was apparent that their relative positions had changed since October 2010 (Fig 3). Further investigation showed that the muzzle of Gun 2 had moved about 0.55m to the west — the gun had been rotated about its breach. The other gun (G1) had moved 1.6m to the south and had been rotated by about 10°. The surface of this gun is also now free from concretion, showing an area of exposed and actively corroding iron on its surface. This is probably where the gun was previously concreted to the seabed, this part now being uppermost, the gun having been rotated by about 180° about its long axis.

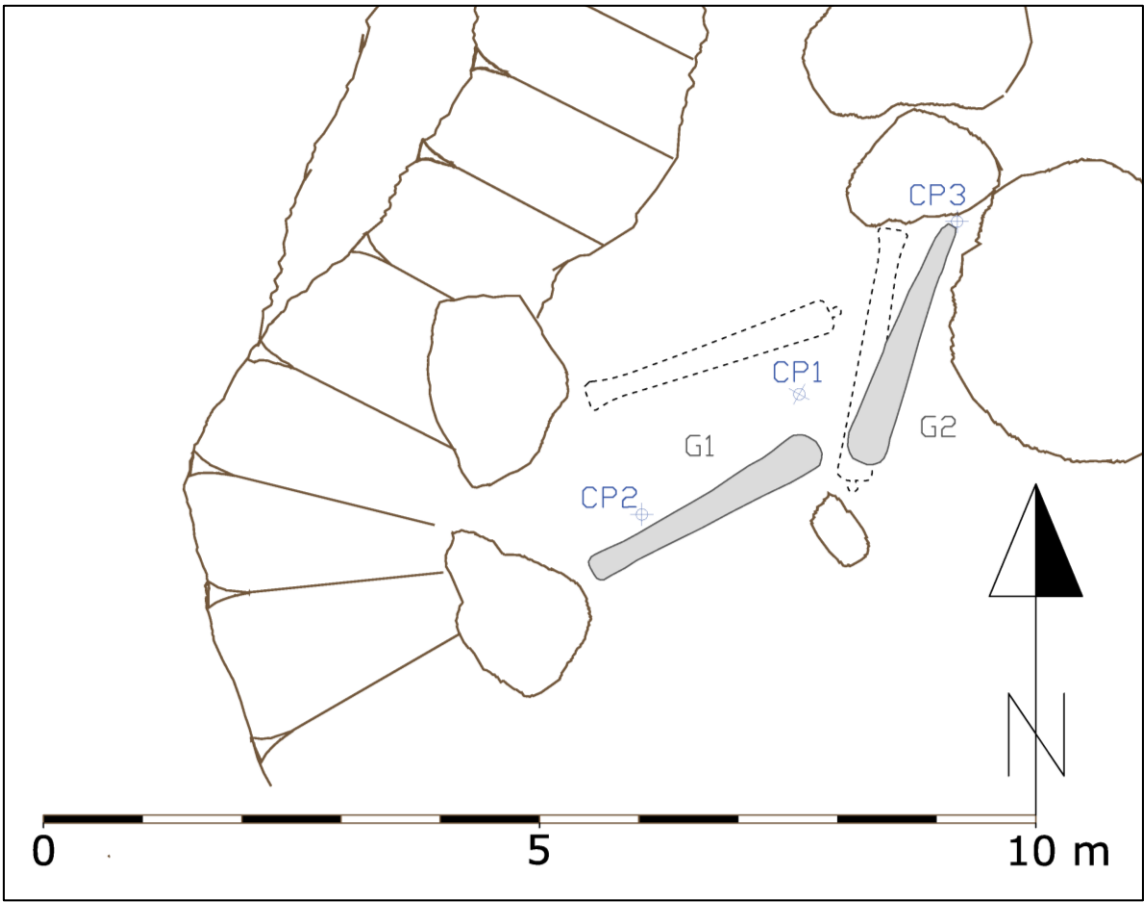


Fig 3 Plan showing the relative positions of Guns 1 and 2. The dashed outlines show the guns as they were in 2010; the solid outlines shaded in grey show the guns as they were surveyed in June 2014. The new control points installed in 2014 are shown in blue (CP1, CP2 and CP3)

Both guns are in poor condition, and are missing their buttons and trunnions. The lack of trunnions in particular suggests that these guns have been subject to movement and erosion since their deposition in 1721. When surveyed in June 2014, Gun 1 showed several areas of active corrosion where concretion had been removed from the surface of the gun, possibly during the winter storms of early 2014. Recording of the guns began by filling in the CISMAS underwater gun recording form, although unfortunately due to the poor state of these guns only a few of the usual measurements were possible (see Table 2 below).

Measurement	Gun 1		Gun 2	
Length	2.60m	8.5ft	2.55m	8.36ft
Base-ring diameter	0.43m	1.41t	0.42m	1.37ft
Bore at muzzle	0.10m	3.93”	Buried	

Table 2 Gun dimensions recorded 2014

These dimensions are consistent with a 9lb (demi-culverin) of the period; a common length for this type of gun was 8 foot (2.43m). The measured bore of gun 1, at 3.93 inches, is consistent with the published bore of the 9lb gun of the period (4.2 inches) allowing for the thickness of the concretion. We do not know exactly what type of guns the *Royal Anne* Galley was carrying when wrecked. We do, however, know what armament was intended when she was built (Table 3).

Complement	High	Mid	Low
Men	190	160	130
Gun Deck	20 x 9lb	20 x 9 b	18 x 9lb
Upper deck	20 x 6lb	20 x 6lb	18 x 6lb

Table 3 Proposed complement for Royal Anne Galley (PRO ADM 7/337)

But this is only what was intended; individual ships at this date often had guns which varied from the official complement for the vessel. To date, no documentary sources outlining the specific armament for the *Royal Anne* Galley have been located. We do, however, have such a record for a similar ship — the *Charles* Galley — for the 30th March 1713. This shows the *Charles* Galley as carrying 20 demi-culverin (9 lb) guns, 16 x 6 lb guns and 4 x 3 lb guns (Caruana 1994).

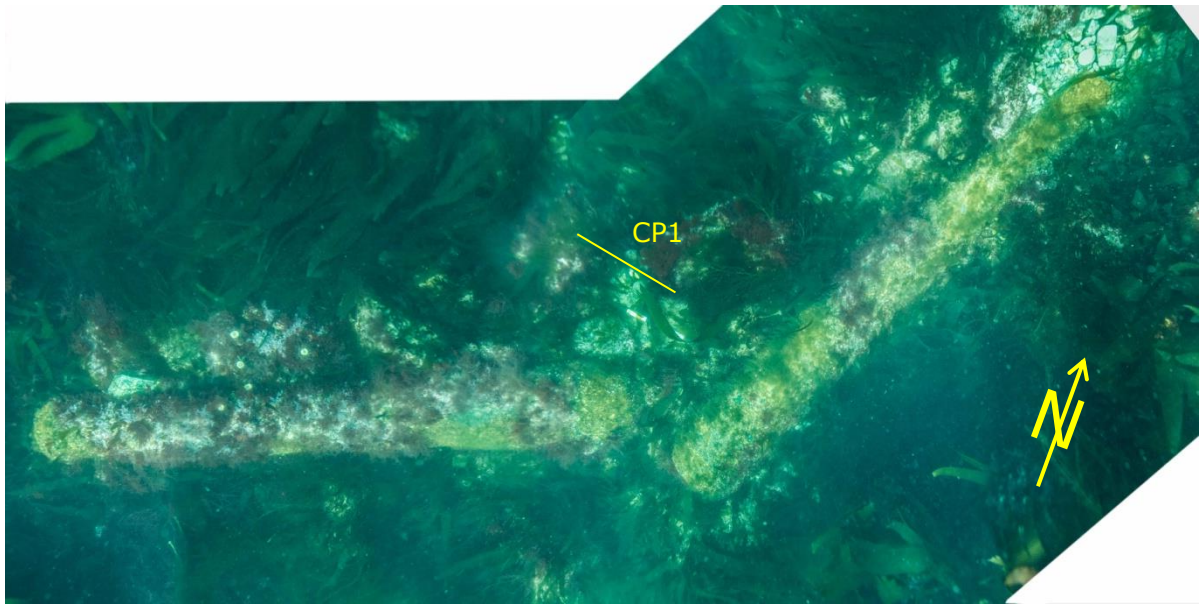
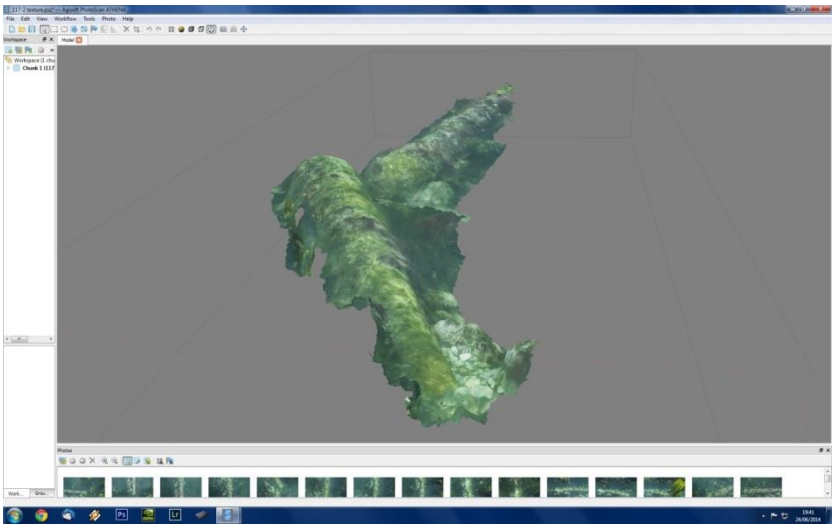


Fig 4 2D photomosaic of Guns 1 and 2. Survey control point 1 is visible near the centre of the picture. The scale (between the two guns, partly obscured by weed, next to the yellow line) is 0.5m long

The next stage in the recording was the production of a 2D photomosaic of the guns produced from a number of overhead underwater photographs (Fig 4). This was necessary as the underwater visibility was not great enough to allow both guns to be captured in a single photograph – even with a wide-angle lens. The photomosaic was then scaled and used to produce the new outline plan of the two guns.

Finally, by way of an experiment, an attempt was made to produce a 3D model of the guns (Fig 5). The conditions were far from perfect, with a profusion of weed and kelp moving in the water making a series of aligned photographs very difficult; the weed moves between camera positions and confuses the alignment software. Normally all weed is removed before attempting 3D photo modelling (McCarthy and Benjamin 2014) but this was impractical in the time available. An alignment was attempted using over 100 underwater photographs processed using Agisoft Photoscan software. The results were never going to be good as the viewpoints were limited by the upstanding weed growth around the guns and by adjacent large rocks. The resulting 3D model has a number of visible lacunae (caused by weed) but it exhibits reasonable dimensional accuracy. CISMAS intends to experiment further with this technique underwater (we have had very good results producing accurate 3D models of cannon and anchors on land).



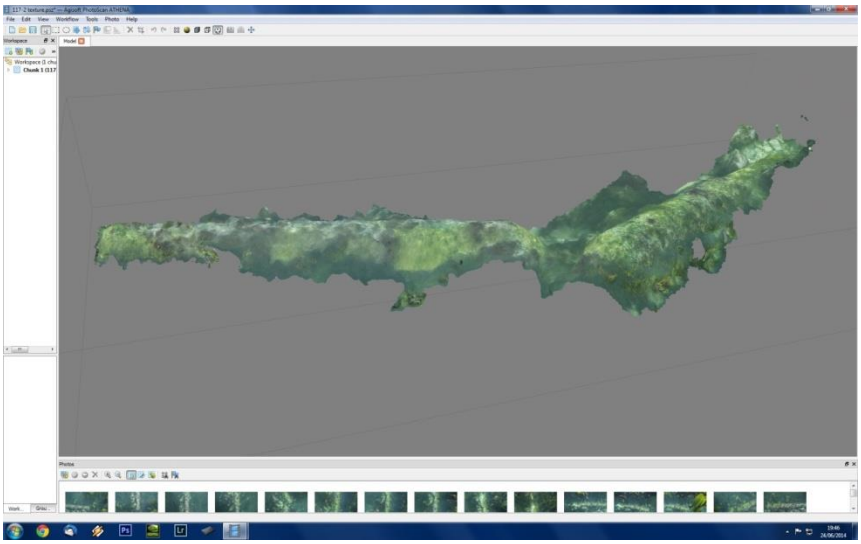


Fig 5 Screen shots of the 3D model of the two guns. Each shot shows a different viewpoint of the model

3.2 Dispersal Objects

3.2.1 Background

Tracer objects have been used elsewhere on historic wreck sites to map the direction and force of water movements (Camidge *et al* 2008). The usual technique is to place tracer objects on the seabed at known locations and to record their positions at set time intervals. At Kinlochbervie, practice golf balls and halved tennis balls were used, weighted respectively with washers and bolts. These relatively light objects did not move far over an annual cycle, indicating relatively benign conditions over the period measured (Robertson 2004).

More recently, ceramic bricks have been deployed on the protected wreck sites *Hazardous Prize* and St Peter Port Harbour. The bricks were of two types, engineering and architectural bricks of different (but unknown) densities. The bricks were used whole, cut in half and into thirds. They were painted to aid location and tagged so that each brick could be individually identified (Holland 2005; 2006; and pers comm). This work is on-going but latest reports indicate that some movement of bricks has been noted. Some bricks could not be relocated, indicating that they were missed by the divers, have become buried or have moved to outside the study area (Holland 2005).

This technique is a useful indicator of potential artefact mobility. It has the advantage of simplicity and low cost. This means that it could be used widely on historic wreck sites, and direct comparisons of the forces acting on the seabed at each site made.

3.2.2 Methods

Two different types of tracer object were employed in this trial. The first group were class 'A' engineering bricks conforming to BS EN 771-1. These have water absorption of $\leq$ 4.5% and a minimum density of 2200kg/m^3. The particular bricks used here were 0.214 x 0.064 x 0.10m and weighed 3.3kg, giving an actual density of 2408kg/ m^3. The bricks were painted yellow to aid visibility on the seabed and numbered (1–20) so that individual bricks could be tracked (Fig 6). Secondly, numbered white ceramic balls (steatite) of 51mm diameter and an average weight of 0.190kg, giving a density of 2735kg/m^3 were used (Fig 6).

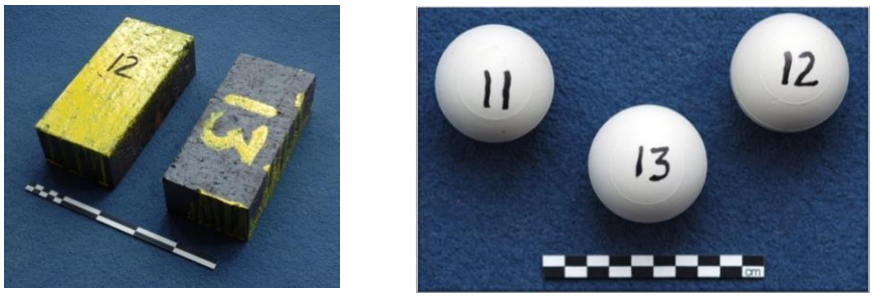


Fig 6 Numbered bricks and steatite spheres, 20 of each were deployed on the site in 2009

Both types of tracer object (20 of each) were placed on the seabed in a symmetric arrangement at position 340978E 5536253N (UTM zone 30 WGS84) on 16 April 2009 (Fig 9). The positions of these objects were recorded again on 16 October 2010 (18 months after deployment) (Fig 9). The record was made by recording the distance and bearing of each object from the original position (Table 4). The objects were located by undertaking a circular search centred on the origin point of the dispersal objects. The seabed around the *Royal Anne* Galley site is normally covered with a thick growth of kelp which makes locating small objects difficult. A circle of radius 5m around the dispersal object starting point was searched thoroughly; a further 5m (from 5m to 10m radius) was also searched, but not quite as thoroughly. It is unlikely that any objects within the 5m radius were missed (the ground was covered meticulously by several

different divers). It is possible that a few objects were missed in the 5–10m radius as this area was only searched once. Thirteen of the original 20 bricks were located while only eight of the original 20 spheres were located.

3.2.3 Positions of the dispersal objects - October 2010

Steatite spheres – positions Oct 2010				
No	Easting	Northing	Moved	Direction
5	340975.85	5536251.69	4.00	230
7	340976.09	5536251.97	3.70	231
8	340988.95	5536259.83	11.40	61
10	340977.87	5536249.35	5.05	190
11	340976.76	5536254.38	2.22	270
12	340974.94	5536250.81	5.33	230
17	340976.33	5536253.66	2.72	260
18	340976.33	5536248.04	6.78	200
		Mean	5.15	209

Bricks – positions Oct 2010				
No	Easting	Northing	Moved	Direction
2	340978.98	5536254.28	9.79	40
4	340983.13	5536259.37	6.56	40
7	340979.94	5536251.41	3.02	160
8	340979.80	5536254.53	0.86	75
9	340979.88	5536250.87	3.52	165
11	340984.65	5536260.61	8.49	40
12	340981.73	5536255.78	3.13	60
13	340982.35	5536258.37	5.29	40
14	340982.25	5536261.62	8.03	25
16	340979.95	5536251.63	2.82	160
17	340982.56	5536258.76	5.73	40
19	340981.65	5536254.27	2.66	90
20	340981.52	5536254.53	2.55	85
		Mean	4.80	78

Table 4 Tables showing the positions of the bricks and spheres as recorded on 16 October 2010. Displacement in metres and directions in degrees (north = 0°, east = 90° south = 180° and west = 270°)

What is remarkable for such a high-energy site is the high percentage of the dispersal objects relocated within 10m of their starting position (Fig 7). Those who know this site all predicted that most—if not all—of the dispersal objects would be lost. What is even more surprising is the distribution of the dispersal objects as recorded in October 2010 (Figs 9 and 10 below). With the single exception of sphere 8, the objects had been sorted into two distinct areas; the bricks had all been moved to the east while the spheres have all been moved to the west of their original positions (Fig 12). This 'sorting' of the dispersal objects was a most unexpected result. As the two types of object have similar densities (2408kg/m^3 and 2735kg/ m^3) the differentiation was likely to be due to their different size and shape. This theory was bolstered by the fact that the granite block SS1 measuring 0.2mx0.35mx0.25m and weighing 30kg was moved by 5m to the east between deployment and recovery—thus behaving in the same way as the bricks. Why the smaller spheres had been moved in a different direction is not clear. The following comments were received from Jon Rees, principal oceanographer at Cefas:

> *I think these results are incredibly good – two very distinct groups. The consistency of the results is also very strong – no "outliers". In terms of analysis, the distributions are also explainable – several different solutions are possible (1) depth variation over tidal cycle – at low tide particles move inshore or high tide offshore (2) different size/density/shape objects will move according to the stress applied to them (the 'bed shear stress' – combination of wave and tidal current components and also depth related) and the critical "movement stress" for that object. I don't know the specific densities of brick or spheres but one group could have been moved north-east during a south-west storm at low tide whilst the other group moved south-west on the same storm at high tide (undertow). Conversely, during a single storm event and with increasing bed shear stress applied to each group could of lead to different transport paths. As well as analysing the 'found' objects the difference in 'lost' objects may give useful information.*

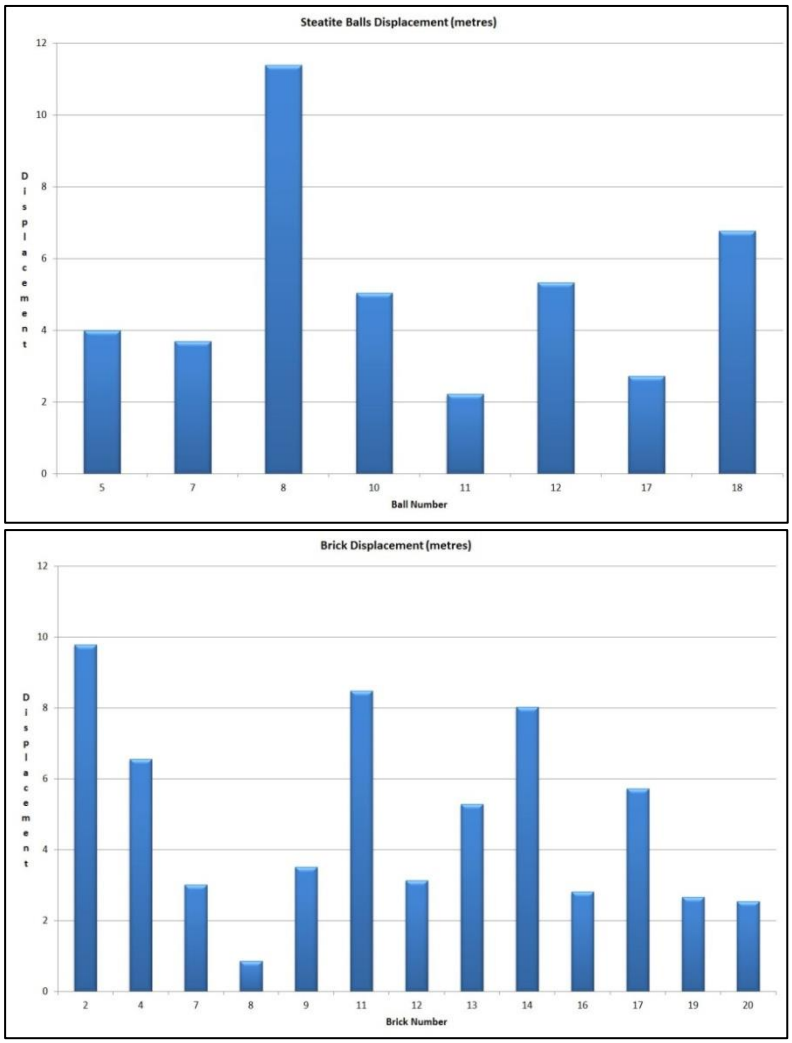


Fig 7 Charts showing the distance of each brick and sphere from their starting point (October 2010)

The dispersal objects now all occupied a narrow corridor aligned north-east/south-west (see Fig 10). This perhaps suggests that the main forces acting on these objects are aligned in a similar direction. This is also surprising as the main observable force acting on the site is the prevailing swell which invariably sweeps the site from west to east, which is different from the observed movement of the dispersal objects. The key to understanding this may lie in the sub-surface terrain of the area around the site. Plotting the rocks which break water at spring lows shows that the site lies in a long north east — south west gulley, which may well channel the swell and current along this alignment (Fig 11). Without proper measurements of water movements over the site, it is not possible to be certain; but the position of the dispersal objects in 2010 would seem to indicate this.

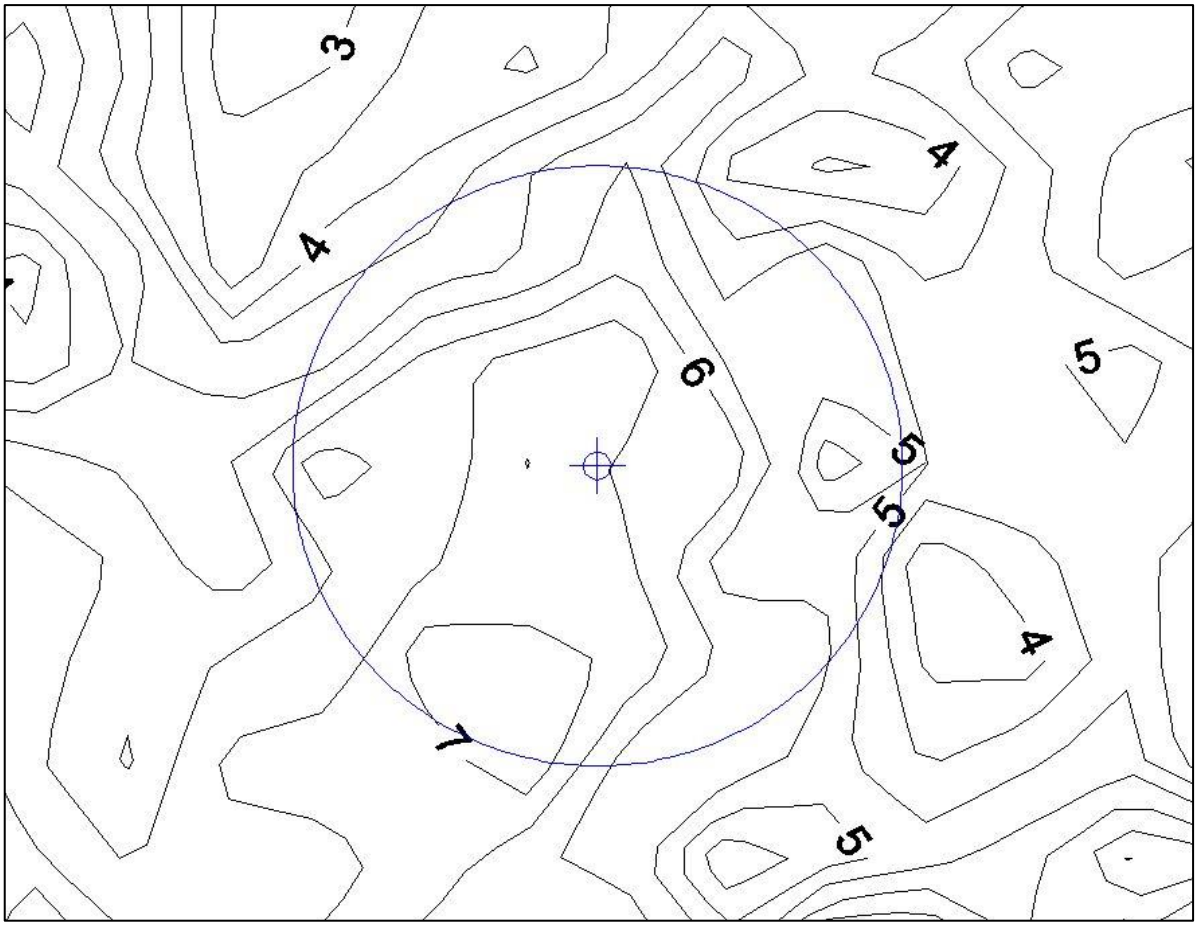


Fig 8 Contour plot of the area around the dispersal trial. The blue circle has a radius of 10m and is centred on the dispersal objects origin. The heights are in metres below chart datum. The contour vertical interval is 0.5m. Derived from Seastar bathymetric data collected September 2009 (RAG MEA stage II).

It has been suggested (EH comments on first draft report) that the differential movement of the two types of object (bricks and spheres) may have been caused by the spheres rolling downhill, while the bricks have reacted to water movements. This is an interesting idea. The impression given to the diver of the seabed in the area of the dispersal trial is that of a flat bottomed gulley. However, reference to the contour plot of the area (Fig 8) shows that the area where the majority of the spheres were observed in 2010 is in fact a shallow depression, while the majority of the bricks have 'travelled' uphill. This may account for the differentiation seen in 2010. By 2014 the spheres had all left the shallow depression and were all found (albeit only three of them) on higher parts of the seabed. We should perhaps be careful not to speculate too much on matters which are clearly the province of an oceanographer. It may be worth undertaking a small study of the data in collaboration with someone with expertise in the area of seabed sediment transport.

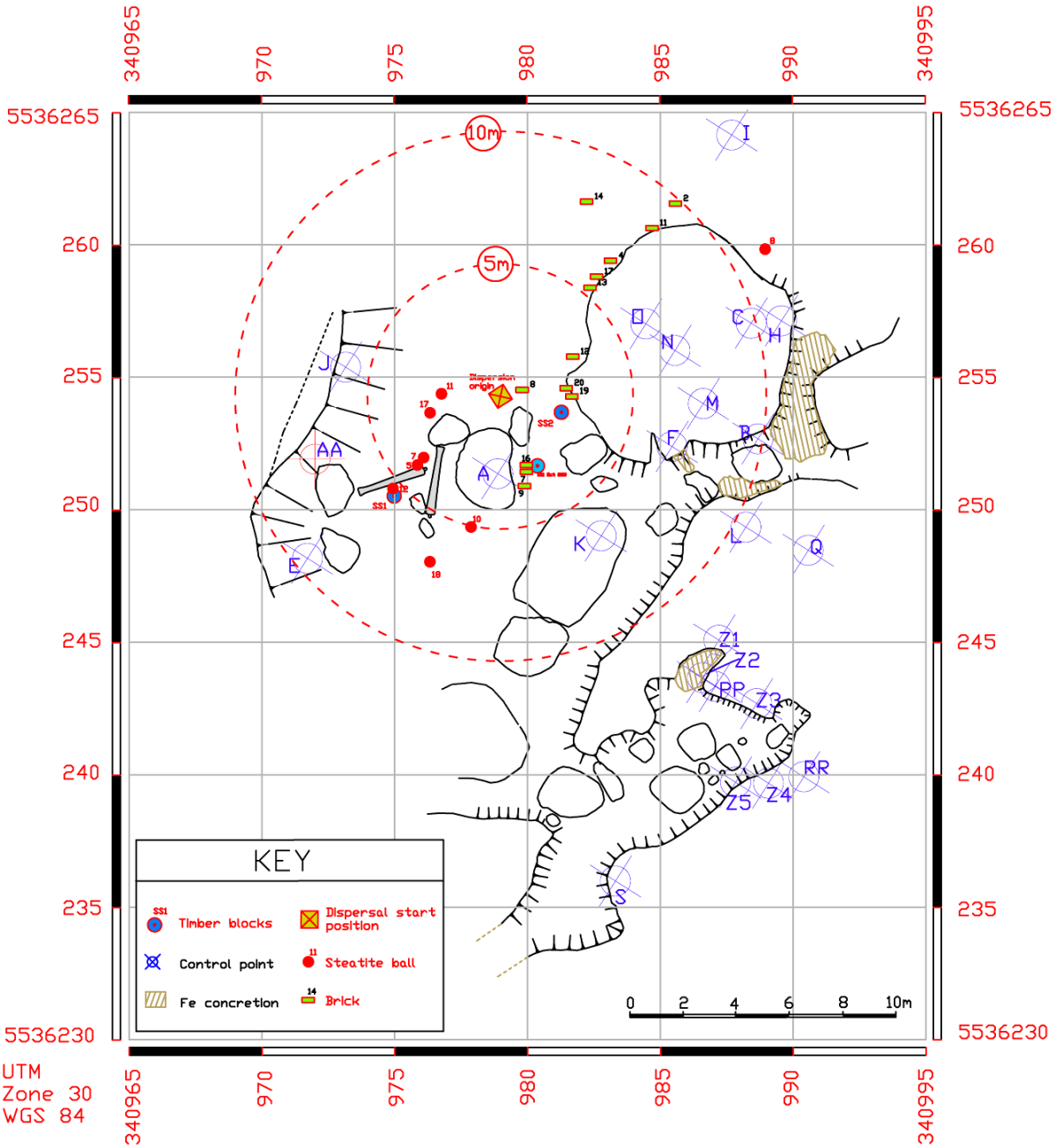


Fig 9 Site plan showing the positions of the dispersal objects (deployed 16 April 2009 and their positions 18 months later, on 16 October 2010)

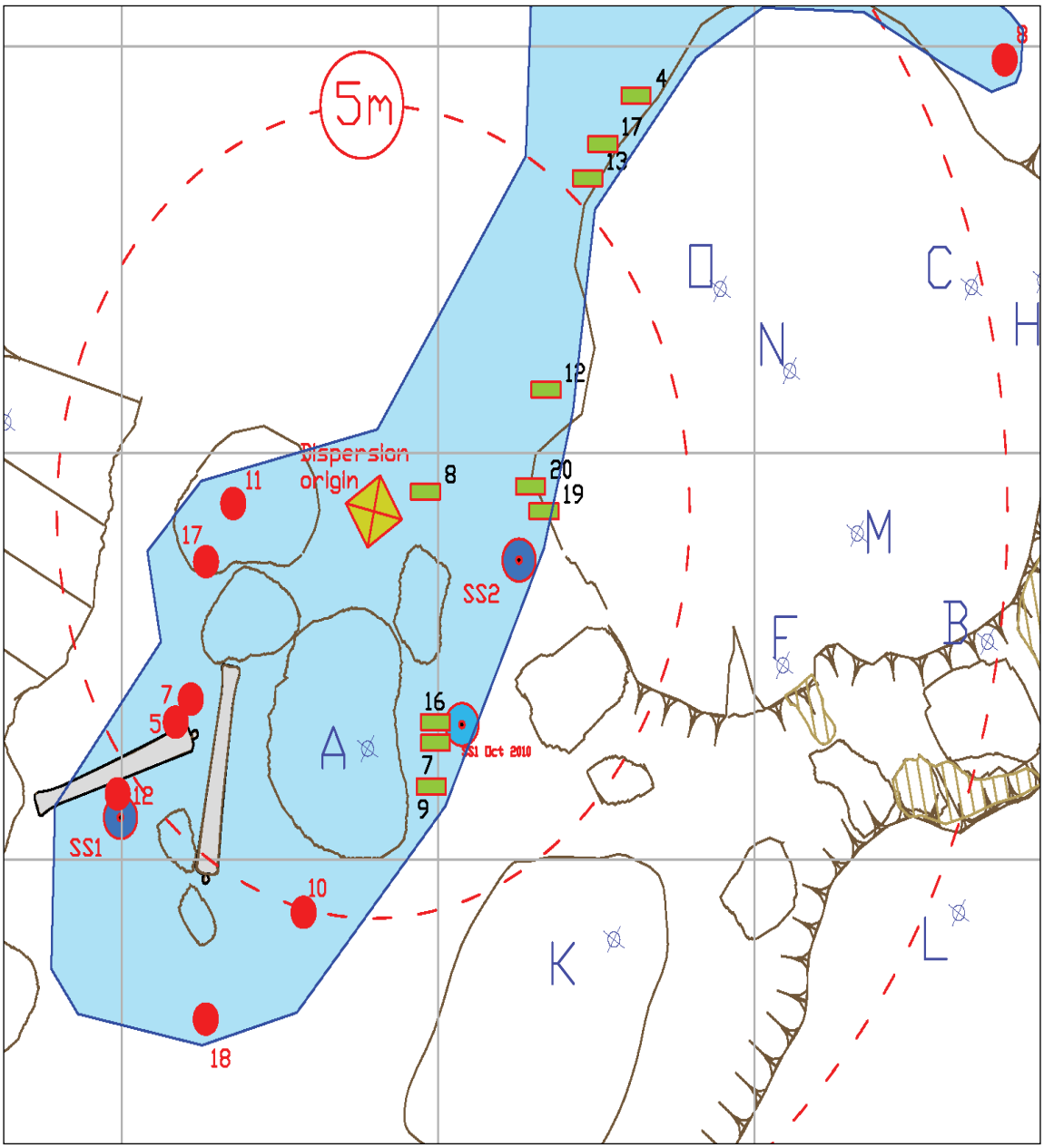


Fig 10 The dispersal objects in October 2010. Note that they all fall within the north-east / south-west corridor outlined in blue above. The grid squares are 5m; north is top of the page

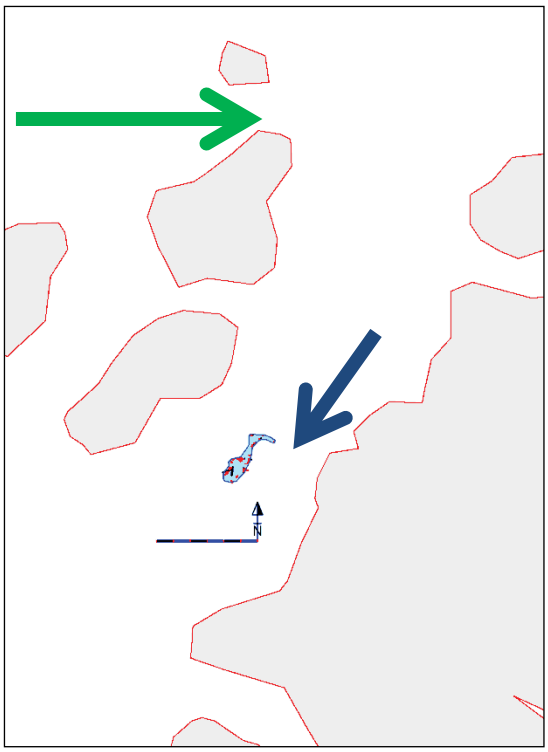


Fig 11
The outline of the dispersal corridor is shown (blue arrow) relative to the rocks which dry at low water. This demonstrates how the dispersal objects form a pattern which aligns with the deeper water running north-east / south west through the site. The scale bar is 30m long with 5m divisions. The green arrow indicates the direction of travel of the prevailing swell

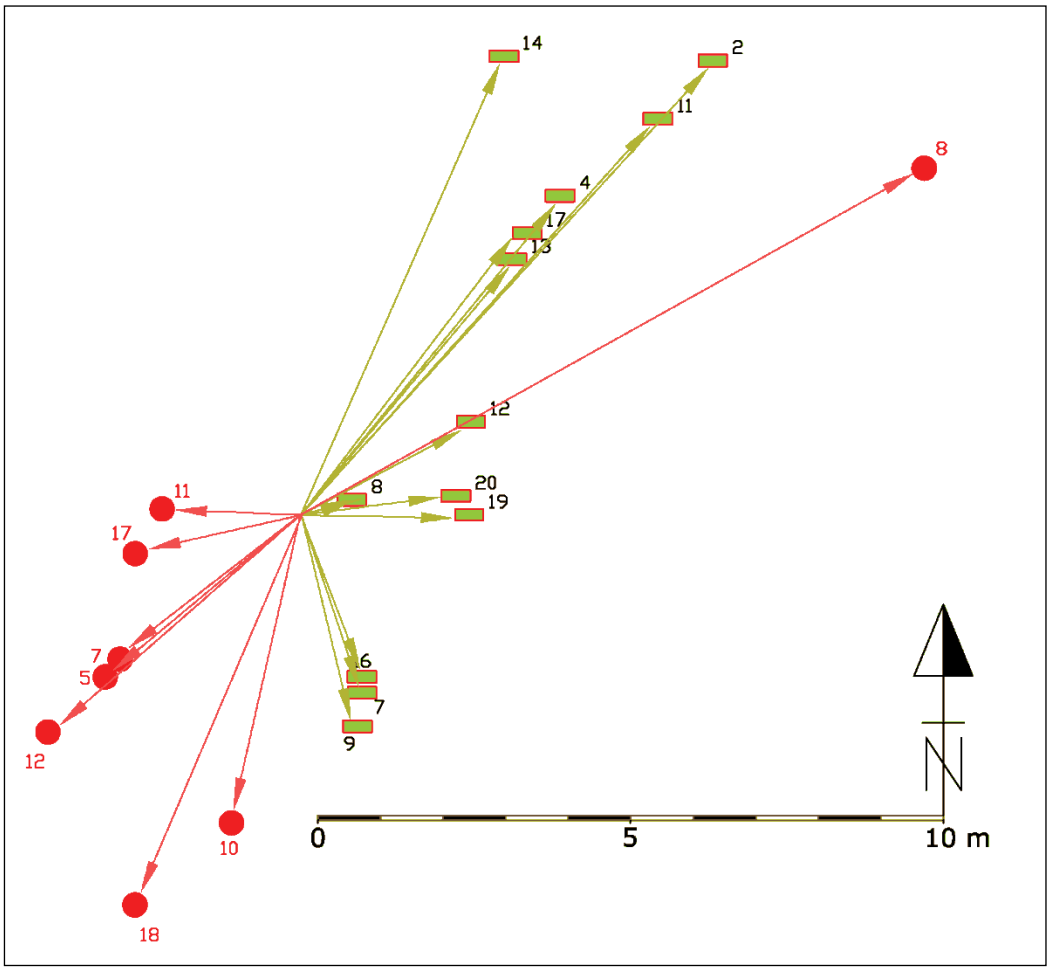


Fig 12 Dispersal objects: movement, clearly showing how the bricks and spheres have been differentially moved. Bricks are shown in yellow and spheres in red

3.2.4 Positions of the dispersal objects – June 2014

Of the 40 dispersal objects originally placed in 2009 only three were located in 2014 (Fig 14). Interestingly, all three of the objects located were steatite balls (Fig 13). None of the bricks were found at all, despite the bricks being by far the larger of the two object types deployed. All four divers were involved in searching for the objects, and in total six man-hours were spent searching. In the final stages of the search the search area was extended out to a radius of 15m from the starting position (as deposited in 2009) (Table 5). There are a number of possible explanations for the paucity of dispersal objects located in 2014. The objects may have been dispersed beyond the area searched; they may have been buried and are no longer visible on the seabed or a combination of both of these factors. What is also of note is that two of the three balls located this year were not found in October 2010 – these were either buried or outside the 10m radius searched in 2010.

Steatite spheres – positions June 2014								
	October 2010				June 2014			
No	Easting	Northing	Moved	Direction	Easting	Northing	Moved	Direction
3	Not found in 2010				340978.24	5536254.11	0.75	255
8	340988.95	5536259.83	11.40	61	340983.43	5536245.20	10.13	150
14	Not found in 2010				340975.90	5536266.18	12.35	345
						Mean	7.74	250

Fig 5 Table showing the positions and the distance moved of the three dispersal objects found in June 2014 (and their positions in October 2010).

The only dispersal object located in 2010 and in 2014 was the steatite ball number 8. It may not be coincidental that this ball was the single exception to the southerly grouping of balls noted in 2010 (see Figs 9 and 10). Ball 8 has moved 15.63m in a south south west direction between 2010 and 2014. Because of the small number of objects located, it is difficult to draw any conclusions about the distribution of the dispersal objects in 2014 – except to note that the three balls located all lie roughly within the same 'corridor' as seen in the 2010 distribution (see Fig 10). Although it is perhaps not surprising that the majority of the dispersal objects have lived up to their name (i.e. had been dispersed) it is hard to account for the fact that no bricks at all were located in 2014. No evidence of bricks being colonised by kelp as holdfasts has been observed on any occasion – so this cannot be advanced as a likely cause of the absence of any of the 20 bricks from the search area in 2014.

Fig 13 One of the dispersal objects (steatite ball 3) as found on the seabed in June 2014.

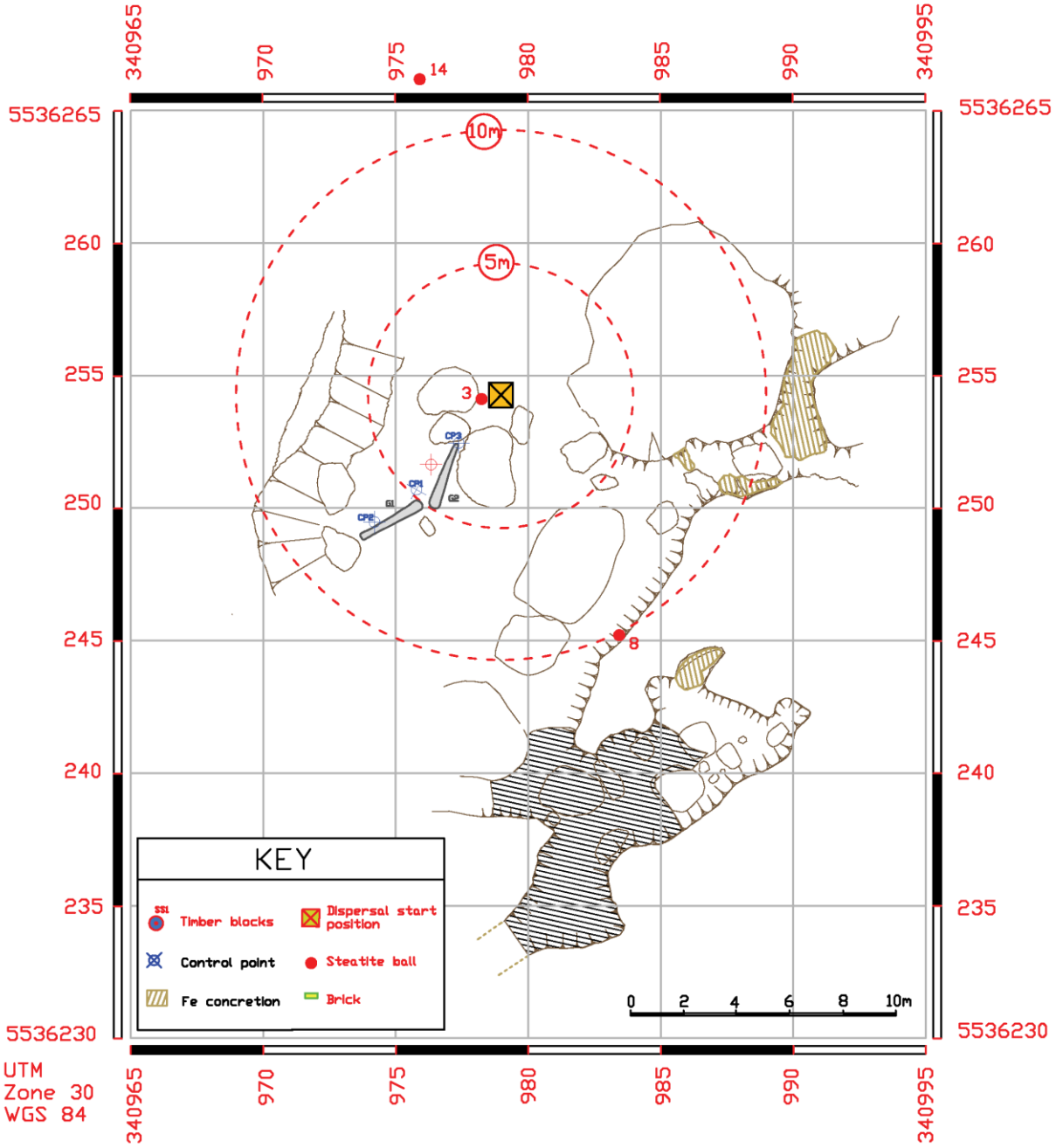


Fig 14 Site plan showing the positions of the three dispersal objects located in 2014, steatite balls 3, 8 and 14. Note also the new positions of the iron guns G1 and G2

3.3 Survey Control Points

None of the existing survey control points were found intact during the 2014 survey. This is not really surprising; during the excavation of the site the control points required regular replacement. Most winters saw the loss of many of the points. It was, however, possible to see where control point A (to the west of gun 2) had been, due to iron staining of the rock it had been driven into. Three new control points consisting of 12mm diameter stainless steel rods 0.4m long were driven into the seabed in the area around the iron guns (see Fig 15). The position of each of the control points is given in the Table 6 below.

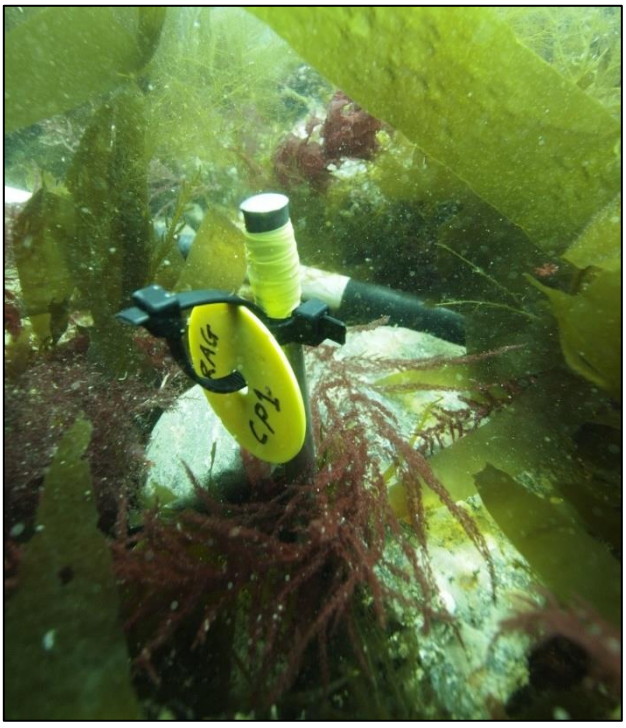


Fig 15 Survey control point CP1 in position on the seabed

Survey Control Points 2014 (UTM zone 30 WGS84)		
Name	**Easting**	**Northing**
CP1	340975.78	5536250.69
CP2	340974.19	5536249.47
CP3	340977.37	5536252.45

Table 6 Positions of the survey control points

4 Conclusions

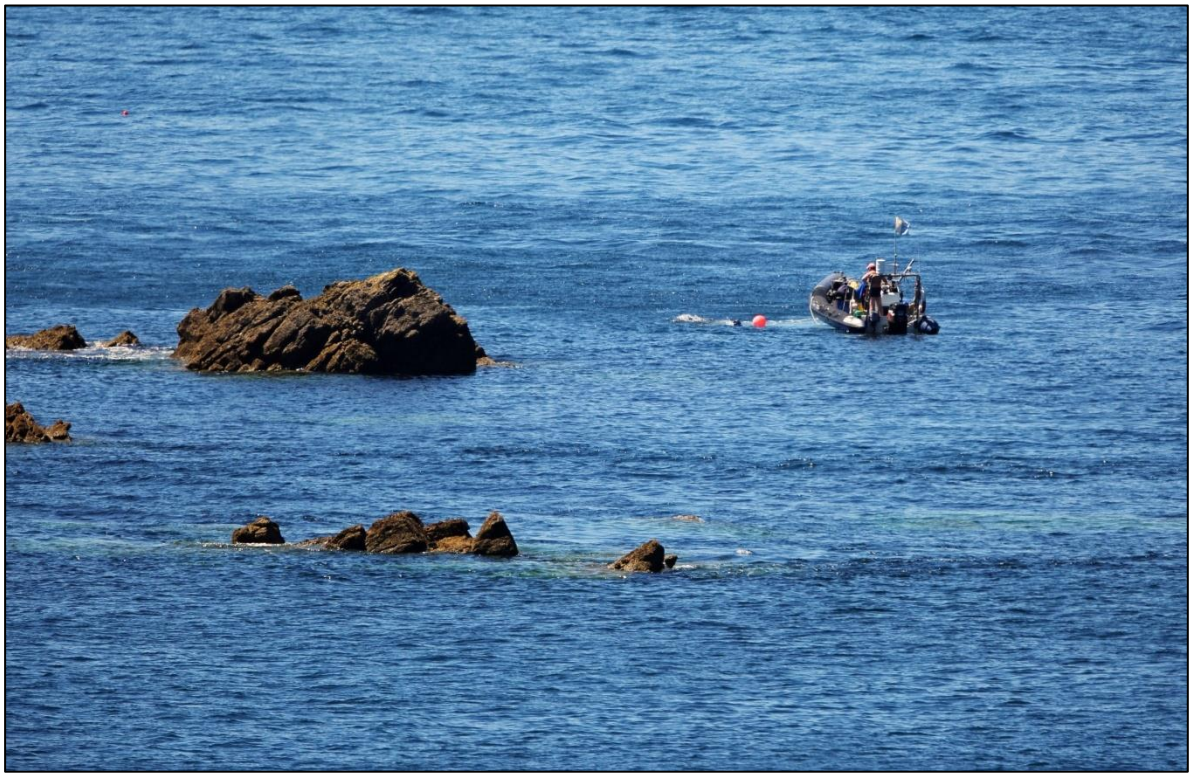


Fig 16 Diving on the Royal Anne Galley, 19 June 2014 —the buoy is attached to a shot weight positioned between guns 1 and 2 (photograph by Terence Thirlaway)

During survey and excavation by licensee Rob Sherratt and the subsequent MEA fieldwork it became clear there was little or no surviving ship structure of the *Royal Anne* Galley. Artefacts are rarely seen on the seabed surface, those that do survive are buried in sediment-filled gullies. The changes noted over the years to the site topography (would suggest that the site is unstable and that the artefacts buried within the shallow sediments of the site are subject to possible disturbance and dispersal. The results from the MEA dispersal trials suggest once artefacts are exposed on the surface they become dispersed, or possibly reburied.

It is clear that the two iron guns and elements of the site topography have been moved by the action of the sea since the last inspection of the site in October 2010. The site has always been subject to storm damage, but it seems likely that much of this recent movement was due to the unusual storms which occurred in the early months of 2014. Another change noted, not seen previously, was the alteration to the dense kelp cover usually in place on the site. The kelp is now sparser and smaller than usual, with more, low- level finer seaweeds in evidence. This may also be due to the recent storms; it seems probable that the normal kelp cover will re-establish itself given a reasonable spell of more settled weather. An inspection of the site later this year will be attempted by the licensee and the situation monitored then.

The two iron guns on the site were surveyed (to establish their new position) and drawn by means of a 2D photo-mosaic. A 3D photo model of the guns was also made; this proved to be reasonably accurate but the resulting image was unsatisfactory due to lacunae caused by the abundant weed growth around the guns.

The majority of the existing survey control points on the site had disappeared, due mainly to the action of mobile rocks rolling over the site. The previous positions of two of these existing points were found and used to position three new control points on the site – CP1, CP2 and CP3. These have been placed in the gulley containing the iron guns

in the hope that they will last longer; however, they should probably be considered as only having a life expectancy of two or three years at the most on this site.

Despite extensive searching, only three of the 40 dispersal objects placed in 2009 were relocated in June 2014. All three of those located were steatite balls. None of the 20 bricks were found despite an extra search in all the locations where the bricks had been found in October 2010. It is hard to draw conclusions as so few of the dispersal objects were relocated. However, given that the 2010 inspection revealed that the bricks and balls had been differentially moved (see Figs 8 and 9) it is tempting to conclude that a different fate has befallen the bricks, which may account for their absence from the 15m radius searched around their original location.

5 Recommendations

The seabed conditions on the site are very dynamic and for this reason further monitoring at two-year intervals of the site should be considered. The difficulty in accessing this site has been discussed at length in this and previous reports. One of the main reasons for this has been our reluctance to attempt diving on the site in all but perfect conditions because of the cost implications of unsuccessful dives. This has obviated abortive (and expensive) attempts to dive the site, but means that we have probably missed opportunities when diving would have been possible. If we are to avoid long delays in accessing the site in future, we may have to accept the possibility of unsuccessful diving attempts.

The artefacts newly exposed on the seabed should be photographed and added to the site plan. A satisfactory 3D model could be made if the weed growth was cleared from around the guns before the photographs were taken. This would take at least two days' diving to achieve. Given that a satisfactory scaled 2D photomosaic has been made of the guns it is possibly not worth the expense of producing a better 3D model although subsequent 3D modelling of guns on the site of *HMS Colossus* in Scilly in July 2014 resulted in very satisfactory 3D models once the guns in question had been de-weeded (Camidge 2014).

Given the paucity of dispersal objects found this year it is probably not worth specific searches for them. However, if searches are made for exposed artefacts (as suggested above) then any dispersal objects located during the process should be plotted on the site plan. Study of dispersal data by oceanographer/expert in seabed sediment transport might be considered.

6 References

6.1 Primary sources

PRO ADM 7/337 Proposed complement of guns for Royal Anne Galley, built at HM yard, Woolwich

Ordnance Survey, 2007. *Mastermap Digital Mapping*

6.2 Publications

Camidge, K, Johns, C and Rees, P, 2006. *Royal Anne Galley Marine Environmental Assessment: Phase 1 Desk-based Assessment*, Truro (Historic Environment Service, Cornwall County Council)

Camidge, K, Johns, C, Rees, P, Canti, M, Hoskin, M, Panter I and Rees, J, 2008. *Royal Anne Galley Marine Environmental Assessment: Revised Project Design for Phase 2 Field Assessment*, Truro (Historic Environment Service, Cornwall County Council)

Camidge, K, Johns, C, Rees, P, Canti, M, Hoskin, M, Panter, I and Rees, J, 2009. *Royal Anne Galley Marine Environmental Assessment Phase 2 Field Assessment Report*, Truro (Historic Environment, Cornwall Council)

Camidge, K, Johns, C, and Panter, I, 2011. *Royal Anne Galley Marine Environmental Assessment: Phase 3 Initial Inspection and Recovery,* Truro (Historic Environment, Cornwall Council)

Camidge, K, and Johns, C, 2011. *Royal Anne Galley Marine Environmental Assessment: Project Design for Phase 4 Inspection and Monitoring* Truro (Historic Environment, Cornwall Council)

Camidge, K. 2014. *HMS Colossus* Sediment Level Monitoring, Unpublished report for English Heritage

Caruana, A, 1994. *The History of English Sea Ordnance 1523–1875*, Rotherfield

Holland, S E, 2005. Following the Yellow Brick Road, *NAS*, 2005.4

Holland, S E, 2006. Following the Yellow Brick Road, *NAS*, 2006.1

McCarthy, J, and Benjamin, J, 2014. Multi-image Photogrammetry for Underwater Archaeological Site Recording: An Accessible Diver-Based Approach, *Jnl Mari Arch*, **9**, 95–114 Robertson, P, 2004. A Shipwreck near Kinlochbervie, Sutherland, Scotland, *Int Jnl Nautical Archaeol*, **33.1**

6.3 Websites

Channel Coastal Observatory, 2014. *Porthleven Wave Buoy*. [Online] Available at: http://www.channelcoast.org/ [Accessed 22 June 2014]

Met_Office, 2014. *Winter Storms January to February 2014*. [Online] Available at: http://www.metoffice.gov.uk/climate/uk/interesting/2014-janwind [Accessed 21 June 2014]

7 Project archive

The HE project number is **146081**

The project's documentary, photographic and drawn archive is housed at the offices of the Cornwall Archaeological Unit, Fal Building, County Hall, Treyew Road, Truro, TR1 3AY. The contents of this archive are as listed below:

1. A project file containing site records and notes, project correspondence and administration and copies of documentary/cartographic source material (file no 146081).
2. Digital photographs stored in the directory ..\Images\Sites\Maritime\Royal Anne Galley MEA Phase 4 146081
3. English Heritage/ADS OASIS online reference: cornwall2-117836

This report text is held in digital form as: ..\HE Projects\Sites\Maritime\Royal Anne Galley MEA Phase 4 146081\Final Report