

# Balchin's *Victory* (Site 25C): Shipwreck Monitoring & Cannon Impacts, 2008-2012

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Monitoring in 2008, 2011 and 2012 of the wreck of Balchin's *Victory*, lost in the western English Channel on 5 October 1744, and discovered by Odyssey Marine Exploration in 2008, has provided new comparative primary archaeological data about the site's natural deterioration and man-made impacts. In addition to lost sections of hull planking, numerous bronze guns display scratches, abraded surfaces, concretion breakage and have been displaced from their 2008 recorded positions. Two guns feature recently severed muzzles and at least one cannon has been illicitly salvaged since 2008.

This report discusses and illustrates in detail the 2008-2012 changes, presents a classification of cannon surface conditions and provides new observations about the site's level of preservation. The analysis indicates that the archaeology of this rare first-rate English warship is at greater risk than previously understood.

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## 1. Introduction

The wreck of the 100-gun, first-rate English warship HMS *Victory* – the only non-salvaged example discovered underwater worldwide and of unparalleled historical and archaeological value to the UK – was discovered by Odyssey Marine Exploration in April 2008. The site is located in international waters at a depth of 74m, 80km southeast of Plymouth and 100km northwest of Guernsey.

Since fieldwork began in May 2008, Odyssey has conducted an extensive monitoring program over the course of three years that enables changes induced by both human and natural forces to be distinguished factually and quantified over time. The most informative and accurate tool are three photomosaics produced in September 2008, October 2011 and February 2012. Unlike side-scan and multibeam sonar, which provide more impressionistic, schematized visual imagery of shipwreck sites, geospatially accurate photomosaics enable every physical detail present on the seabed to be captured (down to the size of small stones, brick fragments and individual crabs).

The 2008 photomosaic was generated by stitching together in Photoshop and ArcGIS software 2,821 individual photographs. The 2011 photomosaic comprised 12,491 digital photographs, and the 2012 photomosaic 4,535 digital photographs.

Non-disturbance monitoring using video, photography and side-scan sonar in April/May 2011, video, photogra-

phy and sub-bottom imaging in October 2011, and video, photography, side-scan and multibeam sonar, and magnetometer in February 2012 has proven that acute concerns raised previously that the site was at high risk from illicit salvage and inadvertent offshore fishing impacts were valid and were disseminated in the public interest (cf. Kingsley, 2010 and *A Vision for Victory. UK MOD/DCMS Victory (1744) Consultation. Site Management Recommendations*, Odyssey Marine Exploration, Tampa, 2010: 2, 13). The wreck continues to be extensively disturbed. Out of the wreck's seven archaeological zones (Areas A-G; Figs. 1-2), all Areas (100% of the site) were impacted between October 2008 and October 2011. Sections of wood up to 2.7m long and eight bronze cannon weighing up to 4 tons have been disturbed and displaced since 2008. To this may be added three cannon dragged 48-233m away from the site, two before October 2008 and one after this date (these changes are presented graphically in Figs. 28-59).

Ongoing monitoring of fishing boat movements in the wreck area conducted by Odyssey since September 2010, using Automatic Identification System (AIS) surveillance, has documented continued fishing through the site. In July 2011 a Dutch company illegally salvaged the wreck of the *Victory* and removed a bronze cannon, which remains in Holland (Figs. 3-4).

Without scientific excavation and the recovery of artifacts following the protocols detailed in the Project

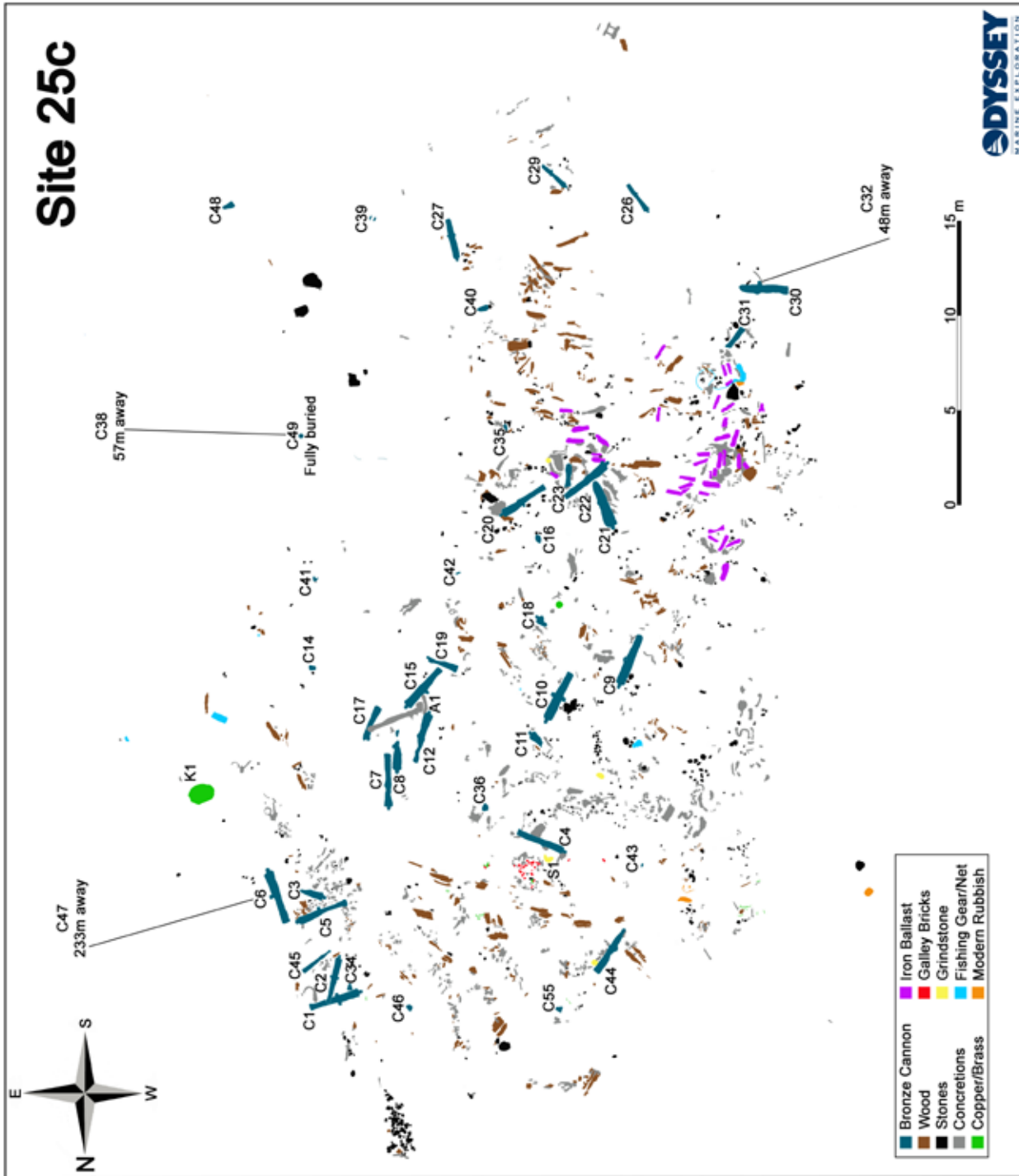


Fig. 1. Site 25c pre-disturbance plan (February 2012).

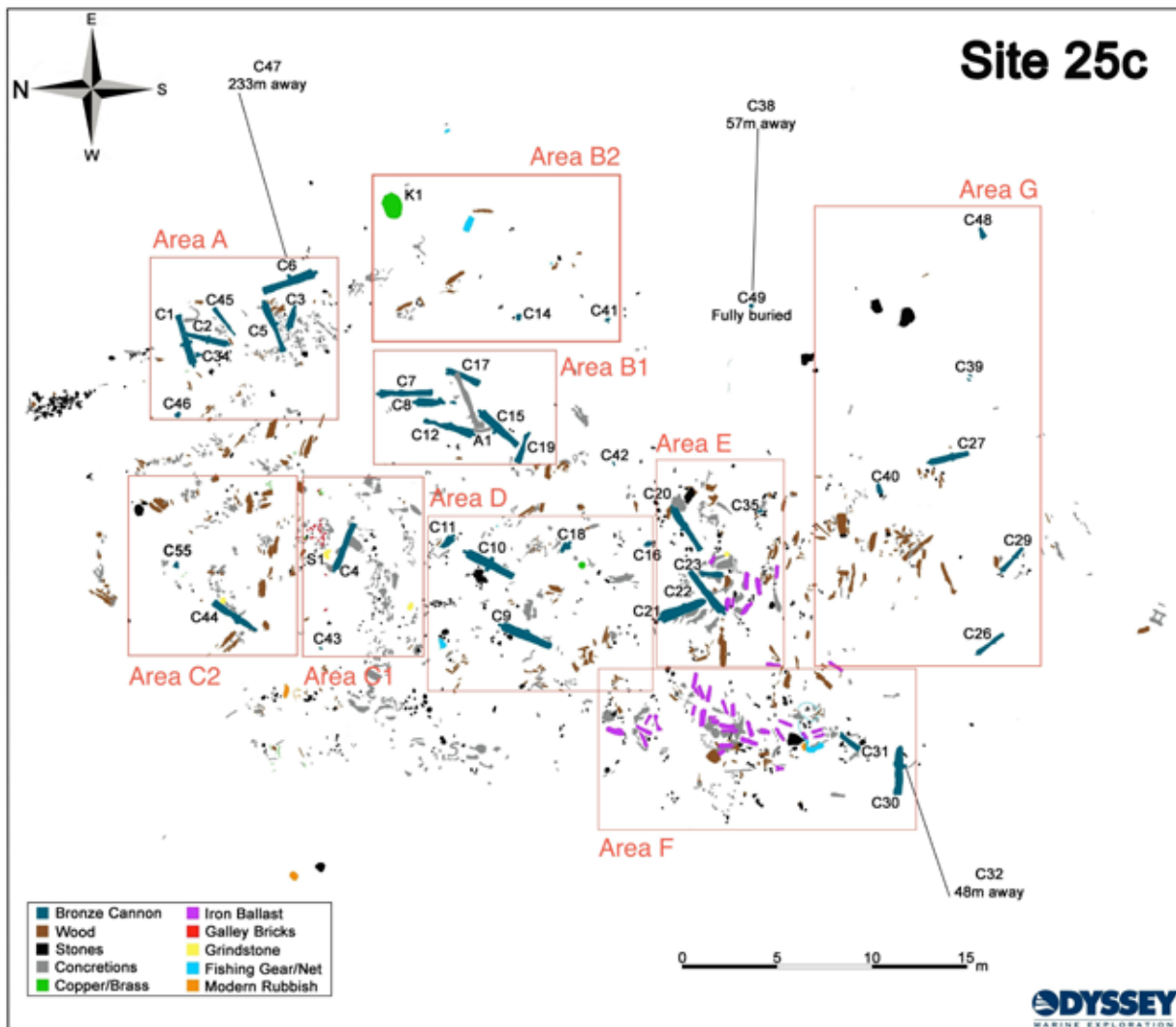


Fig. 2. Site 25C pre-disturbance plan (February 2012) with designated Areas.

Design,<sup>1</sup> HMS *Victory* (1744) will continue to be subjected to accelerated damage, artifact snagging, illicit salvage and context destruction, resulting in increasing knowledge loss and ever-decreasing potential to reconstruct the warship's history. The experience of the last three years has demonstrated that the wreck is not secure. The principal of *in situ* preservation implementation as a leading management tool is unrealistic for the *Victory* site.

## 2. Summary of Results

The photographic record of Balchin's *Victory* documented in 2008, 2011 and 2012 confirms a pattern of ongoing natural and man-made impacts that are continuously eroding the shipwreck's structural integrity. The site cannot be considered stable or to have reached a state of equilibrium where further impacts would be benign. Factual archaeo-

logical data reveal that every one of the seven Areas within the wreck site (Areas A-G) has been impacted by external human forces (Figs. 28-59). Between 2008 and 2011 100% of the site was disturbed.

These adaptations were not superficial, but have caused significant knowledge loss as a result of changes to the archaeological character and inter-related contexts of Balchin's *Victory* and the potential to interpret the shipwreck. The changes comprise:

- Scratched and scoured soft bronze cannon surfaces.
- Breakage of protective hard concretions originally covering bronze cannon, leaving surfaces susceptible to deterioration.
- Seemingly breakage of bronze cannon muzzles.
- Changes to the orientations of bronze cannon and other artifacts.

- Relocation of multiple 4-ton bronze cannon across and beyond the central wreck mound.
- Illicit salvage of at least one bronze cannon.
- Disappearance of significant hull remains.

In summary, the following anthropogenic impacts have been identified across the *Victory* wreck site. The specified loss of wooden planking is a minimal characterization, which only serves as a general index of wider erosion of predominantly disarticulated surface hull remains.

Evidence obtained in 2008 comprised:

1. Four trawl furrows cut into the seabed recorded 500-1,000m east-northeast of the wreck site.
2. VMS monitoring satellite evidence for 72 fishing vessels operating within 1km of the wreck for the period 2000-2008.
3. Snagged fishing net and cable on site.
4. A lobster pot on the site.
5. Two 4-ton bronze cannon (C32 and C38) dragged 48-57m off site to the east and west.
6. Deeply scratched scars on multiple cannon, including the recovered C28 and C33.
7. Muzzles broken off the ends of guns C26 and C27 (Area G). External cannon specialists have identified bottom fishing as the most likely cause underlying these actions.
8. To this may be added data obtained by Wessex Archaeology for a fresh set of trawl scars observed within 100m of the wreck site in 2009.<sup>2</sup>

The post-2008 site changes comprise:

1. Six bronze cannon show evidence of scratched and scoured surfaces caused by cables chafing against them (most plausibly fishing equipment, but possibly also salvage cables; Figs. 16-18, 21-22). Analysis of the illicitly salvaged gun C13 reveals additional evidence of scratched surfaces, which were originally identified underwater in 2008.
2. Sixteen bronze cannon display recent breakage to their overlying concretions (Fig. 10, 14, 15, 20, 23-27).
3. The orientations of six bronze cannon changed (C4, C21, C22, C26, C27, C30).
4. Six bronze cannon (C2, C4, C20, C22, C27, C30) have been displaced from their 2008 positions (Figs. 30-31, 34-35, 40-41, 50-51, 54-55, 58-59).
5. The orientations of the copper cooking cauldron and a modern lobsterpot located in Area B2 have shifted (Figs. 36-37).

6. At least one bronze cannon was illegally looted in July 2011 by a Dutch salvage ship using a hydraulic grab (seemingly C13, Area D; Figs. 43-46).
7. Significant hull remains have disappeared, including a 1.3m-long plank in Area D and a 2.7m-long wooden spar immediately south of C22's cascabel in Area E (Figs. 43-44, 50-51).
8. New fishing equipment in the form of cable and net has appeared in Areas D and F (Figs. 5-6, 45-46, 54-55).
9. A 4-ton bronze cannon (C47) has been dragged 233m off site to the east (Fig. 1).

These changes may be interpreted as having been caused by a minimum of five distinct modern events (although multiple impacts almost certainly underlie each of the below grouped examples). Firstly, the breakage of C26 and C27's gun muzzles (Area G) and the relocation of C32 48m to the southwest and C38 57m to the southeast occurred prior to May 2008. Secondly, the relocation of cannon C2 (Area A), C20 (Area B), C4 (Area C), C21 and C22 (Area E) occurred between October 2008 and April 2011. Thirdly, bronze cannon C13 was illegally salvaged in July 2011 (Area D). Fourthly, the relocation of C30 (Area F), C26 and C27 (Area G) took place between April and October 2011. Fifth, C47 was first identified by side-scan sonar 233m northeast of the site during the February 2012 side-scan survey.

A third photomosaic produced by Odyssey in February 2012 showed no discernible changes to the site's cannon since October 2011, but located newly snagged fishing gear and cables in Areas D and F (Figs. 5-6). Area D contained multiple broken lobster claws and was extensively colonized by crabs, lobsters and a dense coating of hermit crabs. Fishermen working across the *Victory* site in February 2012 confirmed the dumping of by-catch on the wreck, which accounts for the presence of this new marine deposit.

Surface observations made in February 2012 also revealed evidence for widespread fishing within the *Victory* zone. At 6am on 7 February, as Odyssey started its approach towards the wreck location, two French trawlers were observed on the site. Another two French trawlers were on the site at 8am. One of the boats stated it was towing nets solely at depths of 20m and 50m, thus not fluidizing the seabed for demersal species or impacting the sea bottom. Oral communications between skippers confirmed that the same vessels habitually fish these waters. Additional English fishing boats were observed working close to the wreck during the February 2012 survey, seemingly awaiting the departure of Odyssey's research ship to continue working sealanes that pass through the site (see Section 4 below).

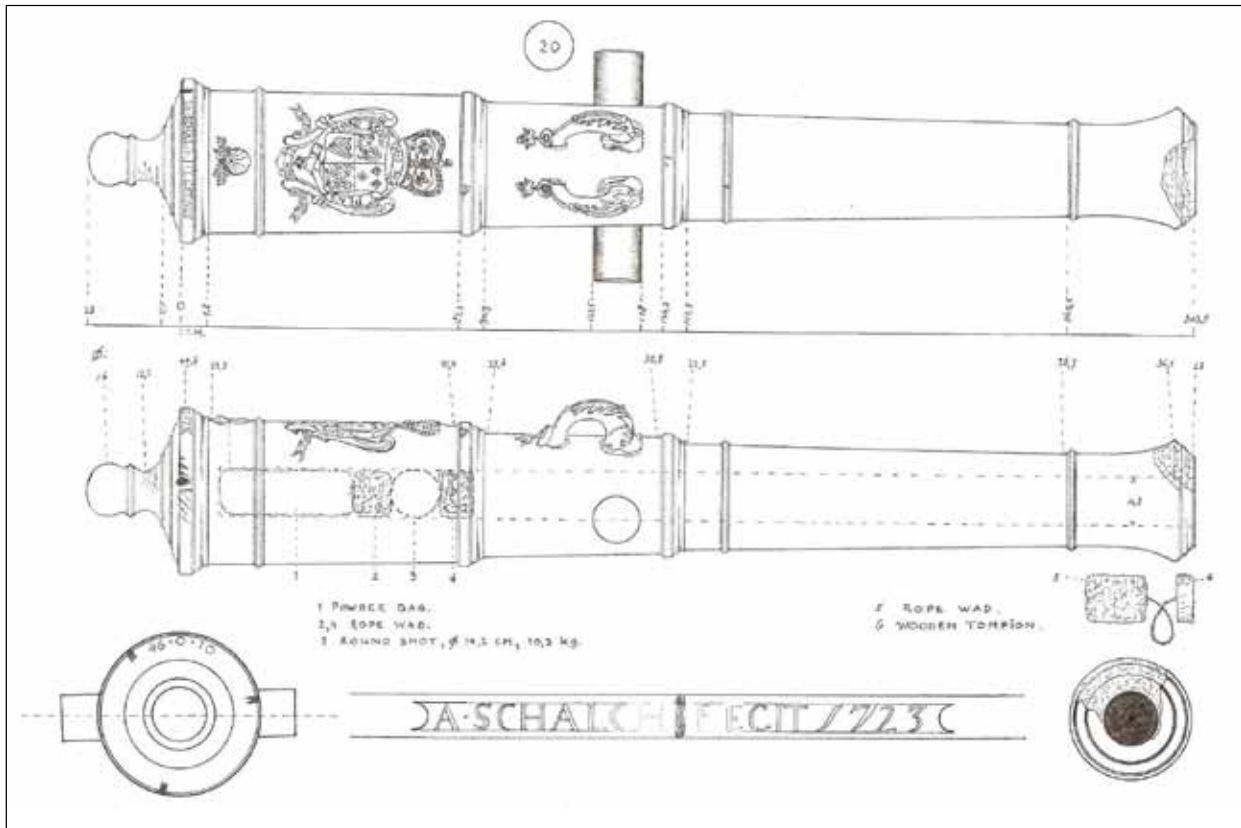


### 3. Illicit Cannon Salvage

Information was received on 30 October 2011 that a Dutch vessel had illegally salvaged a cannon from the wreck of Balchin's *Victory* in July 2011. Usually engaged in recovering lost cargos, anchors and metals from wrecks, the salvage company removed a 24-pounder bronze cannon using a camera-installed hydraulic grab bucket (Fig. 3). Cannon specialist Nico Brinck examined the gun and confirmed through royal arms and stamps, specifically the founder's name 'SCHALCH' followed by the date '1723', its association with Balchin's *Victory* (independently identified as probably C13 from Area D, which correlates with on-site 2012 observations: Figs. 43-46). Mr Brinck's measurements reveal the following dimensions for the cannon (Fig. 4):

- L. 303.5cm
- Base ring Diam. 49.7cm
- Muzzle swell Diam. 36.5cm
- Trunnion Diam. 14.5cm
- Bore Diam. 14.8cm

En route back to Holland the Dutch ship was boarded by French customs officials, who broke through the sealed and intact wooden bore tampion in search of drugs, disturbing



Figs. 3-4. Photo and drawing of the 24-pounder bronze cannon illicitly salvaged from the *Victory* in July 2011, inscribed 'Schalch' and '1723'. Believed to be C13 from Area D. Drawing: by and courtesy of Nico Brinck.

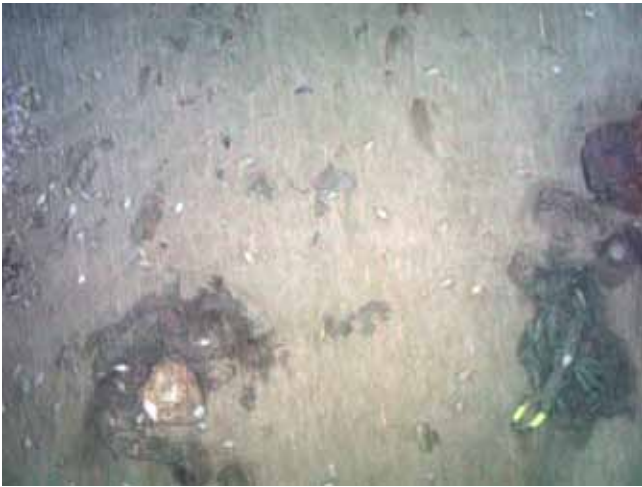


Fig. 5. Fishing cable snagged in Area D (February 2012).



Fig. 6. Fishing cable snagged in Area F (February 2012).

and damaging rare information about the loading and firing of early Georgian ordnance in the form of a powder bag, rope wad, 14.2cm-diameter and 10.3kg round shot, and a wooden tampion. Customs officials intervened in Holland, embargoed the gun and reported the find to Dutch Heritage, who in turn informed English Heritage. The state of current legal proceedings and initiatives to repatriate the cannon are unknown, although the UK Ministry of Defence has claimed the cannon as state property. Meanwhile, the same salvage team raised an iron cannon from the wreck of *La Marquise de Tourny* in the western English Channel (also discovered by Odyssey in 2008 and designated as site 33C: Cunningham Dobson, 2011).

Through the publication of the general coordinates of the *Victory's* location in a desk-based assessment commissioned by English Heritage on behalf of the Department for Culture Media and Sport, fishermen and illicit salvors

have been able to pinpoint the site's location.<sup>3</sup> The exact position of Balchin's *Victory* is now widely known in the fishing and salvage community. Discrete communications within the marine community reveal that further non-UK teams have attempted to and plan to seek out the *Victory* site for future salvage.

#### 4. Fishing Impacts

The English Channel is renowned as one of the world's most heavily exploited sealanes, and the wreck of Balchin's *Victory* lies within an important ground for the international fishing community. Around 219 trawlers, scallop dredges and lobster/crab potters largely based in Brixham, Salcombe, Plymouth, Ilfracombe, Looe, Mevagissey and Newlyn in southern England exploit these regional marine resources (excluding foreign boats). Fishery catches have remained static in the last few years. In 2006 UK vessels alone landed 95,138 tonnes of fish in England and Wales from these waters with a sale value of £137,623,000 (Walmsley and Pawson, 2007: 8, 48-50, 54, 56, table 2.2). A significant proportion of this catch, accounting for 27,483 tonnes (39%), derives from the fishing harbors of Portsmouth, Weymouth, Plymouth, Newlyn, Brixham, Looe and Falmouth, whose fleets operate within fishing grounds where Balchin's *Victory* is located.<sup>4</sup> Total figures for non-UK boats working the same grounds are unavailable, but may be assumed to at least equal the volumes of English landings.

Demersal bottom fishing is acknowledged to be one of the most widespread sources of anthropogenic disturbance to seabed communities (Kaiser *et al.*, 1998: 354; Kaiser *et al.*, 2002: 116). Fishing trawlers and scallop dredges using gear dragged over the seabed physically disturb the upper layer of sediments, flattening the seabed, removing seagrass and coral and exposing buried fauna. Trawling lowers the physical relief of habitats. Beam trawlers are typically fitted with tickler chains or a chain matrix attached between the beam and footrope to exclude rocks from the gear as they penetrate the top layers of sediments to drive flatfish into nets. Otter boards that guide net propulsion and beam wheels further flatten marine habitats (Fonteyne, 2000: 16-17; Duplisea *et al.*, 2001: 1).

Whereas living marine habitats have the opportunity to regenerate over time, once a shipwreck is impacted the damage is permanent and irreversible. Artifacts and wooden/metallic ship's structural elements snagged in trawl nets lead to both site stripping and data diminishment through context erosion and destruction. Within UK territorial waters numerous wrecks – legally protected and not – have been located through such activities or have been




<p><b>Class A</b> Bronze guns entirely covered with a consistent thickness of concretion. Surfaces commonly populated by sea grass and biological matter, including biofouling.</p>	
<p><b>Class B</b> Completely concreted cannon displaying linear scratches cut through the encrustation shell or very minor patches of displaced concretion.</p>	
<p><b>Class C</b> Guns exhibiting extensive encrustation, alongside large sections of exposed bronze surfaces, where the encrustation has been knocked/abraded off. On site 25C the exposed bronze areas on Class C cannon generally occur on the upper surfaces; structurally protected gun components, typically the vertical mouth of the muzzle and trunnions, tend to retain their concretion cover.</p>	

Table 1. Site 25C – HMS Victory (1744): bronze cannon concretion classification.




<p><b>Class D</b></p> <p>Guns displaying a distinct bipartite pattern, whereby the underside (usually including at least one trunnion), physically interacting with sediments, remains covered with concretion but the upper surface exposed to the water column is almost entirely stripped of its concreted veneer.</p>	
<p><b>Class E</b></p> <p>Bronze guns almost completely devoid of concretion and biofouling, frequently associated with extensively abraded upper surfaces intercut with linear scratches. Small patches of concretion may survive on muzzle mouths, trunnions or reinforce rings, seemingly reflecting the former recent concreted condition of the gun.</p>	
<p><b>Class F</b></p> <p>Examples of guns where the muzzle has been completely severed vertically and the broken component is no longer visible on site 25C. Such cannon otherwise display Class B/C forms of incomplete concretion, but with a complete absence of concretion covering the impacted muzzle end.</p>	

Table 2. Site 25C – HMS Victory (1744): bronze cannon concretion classification.



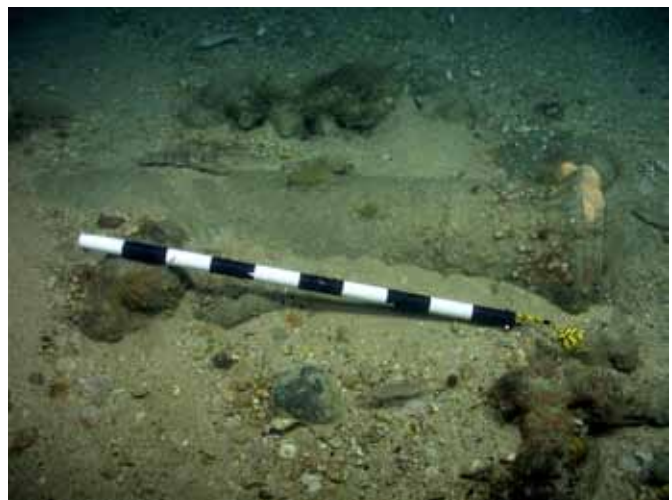
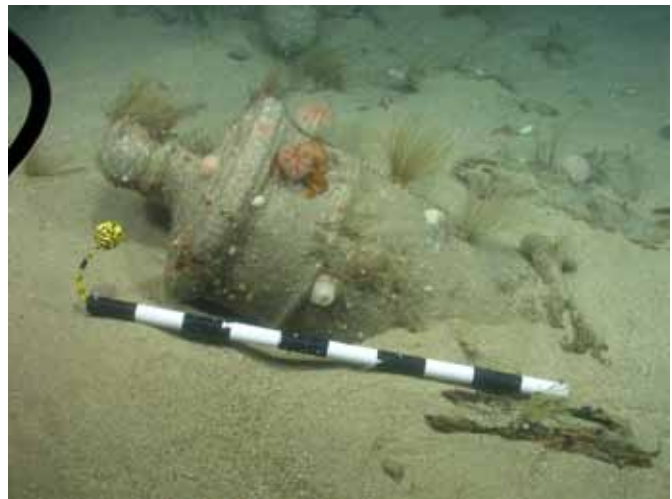
subjected to post-discovery fishing damage, including the Alderney Elizabethan wreck (1590s),<sup>5</sup> the Dunwich Bank armed merchant vessel of the second half of the 16th century,<sup>6</sup> HMS *Stirling Castle* (Goodwin Sands, 1703; Kingsley, 2012), HMS *Hazardous* (1706, Bracklesham Bay, West Sussex)<sup>7</sup> and HMS *Invincible* (1747, East Solent; Bingeman, 2010: 21-2), amongst others.

The University of Birmingham's mapping of nearly 23,000km<sup>2</sup> of the submerged prehistoric land mass of Doggerland in the North Sea, lost to sea rise *c.* 6000 BC, concluded that some 54% of the surface area of the North Sea off eastern England is affected by beam trawling annually, largely conducted by Dutch vessels, and that an estimated 57 tonnes of prehistoric faunal remains are scraped off the seabed over five-year periods (Gaffney *et al.*, 2009: 153). Since 1970 Dutch fishing trawlers working in the English Channel and North Sea have caught an estimated 200 cannon (as well as the stern section of an English submarine, conning towers, complete cars, cargo containers, torpedoes, anchors, airplane engines, modern artillery and mines) (Kingsley, 2012).

The same level of underwater cultural heritage impacts extends into international waters. Of the 267 shipwrecks located during Odyssey's Atlas Shipwreck Survey Project conducted between 2005 and 2008 across 4,725 square nautical miles of the western English Channel and Western Approaches, 112 sites (including 25 wooden, 70 steel and nine submarines) displayed evidence of fishing impacts. These ranged from abundant snagged nets on 108 sites, gill floats snagged on 33 wrecks and trawler hopper gear caught on 17 sites (Kingsley, 2010). These statistics reflect the widespread damage offshore bottom fishing causes underwater cultural heritage. Following the public dissemination of this issue by Odyssey and Wreck Watch in 2008 and 2009, UNESCO, English Heritage and several American universities have started to debate the subject, so far without the introduction of effective proactive mitigation.<sup>8</sup>

## 5. AIS Monitoring of the *Victory* Wreck

Since September 2010 Odyssey has twice daily monitored the wreck zone of Balchin's *Victory* using AIS (Automatic Identification System) surveillance. AIS is an autonomous and continuous vessel identification and monitoring system used for maritime safety and security, which allows vessels to electronically exchange with other nearby ships and authorities ashore vessel identification data, positions, course and speed. The International Maritime Organization's (IMO) International Convention for the Safety of Life at Sea (SOLAS Chapter V, Regulation 19) required



Figs. 7-8. Bronze cannon C11 (top) in Area D and C31 in Area F (bottom) with continuous concretion cover and marine life (Class A).

in December 2004 AIS to be fitted aboard international voyaging ships of 300 gross tons and upwards.<sup>9</sup> It remains inconceivable that the wreck of Balchin's *Victory* has not been heavily impacted by fishing trawlers and that left unprotected damage will not continue inadvertently.

Odyssey's monitoring program observed three fishing boats commonly working the *Victory* zone in late 2011 and 2012, a 18m-long lobster/crab potting boat based in Salcombe that was tracked working directly through the wreck site on 28.7.11 and that on 29.7.11 turned off its AIS while operating within half a mile of the *Victory*. On 1.8.11 the same fishing boat was working three nautical miles east of the wreck, at which point it again deactivated its AIS system for 30 hours, only to reappear on AIS on 3.8.11 at 19.46hrs some five nautical miles southwest of *Victory*. On 10.8.11 this boat was still operating in the *Victory* area, when it was tracked running trawl lines directly



Fig. 9. Cannon C4 in Area C1 as displaced in October 2011, with continuous concretion other than breakage to its exposed trunnion (Class B).



Fig. 10. Cannon C29 in Area G with a well-formed concretion, but broken off on its exposed upper surface over the royal arms resulting in fresh elements of corrosion (Class C).

through the wreck site. On 16.8.11 the vessel was once more observed inside one nautical mile of the site, and within its immediate area on 31.8.11, 6.9.11, 8.9.11 and 9.9.11. Again the boat was present within one nautical mile of the *Victory* site on 3.11.11 and between 10.11.11 and 14.11.11, when the boat deactivated its AIS.

Another UK fishing boat, a 24m-long Brixham-based beam trawler was observed working across the *Victory* site on 9.1.12 and on 17.2.12. A second 30m-long Brixham-based beam trawler was similarly tracked working directly over the wreck on 15.3.12. The above boats are not named in this report in order to protect the interests of fishermen operating in waters in and adjacent to the *Victory* wreck site.

These movements provide little more than a generalized indication of the common presence of fishing boats operating over and in immediate proximity to the wreck of Balchin's *Victory* in 2011 and 2012. The fitting of AIS on fishing boats is currently not obligatory.<sup>10</sup> Only from 31 May 2012 will European Union fishing laws require fishing craft exceeding 24m to be equipped with AIS (followed by over 18m length on 31 May 2013 and more than 15m length on 31 May 2014).<sup>11</sup> Thus, the total volume of the larger fishing vessels exploiting the wreck's surface with bottom gear, and capable of causing the greatest damage, is unverifiable for the last few decades of major exploitation.

## 6. Cannon Damage Pre-2008: New Data

In addition to the evidence of post-2008 site disturbance, excellent underwater visibility in October 2011 allowed improved visual data to be obtained relating to the condition of the site's 41 bronze cannon (increased to 44 in October 2011 and to 50 in February 2012). Many exhibit scratched and abraded surfaces, broken concretion shells and severe breakage that provide an increasingly worrying picture of modern natural damage and human intrusion on the wreck site of the *Victory*, more extreme than previously understood.

Central to attempts to assess the condition of these artifacts, and the risks to which they are susceptible, is the importance to differentiate between damage resulting from the natural state of the cannon within their marine environment and changes attributable to recent natural erosion and man-made impacts. To qualify such understanding, the assemblage has been subdivided into six categories of preservation related to concretion coverage and its breakage (Tables 1-2).

Class A seemingly represents the typical condition of the cannon on site 25C under natural undisturbed circumstances, where the artifact's entire surface is covered with a thin, but hard concretion layer (Figs. 7-8). The metal's microenvironment includes marine growth in the form of sea anemones (*Actinauge richardi*), plumose anemones (*Metridium senile*), dead men's fingers (*Alcyonium digitatum*) and green or edible sea urchins (*Psammechinus miliaris* or *Echinus esculentus*). If left undisturbed by human intervention the majority of the bronze cannon on the *Victory* site would seemingly adhere to Class A levels of marine growth.

At the other extreme, surface concretion layers on some of the wreck's guns are highly limited and consist of minimal patches typically present in naturally sheltered parts of the cannon typified by the intersections between trunnion corners, the outer and inner edges of base rings and vertical muzzle mouths (Class E: Figs. 15-22).



Figs. 11-13. The context of cannon C22 in Area E in 2008 (top) and in April 2011 (middle and bottom) reveals the gun to have been displaced 1.5m to the southwest. Note the positional differences in 2011 between C22 in relation to the cascabel of C23 (middle left) and to the chase of C21 (bottom right). The plank present next to C22 in 2008 had disappeared in 2011. C21: Class B; C22: Class D; C23: Class A. For more detailed graphic representation of this gun cluster, see Figs. 47-51.

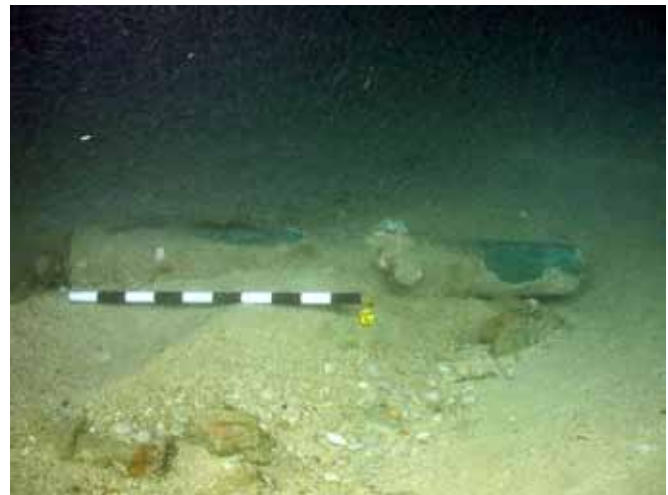


Fig. 14. Cannon C29 in Area G sitting on the seabed surface with sediment accumulating to its southwest. Extensive concretion broken off the upper surfaces (Class D).



Fig. 15. Cannon C7 (right, Class C) and C8 (left, Class E) from Area B1.

The reasons for this differentiated level of concretion cover amongst the *Victory* cannon assemblage is unverifiable without scientifically measuring the site's environmental composition, including examining sediment composition, sea bottom dynamism, bottom current strength and artifact metallurgical composition and thus chemical properties at the bottom of the English Channel. However, the data already suggest that several phenomena are active.

Despite minimal comparative data from other underwater wreck sites (cf. Beltrame and Ridella, 2011, that presents no cannon *in situ* or discusses marine patinas or concretions), bronze guns frequently display varying levels of concretion coverage within marine environments. Clean, non-fouled surfaces are common. Examples recorded off Streedagh Strand, Ireland, on the Spanish Armada transport vessels *La Lavia*, *La Juliana* and the *Santa Maria de Vison* of 1588 exhibited no concretion cover (Birch and McElvogue, 1999: 267, 272, 275, figs. 2, 6, 9). Similarly, a German cannon cast in 1514 recovered from

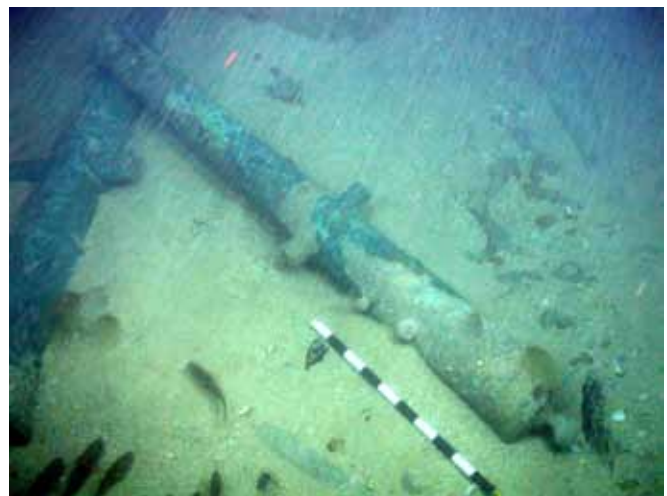


Figs. 16-17. Deep scratches, abrasion marks and corrosion products on cannon C5 in Area A formed since 2008 (Class E).

the *Kronan* surfaced as new (Einarsson, 1990: 291, fig. 13). A 6-pounder bronze cannon from the wreck of the *Adelaar*, a Dutch East-Indiaman wrecked in 1728 off Barra, Scotland, and lying in an exposed gully at a depth of 7-10m, was also completely devoid of marine growth (Martin, 2005: 184, fig. 6).

These non-fouled comparative examples suggest that the concreted condition of *Victory's* guns is unlikely to be explicable exclusively through the corrosion of the artifacts' metallic composition. Their gunmetal composition is likely to be comparable to the bronze cannon examined from HMS *Association*, lost off the Scilly Isles in 1707: two guns were cast with 4-4.5% tin, 0.5-1.0% lead and 1.1-5% zinc, and one with 7% tin, 2-2.5% lead and 0.5% zinc, levels which conform to the compositions of Swedish cannon of the era (Campbell and Mills, 1977: 552).

*Victory's* concreted surfaces may be explained as having formed as a result of galvanic or bimetallic corrosion caused by electrochemical reactions with the marine environment. This occurs when two dissimilar metals are in



Figs. 18-20. A group of three cannon (C1, C2, C34) in Area A. C2 was displaced from the southwest to overlie C1 between 2008 and April 2011 (see Figs. 28-31). The first reinforce of C1 and chase of C2 (Class E) are heavily scoured and abraded, while two scratches are present on the muzzle and chase of C34 (Class B). Extensive evidence of corrosion caused by multiple exposure and non-exposure to oxygen, marine life and gun displacements indicates that site 25C is not stable, but subject to substantial changes in the physical, chemical and biological environment.

direct electrical contact: one metal becomes an anode and corrodes more than normal, while the other is the cathode and becomes less typically corroded (Robinson, 1982: 223). The more reactive metal suffers increased corrosion and the less reactive structure is protected.

For instance, with a galvanic potential of -0.60 to -0.70 volts, cast iron is a classic cause of such corrosion (compared to -0.30 to -0.36 for copper) (North, 1984: 133). Elsewhere, North and MacLeod (1987: 72) provide a value of 0.07 volts for copper. Such a process has been identified on the 'Mombasa Wreck' of the 42-gun Portuguese frigate *Santo Antonio de Tanná* wrecked off Kenya in 1698, where the dense concretion on a bronze swivel gun, inscribed with the date 1677, may have been formed through association with a complete supporting cannon bracket composed of iron (Piercy, 1981: 114, figs. 4-5; Fraga, 2007).

In turn, this poses the question of what metal might be causing the copper alloy within the *Victory's* guns to react? The presence of iron brackets is not relevant to such large cannon, which were not designed to swivel, but were secured and fired from carriages. It is unlikely that the *Victory's* wooden cannon carriages were built with sufficient iron components to induce the level of electrochemical reactions witnessed on site 25C. Copper alloys are generally found non-concreted or lightly so, partly because copper compounds are toxic to marine organisms, greatly reducing growths. Typical corrosion values for isolated copper samples in oxygenated temperate seawater (approx. 15° C) achieve about 0.02mm/year (North and MacLeod, 1987: 80-1).

A current working hypothesis is that a significant cause underlying some galvanic coupling on the *Victory* site could be iron cannonballs present within gun bores. While this can only be proven by lifting examples, the recovery and conservation of one of the guns in 2008 revealed the presence of a concretion layer on the outer gun surface and iron leaching around the touch hole, which may indicate that the gun was primed. The cannon illicitly salvaged in July 2011 was similarly loaded and ready to fire.

In October 1744, Britain was in a heightened state of alert due to hostilities with France and Spain at the end of the War of the Austrian Succession. The Brest fleet had a reputation for blitzing privateers and Royal Navy warships, and an invasion of southern England via the Channel was an imminent threat, having almost become a reality in February 1744 (Cunningham Dobson and Kingsley, 2010: 266-8). Under these historical circumstances it seems reasonable to assume that *Victory* was sailing with her guns armed and prepared for naval warfare at the time of her loss on 5 October 1744.



Figs. 21-22. Cannon C20 dragged 8.5m from Area B1 to Area E between 2008 and April 2011. The gun is heavily abraded and covered with scratches and fresh corrosion products (Class E).

While not especially thick compared to iron guns, the marine concretions on the site 25C cannon are heavily cemented and durable. The concretion on the two cannon recovered from the *Victory* site in 2008 measured around 2.0cm thick maximum (Van de Walle, 2011: 61-8). In addition to galvanic coupling, the formation of the concretions may be a result of changes to the guns' on-site environment. Artifacts made of copper, brass and bronze are often found with little or no concretion, but its presence on the *Victory* site may be explained through the cannon's transition from anaerobic to oxygenated, low sulphide environments in which marine organisms can colonize the sulphide layer to form a typical aerobic outer concretion, as has been recorded on the wreck of HMS *Association* off the Scilly Isles (North and MacLeod, 1987: 84). X-ray diffraction analysis has identified the green corrosion products on the *Association's* French gun, cast in 1635, to have consisted principally of *paratacamite*,  $\text{Cu}^2(\text{OH})_3\text{Cl}$ , with some cupreous oxide beneath (Campbell and Mills, 1977: 553).



*Figs. 26-27. Bronze cannon C27 in Area G with concrete broken off the trunnion and chase (Class C). The muzzle has been completely severed (Class F). This breakage occurred prior to 2008.*



*Figs. 23-25. Bronze cannon C26 in Area G with inconsistent concrete cover: concrete has been knocked off the button, base ring, trunnion, second reinforce and chase (Class C). The muzzle has been completely severed (Class F). This breakage occurred prior to 2008.*

Causes of concrete origins aside, the guns' crusts are well bonded and would require heavy impact to remove or dislodge. A combination of the site's bottom current velocity and sand abrasion is an unlikely explanation for the broken state of most of the concretions present amongst the *Victory* cannon assemblage. This category of concretion is most plausibly explained as the result of site intervention by either trawlers towing fishing gear or by salvage attempts. Human impacts, rather than natural processes, seem currently to explain most objectively the random nature of the sections of concrete broken away on many site 25C guns.

The emerging picture and concern about the possibility that the *Victory* wreck site has been more heavily disturbed by pre- and post-2008 human activities and impacts than previously understood is compounded by the evidence that the muzzle ends of two cannon have been completely

severed (Class F: C26 and C27 Figs. 23-27). Their broken sections have not been detected elsewhere on site 25C. An explanation for this damage is that with most of the parts of the guns buried, the protruding muzzles appear to have been hit by powerful moving objects in modern times with sufficient force to have knocked off the muzzle. This hypothesis is supported by the presence of recent leaching visible on the ends of the muzzles: no secondary concretion has yet formed around the freshly broken sections. The concretion covering the chases of both cannon has also been extensively broken off, while continuous concretion covers the first and second reinforces. Re-analysis of the 2008 archaeological record demonstrates that this damage was inflicted before May 2008, when Odyssey first recorded the *Victory* site.

Cannon muzzles can break for several reasons, including the need in the 16th and 17th centuries to shorten guns for specific shipboard positions. If appropriately sized guns were not available, the muzzle could be cut off. Cannon exhibiting battle damage could also be re-used as 'cuts'. However, since the guns on Balchin's *Victory* were specially cast, an alternative explanation must be sought. They may well have been knocked off by beam-trawler gear if they were protruding vertically out of the sea bottom. The neck of the muzzle is the thinnest part of a cannon, but substantial force is still required to break it. Beam trawling is the only force capable of causing such damage and also explains the concretion removal on the exposed surfaces (pers. comm. Nico Brinck, 8 May 2011). The severed cannon damage is almost certainly recent. If it was original, signs of casting defects or impact marks from a shot ought to be visible. Neither is observable on either broken gun muzzle (pers. comm Charles Trollope, 3 May 2011).

## 7. Conclusion

The above data, illustrated and qualified through imagery (Figs. 28-59), provide comprehensive evidence for past and ongoing site impacts to site 25C by both natural and human forces. Far from untouched in its natural site formation, the wreck's archaeology continues to deteriorate. While the reasons for the guns' concretion growth and breakage remain a matter of necessary ongoing discussion and analysis, the numerous examples of scratched and damaged surfaces, severed muzzles in two instances and dragged and displaced cannon provide substantial and unavoidable testimony to conclude that the wreck of Balchin's *Victory* has been, and continues to be, at high risk.

The question of cannon concretion development is complex and insufficiently studied at present. This report takes tentative steps towards comprehending the issue.

Although the archaeological data support the current proposed hypothesis regarding the site's cannon concretions, some inconsistencies endure. It is unclear why some cannon in close proximity to other bronze guns, but also to iron artifacts, display differing states of preservation and marine growths (such as the seven examples surrounding anchor A1: Figs. 32-33). Whether this is related to the presence of cannonballs in some chambers, and their absence in others, localized galvanic coupling or the displacement of cannon by trawlers across the site from and to different micro-environments, is unverifiable without future gun recovery and analysis. The existence of such iron objects within chambers is a naturally volatile relationship in a marine environment, which is seemingly being compounded in some cases by anthropogenic impacts breaking concretions and re-charging electrochemical processes, ever-increasing the erosion of the cannon's surfaces.

The 2011 and 2012 surveys demonstrate without doubt that the wreck of Balchin's *Victory* has been impacted by both human and natural forces since 2008. Broken concretions exposing unprotected bronze surfaces are left exposed to the current, which under unfavorable conditions can exceed erosion rates of 1cm/year, bronze being naturally softer than iron (North and MacLeod, 1987: 84). This constitutes an urgent call to find solutions to better understand the nature of these activities, to mitigate them and to undertake excavation of the site to maximize the scientific data obtainable from this unique piece of underwater cultural heritage – heritage that is diminishing year by year.

## Notes

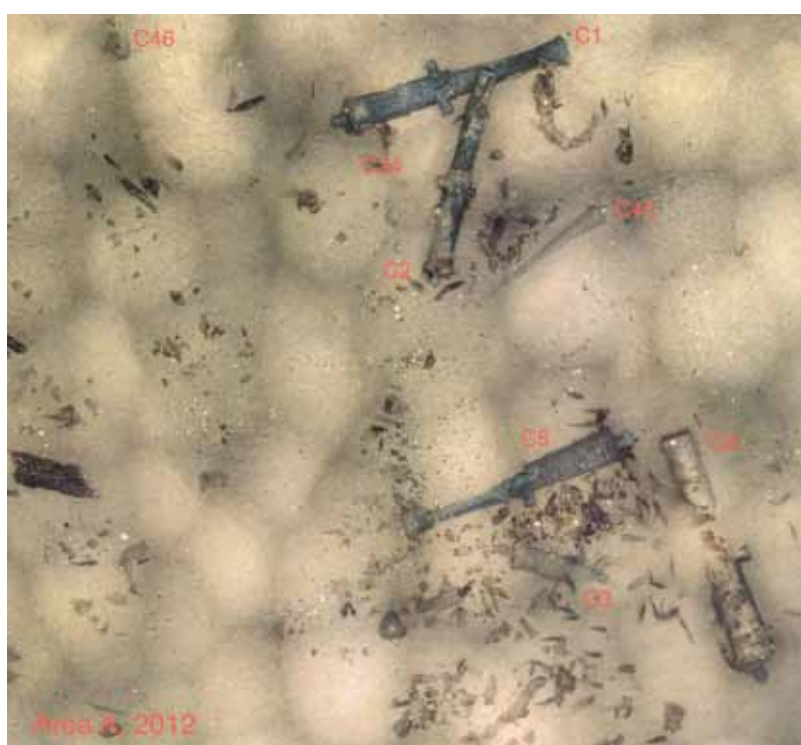
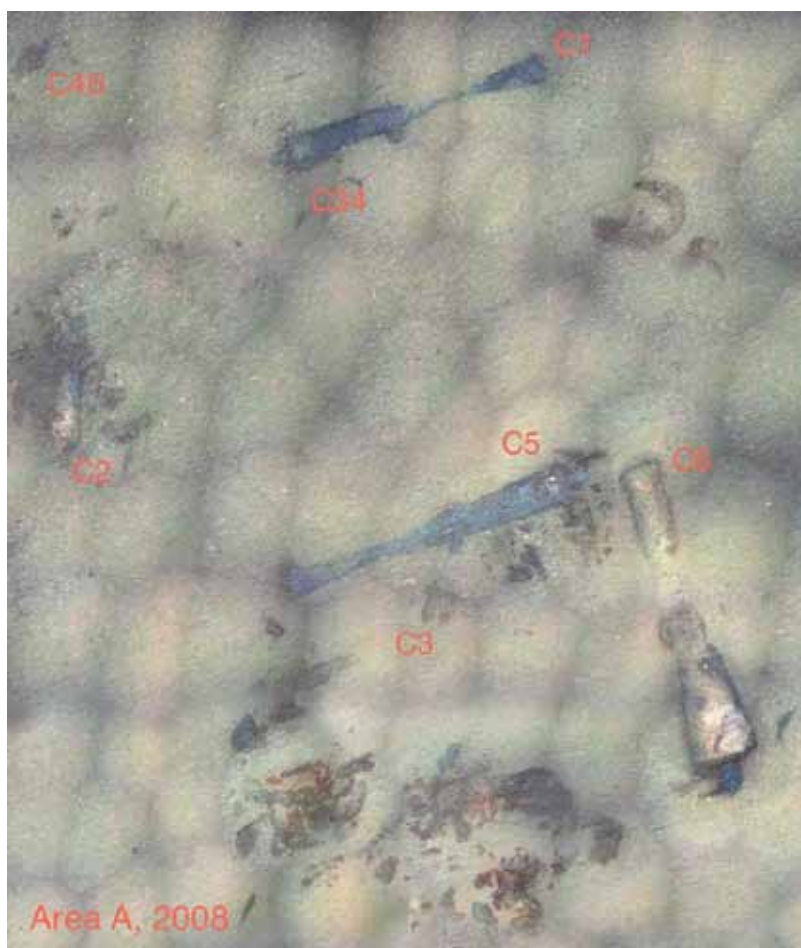
1. *HMS Victory, 1744 (Site 25C) – Project Design* (Odyssey Marine Exploration, 2012).
2. *OME Site 25C, Western English Channel. Archaeological Desk-based Assessment* (Wessex Archaeology, September 2009: 9, point 5.1.2).
3. *OME Site 25C, Western English Channel. Archaeological Desk-based Assessment* (Wessex Archaeology, September 2009), 3.
4. *Monthly Return Of Sea Fisheries Statistics for England, Wales, Scotland and Northern Ireland* (September 2009, Fisheries Statistical Unit, Marine and Fisheries Agency), 6, 16-17.
5. See: <http://www.alderneywreck.com/index.php/the-wreck>.
6. *Dunwich Bank, Suffolk. Designated Site Assessment: Archaeological Report* (Wessex Archaeology, Salisbury, 2006), 4.
7. See: <http://www.english-heritage.org.uk/server/show/conWebDoc.6589>.

8. For the 2012 launch of the Fishing Protocol for Reporting Archaeological Discoveries (FIPAD) related to the Sussex Inshore Fisheries Conservation Area, see [www.fipad.org](http://www.fipad.org). Whilst encouraging fishermen to self-report finds and structures snagged from shipwrecks, the initiative does not have the remit or resources to protect proactively sites at risk from fishing activities.
9. See: [www.imo.org/ourwork/safety/navigation/pages/ais.aspx](http://www.imo.org/ourwork/safety/navigation/pages/ais.aspx).
10. See: *Guidelines for the Onboard Operational Use of Shipborne Automatic Identification Systems* (IALA Guideline No. 1028, December 2004), 8, 10, 21, 75.
11. See: [http://ec.europa.eu/fisheries/cfp/control/technologies/index\\_en.htm](http://ec.europa.eu/fisheries/cfp/control/technologies/index_en.htm).

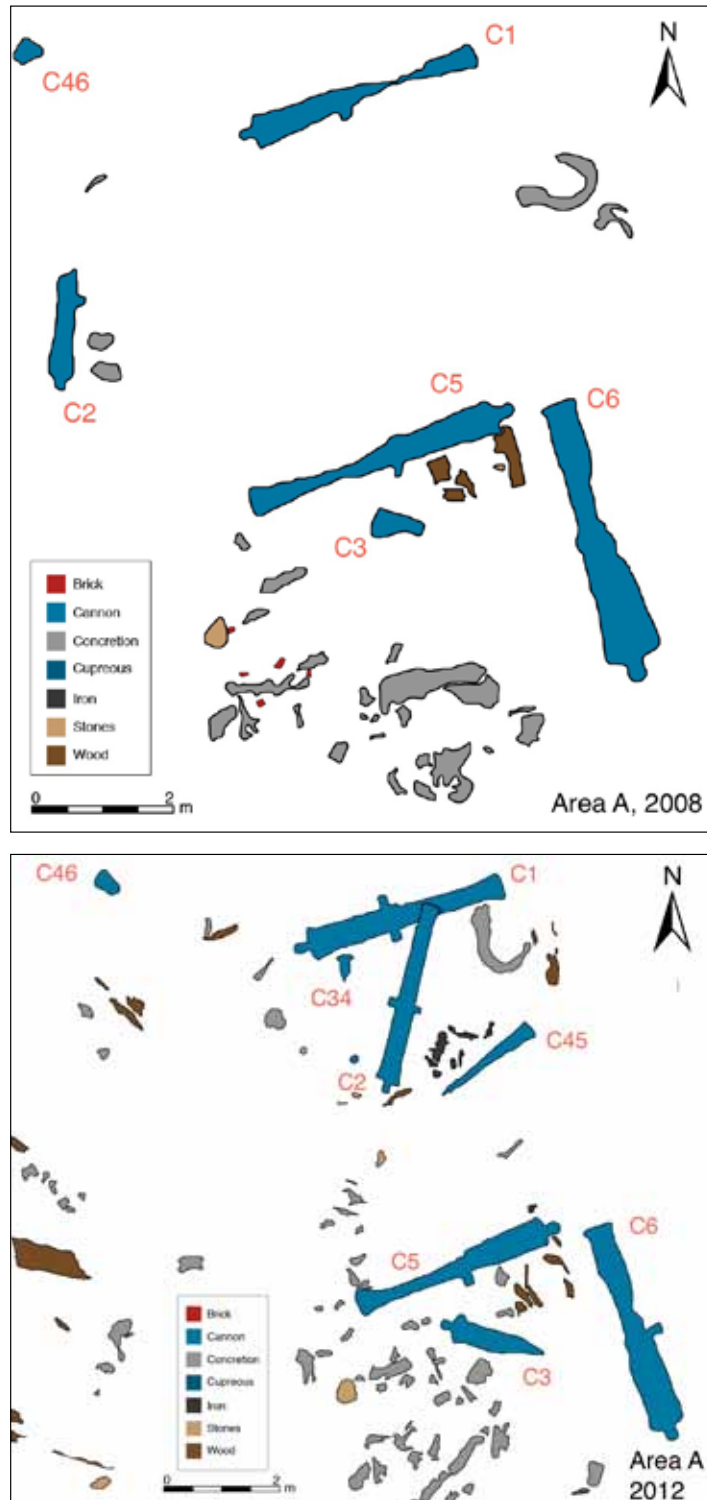
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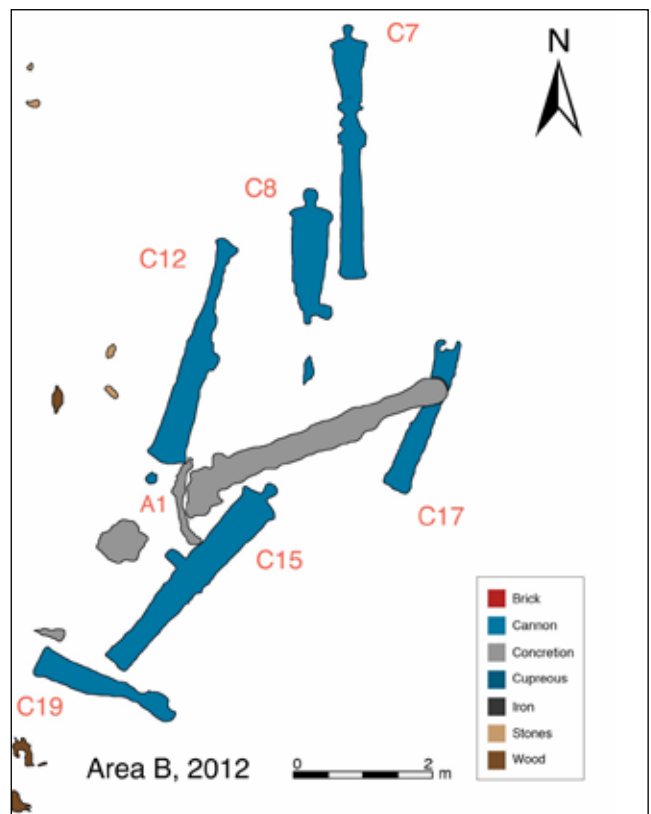
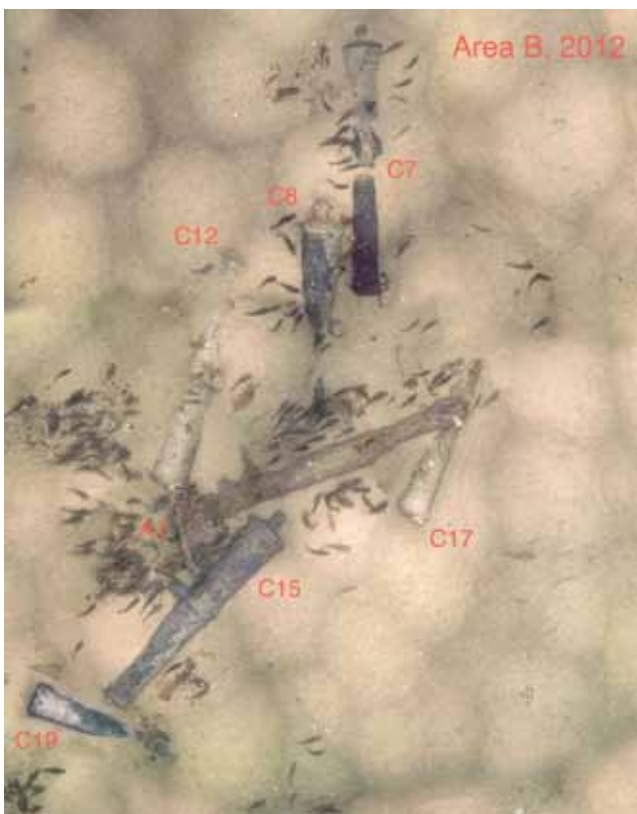
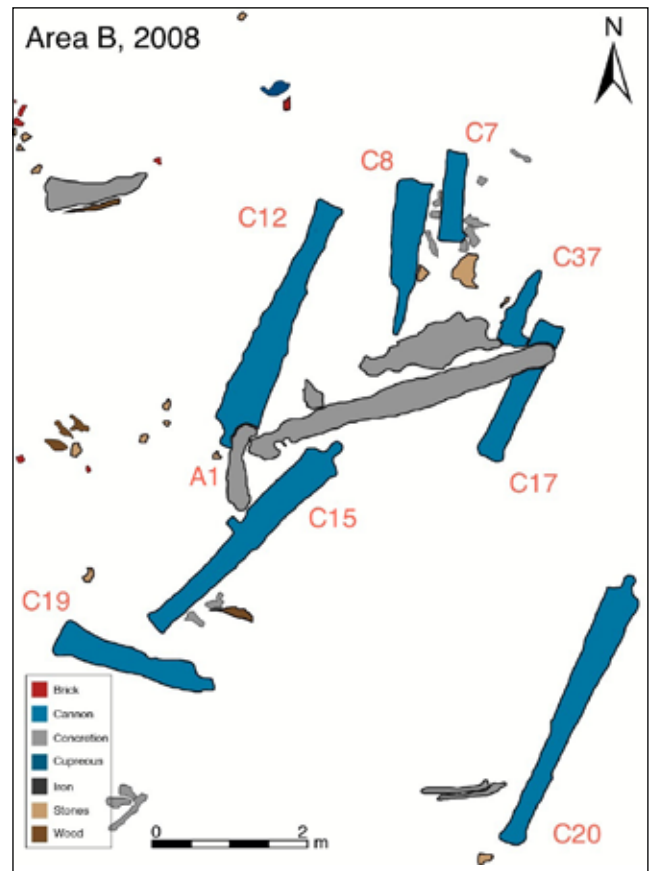
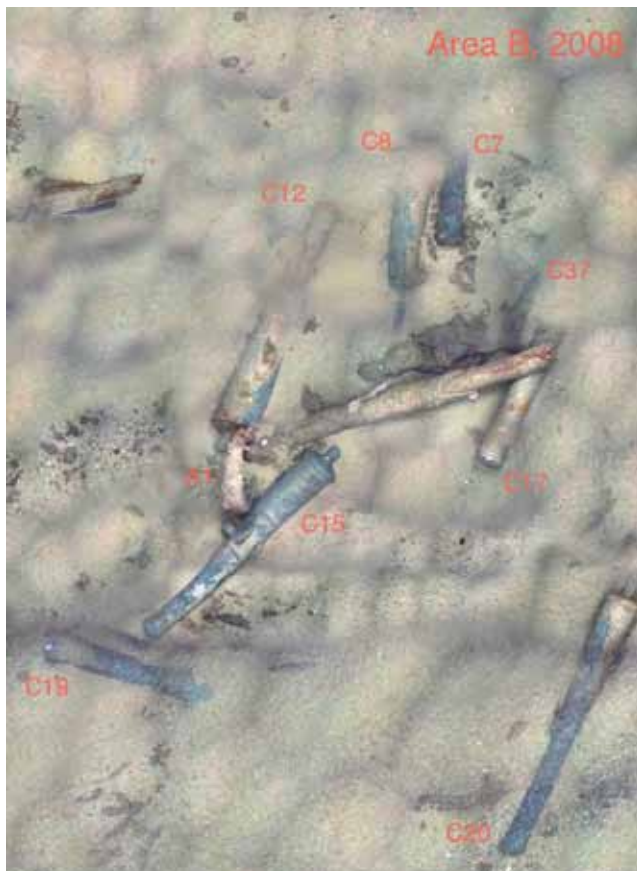


Figs. 28-29. Photomosaic sections of cannon impacts: Area A, 2008 and 2012.



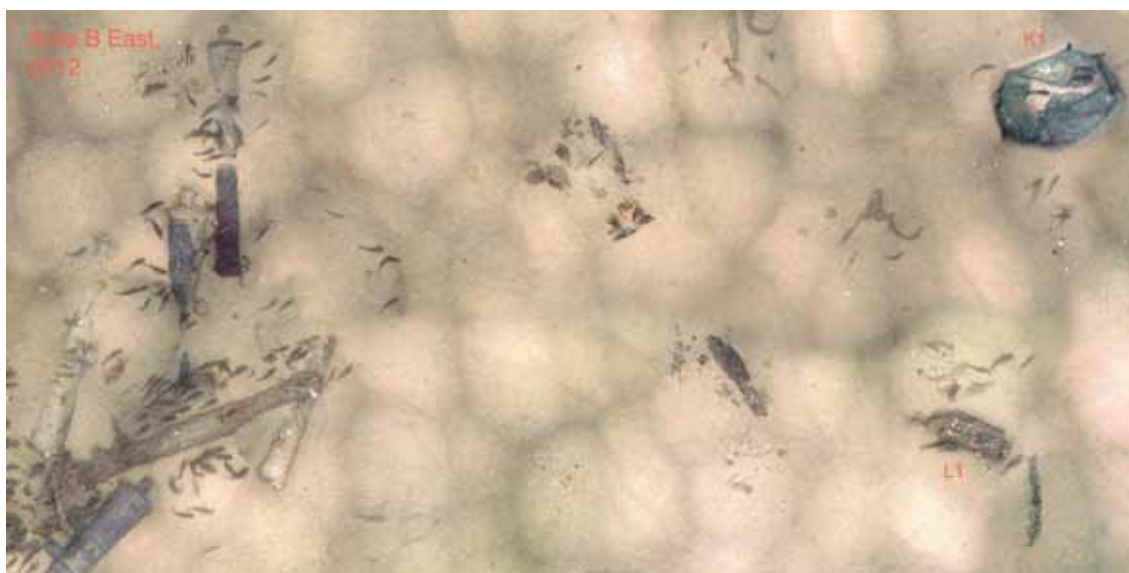
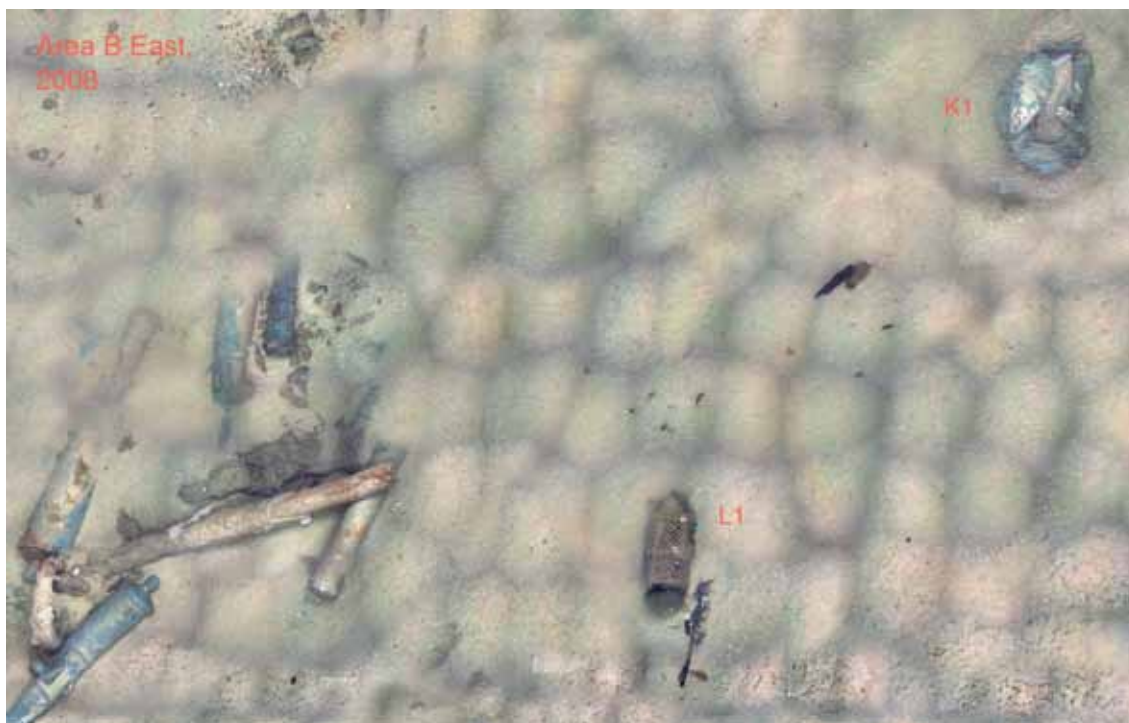
Area	Cannon No.	2008	April 2011
A	C2	Bearing 14°, 3.1m southeast of C1's button.	Relocated 4.8m northeast, overlying C1 mid-chase, bearing 6°.

Fig. 30-31. Site plans of cannon impacts: Area A, 2008 and 2012.



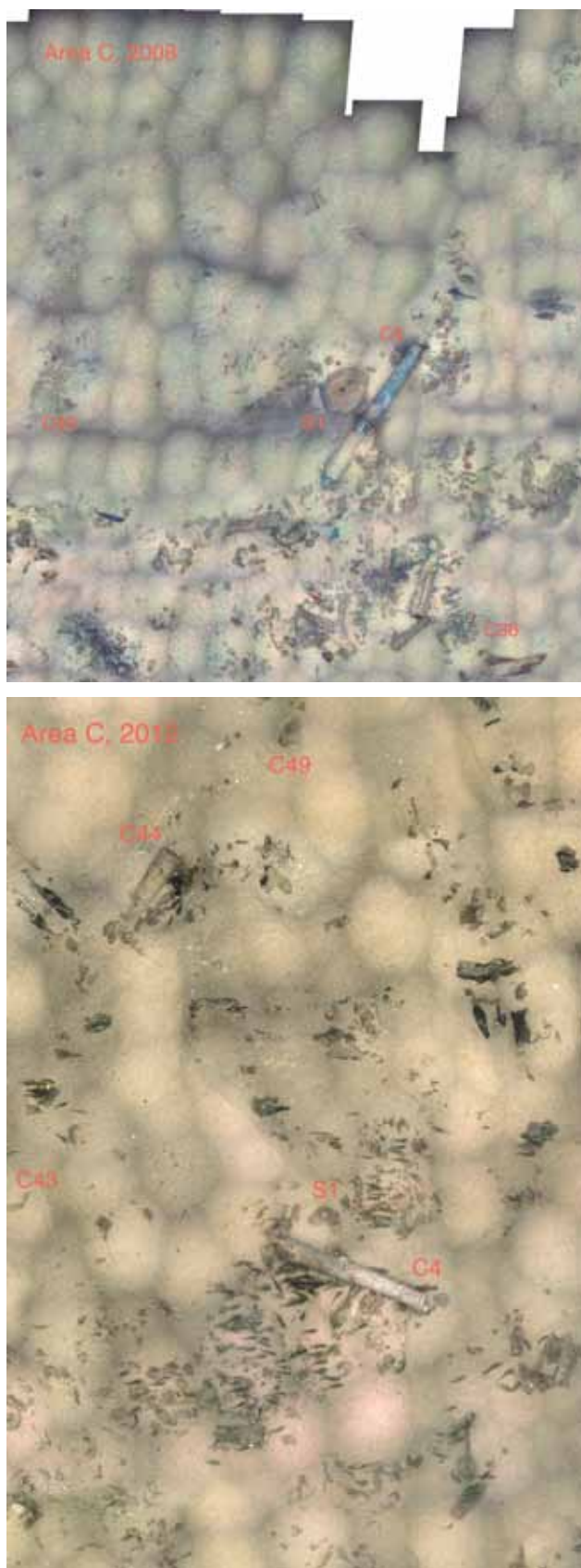
Figs. 32-33. Photomosaic sections of cannon impacts: Area B1, 2008 and 2012.

Figs. 34-35. Site plans of cannon impacts: Area B1, 2008 and 2012.

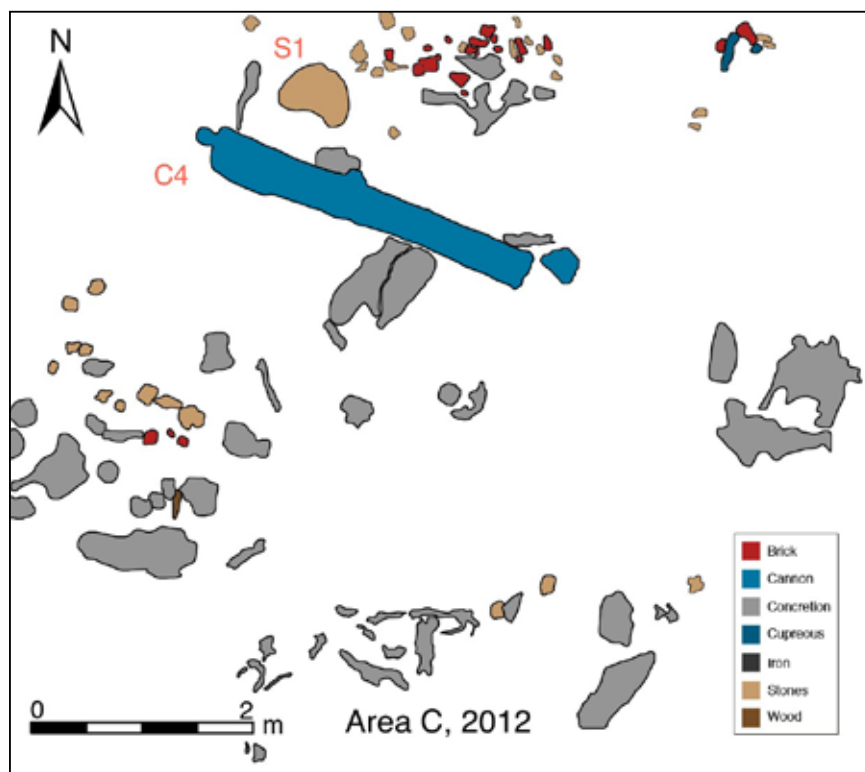
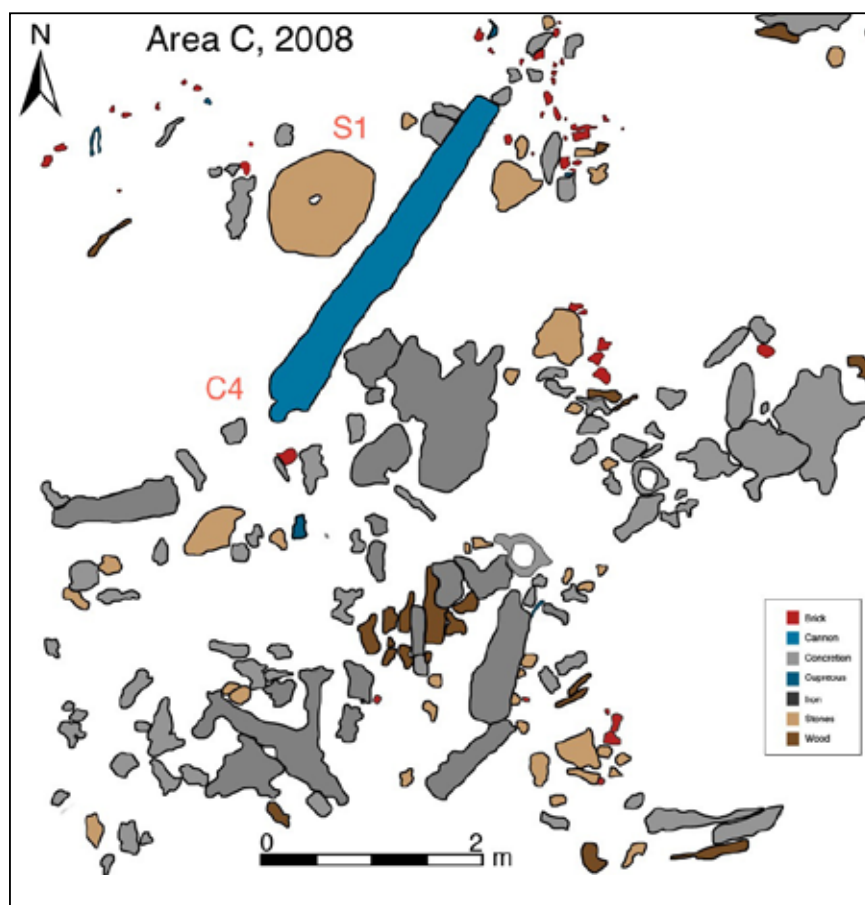


Area	Cannon No.	2008	April/October 2011
B1	C20	Bearing 204°, 4.4m southeast of C15.	Not present. (Seemingly relocated 8.5m southwest to Area E, where a new gun was documented in April 2011.)
B2	K1	Copper kettle, north/south bearing 185°, 7.8m northeast of anchor A1.	Orientation changed to east/west axis, bearing 74°.
B2	L1	Lobster/crab, north/south bearing 183°.	Orientation changed to northeast/southwest axis, bearing 112°.

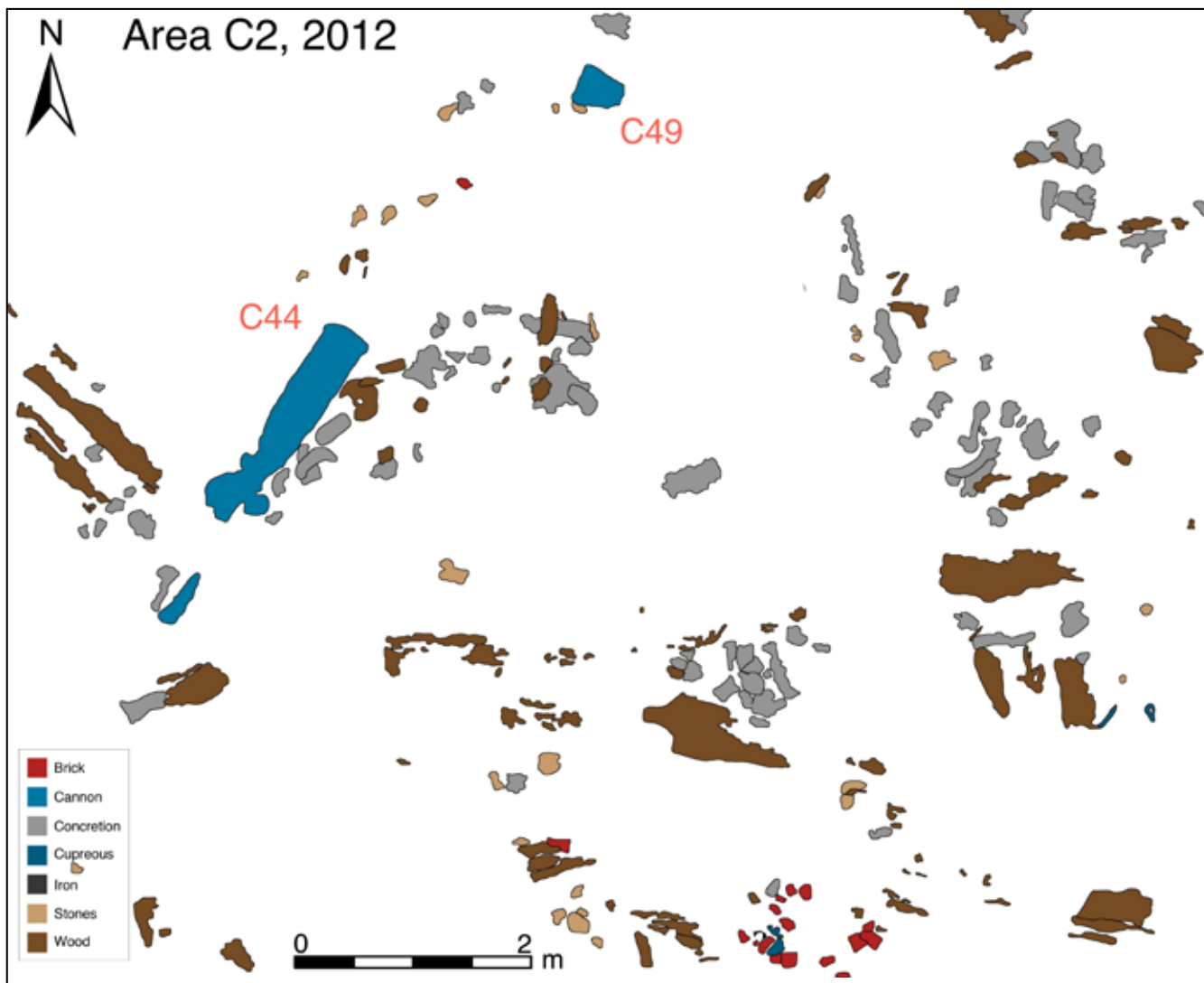
Figs. 36-37. Photomosaic sections of cannon impacts: Area B1 and B2, 2008 and 2012.



Figs. 38-39. Photomosaic sections of cannon impacts: Areas C1 and C2, 2008 and 2012.

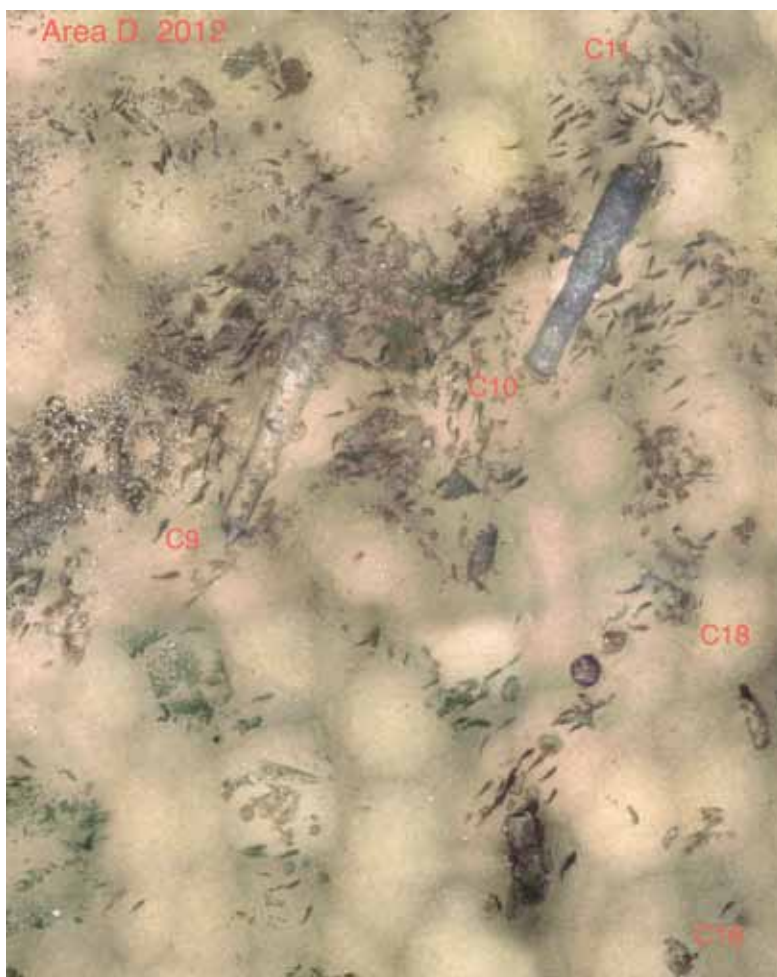
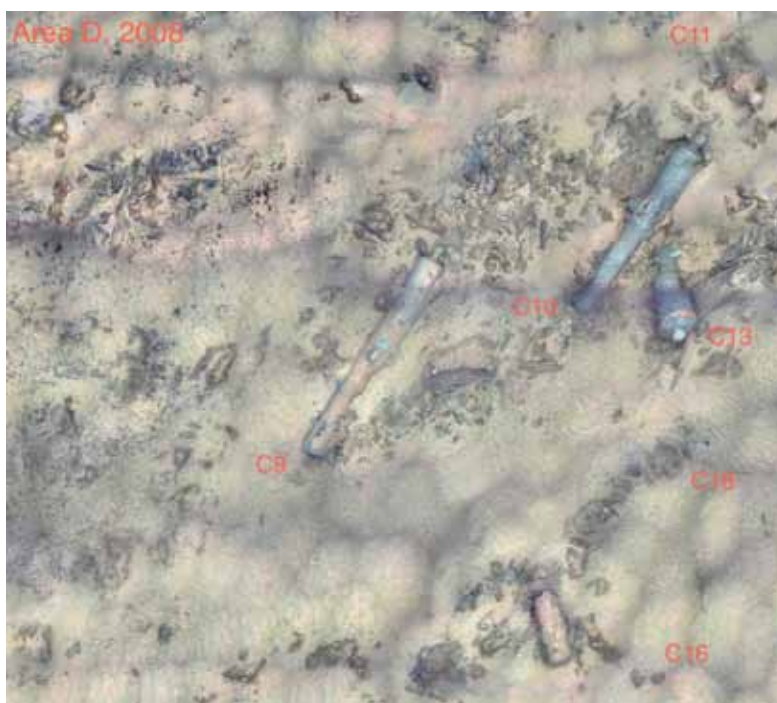


Figs. 40-41. Site plans of cannon impacts: Area C1, 2008 and 2012.



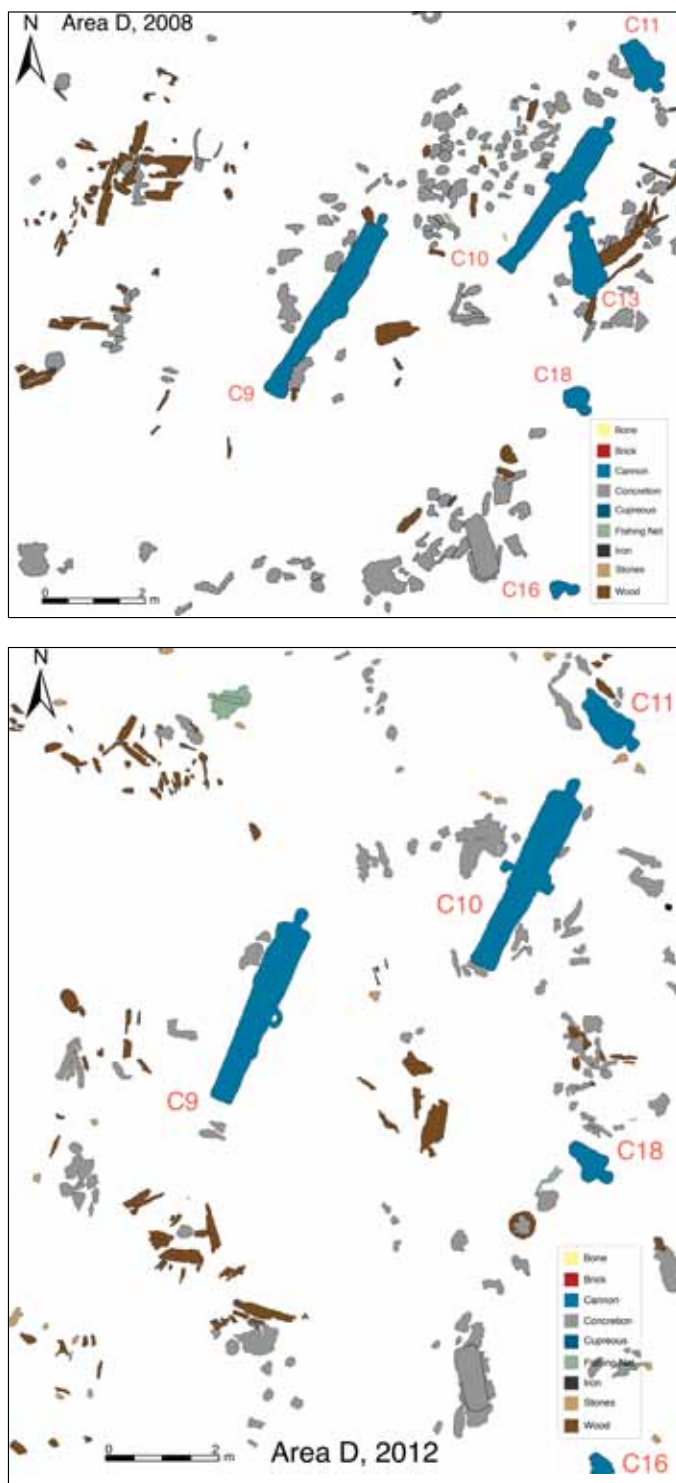
Area	Cannon No.	2008	April 2011
C2	C4	Bearing 35°, facing northeast, stone gunner's wheel immediately to west.	Orientation changed to 112°, facing southeast, gunner's wheel to north.

Fig. 42. Site plan of cannon impacts: Area C2, 2012.



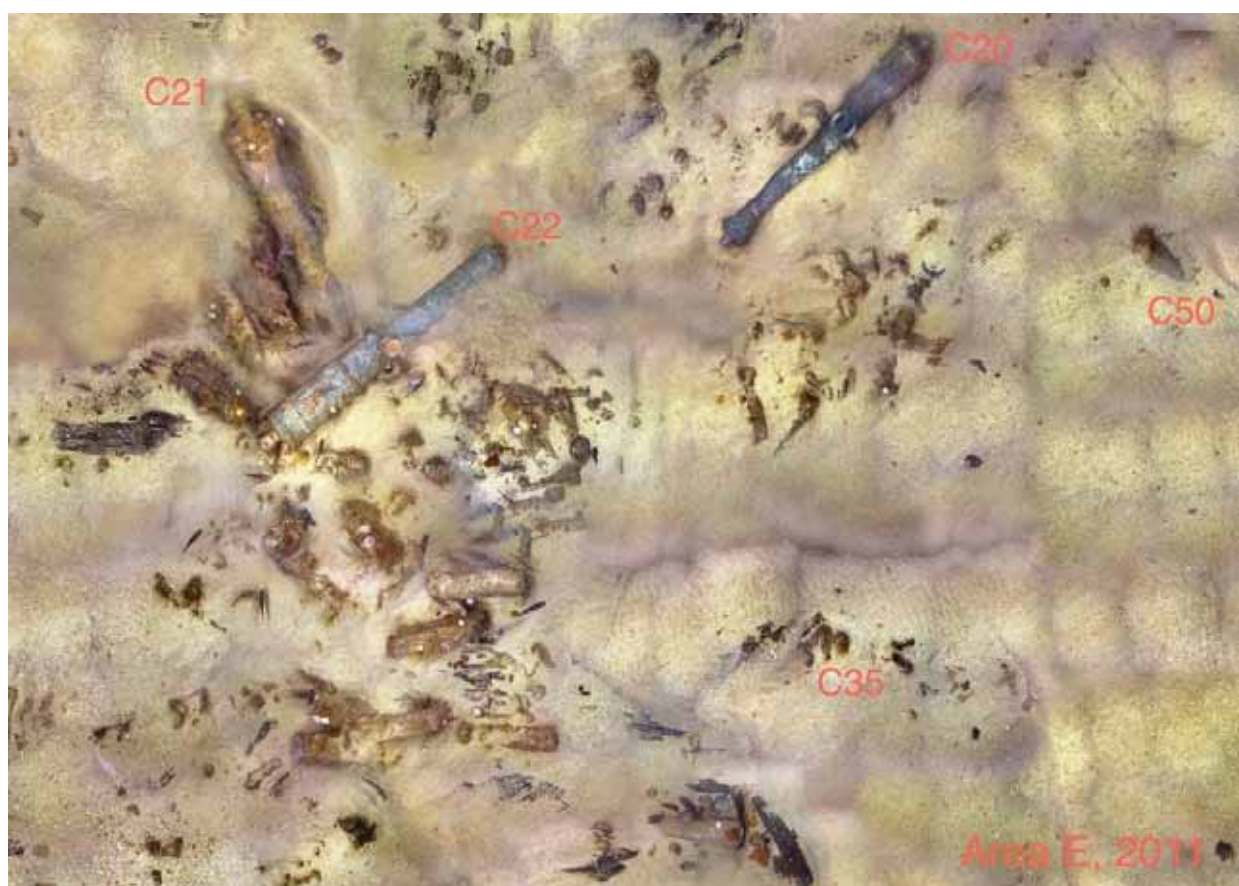
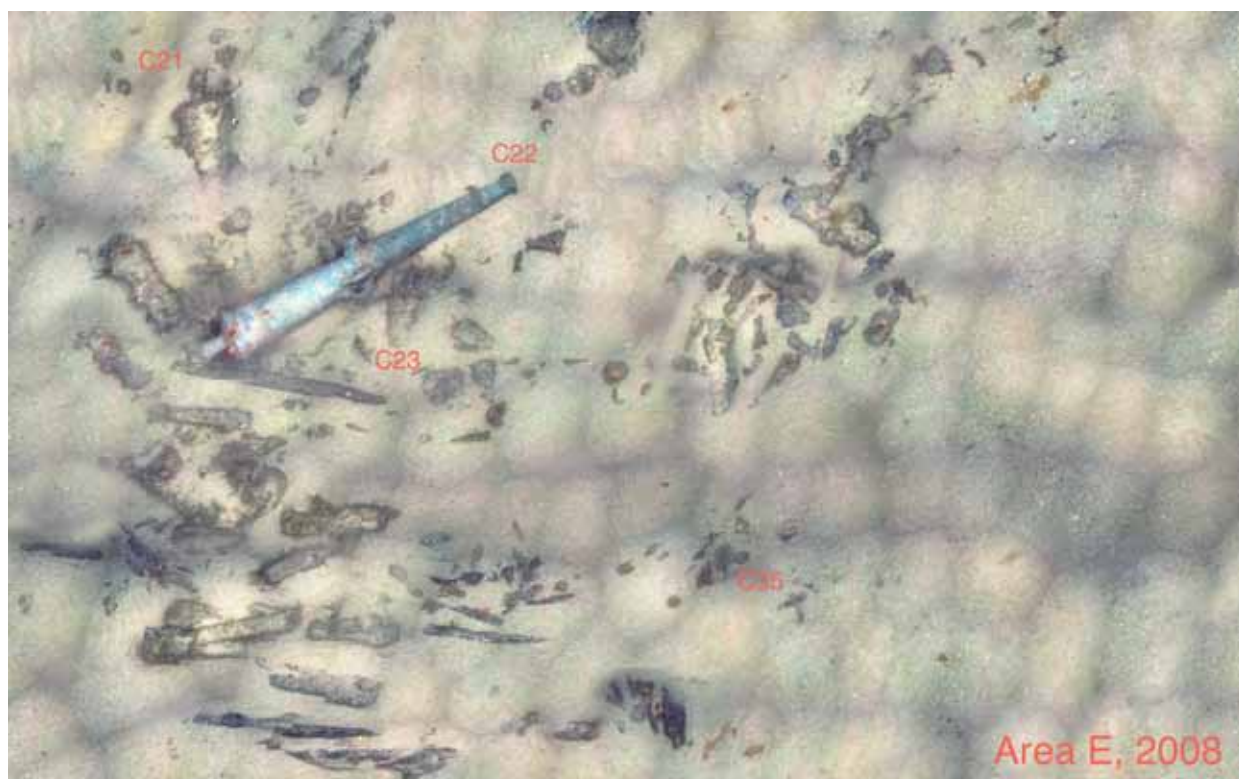
Figs. 43-44. Photomosaic sections of cannon impacts: Area D, 2008 and 2012.



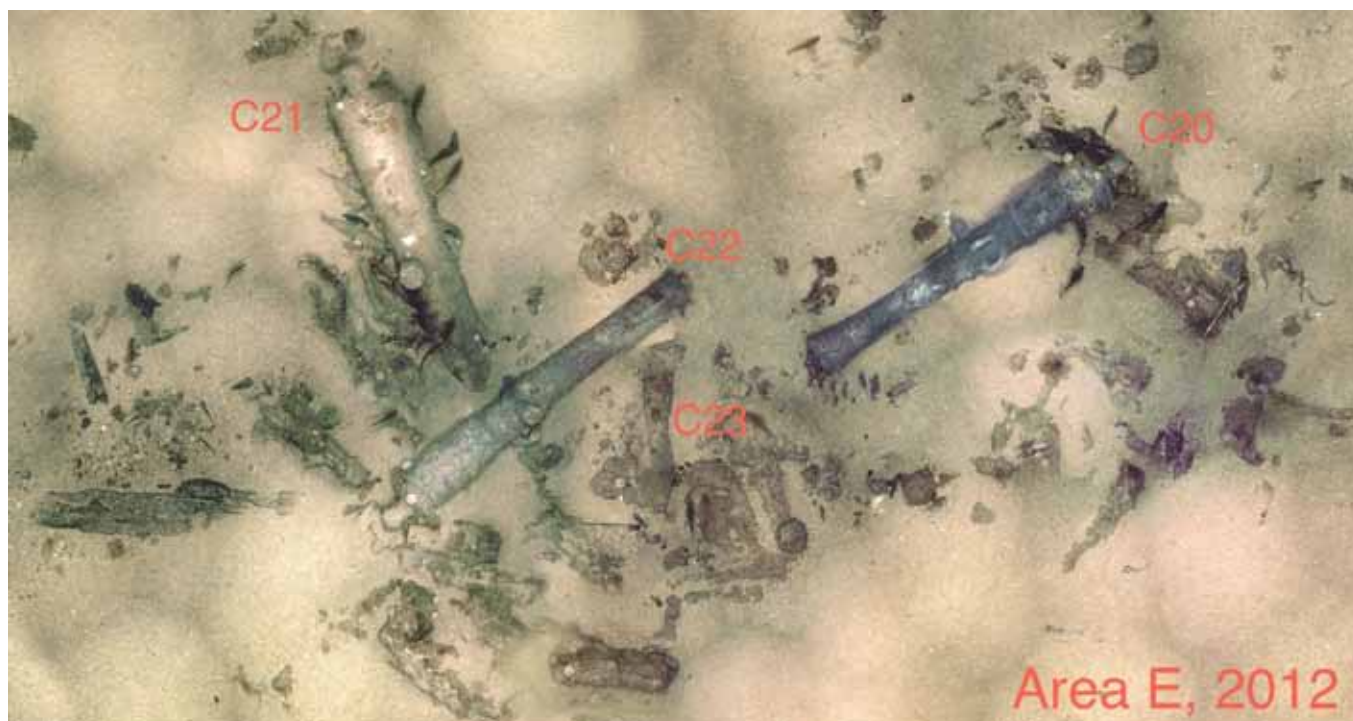


Figs. 45-46. Site plans of cannon impacts: Area D, 2008 and 2012.

Area	Cannon No.	2008	October 2011
D	C13	Bearing 350°, facing north, muzzle underlying C10, 1.3m-long plank at east.	Gun and planking not present.

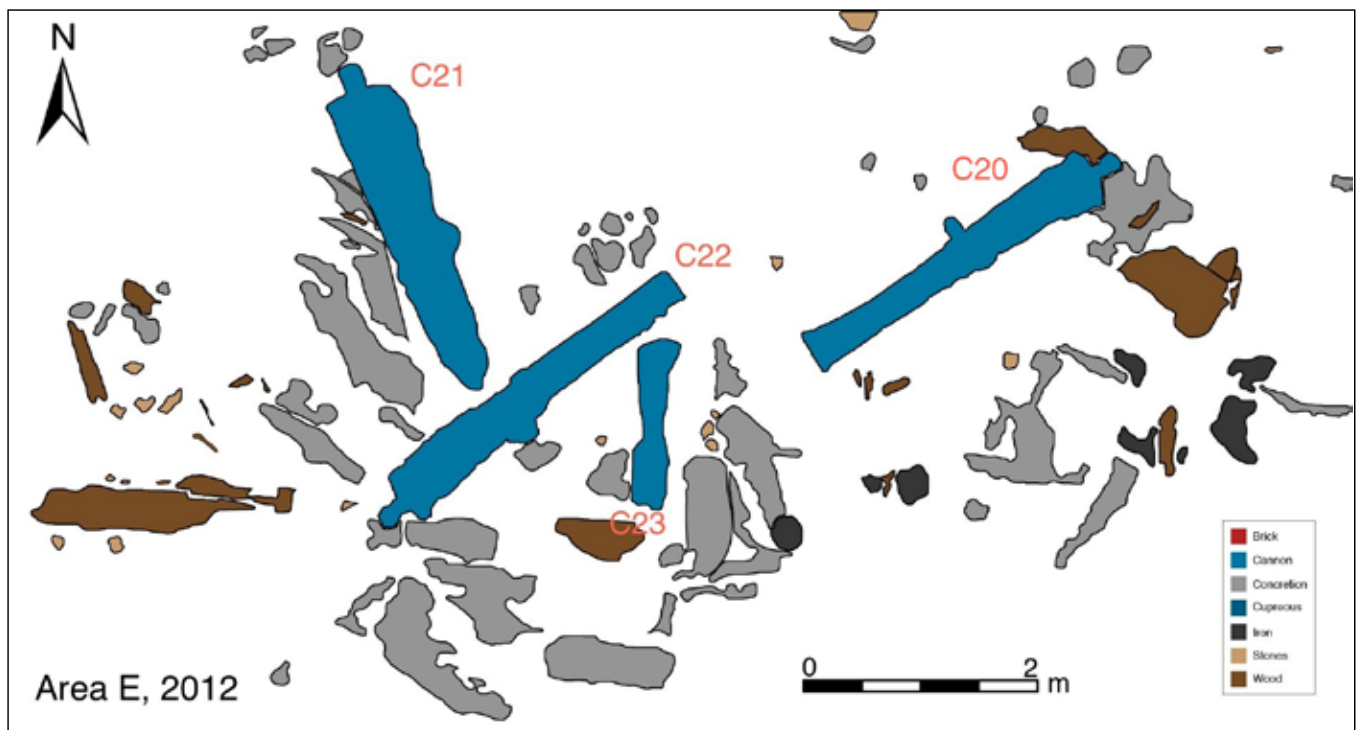
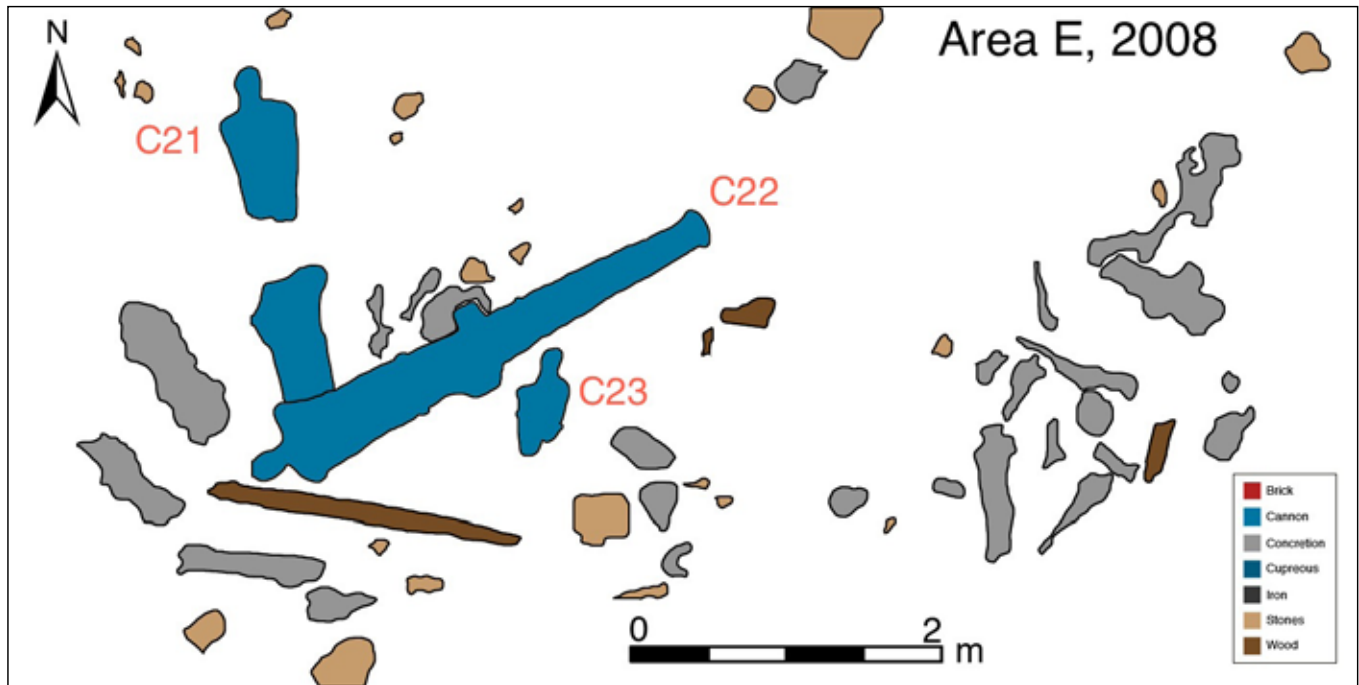


Figs. 47-48. Photomosaic sections of cannon impacts: Area E, 2008 and 2011.



Area	Cannon No.	2008	April 2011
E	C20	Not present.	New cannon, bearing 239°, facing southwest, heavily scoured chase. Believed to be C20 relocated 8.5m from northeast in Area B1.
E	C21	Bearing 168°, facing south, muzzle underlying C22 breech and vent field.	Rotated 45° to west bearing 158°, muzzle underlying C22 second reinforce.
E	C22	Bearing 63°, facing northeast, breech and vent field overlies C21 chase; 2.7m-long wooden spar immediately at south.	Rotated 90° to southeast bearing 56°, second reinforce overlies C21 muzzle. Gun shunted 1.5m to southwest. Wooden spar not present.

Fig. 49. Photomosaic section of cannon impacts: Area E, 2012.



Figs. 50-51. Site plans of cannon impacts: Area E, 2008 and 2012.



Fig. 52. Photomosaic section of cannon impacts:  
Area F, 2008.

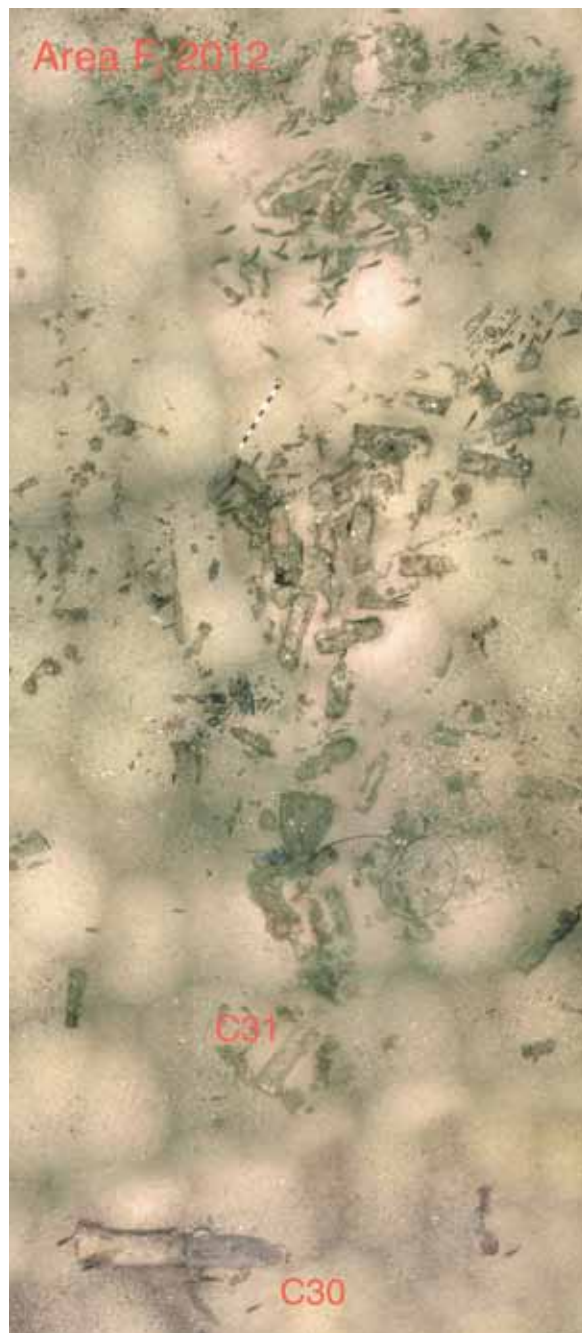


Fig. 53. Photomosaic section of cannon impacts:  
Area F, 2012.



Fig. 54. Site plan of cannon impacts: Area F, 2008.

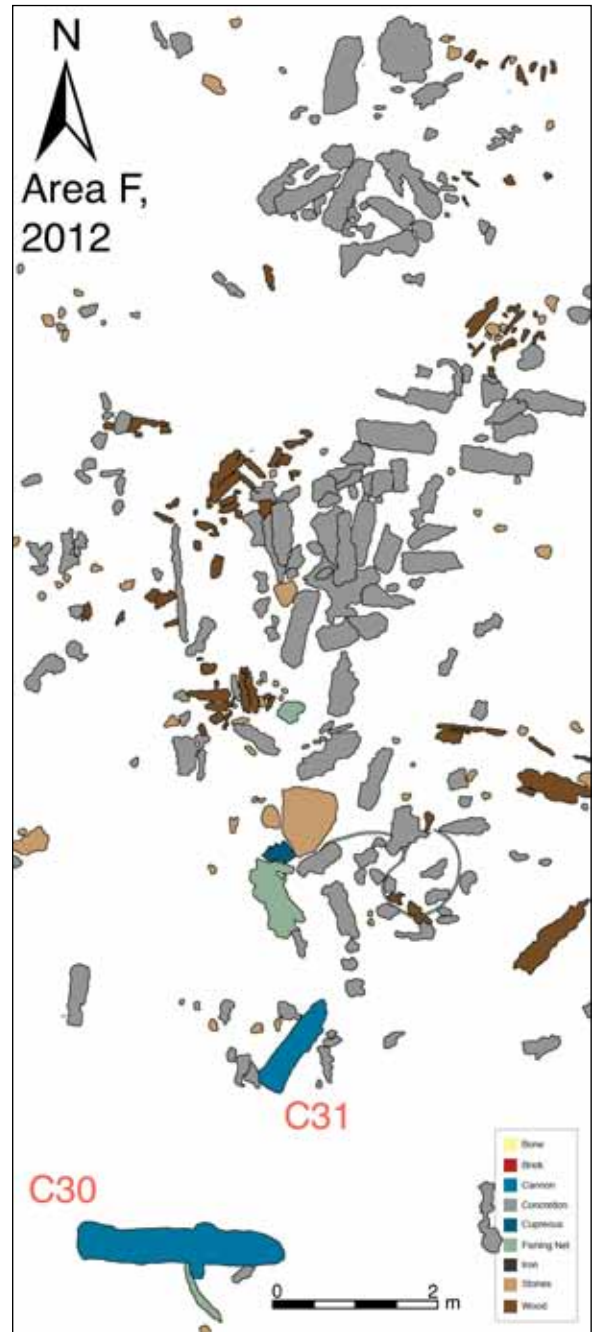
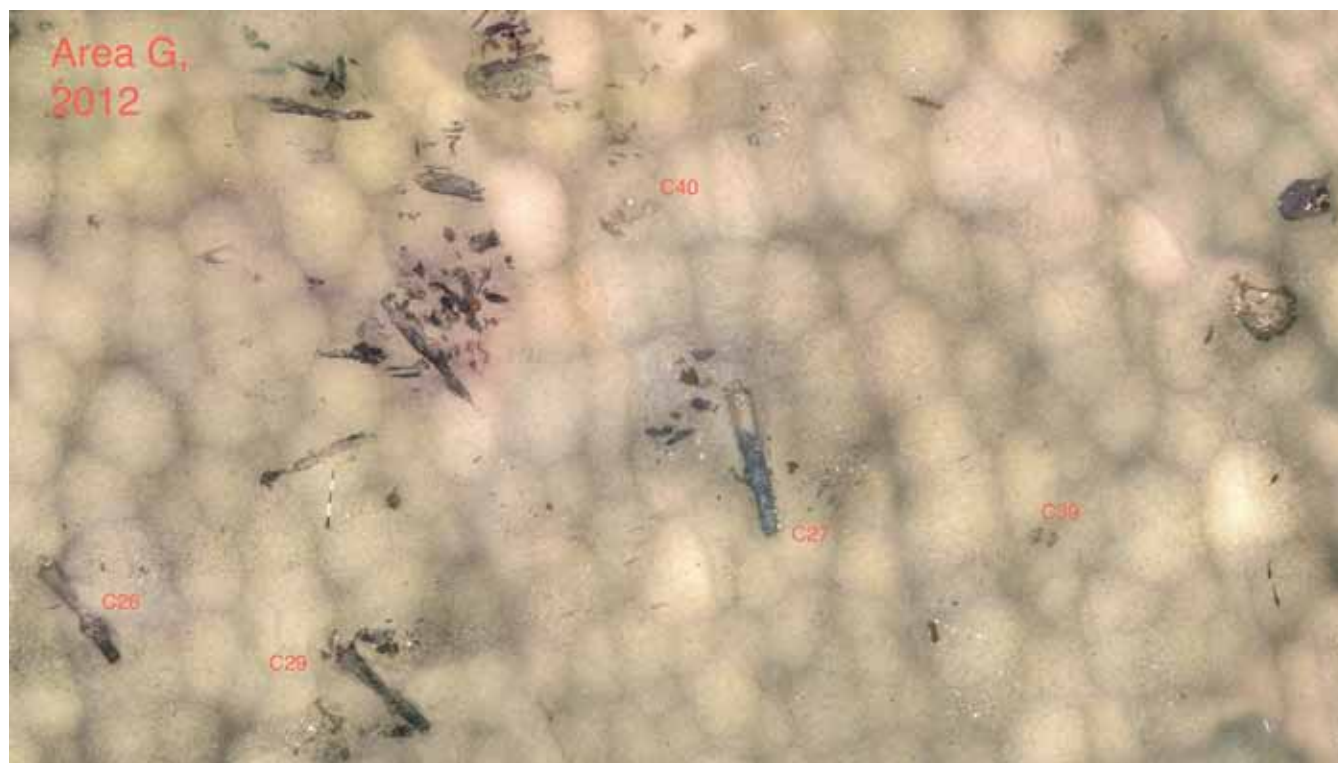
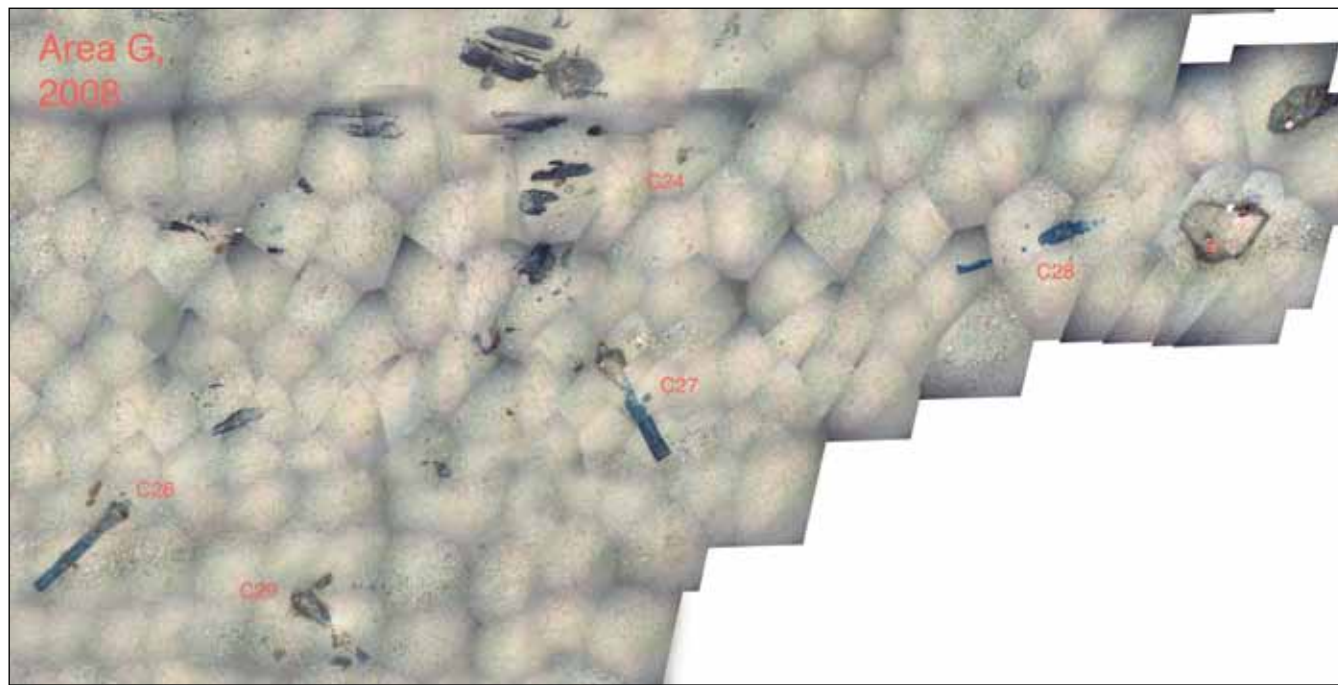
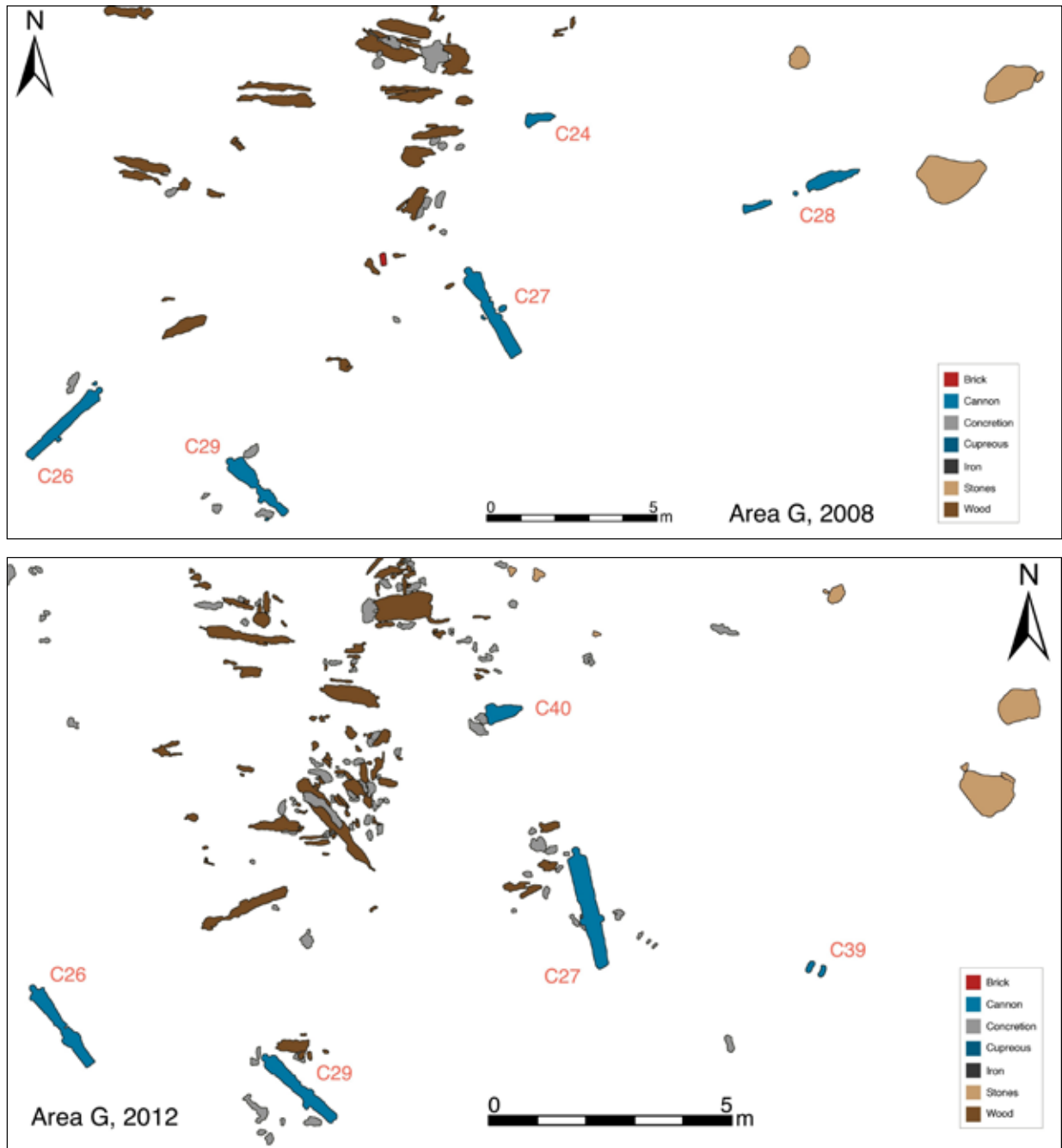


Fig. 55. Site plan of cannon impacts: Area F, 2012.

Area	Cannon No.	2008	October 2011
F	C30	Bearing 285°, facing northwest.	Bearing changed to 273°, gun shunted 2.5m to west.



Figs. 56-57. Photomosaic sections of cannon impacts: Area G, 2008 and 2012.



Area	Cannon No.	2008	October 2011
G	C26	Bearing 226°, facing southwest, broken muzzle (pre-2008 impact).	Bearing changed to 142°, facing southeast.
G	C27	Bearing 150°, facing southeast, broken muzzle (pre-2008 impact).	Bearing changed to 166°, facing south, flipped 90°, shunted 1.5m to northwest.
G	C29	Bearing 128°, facing southeast.	No change.

Fig. 58-59. Site plans of cannon impacts: Area G, 2008 and 2012.