**Unidentified Harbor Wreck**
***Royal Navy Dockyard, Bermuda***

# Report of Fieldwork December 2007

**Nathan Richards**
**Joseph C. Hoyt**
***Program in Maritime Studies***
***East Carolina University***
***Greenville, North Carolina, USA***

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**A USA-Bermuda collaboration of:**

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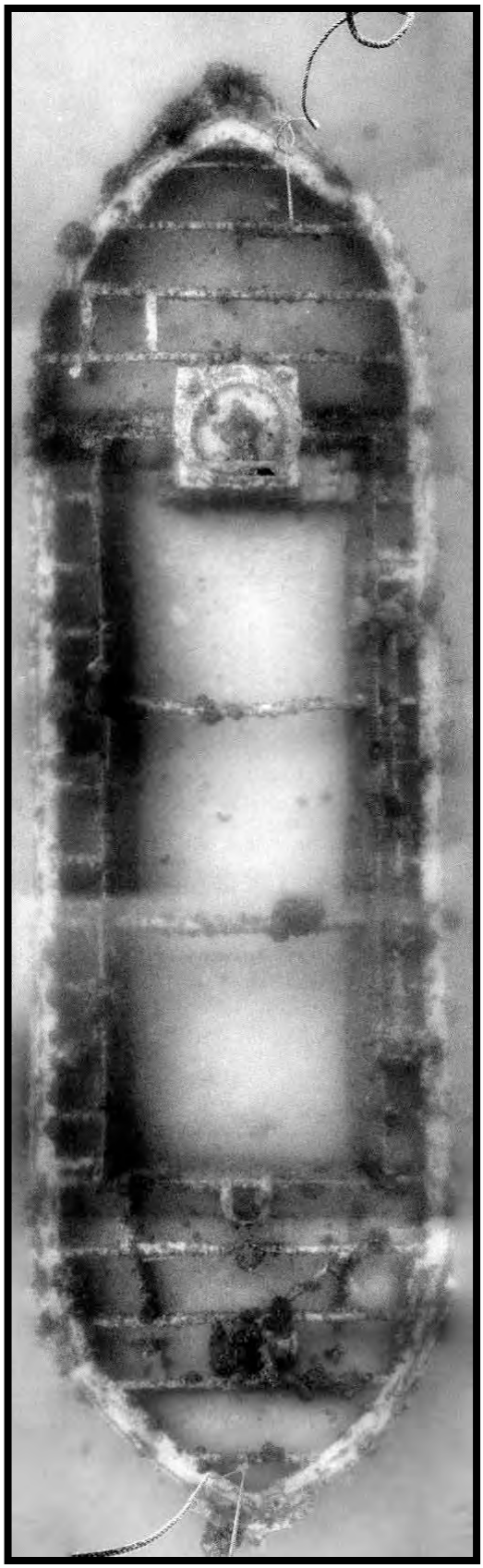
Government of Bermuda



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## PROJECT BACKGROUND

In mid-2007, Dr. Philippe Max Rouja, Custodian of Historic Wrecks inspected the remains of an unidentified vessel located off of the Royal Navy Dockyard, Ireland Island, Bermuda (see Figures 1 and 2). The iron-hulled site, of approximate dimensions 65 by 20 feet (19.81 by 6.1 m) sits in approximately 45 feet (13.72 m) of water. The site is currently under threat from the development of extended piers associated with cruise ships entering the Dockyard, as well as potential damage from prop wash.

On August 10, 2007, while guests of the Bermuda Maritime Museum (BMM), Dr. Nathan Richards and Dr. Bradley Rodgers of the Program in Maritime Studies at East Carolina University (ECU) carried out a reconnaissance dive on the site. The results of the survey culminated in a small not-to-scale site sketch, confirming all of the information outlined by Dr. Rouja. The wreck is very much intact, although it is missing decking, engines and machinery.

In September, 2007, the Bermuda Maritime Museum received funding to carry out site recording of the vessel with the intention to provide recommendations as to the vessel's future. The project was carried out with this financial assistance and with further in-kind contributions from East Carolina University, the Bermuda Maritime Museum, agencies of the Government of Bermuda, and local Bermuda divers.

Between 14 and 20 December a cultural heritage assessment of this unidentified vessel was carried out by underwater archaeologists from the Program in Maritime Studies at East Carolina University. Additionally a film crew accompanied the archaeologists to create a 3-5 minute proof of concept video outlining the project.

The project Primary Investigator for the archaeological components was Dr. Nathan Richards (Assistant Professor, Program in Maritime Studies) and the Co-PI, Dr. Bradley Rodgers (Professor, Program in Maritime Studies). The archaeological fieldwork was carried out with the assistance of Mark Keusenkothen (Ph.D. candidate, Coastal Resources Management, ECU), and Joe Hoyt (MA Candidate, Program in Maritime Studies, ECU). Professor Mike Dermody assisted with underwater filming and Kevin Wells assisting with above water shooting, editing, and post-production.

The work to be carried out was multi-faceted with many parallel goals. The most important goal of the field work is to carry out a **cultural heritage assessment** of the site. This assessment will be provided to the Government of Bermuda and the

Bermuda Maritime Museum to assist in the decision making process regarding potential impacts to the site.

As such, the *question* involved in a cultural heritage assessment revolves around the notion of *significance.* Significance can be determined many ways but is normally a combination of determining the rarity or representativeness of a site in conjunction with an assessment of its archaeological, aesthetic, historical, technical, educational and/or recreational significance (to mention a few). Additionally, the degree to which a site is important on local, regional, national or international levels must be taken into consideration.

In order to make determinations of significance a methodology outlining how diagnostic information is to be retrieved or extracted from a site must be determined. In most cases these methodologies are simply designed to enable the collection of measurements or observations leading to the establishment of a function or actual identity for a site (after which historical research may contribute additional facts to assist in significance determination). Additionally, the activities of collecting data from sites may in itself *create* significance for a site. An example of this is the collection of measurements for dive slates to augment dive tourism.

This project has been designed around these two ideas. On one hand the data will be used to create a comprehensive archive from which significance may be determined for subsequent determination of the vessel's future; on the other hand, the products from the survey may bring to light other opportunities to use the site or the data from the site for research, education and outreach.

The priorities of the project were to record all materials *in situ* and not for the retrieval and conservation of objects. In one instance there was a targeted excavation of the stern to more appropriately categorize some of the diagnostic features of the vessel and provide insight into potential functional classification. The final assessment considers where subsequent work needs to be undertaken to more accurately record information and retrieve material, or whether development plans need to be written or amended.

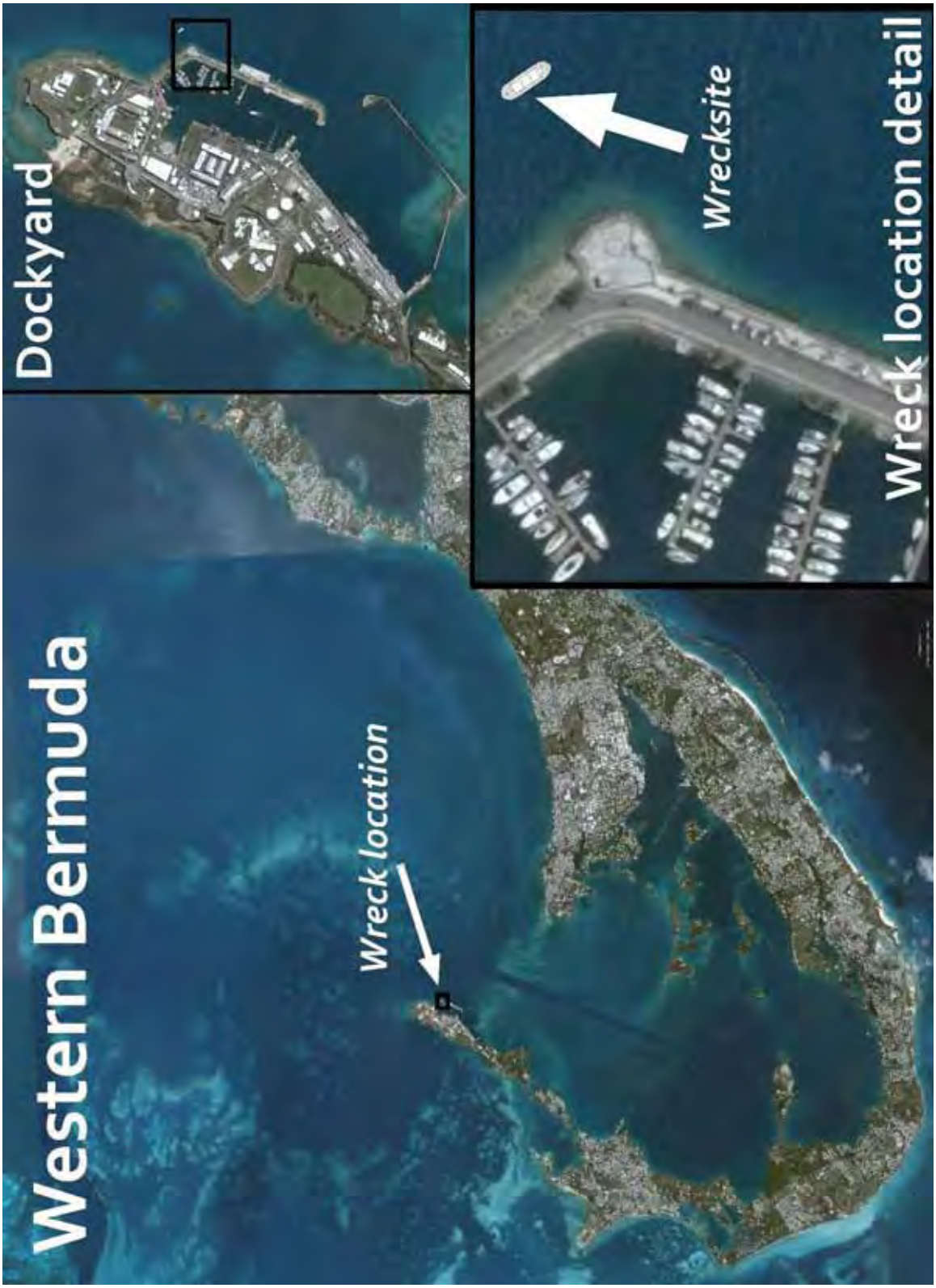



**Figure 1.** Map of Western Bermuda and the Royal Navy Dockyard, Ireland Island showing the location of the unidentified harbour wreck (Image: N. Richards, J. Hoyt, and Google Earth).

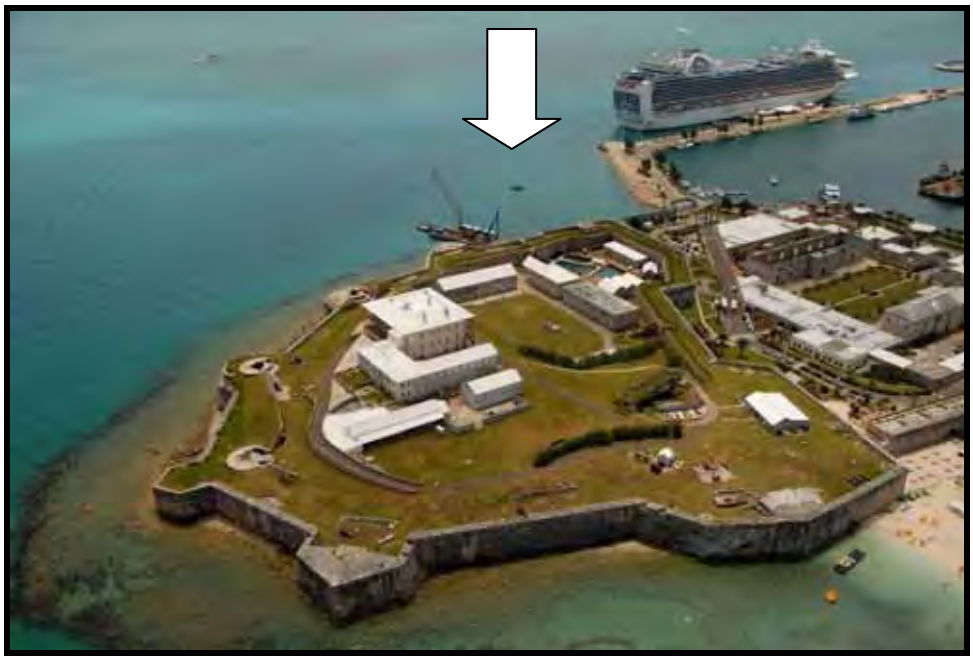


**Figure 2.** Aerial photograph showing approximate location of the unidentified submerged vessel in relationship to the Royal Navy Dockyard (Courtesy, Dr. Edward Harris, Bermuda Maritime Museum)

## METHODOLOGY

The methodology for recording the shipwreck involved underwater data-collection and above water processing of data. Due to the depth, but overlapping methodologies, days were generally long, but diving days relatively short. Following diving, afternoons were used to transcribe datasets, ink drawings, process photographic materials, create photomodels, and edit footage. The text below briefly communicates diving conditions and personnel roles before explaining the methods utilized and the products achieved through fieldwork.

### Diving Conditions

Before departure from Greenville, a dive plan was filed with the Diving and Water Safety Office at East Carolina University. The dive plan accounted for each diver to make two 45′ dives daily, and eight dives weekly with bottom times not exceeding 50 mins. In the likelihood that non-ECU divers were involved in the project, had to be considered as recreational divers covered by BMM insurance policies. Due to liability and indemnity issues, non-ECU divers could not be paired with ECU divers under any circumstances – but paired with other non-ECU divers were able to observe and assist in the field. The basis for participation is outlined in Table 1 below:

| | ECU | Non-ECU |
|---|---|---|
| **Oversight** | ECU Diving and Water Safety Office | Bermuda Maritime Museum |
| **Level of Certification** | AAUS Scientific Diver | Recreational Dive Certification |
| **Medical required** | Yes | Yes |
| **Other training** | First Aid/CPR | NAS Part 1 |

**Table 1.** Basis of participation in archaeological fieldwork.

The ability to work on the site was influenced by three main factors – depth, visibility and boat traffic. Regarding depth, the bottom of the site sits in approximately 45-50′ of water, with the deck of the vessel around 39′. Because of the site's close proximity to shore, it was possible to undertake either shore-dives or diving from boats. Due to the use of expensive camera equipment and large unwieldy housings, as well as a desire to maximize time working on the seabed, the team opted to dive exclusively from a boat. Because of depth divers were reminded of appropriate ascent rates, and observed a safety stop at 15 feet for 3-5 minutes when ascending.

Site visibility was expected to be good, and the team did not anticipate substantial current. Site photography, at the core of the project goals was done during best visibility and sometimes occurred when there are few people in the water.

### Personnel Roles

All divers were involved in one of many tasks, with duties divided day by day, dive by dive according to the primary investigator in conjunction with team members:

1) Videographer and Videographer's Assistant. Acquisition of imagery and dive buddy.
2) Photographer and Photographer's Assistant (for site documentation, photogrammetry and photo-mosaics). Acquisition of imagery, placement of scale bars, and completion of photologs.
3) Site Recorder and Site Recorder's Assistant (for plans, cross-section, profile and detail drawing). Acquisition of field data (measurements) which entails the establishment of baselines and control points, feature measurement, and detail notation (as maps or diarized observations).
4) Standby/safety diver and shore logistics

**Methods and Products**

With the exception of higher-technology photographic methods, the methodologies employed during fieldwork emulated those carried out on most other maritime archaeological sites. When compared to other underwater shipwreck sites, the intactness and small size of the site made this a particularly straightforward project – and it was possible to complete more tasks in greater detail than first anticipated.

The survey utilized three complementary methodologies entailing photography, videography and the completion of scaled drawings. Because this project intended to collect measured spatial information in a very short period of time, the priority was to collect very detailed measurements which could, theoretically, allow for reconstruction. These activities (in order of priority) are discussed in relation to general principles and specific product outcomes.

***Photography***

In order to better understand the nature of the site, and potentially identify the submerged remains, a comprehensive record of still imagery was collected with a Nikon D70 camera with a 12-24mm DX lens in a custom Aquatica housing. All images were transcribed into a photographic database, and correlated with the August unmeasured sketch. The archive of material, saved in two raster formats (*.nef and *.jpg) was transported to Greenville on computer hard drives following the survey, and a clone of the imagery left at the Bermuda Maritime Museum on RAID-system hard drives on 20 December. On the DVDs accompanying this report, another copy has been provided to the BMM and the Government of Bermuda along with the completed image catalog describing the collection. Photographic activities served three main purposes, described below.

*Site documentation:* There were no restrictions on the nature of site photography. Shots were taken on any subject at any level of zoom. At project's end there was a collection of general site shots as well as technical shots of diagnostic features. All technical shots included a scale bar placed parallel with one axis of the photograph. All shots were registered on a photographic log sheet (see Appendix 1) indicating shot

number, subject, compass bearing, and photographer. Each photographic log included date, site, and camera. In addition, this project used a copy of an annotated unmeasured sketch. With each shot, a photo number accompanied with a directional arrow was used to cross-reference the photologs with video footage and the finished site plan.

*Photomosaic*: In conjunction with photographic documentation, the archaeologist successfully created a detailed photo-mosaic of the site (Figure 3). The success of this operation was wholly dependent upon water clarity. Due to water visibility in excess of 25 feet (7.62 m), a photomosaic in plan, and profile (portside) view was completed before the date of departure (18 December 2008) and is now in a digital archive at the BMM (as a layered *.psd file as well as in high-resolution raster file (*.pdf, *.tif and *.jpg) formats. Upon return to North Carolina this photomosaic was printed as a high-resolution black and white poster in a 36" x 45" format and accompanies this report. There were no restrictions on the nature of photomosaic photography, although the best shots were those taken where the degree of parallelism between camera lens and subject were optimal. Additionally, there was no need to complete a photographic log for the photomosaic, and shots did not require the inclusion of a scale bar. The photomosaics (plan and profile) were achieved with the use of Adobe Photoshop CS2 and its autostitch function.

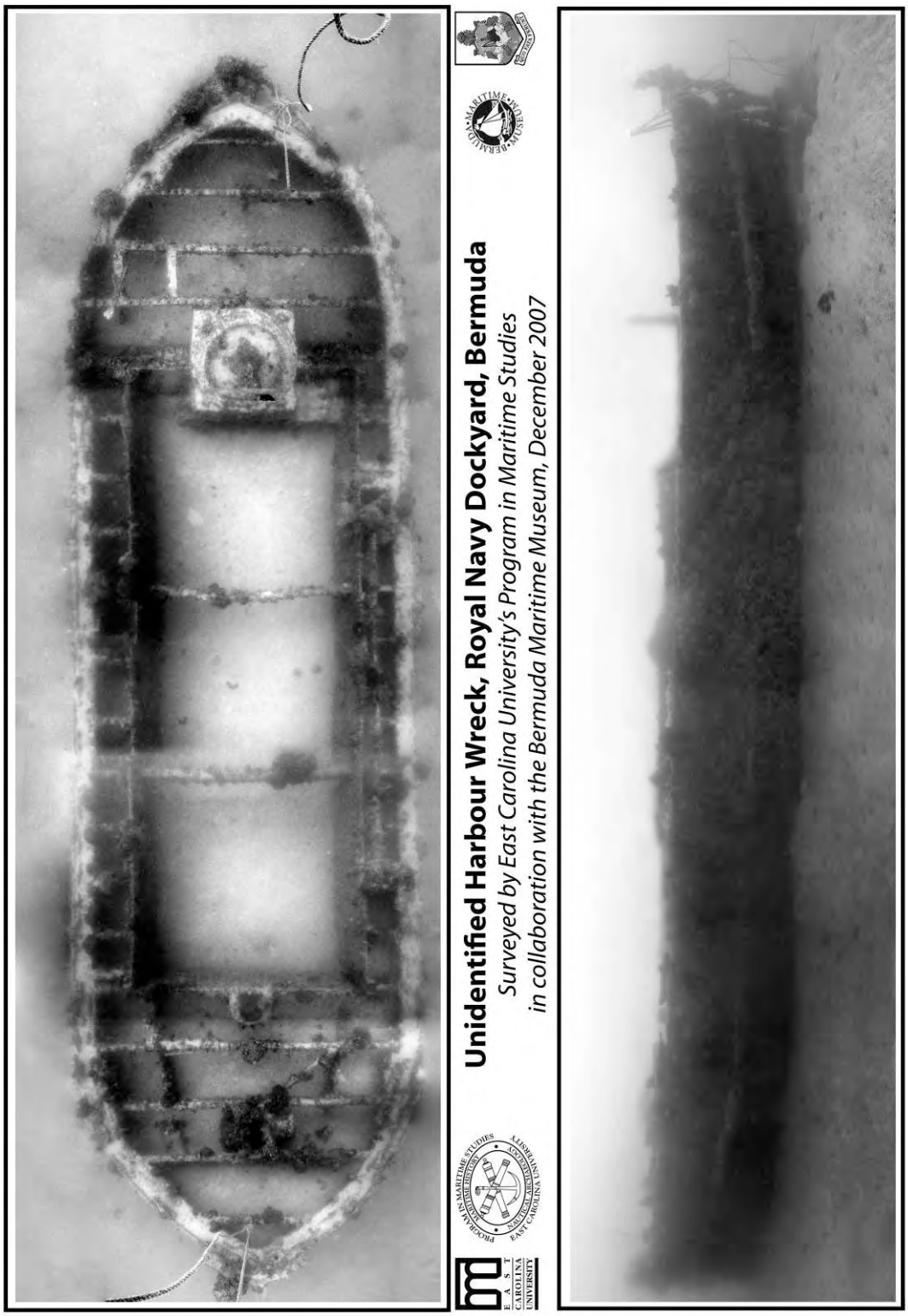



**Figure 3.** Plan and profile (port) photomosaic of the unidentified harbour wrecksite, Royal Navy Dockyard, Bermuda (Photo: J.Hoyt, 15 December 2007).

*3D Virtual Photomodel*: In conjunction with photographic documentation, archaeological field crew attempted to create a three-dimensional model of the unidentified site using the EOS software, *PhotoModeler Pro* version 6.0. In order to do this, all photographs were taken in "power-up" or "un-zoomed" modes on a calibrated camera. Camera calibrations were undertaken before departure in a pool in Greenville, North Carolina to simulate field conditions. Very few underwater three-dimensional photomodels have thus far been produced for dissemination in underwater archaeology. This is largely because of the steep learning curve associated with getting results from the software, as well as the need for certain environmental conditions (i.e. good light and good visibility). Subsequently, the archaeologist felt that there was no guarantee that the photos taken during fieldwork would culminate in a successful photomodel. At the time of this project's writing we are pleased to note that the photomodel, is about 10% complete, and while the procedure is very time consuming and complicated, we will soon have a partial or complete photomodel of the site (date of completion is currently unknown). Should the model be completed to satisfaction, data will eventually be provided to the BMM in *PhotoModeler* format, as well as a number of other formats including AutoCAD (*.dwg, *.dxf), 3D Studio Max (*.3ds), and VRML (*.wrl) for potential web-site integration on CD or DVD.

***Videography***

High-definition underwater site videography was acquired for archival purposes and for the production of a 3-5 minute concept video covering the maritime archaeological fieldwork and/or avocational diving program using a Canon XH-A1 HD camcorder with a custom Equinox Pro 10 mechanical underwater video housing rated up to 250' of water depth. This was used in promotional work undertaken by the Bermuda Maritime Museum, and aired on Bermudan television programs immediately following the project. All raw footage returned to Greenville following fieldwork for post-production of the video. A copy of this video imagery was also left at the BMM upon departure (external hard drive). A finished video piece is scheduled to be finished by Michael Dermody and Kevin Wells (outside the scope of this report) by 28 February 2008 on Digital Video Tape or DVD media.

***Scaled drawings***

In order of priority, an archaeological site plan, site profile, and cross section of the exposed remains in addition to a coastline plan were produced while in Bermuda. Because conditions were conducive to the production of effective photomosaics and photomodels, there was no opportunity to undertake detailed site drawings of other diagnostic features uncovered during fieldwork. The extensive photographs, however, outlining every inch of the wreck site made such work redundant. The field crew was not able to complete final inked versions of the above items in the time allotted in order to undertake scanning and digitization before departure so that all original materials can be archived at the Bermuda Maritime Museum. As a consequence further work producing these results occurred in North Carolina, and all complete site records have been shipped back to Bermuda accompanying this report for storage at the Bermuda

Maritime Museum. In addition, all site plans have been scanned and are included in attached DVDs.

*Plan (birds-eye-view):* With the existence of a detailed unmeasured sketch, a measured plan of the site may take one of two forms. Because of the intactness and apparent symmetry of the vessel, the simplest way to record this plan view of the vessel was to annotate the unmeasured sketch (Figure 4) in enough detail to allow for a subsequent detailed redrawing at a scale (at 1" to 2' scale). The pencil drawing was subsequently scanned and digitized in Adobe Photoshop CS3. (Figure 5).

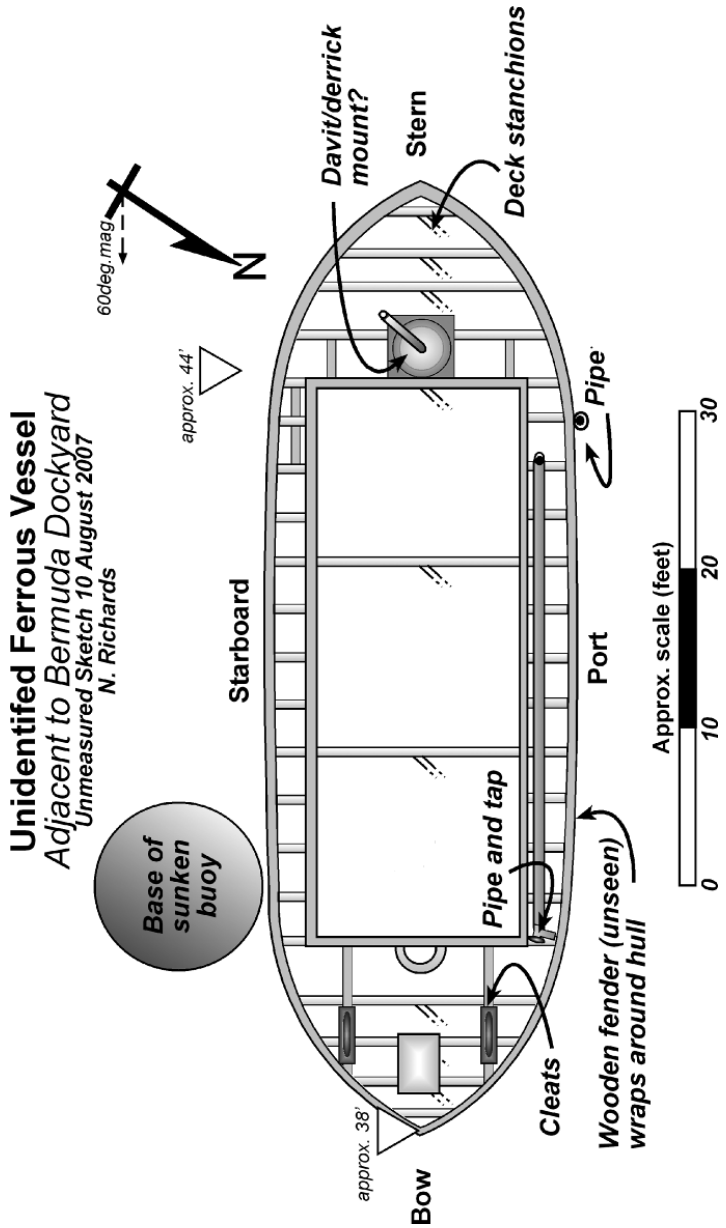



**Figure 4.** Digitized version of unmeasured sketch of the unidentified vessel located off the Royal Navy Dockyard, Ireland Island, Bermuda (Drawing by N. Richards, August, 2007).

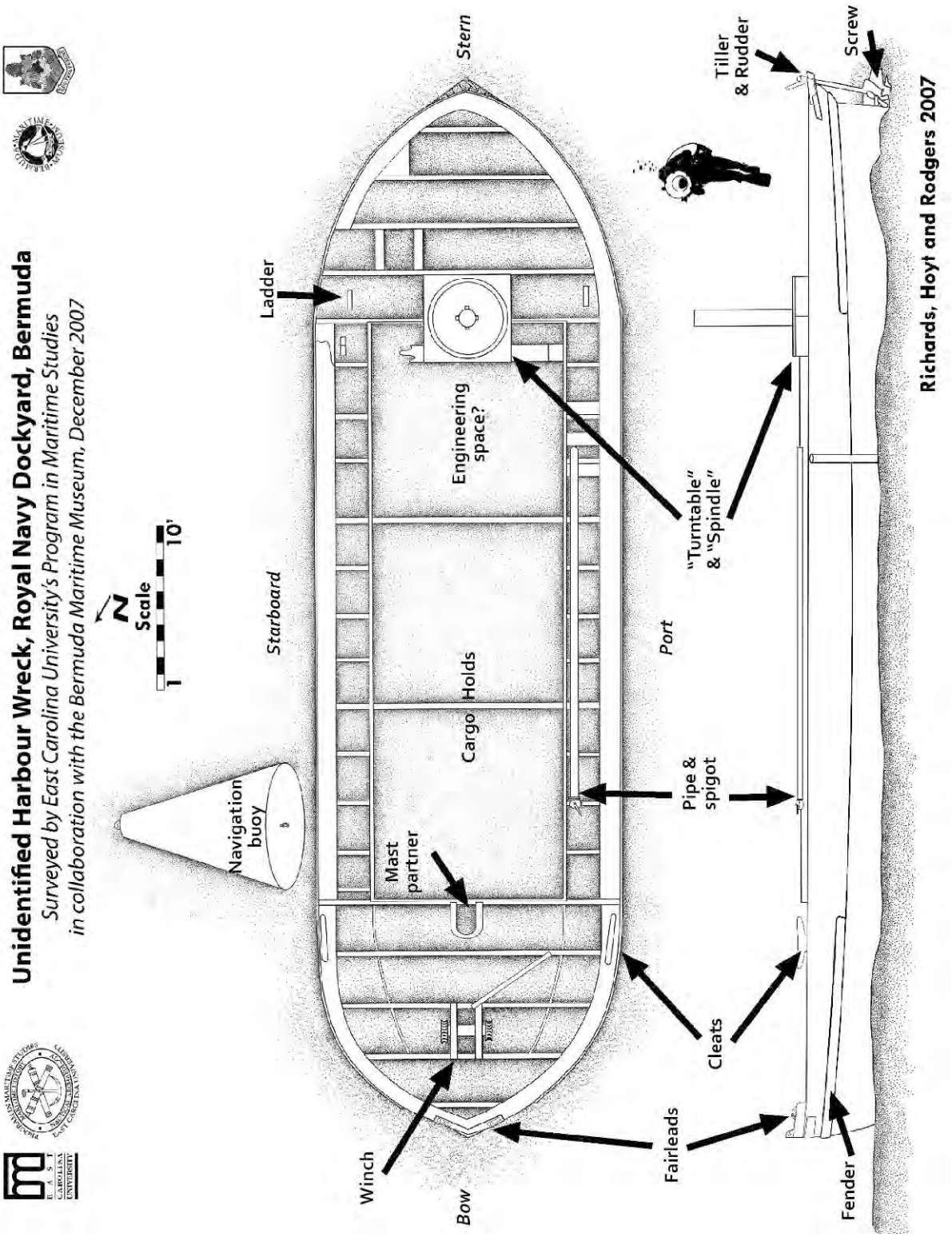



**Figure 5.** Plan and profile drawing of the unidentified harbour wreck (Drawing, N. Richards, J. Hoyt and B. Rodgers, 2007)

*Cross-section (athwartships):* A cross sectional view was created by measuring vertical and horizontal distances across the ships' beam. From these measurements, a depiction of the exposed structure, volume of sediment and conjectural outline of buried remains could be made (Figure 6).

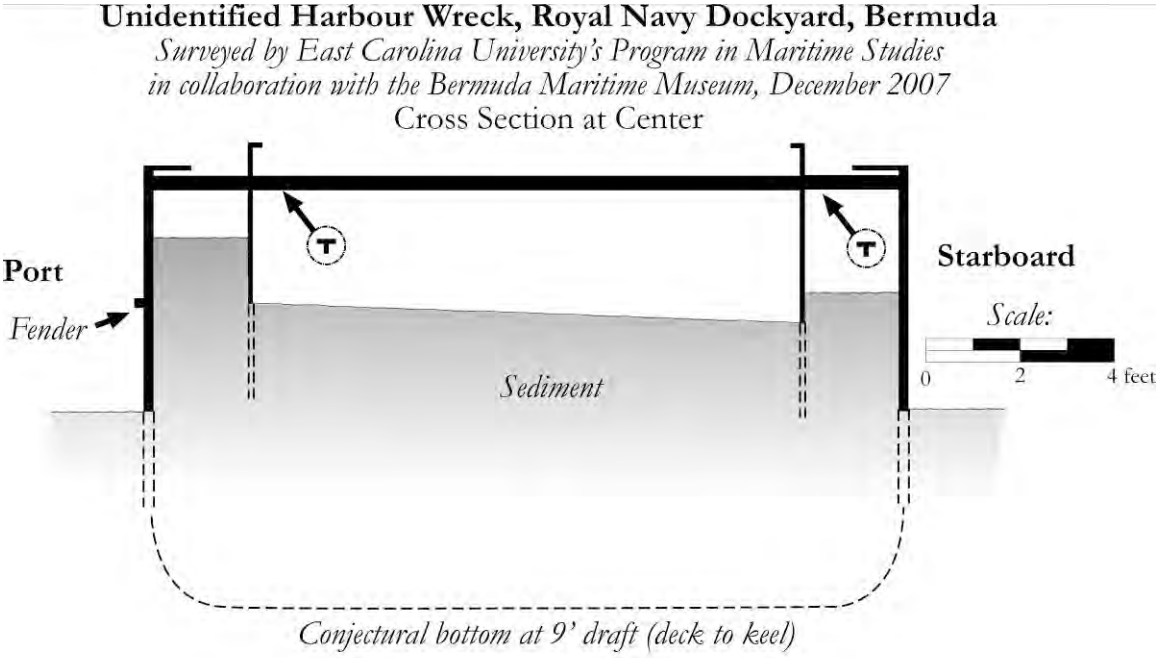



**Figure 6.** Cross section of the unidentified harbor wreck (Drawing by N. Richards)

*Profile (longitudinal):* In a method similar to that above, a series of vertical and horizontal distances were measured down the length of the ship (bow to stern). Following this, the profile measurements were drawn at the same scale as the site plan (see Figure 5).

*Coastline plan:* A coastline plan has been constructed with the assistance of Geographical Information System (GIS) Software ESRI ArcView and Google Earth Pro (Figure 1). Following the completion of all measurements, a GPS measurement was taken at a buoy on the stern of the vessel, and with the assistance of a compass bearing taken underwater, a bow position was extrapolated. These positions were plotted into Google Earth Pro and then the site plan georectified upon the aerial photographic basemap. Accuracy of this depiction is estimated at +/- 20 feet (6.10 m) due to the combined effects of GPS accuracy and possible magnetic variation on the seafloor.

**Other deliverables**

In addition to the above products, the field work has been featured in additional publications (see Appendix 2), such as the Bermuda Newspapers *Royal Gazette* (28 September, 2007, p. 13 and 28 December, 2007, p. 2) *Bermuda Sun* (28 September, 2007), and the North Carolina publications *Pieces of Eight* (January 25, 2008, pps. 1, 12), *The Daily Reflector* (24 December, 2007, p. B1) and *Edge Magazine* (2007 edition

forthcoming). In 2008 this work will be featured within the Program in Maritime Studies annual publication *Stem to Stern* (December), as well as in professional newsletters, such as the *Newsletter of the North American Society for Oceanic History*, the *Newsletter of the Society for Historical Archaeology*, and the *Newsletter of the Australasian Institute for Maritime Archaeology.*

## SITE DESCRIPTION

The wrecksite is located approximately 170 feet (51.82 m) from the nearest shore. The coordinates of the wreck are presented in Table 2.

The measured archaeological dimensions of the wreck are around 64.5 feet (19.66 m) long, and just over 19 feet (5.79 m) wide. The vessel has settled into the sediment to a great extent. From the existing deck level and running down the exterior of the ship there is around 5.2 feet (1.58 m) of exposed hull. Following excavation of the hole at the stern to determine the existence of the propeller, at least another 3 feet (0.91 m) of vessel sits in the sand.

| | Stern | Bow |
|---|---|---|
| **Latitude** | 32°19'33.18" | 32°19'33.74" |
| **Longitude** | 64°49'51.06" | 64°49'51.44" |
| **UTM N** | 3578031 | 3578048.518 |
| **UTM E** | 327668 | 327658.751 |

**Table 2.** Coordinates (Latitude and Longitude and UTM) of the unidentified harbour wreck site (datum=WGS84, UTM Zone=20).

This gives the vessel a minimum draft of 8.2 feet (2.5 m) from deck-level to keel. In all likelihood the draft might be another foot or so to the base of the keel giving an estimated distance from deck to keel of around 9 feet. This is in line with other documented drafts for vessels known as "steam lighters" (to be discussed). The wreck site is oriented at around 27.9° degrees west of magnetic north, or 332° magnetic. A large navigation buoy sits a few feet off bow and adjacent to the starboard side (Figure 7). The buoy has a maximum length of around 11.5 feet (3.51 m) and a base diameter of around 7.9 feet (2.41 m).

**Figure 7.** Navigation buoy (Photo: J. Hoyt, 16 December, 2007).

The vessel is highly intact from stem to stern. It is comprised of intact iron hull plating (flush plating) and 21 sets of deck beams running athwartships. Although difficult to determine from the concreted remains, the hull is probably riveted. Five deck beams run all the way across the bow of the vessel. Of the following twelve only four run all the way across the beam of the ship, essentially delineating three main holds believed to represent two cargo holds (forward and amidships) and an engineering space (aft) The final four deck beams run across the vessel to the stern. Indeed, there are very few above deck features – no deckhouses, wheelhouses or cabins. Additionally the bulwark plates (which could have been wooden or iron) have been removed.

There are, however a number of deck features in situ. Along the centerline of the bow of the vessel there are fairleads, the remains of a windlass or winch (4.8 feet or 1.46 m from the bow), and a mast carling (12.2 feet or 3.72 m from the bow). The port and starboard sides of the ship sport cleats (10.8 feet or 3.29 m from bow). In the midships section a horizontal pipe with spigot run longitudinally along the port side. Towards the end of the internal compartments, there is a large turntable with "spindle." In the bow section two ladders can be seen about 13 feet (3.96 m) from the stern. At the extreme end of the stern the rudder and tiller are still extant. Around the hull remnant fenders once encircled the ship, but are now most obvious at the bow and stern (Figure 8).

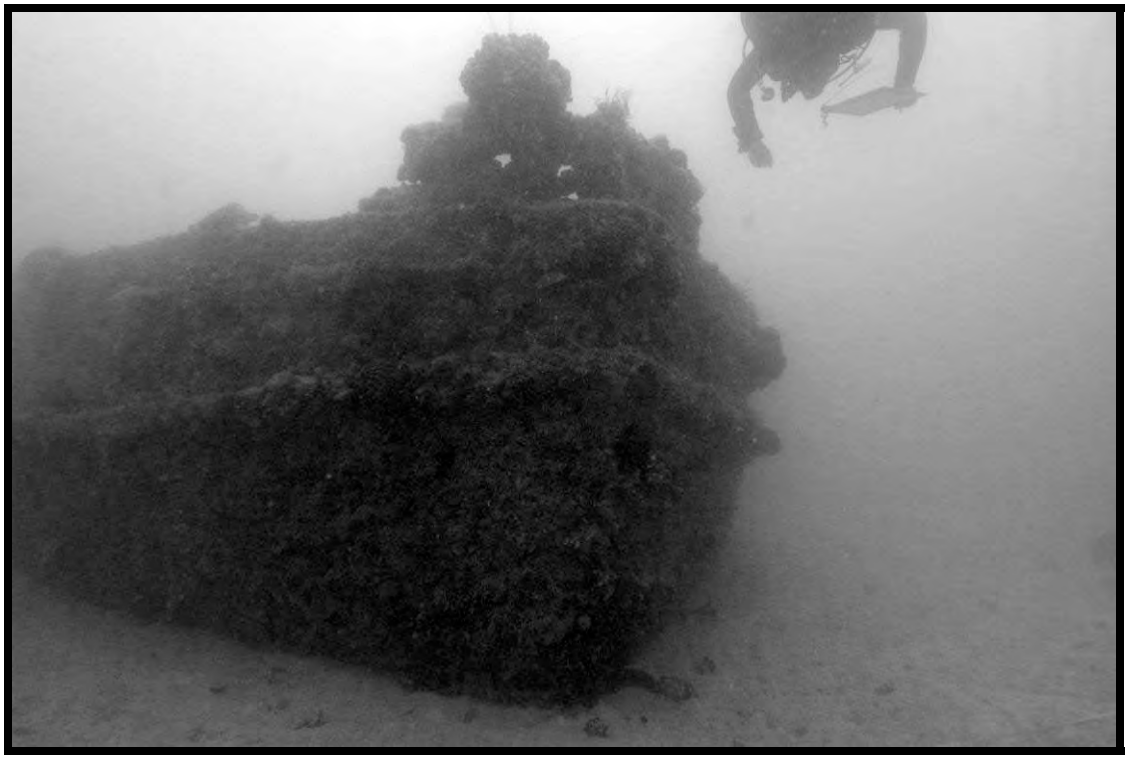


**Figure 8.** Fenders attached to the bow of the wreck (Photo: J. Hoyt, 16 December, 2007).

There is no noticeable damage to the outside of the hull plating or to any of the deck beams. Outside of the hull, the only damage noticeable are missing sections of fender (especially the starboard side) and extensive damage (twisting) to the rudder which is bent over considerably to starboard (Figure 9).

**Figure 9.** Stern of the wreck site showing excavated area in addition to the in site propeller and turned rudder (Photo: J. Hoyt, 18 December, 2007).

The best evidence of damage can be seen in relation to what remains in situ where the deck would have once been. Immediately obvious is the absence of decking. From remnants of wood still attached to deck beams as well as remnant fasteners it is clear that the vessel had a wooden deck throughout. Evidence from some intact iron fasteners still extant on the deck beams suggest that this deck was probably very substantial with planks at least six inches wide and four inches thick. While it is clear that there has been substantial (probably post-depositional) salvage of material from the wreck, it is impossible to say if the decking was salvaged or if it was destroyed. In some parts of the wreck there appear to be evidence of charring, possible hints regarding fire damage.

Other evidence of damage can be seen in the stern on the starboard side. In a 5.5 foot (1.68 m) section of hull across three deck beams there is an absence of deck-side iron plating. Nearby, in the aft hold, a large wooden beam, apparently acting as a thrust bearing for the engine and the "spindle" has also been damaged with just over 2 feet (0.61 m) of the beam missing and the remaining edge terminating in a jagged, uneven surface.

**Diagnostic Construction Elements**

Many of the construction elements discussed above warrant specific analyses due to the potential functional or chronological ramifications and their potential to contribute to a possible future identity of the site.

*Cleats and Fairleads:* As mentioned above, the bow section of the vessel has evidence of various "fastenings and fairleads" probably used for a range of purposes such as for tying up to docks and other vessels (Figure 10). The most obvious are the bow cleats located on either side of the hull (Figure 11). These cleats are about 3.3 feet (1.01 m) wide. In the bow of the vessel two open chock fairleads are also present (Figure 12).

*Mast Carling or Collar:* A metal ring attached to the fifth deck beam appears to resemble a mast collar or mast carling (Figure 13).

The definition of a mast collar is:

> An angle bar formed into a ring and fitted around the mast hole in a steel deck. The horizontal flange is riveted to the deck and the vertical flange is fastened with tap rivets to the mast plating or welded to it. (De Kerchove 1961 497)

A carling supports a similar function, being a "A short fore-and-aft timber or steel girder placed under a deck to stiffen it, used in a way of mooring bitts, winches, windlasses, hatchways, masts and so on" (De Kerchove 1961: 128).

This does not indicate that the vessel was masted and rigged. More likely the ship has a pole mast which would have been setup as a derrick. The pole mast would have been mounted on the deck, with this sturdy ferrous "horseshoe" providing extra stability and strength (had the deck been iron or steel, there would have likely been a mast partner plate).

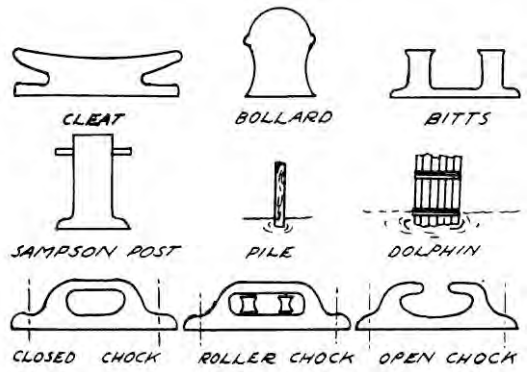



**Figure 10.** Fastenings and fairleads used on tugboats and towboats (Brady 1967:97).

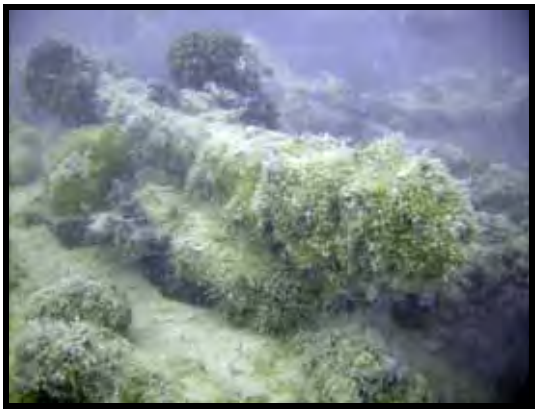


**Figure 11.** One of the bow cleats on the unidentified Bermuda vessel (Photo: N. Richards, August 1997)

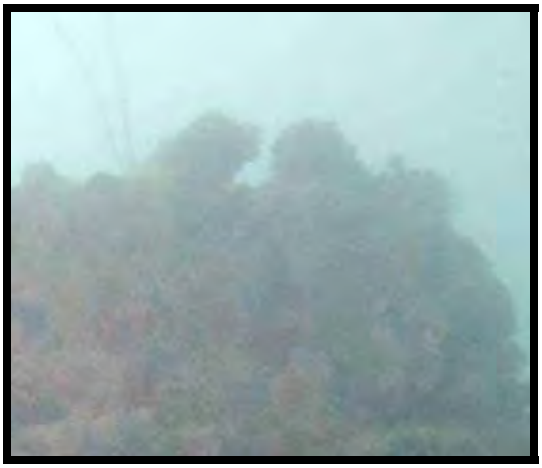


**Figure 12.** Open chock fairleads attached to the bow of the wreck (Photo: J. Hoyt, 18 December, 2007)

**Figure 13.** Detail photograph of the mast partner (scale in inches) (Photo: J. Hoyt, December 2007).

*Propeller:* A cast iron or steel three-bladed propeller is still attached at the stern of the vessel. Each blade is 1.9 feet (0.58 m) long, and 1.2 feet (0.37 m) wide, with a propeller cone/boss diameter of 1.2 feet (0.37 m). As Seaton, writing in 1909 notes,

> Cast iron was the material of most of the screw of the merchant marine from the earliest days, and has continued to be largely used even to-day. It is, of course, the cheapest of metals and the easiest of manipulation, and can be got of fairly good quality almost everywhere.

If the propeller is not iron, it is steel, a material first used in propellers around 1870 but initially were very expensive to make. The prices of steel screw propellers dropped around 1885 due to the use of the Siemens furnace for melting the metal (Seaton 1909: 200-201).

Seaton (1909: 162) also describes the suitability of three-bladed propellers:

> Three bladed screws are, on the whole, the most satisfactory for general purposes, for they possess high efficiency when working under almost any circumstances; that efficiency is satisfactory whether the screw be working at a considerable depth or so near the surface as to induce air currents to follow it.

One last piece of information from Seaton notes that the first patent for blades with curvature was by Herman Hirsch in 1860 (Seaton 1908: 29-30). All the evidence corresponds with a vessel not predating the last few decades of the nineteenth-century.

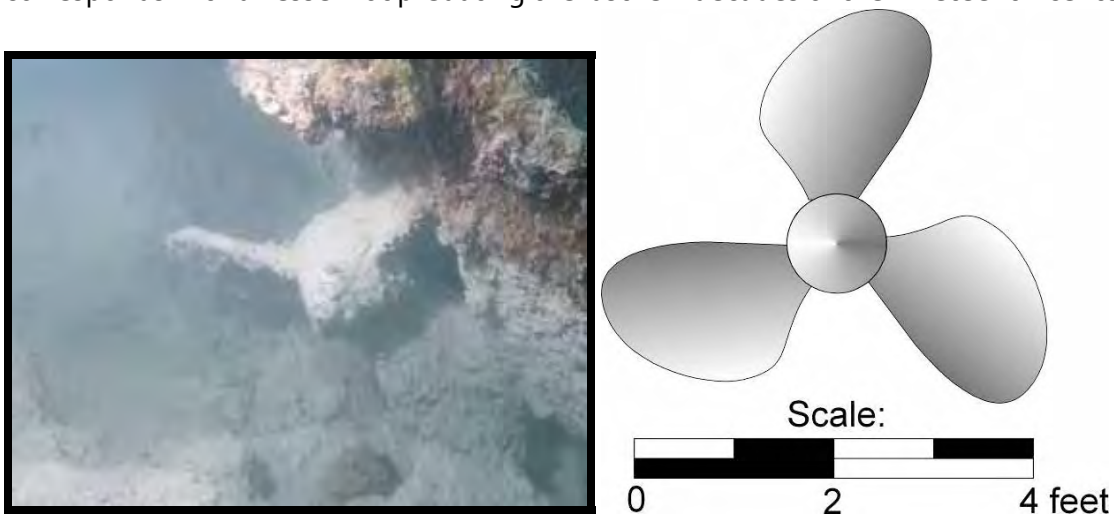



**Figure 14.** Photograph and scaled sketch of propeller (Photo: J. Hoyt, Drawing: N. Richards).

*Bow windlass remnant:* The partial remains of a windlass can be seen in the bow of the vessel. The windlass appears to only be a remnant with much of the apparatus, such as the warping drums missing (presumably removed).

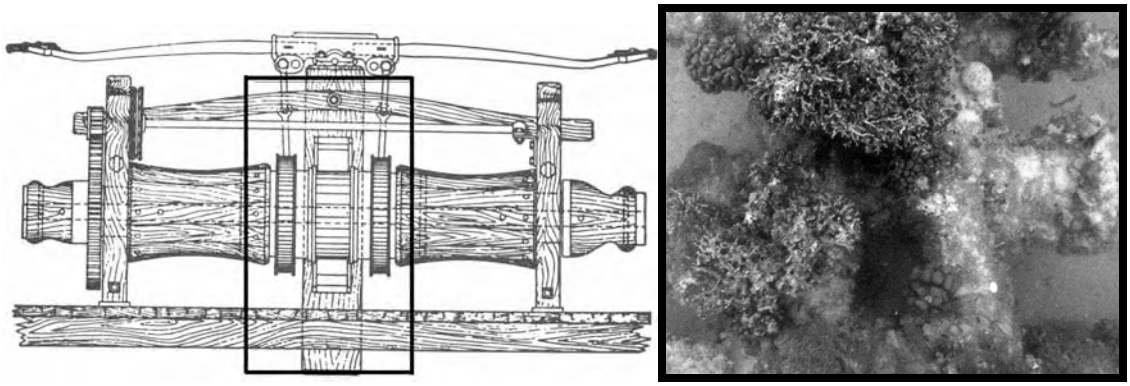


**Figure 15.** Windlass with gearing for a messenger chain system (left). Box inserted by authors to show areas still extant on the wreck site. Photograph of remnant bow windlass (right) (Reproduced from Russell 2005: 131; Photo: J. Hoyt 16 December, 2007)

*Pipes and spigot:* On the port side of the vessel, there are two pieces of piping. One of these pipes runs horizontally in the center of the vessel for about 22 feet (6.71 m), terminating in a spigot or tap at the bow-end. Another pipe runs vertically in line with the stern end of the horizontal pipe down into the sediment (at least 5.2 feet or 1.58 m). The function of either of these pipes is currently unknown. The best guesses regarding their function relate to their use in the transfer of water, fuel or other liquid cargos between ship and shore, or between ships.

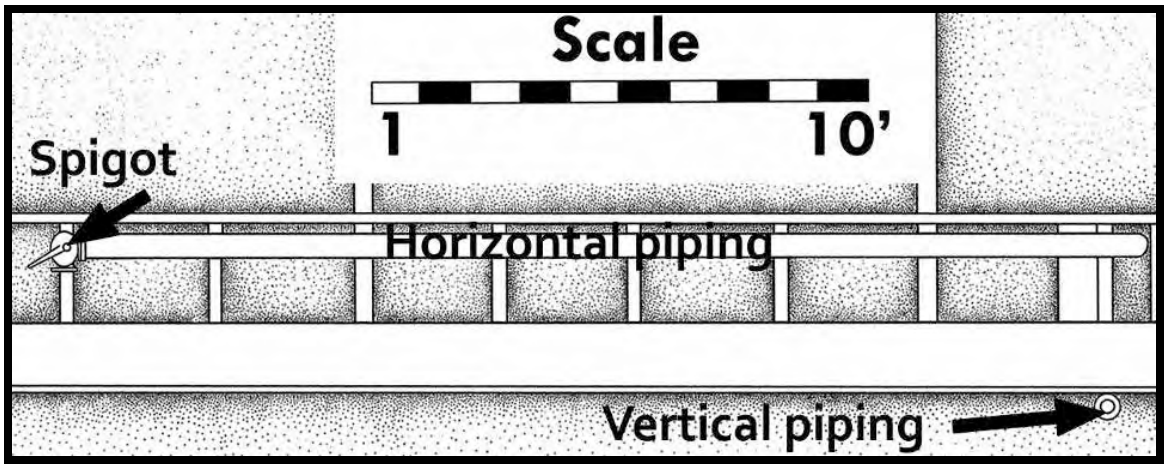



**Figure 16.** Plan view detail of piping along the portside of the wreck site (Drawing: N. Richards, J. Hoyt, B. Rodgers).

*Unidentified Object: "Spindle" and "Turntable":* One of the most visible features on the site is a large object that came to be known as the "spindle" (Figure 17). This object is made up of a number of pieces. Because the authors cannot currently confirm the actual use of the object with absolute certainty we have opted to create terminology in order to make description easier. The object is made up of a number of components – the "turntable," measuring about 5.4 feet (1.65 m) square, a "pawl-rim," a series of circles covering the turntable, a "spindle," of diameter 1-inch (2.5 cm) and extending 5.9 feet (1.8 m) above the turntable, and "teeth" (0.2 by 0.2 feet), which sit at the base of the spindle within the pawl-rim and on top of the turntable.

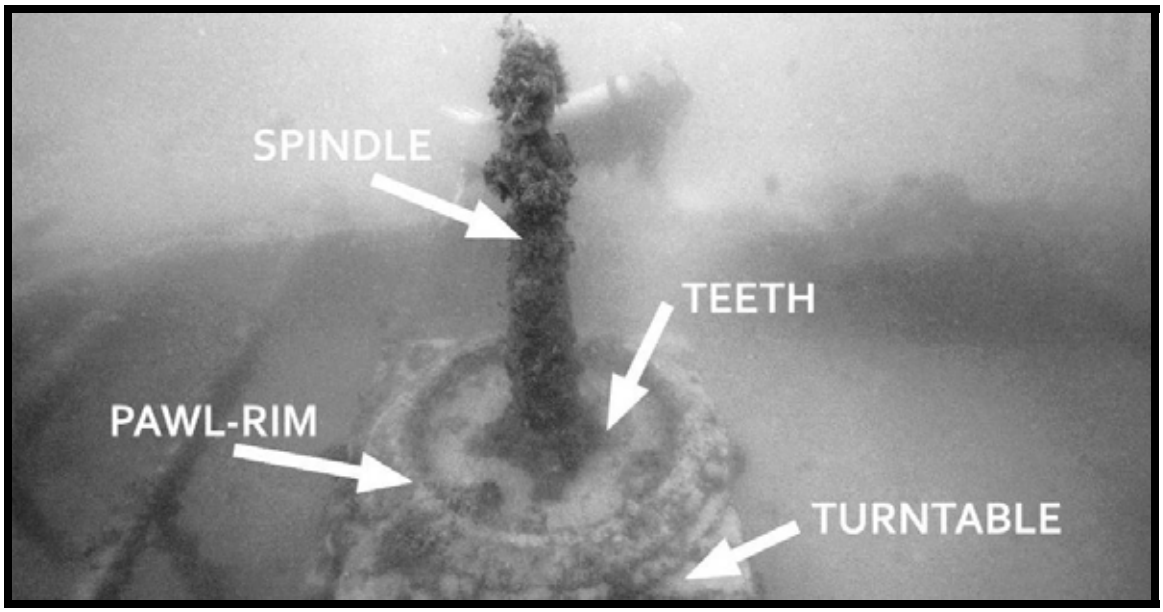



**Figure 17**. Detail of the "spindle" and "turntable" showing terminology created for this discussion (Photo: J. Hoyt, 16 December 2007).

There are a number of hypotheses offered regarding a potential function for this "spindle." All of these hypotheses are currently inconclusive because of the degree of concretion on the site, and the lack of extant architectural drawings for vessels matching or related to the sunken vessel. There have been very many variations on any of the technologies outlined below, and we have been hampered by a lack of sources outlining the diverse variations across the period of time we suspect the wreck dates from.

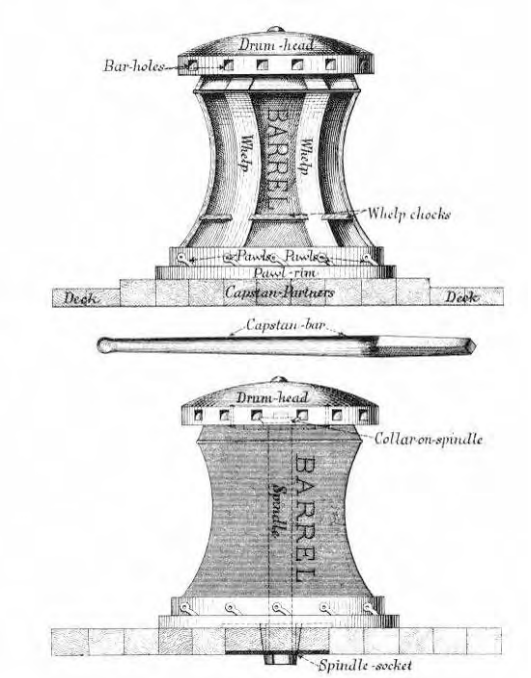



**Figure 18.** Capstan (Paasch 1885, plates)

Hypothesis 1: Evidence of capstan. Originally it was thought that the "spindle" was actually the spindle of a capstan (see "spindle" in Figure 18) or more specifically, the spindle of a steam capstan.

Evidence supporting this hypothesis includes the resemblance of the rings on the object to the "pawl rim" in Figure 18. If this is the case, the moving components of the capstan seem to have been removed (barrel, drum-head, whelp and whelp-chocks), leaving only the deck-mounted components (spindle, collar-on-spindle, spindle-socket, pawls, pawl-rim and capstan partners) intact

Doubts emerge if we consider the large size of the spindle (almost 6 feet high), and the likelihood that this, being at the stern of the vessel would have been covered by a deck-house.

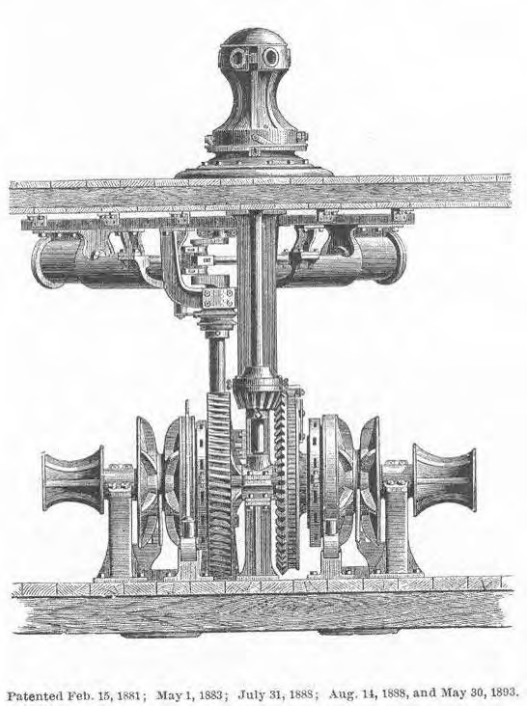



**Figure 19.** The "Providence" Steam Capstan Windlass (1897) (Souza 1998: 51).

Instead of a capstan, it is possible that the remains represent a different type of technology for the handling of lines – better known as a "warping hub." There are

many variations of warping hubs on ships. In some cases they are used in conjunction with windlasses. In one particular study, Matthew Russell noted evidence of a "messenger chain-driven windlass system" (Figure 20) where a large spindle would run off a steam windlass to a vertically-inclined warping hub on the deck above it. Also discovered on the site of *Comet* were large (4-6 feet diameter) discs known as "purchase rims." These discs have hollow centers with teeth that would correspond with the teeth on a center spindle (Figure 21). The outside of the discs would hold chain. Potentially the existence of these discs suggests that similar discs might have fit over the spindle on the dockyard wreck and had corresponding teeth. A chain linked to some steam auxiliary machinery or some gearing then might have been used to power a deck-mounted warping hub at the top of the spindle, and potentially other machinery would have been attached to it.

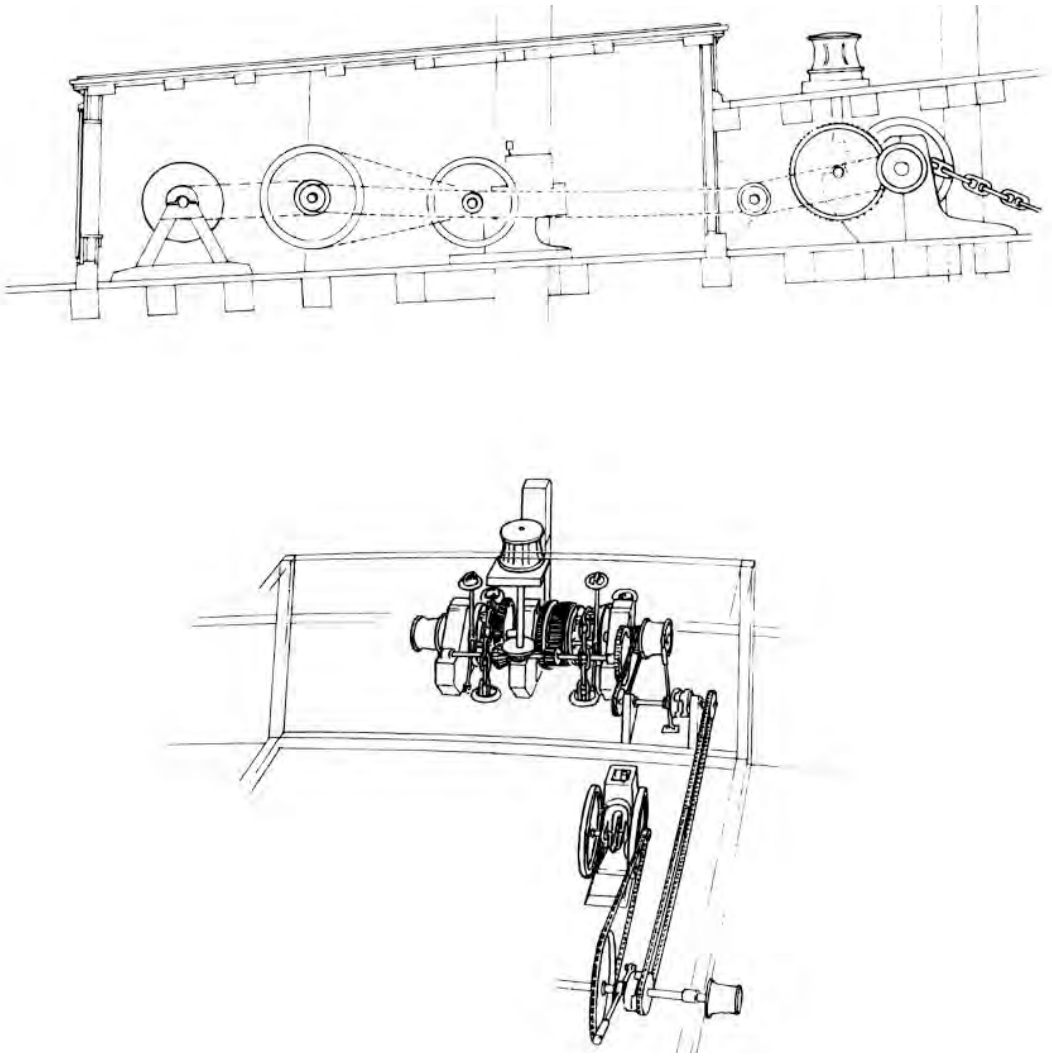


**Figure 20.** Messenger chain-driven windlass system (From Greenhill and Manning 1995: 79 and 90 reproduced from Russell 2005: 132)

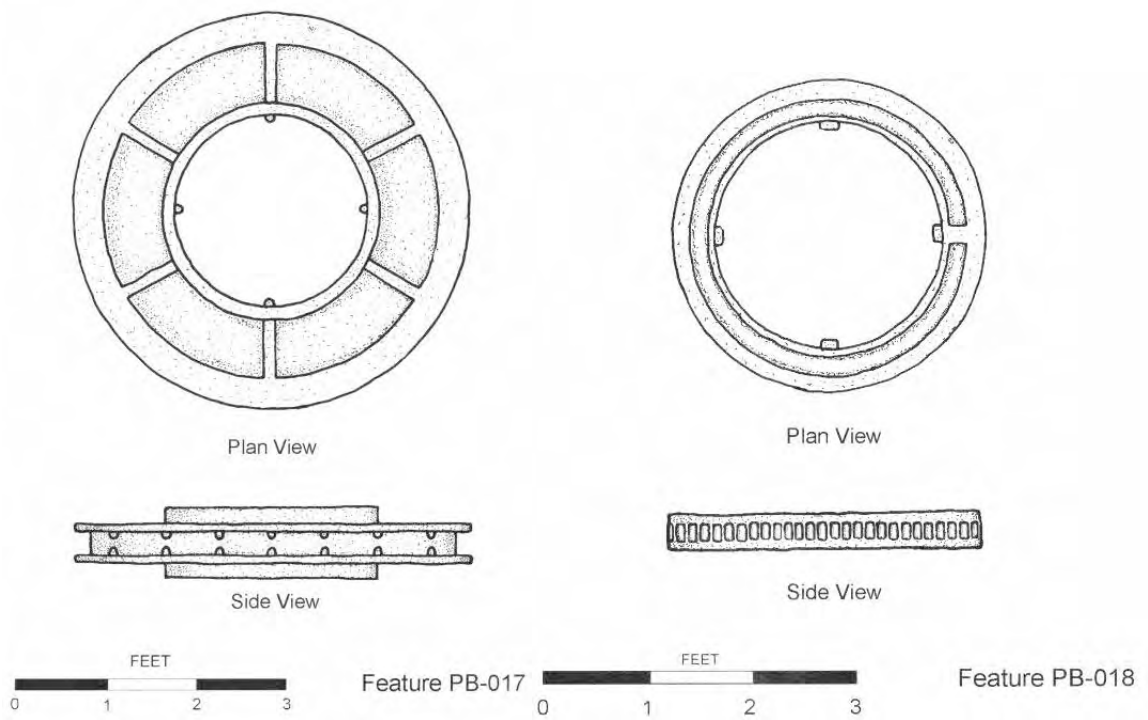



**Figure 21.** Purchase rim for a messenger chain system (left) and a pump-brake windlass (From Russell 2005: 63 and 64).

Hypothesis 2: Evidence of derrick. An alternative hypothesis is that the object represents the mounting plate and bearing keeper of a derrick or some other stern-mounted crane. The definition of a derrick (as seen in Figure 22) is as follows.

> Derrick. An apparatus designed to hoist heavy weights. The general design of a derrick is similar to that of a post crane except that the boom is hinged at the heel which allows it to be set at any angle with the post. The post of a derrick usually rotates with the boom (Webster 1920: 38)
>
> Derrick, on a Ship. A spar or a boom, one end of which is stepped in a pivot bearing on the lower portion of a vertical post erected on the deck of a ship or on a pedestal fitted to the deck at the foot of the vertical post. A hinged connection fitted to the pivot bearing allows the boom to be inclined at any angle with the post while the pivot permits it to be revolved. The derrick is fitted with ropes, guys and tackles and is used for transferring cargo from and into the holds. Unlike most derricks on land the derrick post itself does not revolve (Webster 1920: 38).

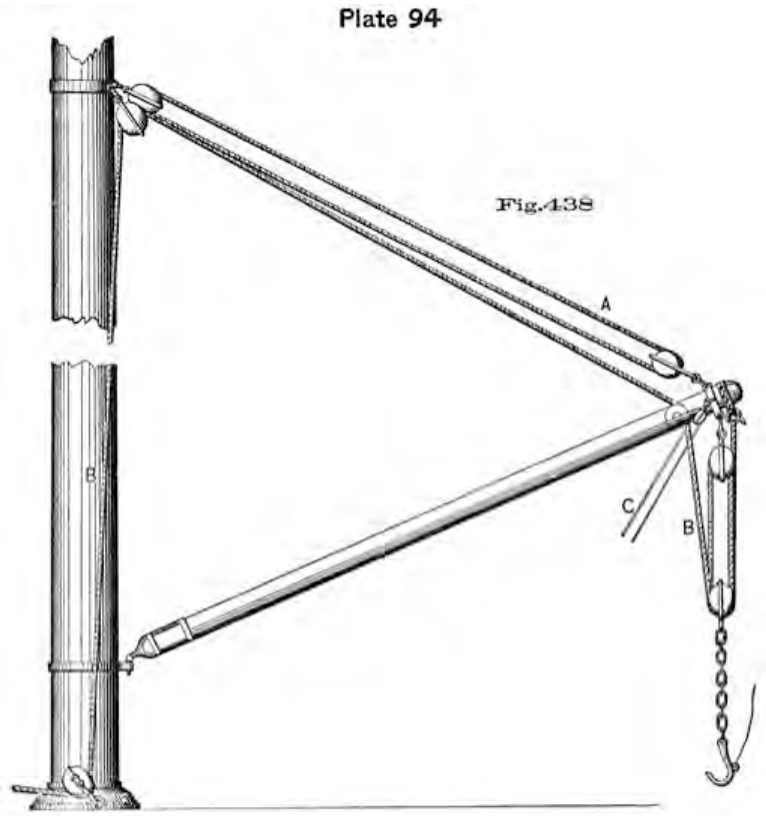



**Figure 22.** Derrick configuration (Luce 1891: Plate 94)

As we can see from Figure 22, derricks did not tend to have turntables or bearings to allow the mast itself to swivel, but instead relied on the movement of a boom via block and tackle. Because the object on the site obviously represents some object on some sort of turn-table, it is not likely to be a true "derrick" by definition. Further research opened the possibility that the feature could more likely resemble "post crane" or "pillar crane" (see Figures 23 and 24). Problems with this hypothesis include the position of the object where a deckhouse would have existed and the lack of a precedent for this in maritime-related research.

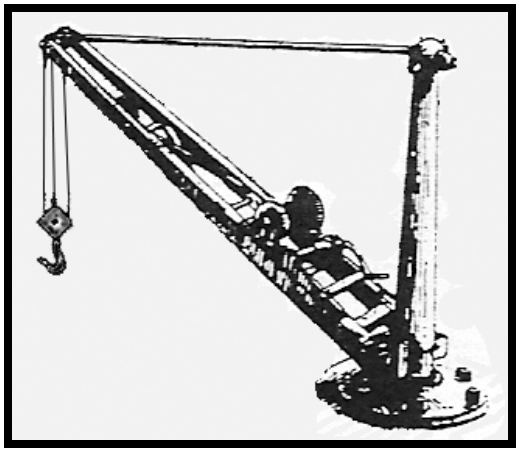


**Figure 23.** Example of a post crane (http://www.turnermodelworks.com/MainPage.htm)

As will be shown, additionally, this is not supported with the historical photographic research of "steam lighters" which tended to have bow-mounted derricks.

Hypothesis 3: Evidence of steering apparatus. Not enough research has been determined at this stage to definitively say, but there is some potential that the "spindle" represents a steering shaft extending from the helm to some kind of steam-assisted machinery (Figure 25).

Many steam vessels utilized steering apparatus that involved steering shafts that were assisted with steam engines. "Steering apparatus" is defined as "A device in aid of the steersman, being interposed between the tiller or tiller-wheel and the rudder-head (Knight 1876: 2371).

**Figure 24.** Pillar Crane, Rockford, Illinois (http://www.rootsweb.com/~usgenweb/il/winnebago/postcards/pilcrn.jpg)

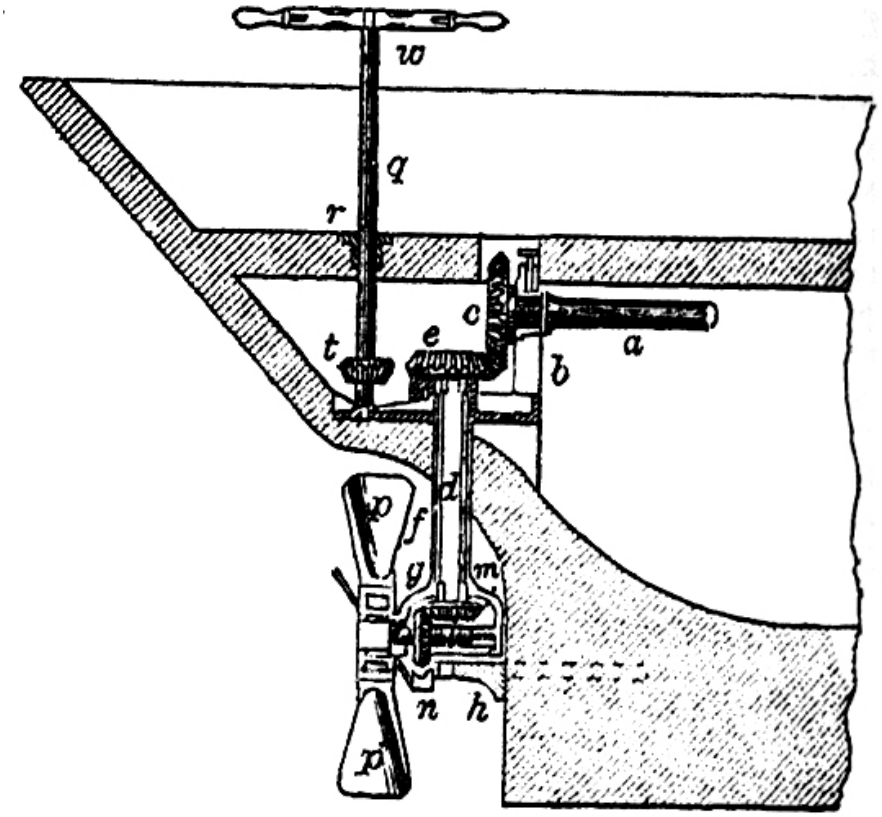



**Figure 25**. Example of a deck mounted steam-assisted steering apparatus showing the "spindle" that extends below deck (Knight 1876: 2372).

There are many variations of steering apparatus. For example, Sickel's steam steering gear (Figure 26), introduced around 1860 utilized a small steam engine mounted adjacent to the steering wheel itself. Other steering apparatus, like North's steering apparatus (post 1865) were attached to shafts that ran beneath deck (Figure 27). It is something resembling this latter variety that bears a resemblance to the remains at the Dockyard, with the top of the spindle representing the deck-level coupling that attached steam-assisted engine and spindle to the deck-level helm. Another later variety (c.1913), of "steam steering wheel" shown in Figure 28, although designed for a much larger ship outlines the shaft within a steering pedestal that ran below deck. In this particular instance, when we compare the diagram to the image of the spindle, it is possible to imagine that the wider portions on the spindle may be gearing or threading now obscured by concretion. The one major drawback of this hypothesis is the diameter of the circle on the turntable, which would imply very heavy machinery.

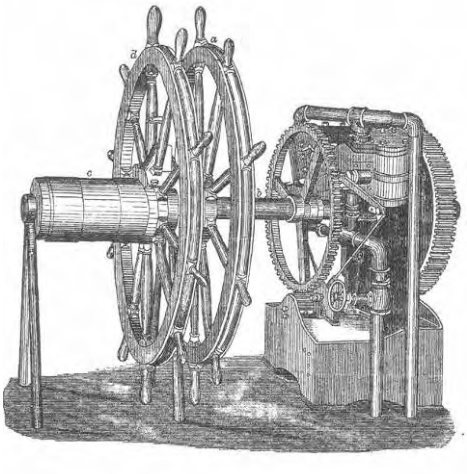


**Figure 26.** Sickel's Steam Steering Gear (Knight 1876: 2372).

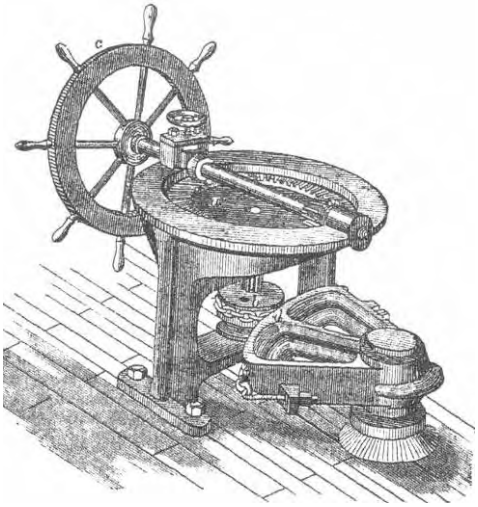


**Figure 27.** North's Steering-Apparatus (Knight 1876: 2372).

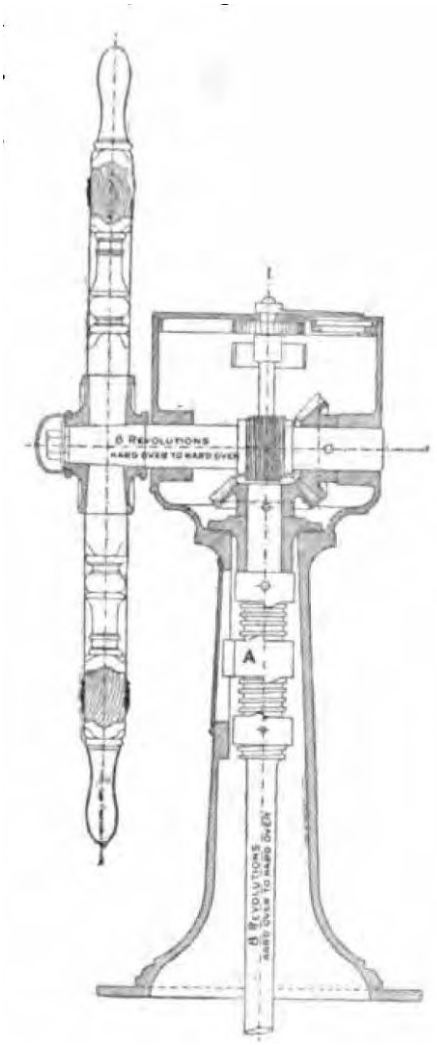



**Figure 28.** Example of "Steam steering wheel" showing the steering shaft extending below deck to auxiliary steam machinery (Sennett 1913: 375).

## HISTORICAL RESEARCH

The results presented here represent a cursory examination of this watercraft and a discussion of its potential function and history. Being a harbor support craft of some sort, there have been substantial difficulties in gaining relevant primary source material and site plans.

Before fieldwork, it was not considered very likely that the vessel would have a name associated with it by the end of fieldwork, and that only detailed post-fieldwork historical research following fieldwork. The researchers believed this for a number of reasons, 1) we believed that the vessel might have been abandoned and hence disposed of without fanfare, and 2) researching harbor support vessels rather than ocean-going vessels, and are amongst the most difficult to research. This is because they are most often discarded without ceremony, and/or were commonly un-registered and without insurance. Most often inner harbor support craft (tugs, tenders, barges, lighters, hulks) were either unofficially named or were numbered (with numbers that were used again and again), and are therefore more "invisible" or "buried" in the historical record. In addition, tugboats, towboats, and other harbor support craft are rare in the archaeological literature. They are largely absent from published studies, and are mainly found in grey literature – most commonly student assignments and cultural resource management reports (see, for example Gulf Engineers & Consultants Inc. and Tidewater Atlantic Research, 1991, Damian 2006, Dodds 2006, Friedman 2006, Leuchtmann 2006, Tock 2006, Eamick 2007, Kopp 2007, and Seeb 2007).

Pinning down the type of vessel, however, is a more realistic goal. On 26 July, 2007, Dr. Philippe Max Rouja wrote that he had "hypothesized that this wreck could be one of the original tugs to build the dockyard" (Rouja 2007: 2) (Figures 29 and 30). While this is a very good hypothesis to begin with, additional archaeological and historical research has outlined a number of alternatives that must be pursued.

**Figure 29:** Examples of watercraft believed to resemble the vessel currently submerged off the Royal Navy Dockyard, Bermuda (Rouja 2007: 2)

**Figure 30.** Examples of watercraft believed to resemble the vessel currently submerged off the Royal Navy Dockyard, Bermuda (Photo: Brad Rodgers, 18 December, 2007 from Frog and Onion restaurant foyer).

While the vessel might not have been a "tug" by modern standards it was likely some kind of multi-purpose vessel which had, as a part of its job a range of support roles which included towing, lightering, and other harbor construction roles. Some of the factors to be considered in constructing functional hypotheses are outlined below:

*Size*. At almost 65 feet long the vessel is much smaller than most modern-days tugs, but is still in the close to the size of a small tug or harbor tender of some variety.

*Hull form*. Wrecks tend to settle into sediment approximately at the same level that they would have sat upon the water. Tug and towboats have a characteristic silhouette defined by the marked rise in their bow. The unidentified site has no such rise, and is instead very even-decked. This however may be because of the removal of bulwarks and other deck structures.

*Propulsion*. An examination of the vessel remains indicates that the vessel has a single rudder, and a propeller aperture. The propeller is still there, due to the extent to which the hull has been buried (at least 3 feet). The fact that the vessel has only one rudder is not good supporting evidence of that it is a tug from the mid-twentieth century, but good evidence that it might be a vessel from the late nineteenth or early twentieth century. An examination of historical records indicates that after 1937 an increasing amount of British tug and towboats used kort nozzles (invented in Germany in the 1930s), or were twin-screw vessels utilizing shrouds around the propeller to help maneuverability. This technology was introduced into the USA in 1959 with the

construction of *Dravo Pioneer* but not popular until the early 1960s (Leventhal 1999: 82-83, Shaw 2001: 19-21).

*Towing apparatus and fittings*. The vessel lacks heavy-duty line handing fasteners or fairleads. While it is possible that the bitts or bollards were removed from the vessel before, or after sinking, the existence of large cleats at the bow suggests otherwise (Leventhal 1999: 4, 24, 39, 78). There is, however, an object in the stern of the vessel which as mentioned could represent the remains of a capstan.

It should be said that the vessel does have the general shape (plan view) of a tugboat, towboat or other harbor support vessel.

Some very good leads for research were provided to us by local Bermudian Teddy Tucker in a written recollection dated December 12, 2007.

In this, Mr. Tucker notes

> This wreck has been known to local divers and fishermen for many years. The fishermen always avoided it when setting nets. The area besides having the wreck to contend with has a large quantity of old channel markers plus many pieces of ship iron, probably from world war 2 ships that were repaired in the floating dock.

His recollection of this site corresponds with observations already cited by Dr. Rouja, and by the authors of this report:

> The wreck … is roughly 60 to 65 feet long and 20 feet wide and 8 plus feet deep. The actual depth of the hull would have to be determined by excavation, as the area has a deep build-up of silt, some of which is inside the hull. This can be accounted for by the coming and going of cruise and war ships for many many years causing heavy scouring of the seabed while maneuvering.

Probably the most important information he gives us refers to a potential function:

> The Wreck as we know it today would be classified as a self propelled steam lighter. The engine and boiler have been removed, and the crane that was mounted aft is also missing, however the turn table that the crane would have been mounted on is still in place.

Taking the identification of the vessel as a "Steam Lighter" to be a good suggestion, research following fieldwork focused on finding out more about this type of vessel. It was soon discovered that the terms "steam lighter" and "derrick lighter" were often used interchangeably.

The term lighter has a range of meanings, ranging from "A large open flat-bottom boat used in conveying cargo to ships" (Mason 1908: 350), to "a dumb vessel (i.e., one without its own means of propulsion, usually of … barge or similar build, used for the

conveyance of cargo from ship to shore, or vice versa" (Kemp 1988: 482). Other sources however, note that they could be propelled. For example, Rene De Kerchove's *International Maritime Dictionary* (1961:215) has the following definition of "Derrick Lighter":

> DERRICK LIGHTER: A harbor lighter fitted with hoisting apparatus and able to handle its own cargo with the assistance of ship's winches and tackle. A self-propelled harbor lighter; also called Steam lighter.

These "Steam Lighters" or "Derrick Lighters" have been used extensively around the world. Examples have been found in the United Kingdom, the United States, and as far away as Australia (see Figures 31-35). From a quick examination of photographic records, these vessels tended to have some features in common in particular their aft deckhouses, open decks or hatches located amidships multiple derricks (mounted forward, aft, or both). While many were wooden hulled, many were ferrous hulled, and between 60 and 120 feet long. Although some lighters were named vessels, they also tended to be numbered. For instance, the US Navy had a "self-propelled covered lighter" or "freight lighter" class with the "YF" designation (i.e. YF-123). These watercraft were around 85-133 feet (25.91-40.54 m) in length with an average draught of 8-9 feet (2.44-2.74 m).

**Figure 31.** "Steam Lighter *Commerce,* which became U.S. Navy Freight Lighter #123" (Photo#NH102830, Naval Historical Center).

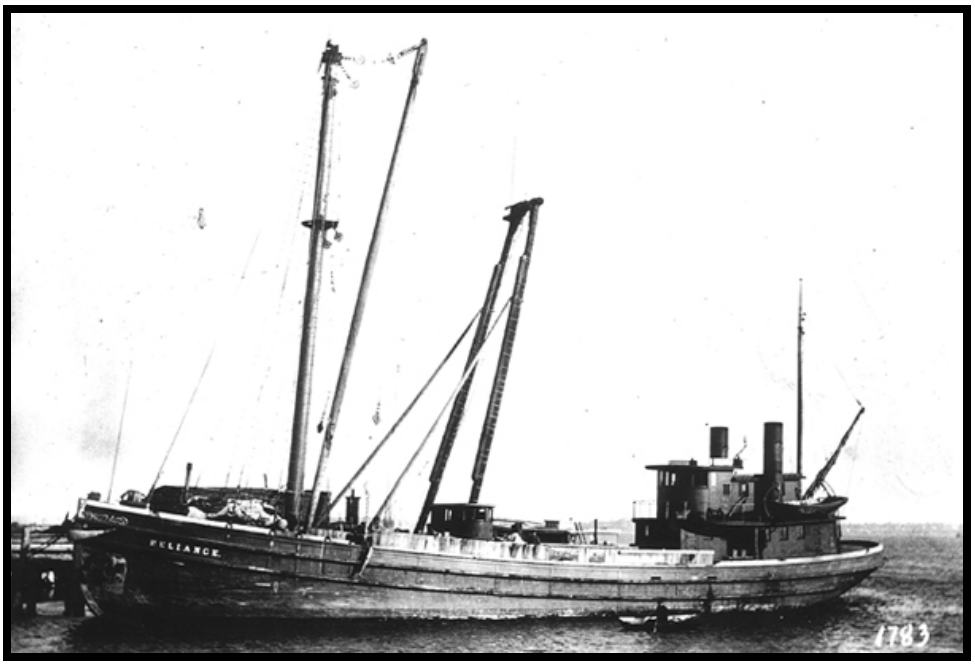



**Figure 32.** Steam lighter/barge *Reliance* (109.8′ x 30.5′ x 10.1′) built in Bath, Maine, scuttled in Massachusetts Bay, 1933 (Image: http://www.northernatlanticdive.com/shipwrecks/reliance/reliance.htm)


**Figure 33.** "A steam lighter at the Munn St wharf, Millers Point (NSW)," c. 1 January 1941 (Photo: State Records of New South Wales).

**Figure 34.** "The steam lighter 'Star' at Pier One, Walsh Bay," n.d. (Photo: State Records of New South Wales)

**Figure 35.** Nitrate negative. 'Sydney Waterfront Scenes, July 1937, 394'. The steam lighter 'Zelma' pulling a load of coal on a barge towards Pyrmont Bridge and Berth 1 Pyrmont Bay (Photo: Sam Hood, Hood Collection, Australian National Maritime Museum).

During research, one particular type of steam lighter known as a "Clyde Puffer" surfaced. From an examination of the external characteristics of the vessels, there was some resemblance to the dockyard vessel, though the "Clyde Puffer" tended to lack an aft derrick (in preference to a forward one) and also sported a built up deckhouse. The resemblance of the main hull, with its large breadth to length and breadth to depth ratio warranted (and continues to merit) further research.

Should the dockyard vessel be a derivative of these VIC ships it will be a remnant of a rare vessel type of which few survive afloat today.

**Possible Identification**

There is some potential for identification of the unidentified harbor wreck site. A notation on page 204 of the diary of Benjamin Barritt between 1891 and 1949 (in possession of the Bermuda Maritime Museum) dated to September 15, 1921 notes the following (see also Figure 36):

> Septr 15th A severe hurricane passed over Bda [Bermuda] doing damage to large number of houses uprooting trees & during this storm the motor Boat Sir George Somers, Steam Boat D.S.B. No 175, a large iron coal lighter also lighter No 242 was sunk in the old Camber.

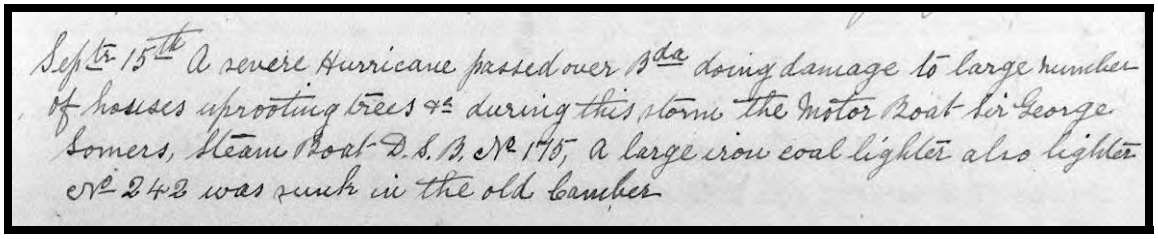

Sept^r 15^th A severe Hurricane passed over Bda doing damage to large number of houses uprooting trees &c during this storm the Motor Boat Sir George Somers, Steam Boat D.S.B. № 175, a large iron coal lighter also lighter № 242 was sunk in the old Camber

**Figure 36.** Extract from Barritt Diary (Bermuda Maritime Museum).

The vessel in the Dockyard is definitely iron-hulled, resembles a vessel that could have been used for coal lightering, and is apparently in the "Old Camber" (pers. Comm. Dr. Edward Harris, 2007). Adding to this is the fact that another vessel resembling the dockyard wreck may be located a short distance away. In August 2007 while undertaking our inspection of the site Drs. Richards and Rodgers were taken further around the edge of the Dockyard and the remains of a similarly configured vessel on a hull-mounted Humminbird sonar system. Potentially this could be the remains of one of the two numbered DSB vessels.

In an additional quirk of fate, upon departing from Bermuda the archaeological personnel were delayed at the airport and were housed at the Grotto Bay Beach Resort near St. Georges. Upon being given their pamphlet "A one minute tour of Grotto Bay Beach" crew members noticed the text "sunken wreck for snorkeling" printed on the inside (see Figure 37). The wreck appears to be about the same size, and of similar configuration (a squat vessel of rounded ends and open hatches amidships) as the other two vessels. This adds to a hypothesis that there was a class of steam lighters in operation in the coastal areas of Bermuda. Given the propensity for vessels to be taken to St. Georges for stripping, salvage and/or abandonment this may be a sister ship to the vessels potentially identified as DSB No.175 and 242 in the vicinity of the Royal Navy Dockyard.


**Figure 37.** Portion of Grotto Bay Beach resort pamphlet (inside) showing two details of the shipwreck potentially related to the unidentified Dockyard site.

It should be noted that at the time of the writing of this report that the definite resemblance of these other vessels to the unidentified dockyard wreck have not been substantiated, and that site inspections of the other two vessels as well as searches of dockyard and other government archival sources would be the only way to confirm these claims.

## RECOMMENDATIONS

The state of current research has established that in all likelihood, the unidentified vessel adjacent to the Royal Navy Dockyard is an iron-hulled wreck built sometime in the late nineteenth-century and probably lost in the first quarter of the twentieth century. It is believed that the wreck is of local significance because of its possible role in the development of the Dockyard itself. There are also some indications that the vessel may have a greater regional significance as a derivative of a vessel used to service vessels in World War One. Further research to establish the facts is required to better back this assertion up.

Irrespective of the final significance of the ship, there is little cause to disturb the wreck too much. In making this statement, there are two perspectives to consider – the degree to which human forces (divers and cruise ships) might negatively impact its integrity, and the degree to which it may impact cruise ships visiting the area.

A short list of twelve cruise liners that have recently visited, or are scheduled to visit have been listed in Table 3. This list shows that the maximum draft of the vessels is no deeper than 27 feet (8.23 m) in tropical water. This would leave (depending on tidal variation of +/-4 feet/1.22 m) at least 14-18 feet (4.27-5.29 m) of clearance at any stage of the year.

| Cruise Line | Ship Name | Gross tons | Length (ft.) | Beam (ft.) | Draft (ft.) |
|---|---|---|---|---|---|
| Carnival Cruise Lines | *Carnival Legend* | 88500 | 963 | 106 | 25 |
| Celebrity Cruises | *Celebrity Journey* | 30277 | 593 | 95 | 19.85 |
| Costa Cruises | ***Costa Magica*** | **102587** | **893** | **124** | **27** |
| Norwegian Cruise Lines | *Norwegian Dream* | 50764 | 754 | 94 | 23 |
| | *Norwegian Spirit* | 77000 | 879 | 106 | 26 |
| | ***Norwegian Dawn*** | **91740** | **965** | **105** | **27** |
| | *Norwegian Majesty* | 40876 | 680 | 91 | 20 |
| Princess Cruises | *Crown Princess* | 113000 | 951 | 118 | 26 |
| | *Golden Princess* | 109000 | 951 | 118 | 26 |
| Royal Caribbean | ***Explorer of the Seas*** | **137308** | **1020** | **157.5** | **29** |
| | *Grandeur of the Seas* | 74000 | 916 | 106 | 25 |
| | *Jewel of the Seas* | 90090 | 962 | 105.6 | 26.7 |
| | **AVERAGE** | **83762** | **877** | **111** | **25** |

**Table 3.** List of twelve cruise liners that have recently visited Bermuda or are scheduled to visit. Three largest draft vessels have been bolded (Sources: http://www.marinelink.com, http://www.celebritycruises.com, http://www.tripcentral.ca, http://www.cruise-norwegian.net, http://boscovstravel.poweragentnet.com, http://www.cruisedeals.com, http://sarmiger.cruiseone.com, http://www.royalcaribbean.com.)

The modern size definition InfoSheet (No.30) provided by Lloyd's Register of Shipping (2004) refers mainly to tonnages for all classes of vessels with the exception of Suezmax which has a maximum draft of 37 feet. It should be noted, however, that the

dimensional definitions of panamax and post-panamax vessels dues not exclusively apply to cruise liners. Dimension restrictions of Panamax vessels are 294.1 m (965 feet) for length, 32.3 m (106 feet) for beam and 12.0 m (39.5 feet) for draft. Post-panamax or "over-panamax" vessels are of two classes, Panamax I and Panamax II. The dimensions as cited online (http://en.wikipedia.org/wiki/Panamax) are as follows:

| Class | Length | Width | Draft |
|---|---|---|---|
| Panamax | 1050 ft (320.04 m) | 110 ft (33.53 m) | 41 ft (12.50 m) |
| Panamax II | 1400 ft (426.72 m) | 180 ft (54.86 m) | 60 ft (18.29 m) |

Here it is clear that in the case of either deep-draft Panamax or Post-Panamax vessels, both the shipwreck and the floating ship would be in danger of collision. Hence there are only two recommendations that can be made, one based on the short to medium term and contingent upon a stabilization of cruise liner drafts, and a longer term view should deeper draft Panamax or Post-panamax vessels (cargo or passenger) start using the dockyard.

**Recommendation 1**

The remnant "spindle" should be cut down to as close as possible to the "turntable" attached to the wreck. This will give cruise liners the additional approximately 6 feet (1.83 m) needed to ensure that they do not come into contact with the ship. As noted before this will give the vessels at least 16-18 feet of clearance above the wreck. Because the spindle appears to be a critical feature for the potential identification of the site, it is recommended that the iron remnant be given to an agency for de-concreting and analysis to determine its function, and help add to information regarding identity. Additionally, it would be prudent to inspect the vessel annually to examine the impact scour from liner propeller wash and/or an increase in sedimentation within the hull has on the wreck's stability and preservation. Should inspection suggest that the vessel is being undermined (i.e. it is shifting or listing), recommendation 2 may be warranted. The removal of the spindle and some monitoring is also a low-cost option, and should be easy to carry out.

**Recommendation 2**

Should the drafts of the vessels visiting the dockyard continue to increase, or if sedimentation and scour suggest that the vessel is being undermined, one suggestion would be to excavate and partially refloat the vessel from its current location. With the escalating costs involved with the scuttling of ships for dive sites and artificial reefs becoming increasingly prohibitive, the moving of said vessel would be an opportunity to set up a relatively inexpensive dive tourism and fishing location (should an appropriate site be determined).

## ACKNOWLEDGEMENTS

The authors would like to thank the ECU divers, Dr. Bradley Rodgers (Program in Maritime Studies) and Mark Keusenkothen (Diving and Water Safety). Additionally the film crew headed by Michael Dermody (also part of the dive team), and Kevin Wells of Emergent Pictures are owed our thanks. We would like to thank staff of the Bermuda Maritime Museum, especially Dr. Edward Harris (Director), and Elena Strong (Acting Curator). Dr. Philippe Max Rouja (Custodian of Wreck, Ministry of the Environment, Telecommunications and E-Commerce, Department of Conservation Services, Bermuda Government) also played a central role in making this project happen.

We would also like to extend our thanks to the Board of Trustees, Bermuda Maritime Museum, and Dame Jennifer Smith, Chairman of the government Historic Wrecks committee for the opportunity to work in Bermuda as well as their considerable assistance and hospitality. Last but not least, the authors would like to thank the Correia Construction Company, and especially Dennis Correia, CEO for their support in this project.

## REFERENCES


Brady, Edward M.
1967 *Tugs, Towboats and Towing*. Cornell Maritime Press: Centreville, MD.

Damian, Michelle
2006 An Archaeological Investigation of the *Stone 3* (ex. *Isabel*) at Eagles Island, Wilmington, North Carolina. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

De Kerchove, Rene
1961 *International Maritime Dictionary: An encyclopedic dictionary of useful maritime terms and phrases, together with their equivalents in French and German,* 2nd Edition, Van Nostrand Reinhold Company, New York, NY.

Dodds, Tricia
2006 The Eagles Island Abandoned Shipwreck Project: An Investigation of *Stone 5*. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

Eamick, Jeremy
2007 An Archaeological and Historical investigation of the Steam Tug, *Atlantic City,* UAU 0012-CFR, located in the Cape Fear River, Wilmington, North Carolina. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

Friedman, Adam
2006 An Historical and Archaeological Investigation of the Steam Tug *Argonauta*, UAU 00115CFR, Eagles Island, Cape Fear River, Wilmington, North Carolina. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

Gaston, M.J.
2002 *The Tug Book.* Patrick Stephens Limited: Sparkford, United Kingdom

Gulf Engineers & Consultants Inc. and Tidewater Atlantic Research
1991 *Archeological Documentation and Data Recovery of a mid-nineteenth Century Tugboat at Hutchinson Island, Savannah, Georgia.* Report submitted to the U.S. Army Corps of Engineers, Savanna District

Kemp, Peter (editor)
1988 *The Oxford Companion to Ships and the Sea*. Oxford University Press: Oxford, United Kingdom.

Knight, Edward H.
1876 *Knight's American Mechanical Dictionary: A Description of Tools, Instruments, Machines, Processes, and Engineering; History of Inventions; General Technological Vocabulary and Digest of Mechanical Appliances in Science and the Arts, Volume 3 – Per-Zym.* Hurd and Houghton: New York, NY.

Kopp, Nadine
2007 The Steam Tug *Dolphin:* An Archaeological and Historical Investigation. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

Leuchtmann, Amy
2006 Recording *Isco*, the Intact Tug. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

Leventhal, Josh
1999 *Tugs, the world's hardest working boats: Mechanics, lore and history of tugboats, barges and scows around the world.* Black Dog and Leventhal: New York, NY.

Lloyd's Register of Shipping
2004 *Infosheet No. 30, Modern ship size definitions*. Lloyd's Register Information Services: London, UK.

Luce, S.B.
1891 *Text-book of Seamanship: The Equipping and Handing of Vessels under Sail or Steam*, Van Nostrand Company: New York, NY.

Marshall, Amy K.
1995 *A History of Buoys and Tenders*, Coast Guard Historian's Office: Washington, D.C.

Mason, Herbert B. (editor)
1908 *Encyclopedia of Ships and Shipping.* The Shipping Encyclopedia Limited: London, United Kingdom

Newport News Shipbuilding and Dry Dock Company
1961 *Three Generations of Shipbuilding*. Newport News Shipbuilding and Dry Dock Company: Newport News, VA.

Paasch, Henry
1997[1885] *Paasch's Illustrated Marine Dictionary*. Lyons & Burford, United Kingdom.

Rouja, Phillip Max

2007 The Dockyard Cruise ship Arm Pier and Parking turnaround areas and the impact on underwater maritime heritage. The Opinion of the Custodian of Historic Wrecks and the Historic Wrecks Authority. Correspondence with Jack Ward, Director, Conservation Services, July 26 2007.

Russell, Matthew A.
2005 *Beached Shipwreck Archeology: Case Studies fro Channel Islands National Park.* Submerged Resources Center, National Park Service: Santa Fe, NM.

Seeb, Sami
2007 Cape Fear's Forgotten Fleet: The Eagles Island Ships' Graveyard, Wilmington, North Carolina. MA Thesis, Program in Maritime Studies, East Carolina University, Greenville, NC.

Sennett, R., and H.J. Oran
1913 *The Marine Steam Engine: A Treatise for Engineering Students, Young Engineers, and Offices of the Royal Navy and Mercantile Marine*, 11th Edition. Longmans, Green, and Company: London, United Kingdom.

Shaw, Jim
2001 *Tugboats.* Metrobooks: New York, NY.

Souza, Donna J.
1998 *The Persistence of Sail in the Age of Steam: Underwater Archaeological Evidence from the Dry Tortugas*. Plenum Press: New York, NY.

Stanton, Samuel Ward
1989 *Towboats and Tugs: Drawings by Samuel Ward Stanton.* Elizabeth Stanton Anderson: Meriden, CT.

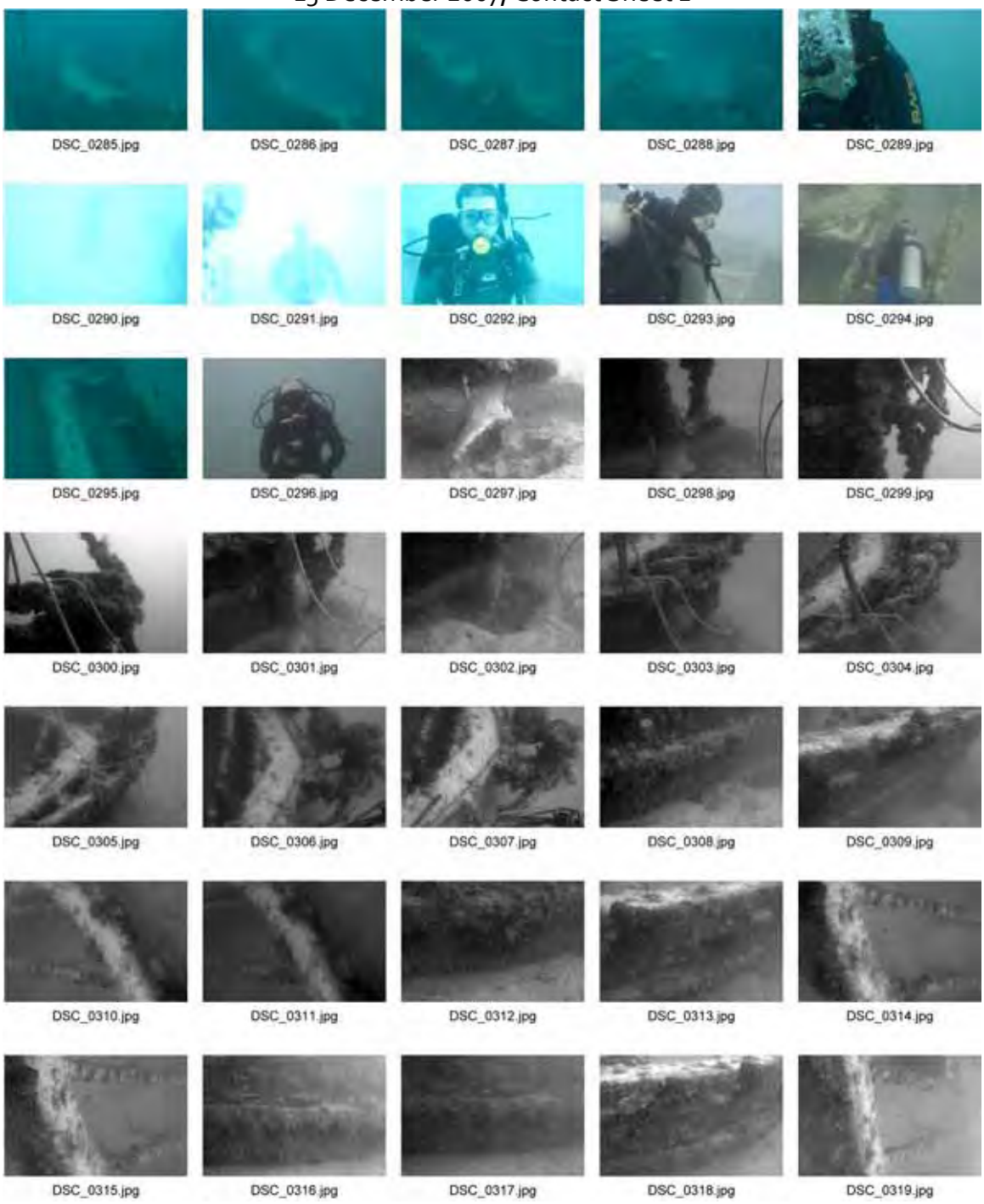
Thorndike, Virginia L.
2004 *On Tugboats: Stories of work and life aboard.* Down East Books: Peoria, IL.

Tock, Annie
2006 *Stone 4 (Eva)* Site Report, Eagles Island, NC. Unpublished manuscript on file, Program in Maritime Studies, East Carolina University, Greenville, NC.

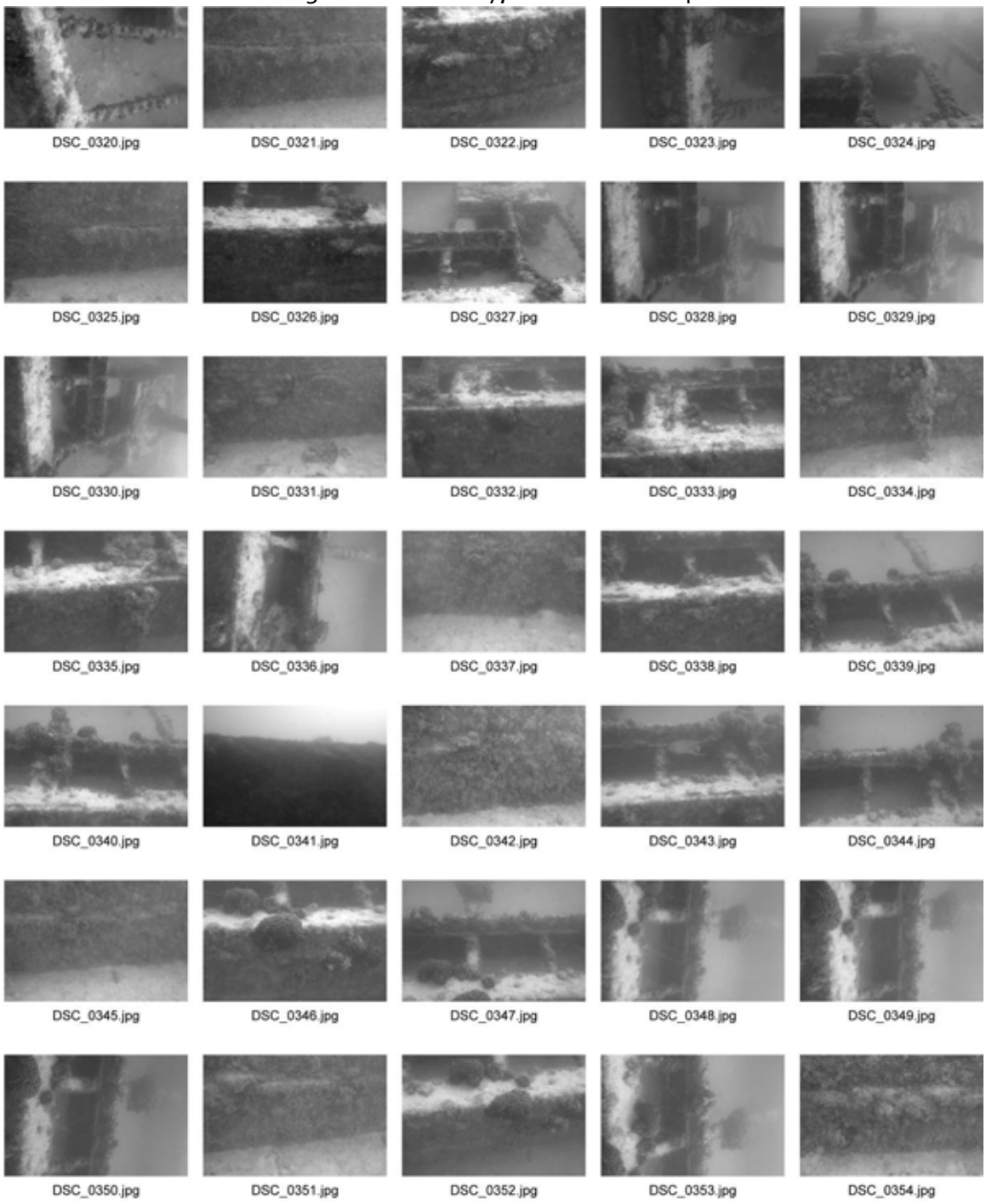
Webster, F.B. (editor).
1920 *Shipbuilding Cyclopedia: A reference book covering definitions of shipbuilding terms, basic design, hull specifications, planning and estimating, ship's rigging and cargo handing gear, tables of displacement of commodities, arrangement and working of drawings of modern vessels and a composite catalog of marine equipment.* Simmons-Boardman Publishing Company: New York, NY.

## APPENDIX 1: PHOTOGRAPHIC LOGS AND REFERENCE SHEETS

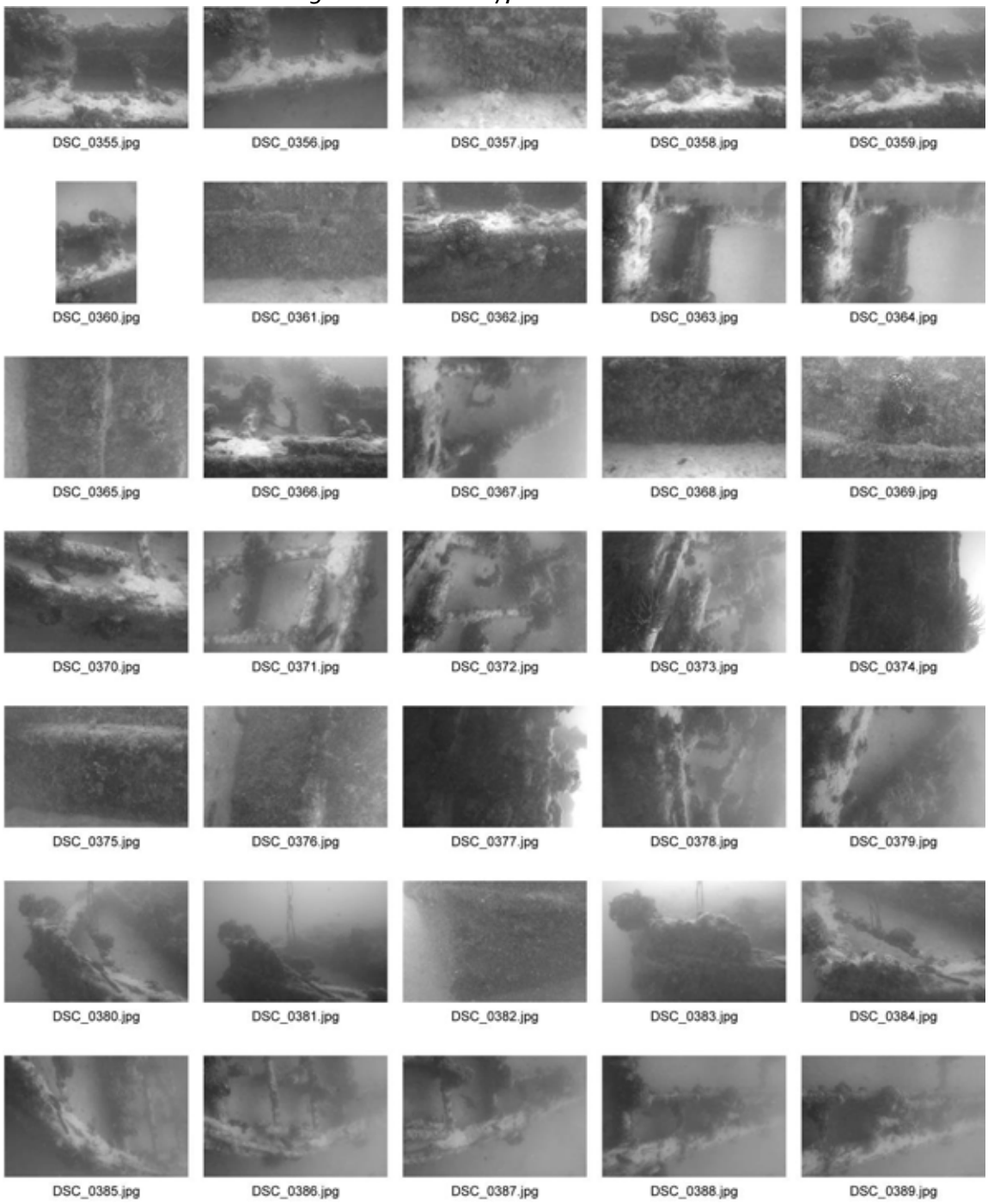
15 December 2007, Contact Sheet 1



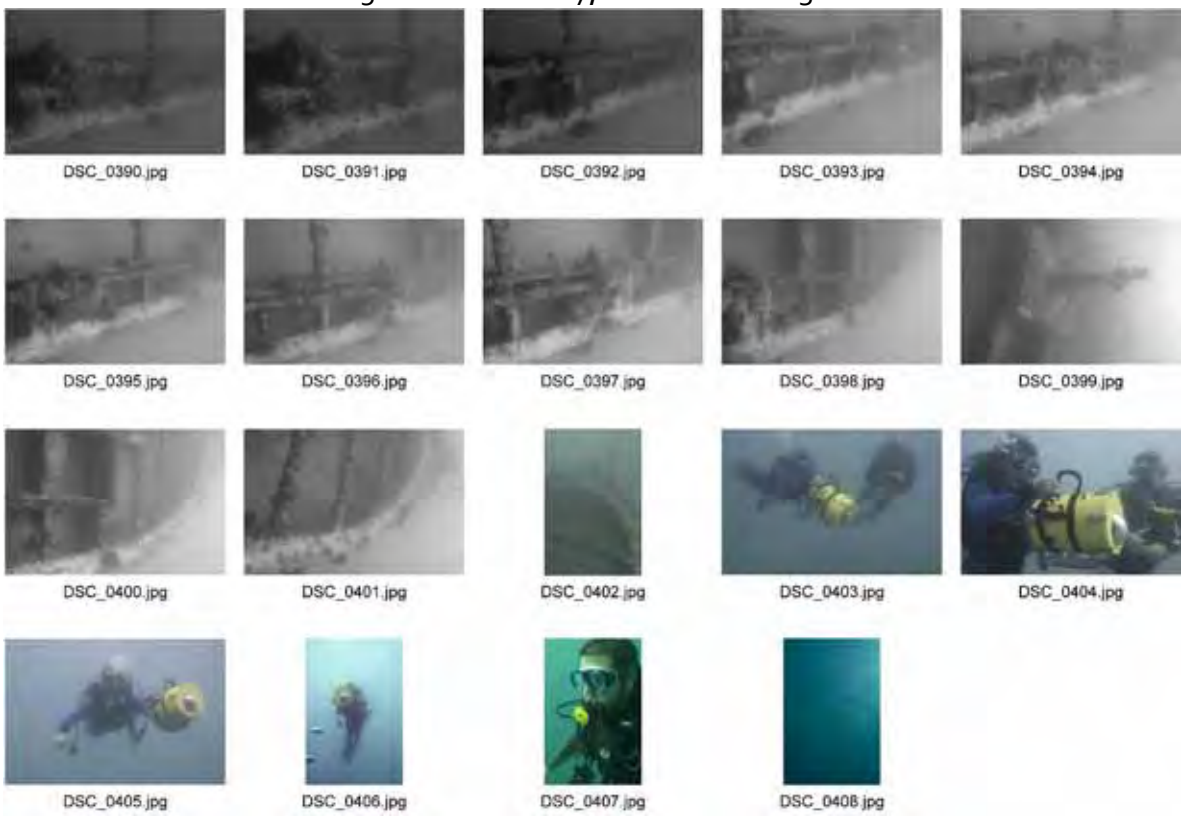
15 December 2007, Contact Sheet 4



15 December 2007, Contact Sheet 2



15 December 2007, Contact Sheet 3




| Site: | Unidentified Royal Navy Dockyard Wreck | Camera: | | Nikon D |
|---|---|---|---|---|
| # | Description | Date | Bearing | By |
| 285 | Stern | 15 Dec 07 | N | J. Hoyt |
| 286 | Stern | 15 Dec 07 | NNW | J. Hoyt |
| 287 | Starboard stern quarter | 15 Dec 07 | NNW | J. Hoyt |
| 288 | Starboard stern quarter | 15 Dec 07 | NW | J. Hoyt |
| 289 | Diver | 15 Dec 07 | - | J. Hoyt |
| 290 | Overexposure | 15 Dec 07 | - | J. Hoyt |
| 291 | Overexposure | 15 Dec 07 | - | J. Hoyt |
| 292 | Richards - overexposure | 15 Dec 07 | - | J. Hoyt |
| 293 | Richards - blurry | 15 Dec 07 | - | J. Hoyt |
| 294 | Richards examining underside of "turntable" | 15 Dec 07 | SE | J. Hoyt |
| 295 | Portside amidships framing | 15 Dec 07 | N | J. Hoyt |
| 296 | Joe Hoyt | 15 Dec 07 | - | M. Keusenkothen |
| 297 | Propeller | 15 Dec 07 | E | J. Hoyt |
| 298 | Propeller | 15 Dec 07 | E | J. Hoyt |
| 299 | Rudder post | 15 Dec 07 | E | J. Hoyt |
| 300 | Tiller and rudder post | 15 Dec 07 | E | J. Hoyt |
| 301 | Rudder post | 15 Dec 07 | E | J. Hoyt |
| 302 | Propeller | 15 Dec 07 | NNE | J. Hoyt |
| 303 | Stern | 15 Dec 07 | NNE | J. Hoyt |

| | | | | |
|---|---|---|---|---|
| 304 | Stern | 15 Dec 07 | N | J. Hoyt |
| 305 | Stern | 15 Dec 07 | NNE | J. Hoyt |
| 306 | Stern | 15 Dec 07 | E | J. Hoyt |
| 307 | Stern | 15 Dec 07 | E | J. Hoyt |
| 308 | Portside fender | 15 Dec 07 | ESE | J. Hoyt |
| 309 | Port plating (aft) | 15 Dec 07 | SE | J. Hoyt |
| 310 | Aft framing | 15 Dec 07 | S | J. Hoyt |
| 311 | Aft framing | 15 Dec 07 | S | J. Hoyt |
| 312 | Portside plating | 15 Dec 07 | E | J. Hoyt |
| 313 | Portside plating | 15 Dec 07 | E | J. Hoyt |
| 314 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 315 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 316 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 317 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 318 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 319 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 320 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 321 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 322 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 323 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 324 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 325 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 326 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 327 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 328 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 329 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 330 | Portside framing and "spindle" | 15 Dec 07 | E | J. Hoyt |
| 331 | Portside fender | 15 Dec 07 | E | J. Hoyt |
| 332 | Portside plating | 15 Dec 07 | E | J. Hoyt |
| 333 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 334 | Vertical pipe, port side | 15 Dec 07 | E | J. Hoyt |
| 335 | Portside plating showing location of vertical pipe | 15 Dec 07 | E | J. Hoyt |
| 336 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 337 | Portside plating | 15 Dec 07 | E | J. Hoyt |
| 338 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 339 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 340 | Portside framing and internal compartment (f'ward) | 15 Dec 07 | E | J. Hoyt |
| 341 | Portside plating | 15 Dec 07 | E | J. Hoyt |
| 342 | Portside plating with remnant fender | 15 Dec 07 | E | J. Hoyt |
| 343 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 344 | Portside framing | 15 Dec 07 | E | J. Hoyt |
| 345 | Portside plating with fender | 15 Dec 07 | NE | J. Hoyt |
| 346 | Portside plating and framing | 15 Dec 07 | NE | J. Hoyt |
| 347 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 348 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 349 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 350 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 351 | Portside plating | 15 Dec 07 | NE | J. Hoyt |

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|---|---|---|---|---|
| 352 | Portside plating and framing | 15 Dec 07 | NE | J. Hoyt |
| 353 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 354 | Portside plating and fendering | 15 Dec 07 | NE | J. Hoyt |
| 355 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 356 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 357 | Portside plating and fendering | 15 Dec 07 | NE | J. Hoyt |
| 358 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 359 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 360 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 361 | Portside plating with intact fender | 15 Dec 07 | NE | J. Hoyt |
| 362 | Portside plating and framing | 15 Dec 07 | NE | J. Hoyt |
| 363 | Portside internal compartment | 15 Dec 07 | NW | J. Hoyt |
| 364 | Portside internal compartment | 15 Dec 07 | NW | J. Hoyt |
| 365 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 366 | Portside detail of bow | 15 Dec 07 | NE | J. Hoyt |
| 367 | Portside detail of bow | 15 Dec 07 | NW | J. Hoyt |
| 368 | Portside plating | 15 Dec 07 | NE | J. Hoyt |
| 369 | Portside plating | 15 Dec 07 | NE | J. Hoyt |
| 370 | Portside plating | 15 Dec 07 | NE | J. Hoyt |
| 371 | Portside framing | 15 Dec 07 | NW | J. Hoyt |
| 372 | Portside framing with bow windlass | 15 Dec 07 | NW | J. Hoyt |
| 373 | Portside framing with bow windlass | 15 Dec 07 | NW | J. Hoyt |
| 374 | Portside plating with fender | 15 Dec 07 | NE | J. Hoyt |
| 375 | Portside plating with fender | 15 Dec 07 | NE | J. Hoyt |
| 376 | Portside plating with fender | 15 Dec 07 | NE | J. Hoyt |
| 377 | Portside plating with fender | 15 Dec 07 | NE | J. Hoyt |
| 378 | Portside framing with bow windlass | 15 Dec 07 | NE | J. Hoyt |
| 379 | Portside framing | 15 Dec 07 | NE | J. Hoyt |
| 380 | Detail of bow | 15 Dec 07 | NE | J. Hoyt |
| 381 | Bow of wreck showing buoy line and windlass | 15 Dec 07 | NE | J. Hoyt |
| 382 | Bow of wreck showing cutwater | 15 Dec 07 | NE | J. Hoyt |
| 383 | Bow of wreck showing fairleads | 15 Dec 07 | NE | J. Hoyt |
| 384 | Bow of wreck showing forward most deck frame | 15 Dec 07 | E | J. Hoyt |
| 385 | Bow of wreck (port quarter) | 15 Dec 07 | NE | J. Hoyt |
| 386 | Bow of wreck | 15 Dec 07 | NE | J. Hoyt |
| 387 | Bow of wreck (port quarter) | 15 Dec 07 | NE | J. Hoyt |
| 388 | Forward compartment showing beginning of pipe | 15 Dec 07 | NE | J. Hoyt |
| 389 | Forward compartment showing beginning of pipe | 15 Dec 07 | NE | J. Hoyt |
| 390 | Forward and central compartment with pipe | 15 Dec 07 | NE | J. Hoyt |
| 391 | Forward and central compartment with pipe | 15 Dec 07 | NE | J. Hoyt |
| 392 | Forward and central compartment with pipe | 15 Dec 07 | NE | J. Hoyt |
| 393 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |
| 394 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |
| 395 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |
| 396 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |

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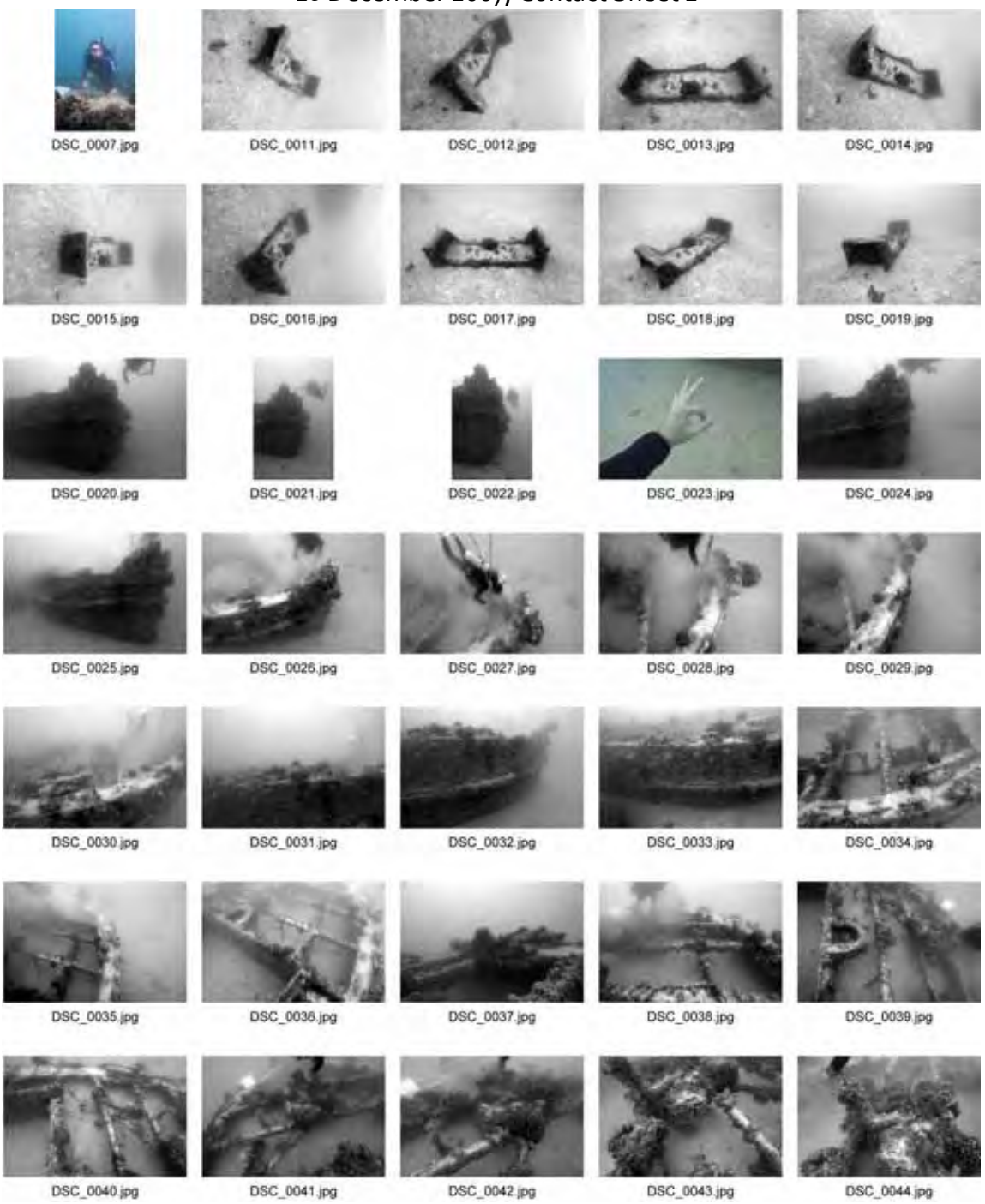
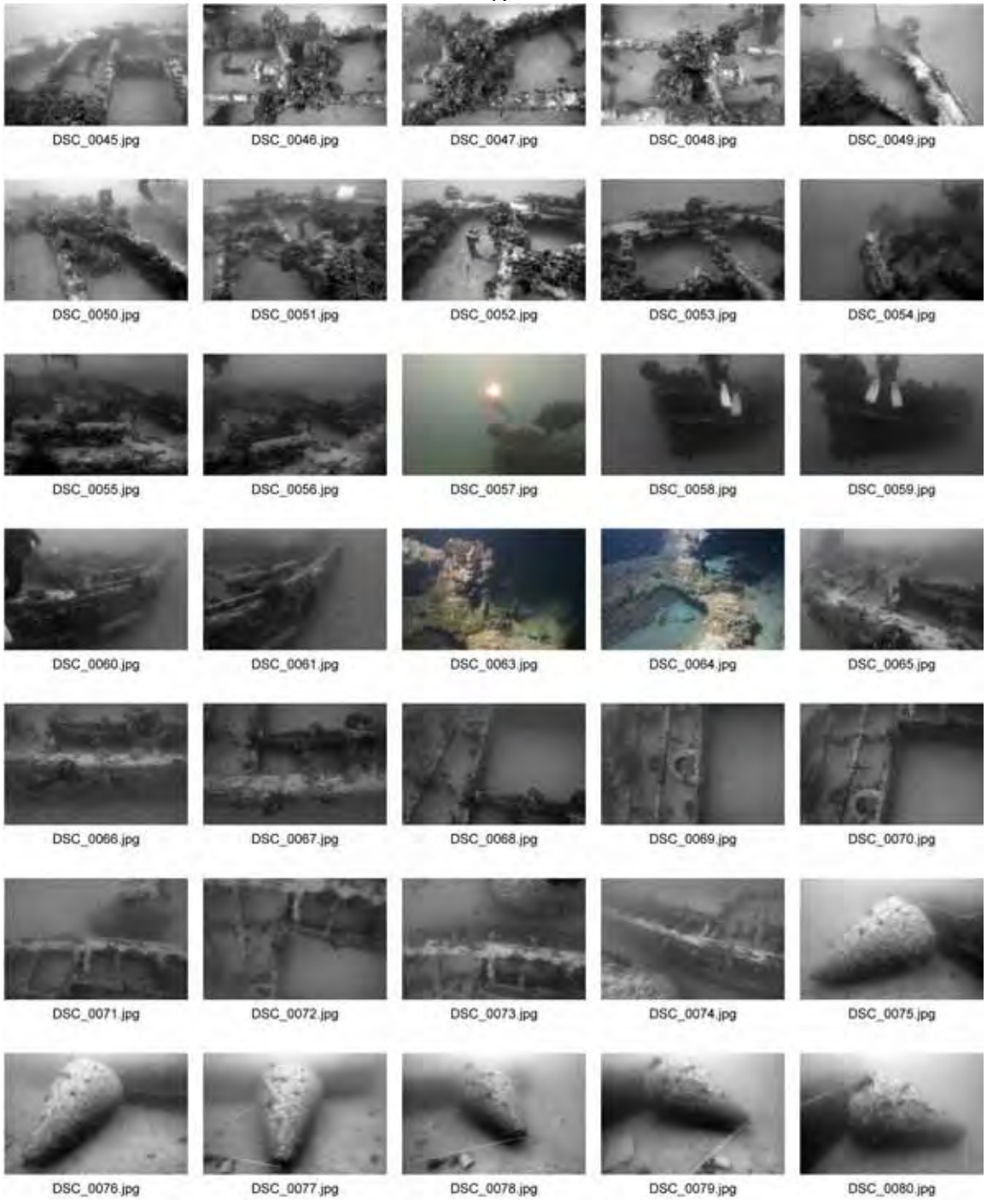
|---|---|---|---|---|
| 397 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |
| 398 | Framing (portside) showing horiz. pipe around midships | 15 Dec 07 | SSW | J. Hoyt |
| 399 | "Spindle" and "Turntable" | 15 Dec 07 | SSW | J. Hoyt |
| 400 | Stern framing (portside) | 15 Dec 07 | SSW | J. Hoyt |
| 401 | Stern framing (portside) | 15 Dec 07 | SSW | J. Hoyt |
| 402 | Stern | 15 Dec 07 | SSW | J. Hoyt |
| 403 | Mike Dermody with HD camcorder and Mark Keusenkothen | 15 Dec 07 | - | J. Hoyt |
| 404 | Mike Dermody with HD camcorder and Mark Keusenkothen | 15 Dec 07 | - | J. Hoyt |
| 405 | Mike Dermody with HD camcorder | 15 Dec 07 | - | J. Hoyt |
| 406 | Mike Dermody with HD camcorder | 15 Dec 07 | - | J. Hoyt |
| 407 | Nathan Richards | 15 Dec 07 | - | J. Hoyt |
| 408 | Anemone | 15 Dec 07 | - | J. Hoyt |

16 December 2007, Contact Sheet 1

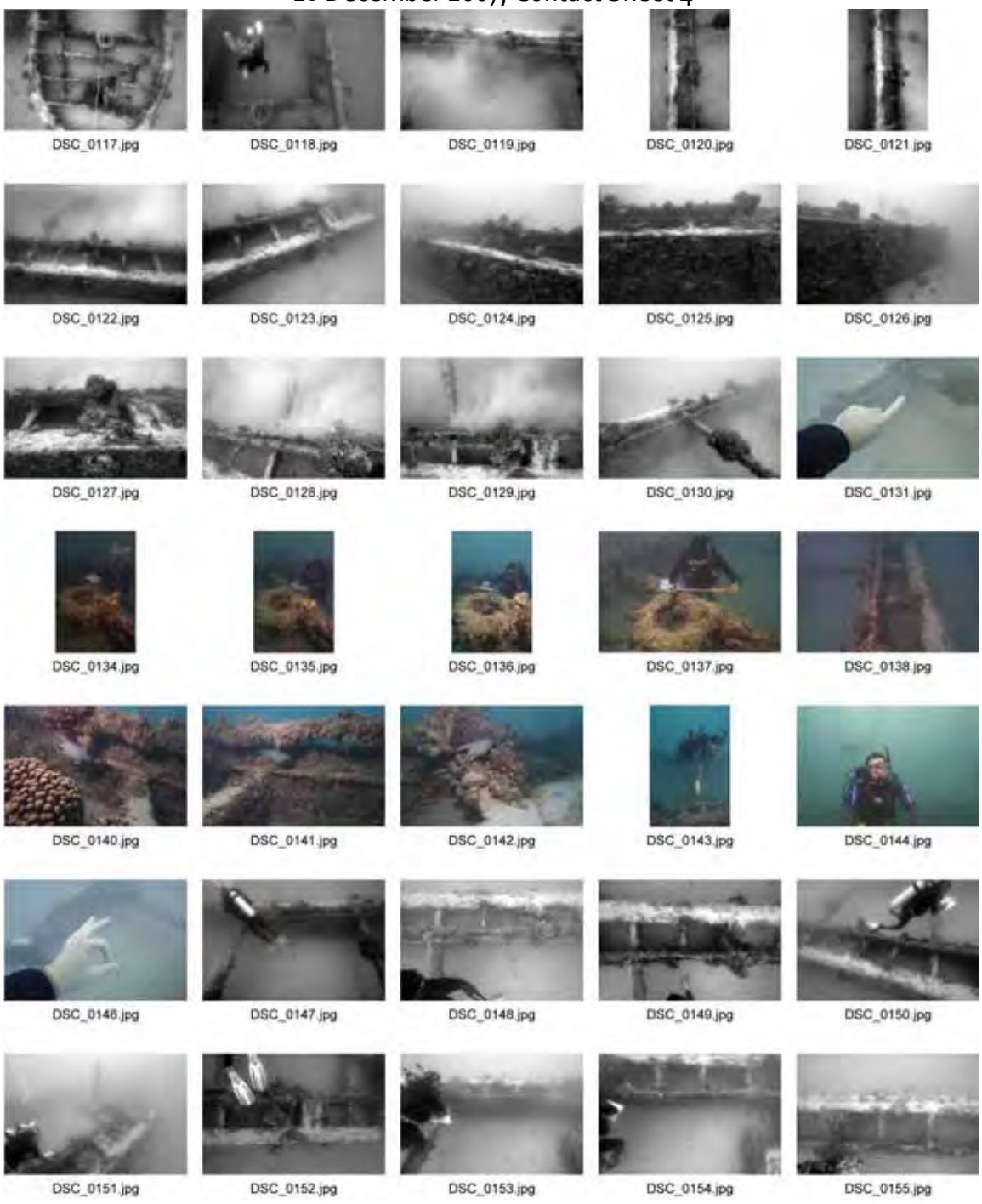


16 December 2007, Contact Sheet 2



16 December 2007, Contact Sheet 3

16 December 2007, Contact Sheet 4



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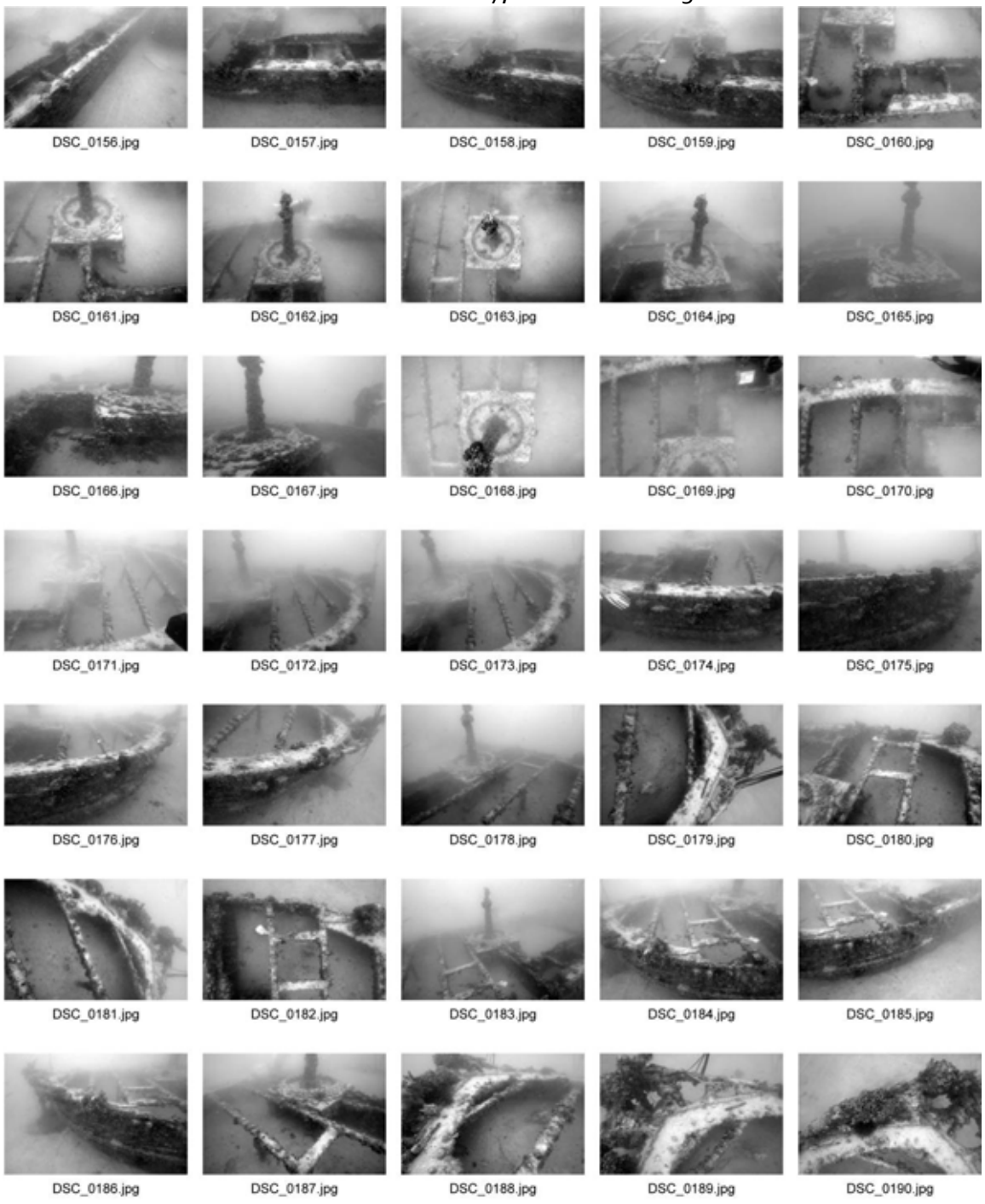

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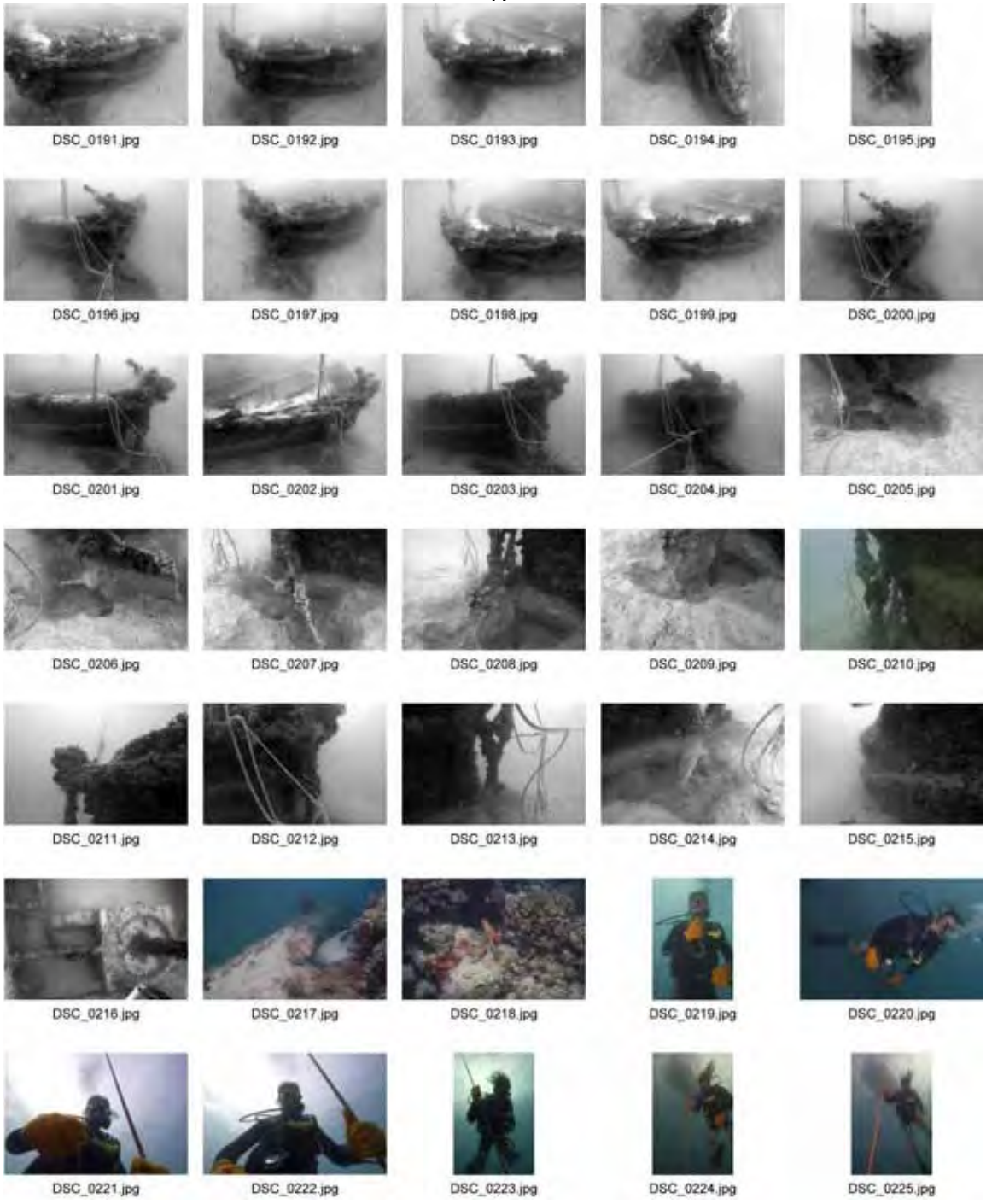

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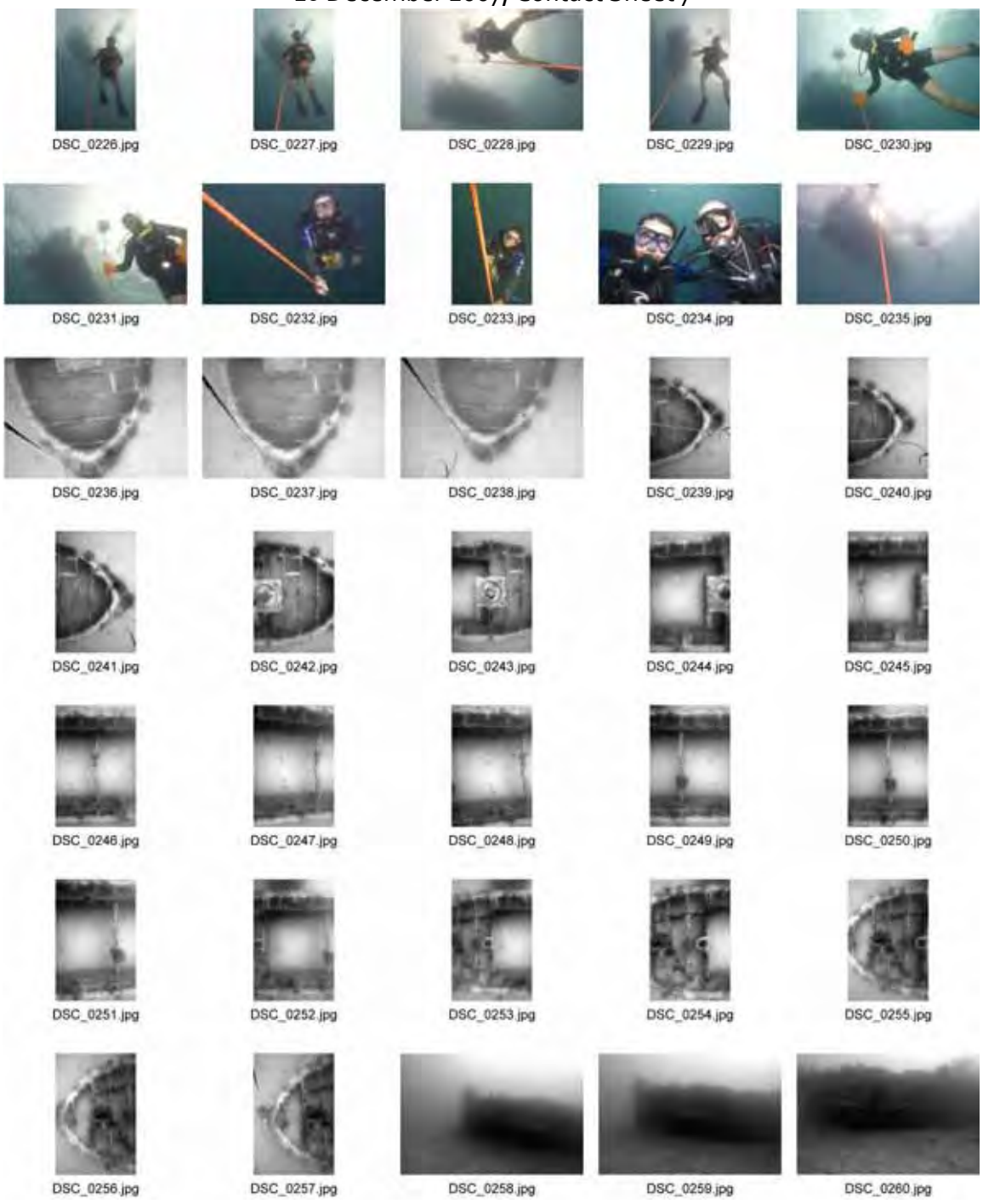

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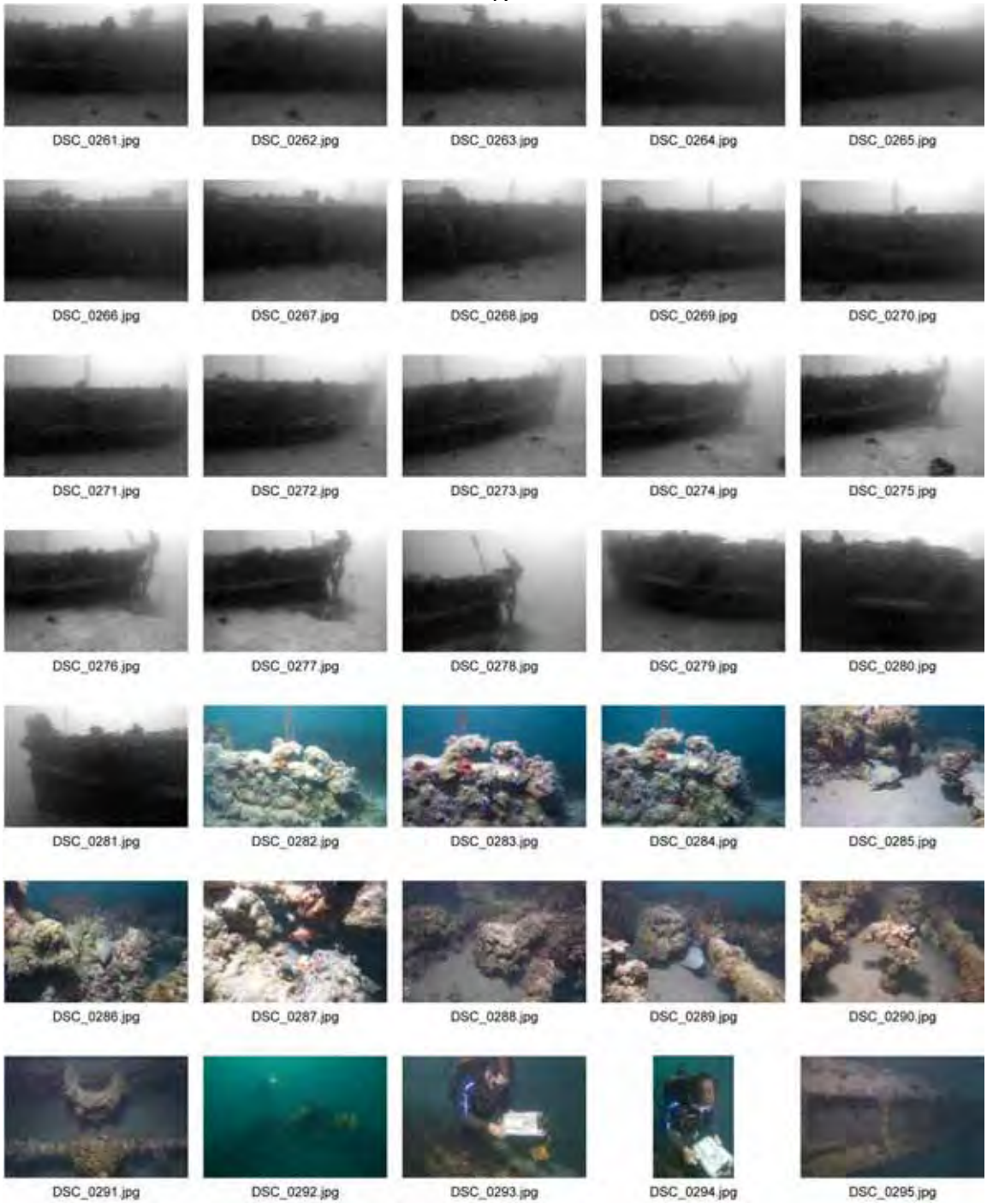
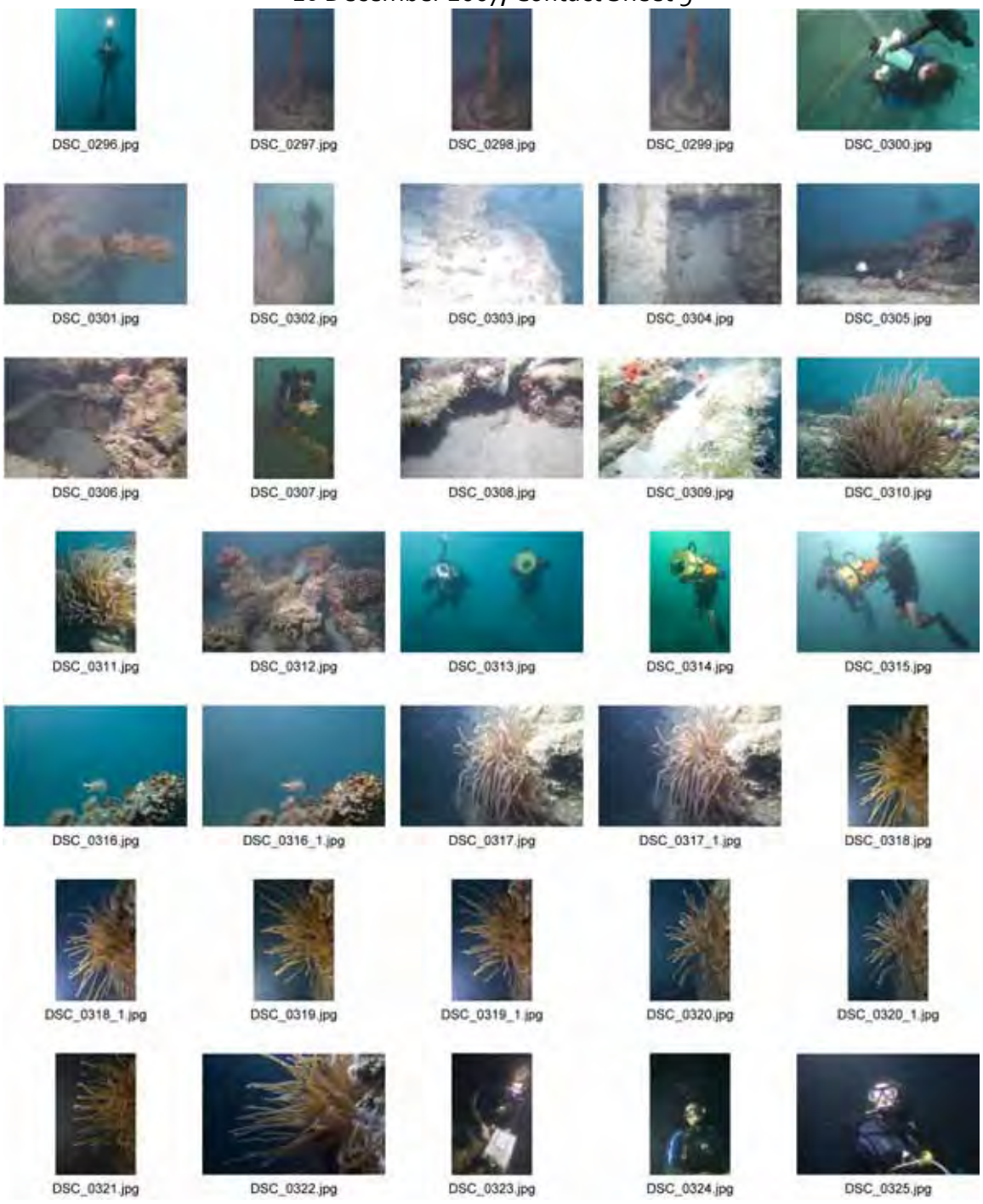


16 December 2007, Contact Sheet 9



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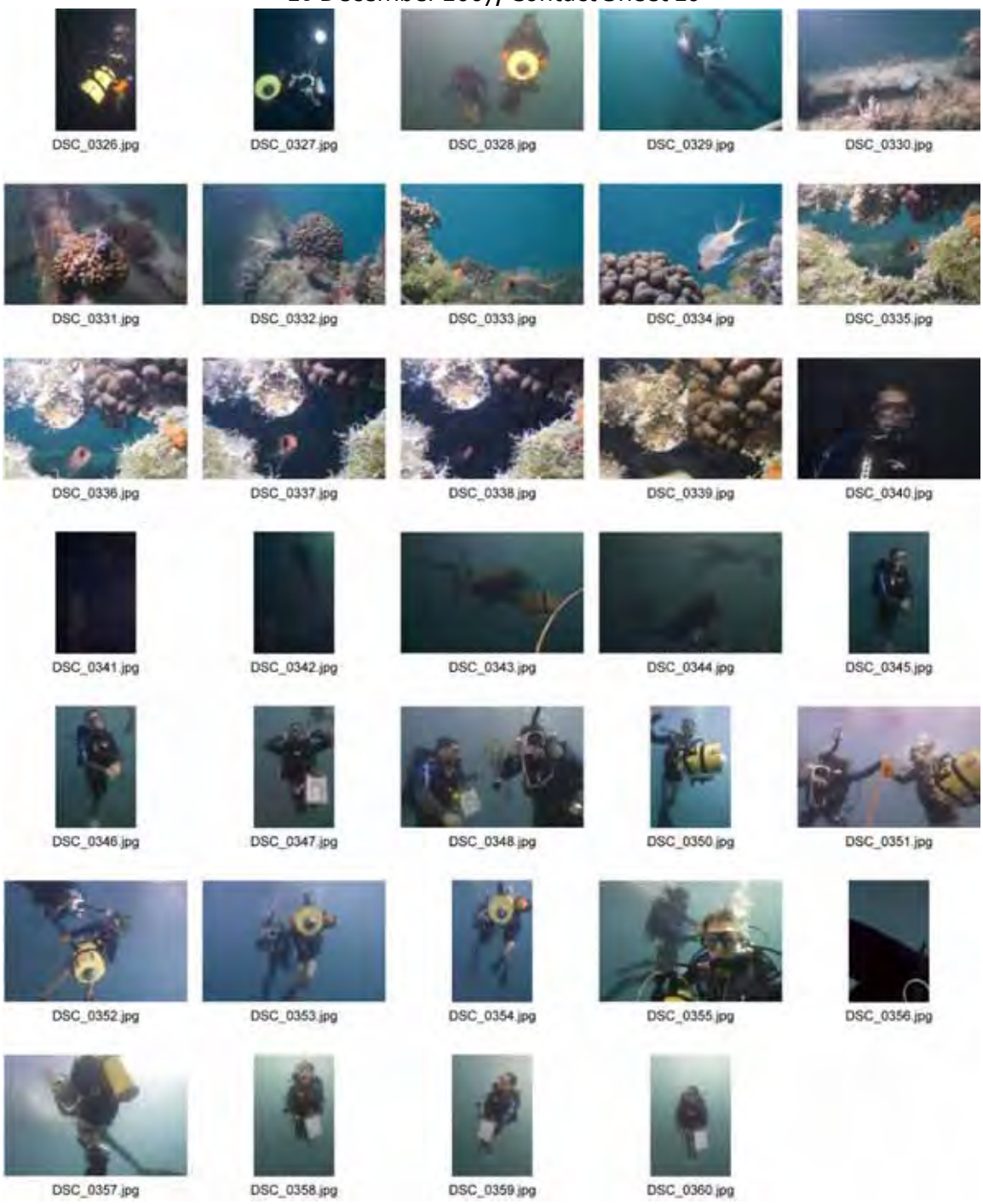


| Site: Unidentified Royal Navy Dockyard Wreck | | Camera: Nikon D | | |
|---|---|---|---|---|
| # | Description | Date | Bearing | By |
| 7 | Nathan Richards | 16-Dec-07 | - | J. Hoyt |
| 11 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 12 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 13 | Unidentified object | 16-Dec-07 | - | J. Hoyt |

| | | | | |
|---|---|---|---|---|
| 14 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 15 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 16 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 17 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 18 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 19 | Unidentified object | 16-Dec-07 | - | J. Hoyt |
| 20 | Bow of wreck | 16-Dec-07 | S | J. Hoyt |
| 21 | Bow of wreck | 16-Dec-07 | S | J. Hoyt |
| 22 | Bow of wreck | 16-Dec-07 | S | J. Hoyt |
| 23 | Hand signal | 16-Dec-07 | - | J. Hoyt |
| 24 | Bow of wreck | 16-Dec-07 | SW | J. Hoyt |
| 25 | Bow of wreck | 16-Dec-07 | SW | J. Hoyt |
| 26 | Bow of wreck with B. Rodgers working | 16-Dec-07 | SSW | J. Hoyt |
| 27 | Bow of wreck with B. Rodgers working | 16-Dec-07 | SW | J. Hoyt |
| 28 | Bow of wreck with B. Rodgers working | 16-Dec-07 | SSW | J. Hoyt |
| 29 | Bow of wreck (starboard quarter) | 16-Dec-07 | W | J. Hoyt |
| 30 | Bow of wreck (starboard quarter) | 16-Dec-07 | SW | J. Hoyt |
| 31 | Starboard side framing | 16-Dec-07 | SW | J. Hoyt |
| 32 | Bow of vessel (starboard quarter) | 16-Dec-07 | W | J. Hoyt |
| 33 | Starboard quarter of wreck with fendering | 16-Dec-07 | W | J. Hoyt |
| 34 | Starboard quarter of wreck showing frames and bow cleat | 16-Dec-07 | WSW | J. Hoyt |
| 35 | Bow (starboard quarter) | 16-Dec-07 | NW | J. Hoyt |
| 36 | Bow (starboard quarter) showing mast carling | 16-Dec-07 | W | J. Hoyt |
| 37 | Bow (starboard quarter) detail of bow cleat | 16-Dec-07 | NE | J. Hoyt |
| 38 | Inside bow with B. Rodgers measuring | 16-Dec-07 | NW | J. Hoyt |
| 39 | Inside bow with detail of mast carling | 16-Dec-07 | SW | J. Hoyt |
| 40 | Inside bow showing port side | 16-Dec-07 | SW | J. Hoyt |
| 41 | Inside bow showing remnant windlass | 16-Dec-07 | NW | J. Hoyt |
| 42 | Inside bow showing remnant windlass | 16-Dec-07 | NW | J. Hoyt |
| 43 | Inside bow showing remnant windlass | 16-Dec-07 | NE | J. Hoyt |
| 44 | Inside bow showing remnant windlass | 16-Dec-07 | NE | J. Hoyt |
| 45 | Inside bow with view to starboard side quarter | 16-Dec-07 | NE | J. Hoyt |
| 46 | Plan view of remnant windlass | 16-Dec-07 | NW | J. Hoyt |
| 47 | Looking down on forward frames and remnant windlass | 16-Dec-07 | NW | J. Hoyt |
| 48 | Plan view of remnant windlass | 16-Dec-07 | NW | J. Hoyt |
| 49 | View of bow configuration | 16-Dec-07 | NNW | J. Hoyt |
| 50 | View of bow and remnant windlass | 16-Dec-07 | W | J. Hoyt |
| 51 | View of internal configuration of bow | 16-Dec-07 | W | J. Hoyt |
| 52 | Inside bow | 16-Dec-07 | NE | J. Hoyt |
| 53 | Inside bow | 16-Dec-07 | NE | J. Hoyt |
| 54 | View of bow from port quarter | 16-Dec-07 | N | J. Hoyt |
| 55 | View of bow from port quarter showing bow cleat | 16-Dec-07 | NE | J. Hoyt |
| 56 | View of bow from port quarter showing bow cleat | 16-Dec-07 | N | J. Hoyt |
| 57 | View of bow with divers showing open chock fairlead | 16-Dec-07 | N | J. Hoyt |
| 58 | View of bow with diver | 16-Dec-07 | NE | J. Hoyt |
| 59 | View of bow with diver | 16-Dec-07 | N | J. Hoyt |
| 60 | View of bow with diver | 16-Dec-07 | N | J. Hoyt |
| 61 | View of bow and portside cleat | 16-Dec-07 | NE | J. Hoyt |

| | | | | |
|---|---|---|---|---|
| 62 | Fish | 16-Dec-07 | - | J. Hoyt |
| 63 | Fish inside bow | 16-Dec-07 | - | J. Hoyt |
| 64 | View of forward compartment | 16-Dec-07 | N | J. Hoyt |
| 65 | View of portside plating and forward compartment | 16-Dec-07 | NE | J. Hoyt |
| 66 | View of portside plating and forward compartment | 16-Dec-07 | NE | J. Hoyt |
| 67 | View of forward compartment and mast carling | 16-Dec-07 | N | J. Hoyt |
| 68 | Mast carling | 16-Dec-07 | NW | J. Hoyt |
| 69 | Mast carling and corner of forward compartment | 16-Dec-07 | NE | J. Hoyt |
| 70 | View of sunken buoy and starboard side framing | 16-Dec-07 | NE | J. Hoyt |
| 71 | Forward compartment and mast carling | 16-Dec-07 | N | J. Hoyt |
| 72 | View of sunken buoy and starboard side framing | 16-Dec-07 | N | J. Hoyt |
| 73 | View of starboard side plating and framing near bow | 16-Dec-07 | SW | J. Hoyt |
| 74 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | SE | J. Hoyt |
| 75 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | SW | J. Hoyt |
| 76 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | WSW | J. Hoyt |
| 77 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | W | J. Hoyt |
| 78 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | NW | J. Hoyt |
| 79 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | NW | J. Hoyt |
| 80 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | NNW | J. Hoyt |
| 81 | Navigation buoy alongside starboard plating (at bow) | 16-Dec-07 | | J. Hoyt |
| 82 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 83 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 84 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 85 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 86 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 87 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 88 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 89 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 90 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 91 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 92 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 93 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 94 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 95 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 96 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 97 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 98 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 99 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 100 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 101 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 102 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 103 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 104 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 105 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 106 | Photomodeling shot: amidships | 16-Dec-07 | | J. Hoyt |
| 107 | Silt out | 16-Dec-07 | | J. Hoyt |
| 108 | Silt out | 16-Dec-07 | | J. Hoyt |
| 109 | Midship looking forward | 16-Dec-07 | | J. Hoyt |

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|---|---|---|---|---|
| 110 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 111 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 112 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 113 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 114 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 115 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 116 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 117 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 118 | M. Keusenkothen at bow | 16-Dec-07 | | J. Hoyt |
| 119 | Brad Rodgers | 16-Dec-07 | | J. Hoyt |
| 120 | Silt out | 16-Dec-07 | | J. Hoyt |
| 121 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 122 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 123 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 124 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 125 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 126 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 127 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 128 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 129 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 130 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 131 | Photomodeling shot: sides of vessel | 16-Dec-07 | | J. Hoyt |
| 132 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 133 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 134 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 135 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 136 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 137 | N. Richards measuring | 16-Dec-07 | | J. Hoyt |
| 138 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 139 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 140 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 141 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 142 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 143 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 144 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 145 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 146 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 147 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 148 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 149 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 150 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 151 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 152 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 153 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 154 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 155 | Starboard stern | 16-Dec-07 | | J. Hoyt |
| 156 | Starboard stern | 16-Dec-07 | | J. Hoyt |
| 157 | Starboard stern | 16-Dec-07 | | J. Hoyt |

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|---|---|---|---|---|
| 158 | Starboard stern | 16-Dec-07 | | J. Hoyt |
| 159 | Starboard stern | 16-Dec-07 | | J. Hoyt |
| 160 | Starboard stern | 16-Dec-07 | | J. Hoyt |
| 161 | Spindle | 16-Dec-07 | | J. Hoyt |
| 162 | Spindle | 16-Dec-07 | | J. Hoyt |
| 163 | Spindle | 16-Dec-07 | | J. Hoyt |
| 164 | Spindle | 16-Dec-07 | | J. Hoyt |
| 165 | Spindle | 16-Dec-07 | | J. Hoyt |
| 166 | Spindle | 16-Dec-07 | | J. Hoyt |
| 167 | Spindle | 16-Dec-07 | | J. Hoyt |
| 168 | Spindle | 16-Dec-07 | | J. Hoyt |
| 169 | Spindle | 16-Dec-07 | | J. Hoyt |
| 170 | Spindle | 16-Dec-07 | | J. Hoyt |
| 171 | Spindle | 16-Dec-07 | | J. Hoyt |
| 172 | Spindle | 16-Dec-07 | | J. Hoyt |
| 173 | Spindle | 16-Dec-07 | | J. Hoyt |
| 174 | Spindle | 16-Dec-07 | | J. Hoyt |
| 175 | Spindle | 16-Dec-07 | | J. Hoyt |
| 176 | Spindle | 16-Dec-07 | | J. Hoyt |
| 177 | Spindle | 16-Dec-07 | | J. Hoyt |
| 178 | Spindle | 16-Dec-07 | | J. Hoyt |
| 179 | Stern | 16-Dec-07 | | J. Hoyt |
| 180 | Stern | 16-Dec-07 | | J. Hoyt |
| 181 | Stern | 16-Dec-07 | | J. Hoyt |
| 182 | Stern | 16-Dec-07 | | J. Hoyt |
| 183 | Stern | 16-Dec-07 | | J. Hoyt |
| 184 | Stern | 16-Dec-07 | | J. Hoyt |
| 185 | Stern | 16-Dec-07 | | J. Hoyt |
| 186 | Stern | 16-Dec-07 | | J. Hoyt |
| 187 | Stern | 16-Dec-07 | | J. Hoyt |
| 188 | Stern | 16-Dec-07 | | J. Hoyt |
| 189 | Stern | 16-Dec-07 | | J. Hoyt |
| 190 | Stern | 16-Dec-07 | | J. Hoyt |
| 191 | Stern | 16-Dec-07 | | J. Hoyt |
| 192 | Stern | 16-Dec-07 | | J. Hoyt |
| 193 | Stern | 16-Dec-07 | | J. Hoyt |
| 194 | Stern | 16-Dec-07 | | J. Hoyt |
| 195 | Stern | 16-Dec-07 | | J. Hoyt |
| 196 | Stern | 16-Dec-07 | | J. Hoyt |
| 197 | Stern | 16-Dec-07 | | J. Hoyt |
| 198 | Stern | 16-Dec-07 | | J. Hoyt |
| 199 | Stern | 16-Dec-07 | | J. Hoyt |
| 200 | Stern | 16-Dec-07 | | J. Hoyt |
| 201 | Stern | 16-Dec-07 | | J. Hoyt |
| 202 | Stern | 16-Dec-07 | | J. Hoyt |
| 203 | Stern | 16-Dec-07 | | J. Hoyt |
| 204 | Stern | 16-Dec-07 | | J. Hoyt |
| 205 | Propeller | 16-Dec-07 | | J. Hoyt |

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|---|---|---|---|---|
| 206 | Propeller | 16-Dec-07 | | J. Hoyt |
| 207 | Propeller | 16-Dec-07 | | J. Hoyt |
| 208 | Propeller | 16-Dec-07 | | J. Hoyt |
| 209 | Propeller | 16-Dec-07 | | J. Hoyt |
| 210 | Propeller | 16-Dec-07 | | J. Hoyt |
| 211 | Propeller | 16-Dec-07 | | J. Hoyt |
| 212 | Propeller | 16-Dec-07 | | J. Hoyt |
| 213 | Propeller | 16-Dec-07 | | J. Hoyt |
| 214 | Propeller | 16-Dec-07 | | J. Hoyt |
| 215 | Stern and port fender | 16-Dec-07 | | J. Hoyt |
| 216 | Spindle | 16-Dec-07 | | J. Hoyt |
| 217 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 218 | Angelfish | 16-Dec-07 | | J. Hoyt |
| 219 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 220 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 221 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 222 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 223 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 224 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 225 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 226 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 227 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 228 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 229 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 230 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 231 | M. Keusenkothen | 16-Dec-07 | | J. Hoyt |
| 232 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 233 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 234 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 235 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 236 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 237 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 238 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 239 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 240 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 241 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 242 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 243 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 244 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 245 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 246 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 247 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 248 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 249 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 250 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 251 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 252 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 253 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |

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| 254 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 255 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 256 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 257 | Photomodeling shot: Plan view | 16-Dec-07 | | J. Hoyt |
| 258 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 259 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 260 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 261 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 262 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 263 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 264 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 265 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 266 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 267 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 268 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 269 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 270 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 271 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 272 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 273 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 274 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 275 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 276 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 277 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 278 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 279 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 280 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 281 | Port profile mosaic | 16-Dec-07 | NE | J. Hoyt |
| 282 | Fairleads | 16-Dec-07 | | J. Hoyt |
| 283 | Fairleads | 16-Dec-07 | | J. Hoyt |
| 284 | Fairleads | 16-Dec-07 | | J. Hoyt |
| 285 | Fairleads | 16-Dec-07 | | J. Hoyt |
| 286 | Bow details | 16-Dec-07 | | J. Hoyt |
| 287 | Bow details | 16-Dec-07 | | J. Hoyt |
| 288 | Bow details | 16-Dec-07 | | J. Hoyt |
| 289 | Bow details | 16-Dec-07 | | J. Hoyt |
| 290 | Bow details | 16-Dec-07 | | J. Hoyt |
| 291 | Bow details | 16-Dec-07 | | J. Hoyt |
| 292 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 293 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 294 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 295 | Port side frame | 16-Dec-07 | | J. Hoyt |
| 296 | M. Dermody | 16-Dec-07 | | J. Hoyt |
| 297 | Spindle | 16-Dec-07 | | J. Hoyt |
| 298 | Spindle | 16-Dec-07 | | J. Hoyt |
| 299 | Spindle | 16-Dec-07 | | J. Hoyt |
| 300 | M. Dermody | 16-Dec-07 | | J. Hoyt |
| 301 | Spindle | 16-Dec-07 | | J. Hoyt |

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|---|---|---|---|---|
| 302 | M. Dermody | 16-Dec-07 | | J. Hoyt |
| 303 | Spindle | 16-Dec-07 | | J. Hoyt |
| 304 | Spindle | 16-Dec-07 | | J. Hoyt |
| 305 | Spindle | 16-Dec-07 | | J. Hoyt |
| 306 | Spindle | 16-Dec-07 | | J. Hoyt |
| 307 | N. Richards | 16-Dec-07 | | J. Hoyt |
| 308 | Fish | 16-Dec-07 | | J. Hoyt |
| 309 | Fish | 16-Dec-07 | | J. Hoyt |
| 310 | Fish | 16-Dec-07 | | J. Hoyt |
| 311 | Fish | 16-Dec-07 | | J. Hoyt |
| 312 | Fish | 16-Dec-07 | | J. Hoyt |
| 313 | M. Keusenkothen and M. Dermody | 16-Dec-07 | | J. Hoyt |
| 314 | M. Keusenkothen and M. Dermody | 16-Dec-07 | | J. Hoyt |
| 315 | M. Keusenkothen and M. Dermody | 16-Dec-07 | | J. Hoyt |
| 316 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 317 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 318 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 319 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 320 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 321 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 322 | Fish and anemone | 16-Dec-07 | | J. Hoyt |
| 323 | Divers | 16-Dec-07 | | J. Hoyt |
| 324 | Divers | 16-Dec-07 | | J. Hoyt |
| 325 | Divers | 16-Dec-07 | | J. Hoyt |
| 326 | Divers | 16-Dec-07 | | J. Hoyt |
| 327 | Divers | 16-Dec-07 | | J. Hoyt |
| 328 | Divers | 16-Dec-07 | | J. Hoyt |
| 329 | Divers | 16-Dec-07 | | J. Hoyt |
| 330 | Fish | 16-Dec-07 | | J. Hoyt |
| 331 | Fish | 16-Dec-07 | | J. Hoyt |
| 332 | Fish | 16-Dec-07 | | J. Hoyt |
| 333 | Fish | 16-Dec-07 | | J. Hoyt |
| 334 | Fish | 16-Dec-07 | | J. Hoyt |
| 335 | Fish | 16-Dec-07 | | J. Hoyt |
| 336 | Fish | 16-Dec-07 | | J. Hoyt |
| 337 | Fish | 16-Dec-07 | | J. Hoyt |
| 338 | Fish | 16-Dec-07 | | J. Hoyt |
| 339 | Fish | 16-Dec-07 | | J. Hoyt |
| 340 | Divers | 16-Dec-07 | | J. Hoyt |
| 341 | Divers | 16-Dec-07 | | J. Hoyt |
| 342 | Divers | 16-Dec-07 | | J. Hoyt |
| 343 | Divers | 16-Dec-07 | | J. Hoyt |
| 344 | Divers | 16-Dec-07 | | J. Hoyt |
| 345 | Divers | 16-Dec-07 | | J. Hoyt |
| 346 | Divers | 16-Dec-07 | | J. Hoyt |
| 347 | Divers | 16-Dec-07 | | J. Hoyt |
| 348 | Divers | 16-Dec-07 | | J. Hoyt |
| 349 | Divers | 16-Dec-07 | | J. Hoyt |

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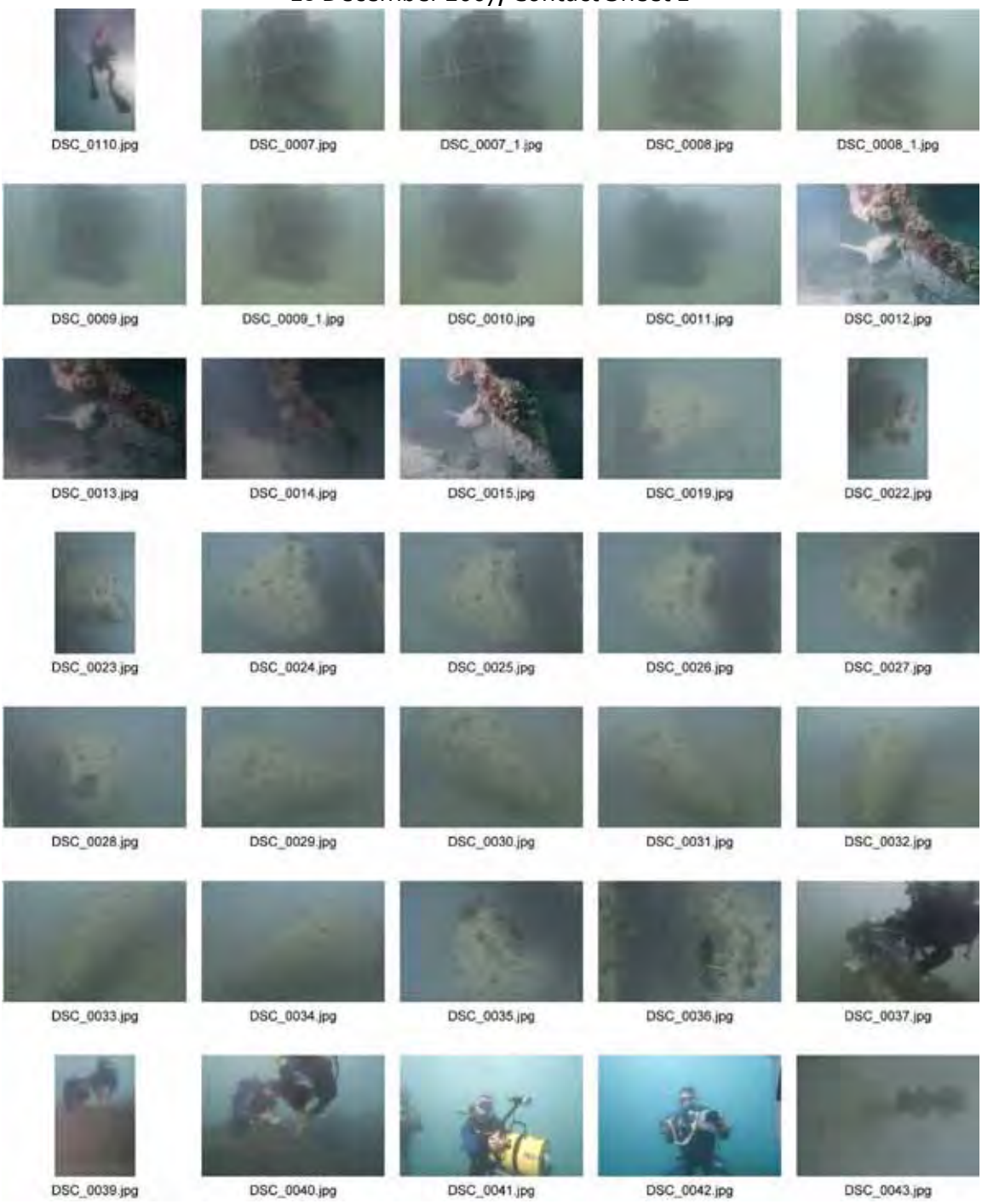
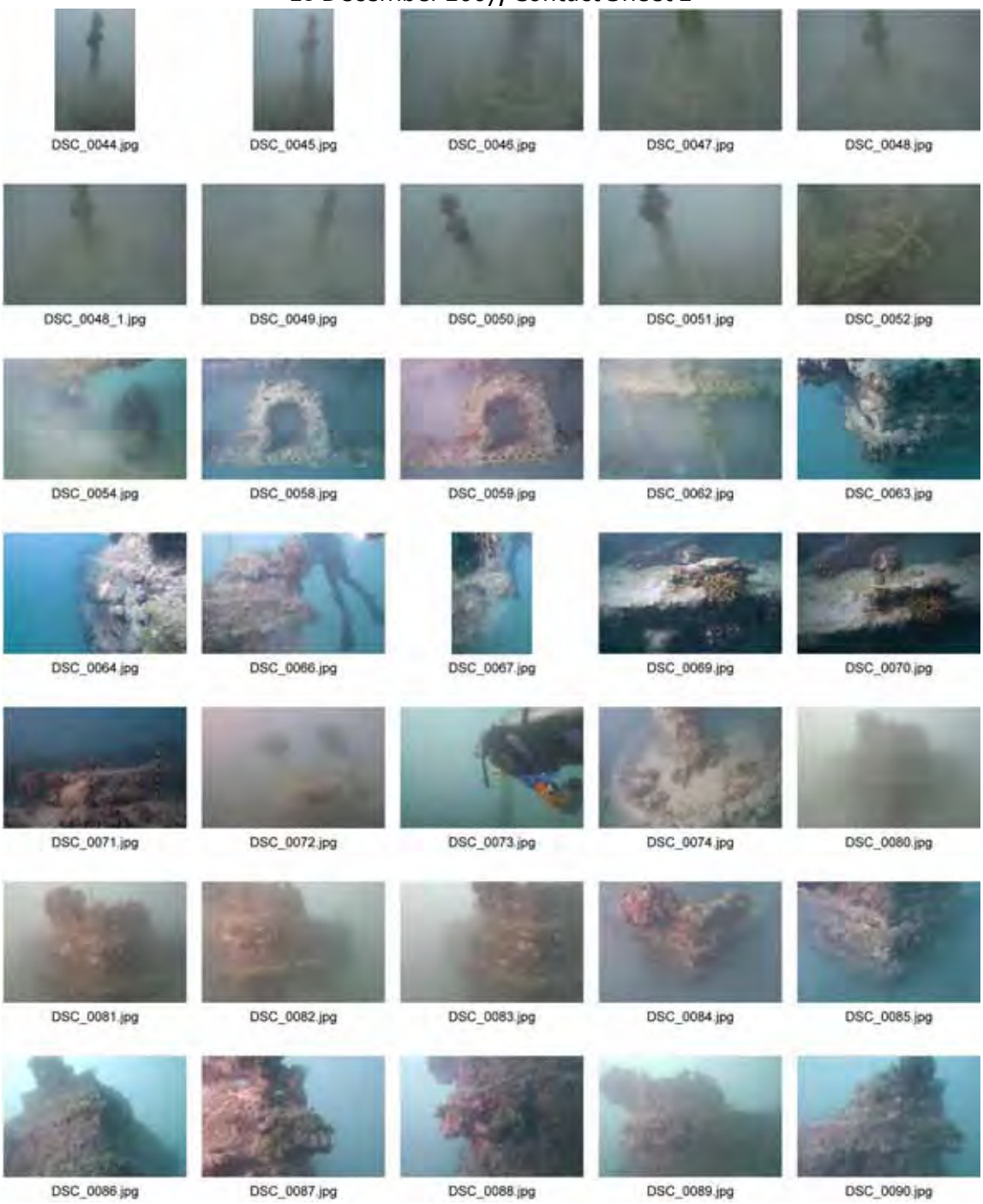
|---|---|---|---|---|
| 350 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 351 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 352 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 353 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 354 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 355 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 356 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 357 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 358 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 359 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |
| 360 | Divers at safety stop | 16-Dec-07 | - | J. Hoyt |

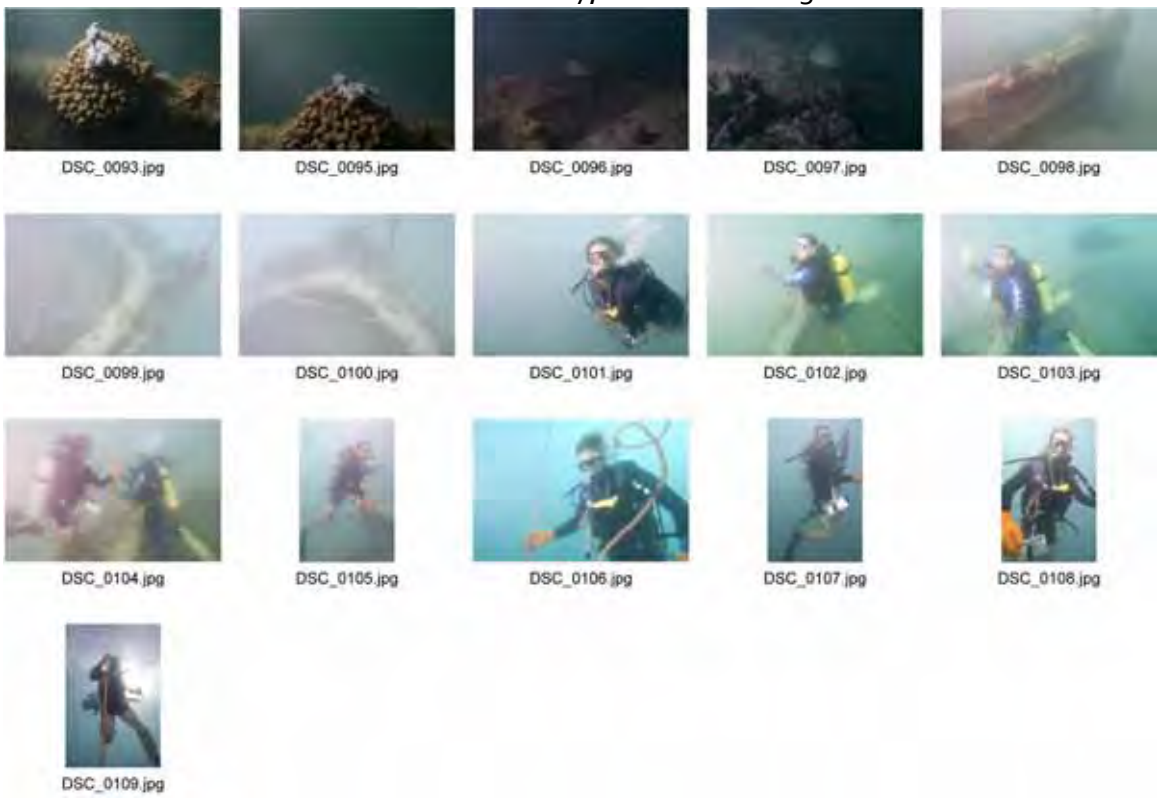
18 December 2007, Contact Sheet 1



18 December 2007, Contact Sheet 2



18 December 2007, Contact Sheet 3




| Site: | Unidentified Royal Navy Dockyard Wreck | Camera: | Nikon D | |
|---|---|---|---|---|
| # | Description | Date | Bearing | By |
| 7 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 8 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 9 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 10 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 11 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 12 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 13 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 14 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 15 | Stern and propeller | 18-Dec-07 | | J. Hoyt |
| 16 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 17 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 18 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 19 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 20 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 21 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 22 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
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| 29 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 30 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 31 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 32 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
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| 34 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 35 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 36 | Buoy with scale | 18-Dec-07 | | J. Hoyt |
| 37 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 38 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 39 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 40 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 41 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 42 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 43 | Spindle | 18-Dec-07 | | J. Hoyt |
| 44 | Spindle | 18-Dec-07 | | J. Hoyt |
| 45 | Spindle | 18-Dec-07 | | J. Hoyt |
| 46 | Spindle | 18-Dec-07 | | J. Hoyt |
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| 50 | Spindle | 18-Dec-07 | | J. Hoyt |
| 51 | Spindle | 18-Dec-07 | | J. Hoyt |
| 52 | Spindle | 18-Dec-07 | | J. Hoyt |
| 54 | N. Richards and B. Rodgers | 18-Dec-07 | | J. Hoyt |
| 58 | Mast carling | 18-Dec-07 | | J. Hoyt |
| 59 | Mast carling | 18-Dec-07 | | J. Hoyt |
| 62 | Cleat | 18-Dec-07 | | J. Hoyt |
| 63 | Bow | 18-Dec-07 | | J. Hoyt |
| 64 | Bow | 18-Dec-07 | | J. Hoyt |
| 65 | Bow | 18-Dec-07 | | J. Hoyt |
| 66 | Bow | 18-Dec-07 | | J. Hoyt |
| 67 | Bow | 18-Dec-07 | | J. Hoyt |
| 68 | Bow | 18-Dec-07 | | J. Hoyt |
| 69 | Cleats | 18-Dec-07 | | J. Hoyt |
| 70 | Cleats | 18-Dec-07 | | J. Hoyt |
| 71 | Cleats | 18-Dec-07 | | J. Hoyt |
| 72 | Diver | 18-Dec-07 | | J. Hoyt |
| 73 | Diver | 18-Dec-07 | | J. Hoyt |
| 74 | Spindle | 18-Dec-07 | | J. Hoyt |
| 75 | Bow | 18-Dec-07 | | J. Hoyt |
| 76 | Bow | 18-Dec-07 | | J. Hoyt |
| 77 | Bow | 18-Dec-07 | | J. Hoyt |
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| 83 | Bow | 18-Dec-07 | | J. Hoyt |
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| 88 | Bow | 18-Dec-07 | | J. Hoyt |
| 89 | Bow | 18-Dec-07 | | J. Hoyt |
| 90 | Bow | 18-Dec-07 | | J. Hoyt |
| 93 | Fish and coral | 18-Dec-07 | | J. Hoyt |
| 94 | Fish and coral | 18-Dec-07 | | J. Hoyt |
| 95 | Fish and coral | 18-Dec-07 | | J. Hoyt |
| 96 | Fish and coral | 18-Dec-07 | | J. Hoyt |
| 97 | Fish and coral | 18-Dec-07 | | J. Hoyt |
| 98 | Stern | 18-Dec-07 | | J. Hoyt |
| 99 | Stern | 18-Dec-07 | | J. Hoyt |
| 100 | Stern | 18-Dec-07 | | J. Hoyt |
| 101 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 102 | N. Richards | 18-Dec-07 | | J. Hoyt |
| 103 | N. Richards | 18-Dec-07 | | J. Hoyt |
| 104 | N. Richards and M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 105 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 106 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 107 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 108 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 109 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |
| 110 | M. Keusenkothen | 18-Dec-07 | | J. Hoyt |

## APPENDIX 2: PROJECT PRESS

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# Archaeologists to examine wreck beneath proposed berth of new cruise terminal

By Amanda Dale

Government has commissioned a team of archaeologists to examine the wreck which lies beneath the proposed berth of Dockyard's new cruise ship terminal.

As reported in *The Royal Gazette*, former Premier Dame Jennifer Smith instructed that developers undertake an archaeological survey prior to any construction. Dame Jennifer, who is chairman of the Historic Wrecks Authority, wrote to the Ministry of Tourism and Transport, saying: "Of concern is the plan to dredge an area of the seafloor below the projected berth of the cruise ship. The Custodian (Dr. Philippe Rouja) has surveyed this area and discovered that what has been termed an obstruction is in fact a historic wreck."

The 65ft long by 19ft wide iron vessel is thought to be one of the original tugs used to build Royal Naval Dockyard in the mid-19th century. And remnants of Prison Hulks and The Woodside, a 200ft iron and wooden ship, have also been discovered, raising concern about the impact of dredging and piling work during construction.

According to Bermuda's Historic Wrecks Act 2001, a wreck can only be removed with a permit from the Historic Wrecks Authority. Construction of the cruise ship terminal therefore hinges on the findings of the archaeological survey.

The team, headed by Dr. Nathan Richards and Dr. Bradley Rodgers of the Department of Maritime Studies at East Carolina University, Greenville, North Carolina, will arrive in Bermuda at the end of the cruise ship season in November.

A Government spokesman said yesterday: "To date no one has been able to definitively determine what the wreck is. Speculators have suspected anything from a sunken barge to a historically significant tug boat.

"In a dedicated effort to make a definitive and reliable determination, the Ministry of Tourism and Transport has enlisted the assistance of archaeological experts from overseas.

"Meantime, while the Ministry awaits the result of this prudent approach, no work on the future cruise ship pier is being conducted anywhere in the vicinity of the wreck. The Ministry is communicating with the Historic Wrecks Authority to ensure maritime heritage is properly protected during all phases of this project. All preliminary work currently being performed (test pile driving) will not impact the wreck."

Government Cabinet Secretary Marc Telemaque added: "This work is specifically required so that the work can be photographed and the effects on the marine environment can be observed, recorded, and made part of the Environmental Impact Study."

Dr. Edward Harris of the Bermuda Maritime Museum said: "This is the best approach to any matter such as this, where the facts are not known. We put the scientists, that is to say the archaeologists in this instance, onto the job and they will record and determine the nature of the wreck."

Plans for Phase One of the New Cruise Ship Pier, by the West End Development Corporation, are currently under review by Planning officers. The new terminal will accommodate Panamax and Post-Panamax size megaships, bringing thousands of tourists to the Island.

Construction requires stabilising 300 circular steel piles into the seabed in a yearlong operation. Test piling has already started to calculate the building materials needed and to monitor noise levels through the water — so as not to harm the dolphins at Dolphin Quest.

Jennifer Smith

*The Royal Gazette*, September 28, 2007, page 13

# Experts coming to study mysterious Dockyard wreck

**BY MARK KENNEDY**
mkennedy@bermudasun.bm

The Ministry of Tourism and Transport is getting on board the effort to protect what may be a historic wreck below the surface of the waters off Dockyard, it said in a press statement.

To date no one has been able to definitively determine what the wreck is.

It could be anything from a sunken barge to a historically significant tug boat, but it's all speculation — for now.

In an effort to determine what it is the Ministry has enlisted the assistance of archeological experts from overseas.

They will come to Bermuda in November to perform an archeological survey on the wreck. The archeological group was approached earlier this month and a proposal was finalized one week ago.

Until the archeological work is completed, no one can speak confidently on what exactly lies beneath the surface.

"This is the best approach to any matter such as this, where the facts are not known," said Dr. Edward Harris, of the Bermuda Maritime Museum.

"We put the scientists, that is to say, the archeologists in this instance onto the job and they will record and determine the nature of the wreck," he said.

The archeologists will be using video cameras to conduct their survey.

Until excavation work is complete, no work on the planned cruise ship pier will take place anywhere in the vicinity of the wreck.

"The work that has been done to date has been done with the full knowledge of the Department of Planning and the Department of the Environmental Protection," said, Marc Telemaque, Cabinet Secretary.

"This work is specifically required so that the work can be photographed and the effects on the marine environment can be observed, recorded, and made part of the environmental impact study.

The Ministry of Tourism and Transport is communicating with the Historic Wrecks Authority to ensure maritime heritage is properly protected during all phases of this project.

The Historic Wrecks Authority recommended the archeological surveyors the Government has chosen to use.

All preliminary work currently being performed will not impact the wreck. ■

**The Bermuda Sun**
**28 September 2007**

*The Bermuda Sun*, September 28, 2007.

*The Royal Gazette* 28 December 2007, p. 2

Photos by Joe Hoyt

**Dr. Brad Rodgers** recording the bow of the unidentified shipwreck just off the North Pier, King's Wharf, Ireland Island North.

# King's Wharf wreck could be cut down – archaeologists

**By Elizabeth Roberts**

Part of a 100-year-old wreck may be sawn off to make way for mega cruise ships in Dockyard.

The iron vessel has recently been examined by a team of maritime archaeologists from East Carolina University ahead of the construction of a $35 million new ship terminal.

According to Assistant Professor Nathan Richards from the team, the 65-foot wreck could be "of great significance" to Bermuda as a vessel used to transport building materials during the expansion of the Dockyard around 1901.

He is also researching the possibility that it is the only known example of a class built specifically to construct all Royal Naval Dockyards across the globe.

**Mark Kěusenkothen** shoots video of the wrecksite at King's Wharf, North Arm, Ireland Island.

Although the wreck is not in the way of the planned terminal, Prof. Richards said it is possible the new generation of Panamax and Post Panamax ships to dock there could scrape their hulls on a spindle.

That structure sticks up around six feet from the stern of the ship and is believed to have been a support for a crane.

Prof. Richards is considering a number of recommendations on how to deal with the wreck, which he described as a good dive site. The most viable is cutting off the protruding section.

"That's the lowest-impact thing to be done and the cheapest thing to be done. It's probably best for everyone is that's taken off," he explained. "Cutting off one very small part of it now it's been recorded is perfectly acceptable."

However, Prof. Richards said there is also a possibility that the wash from the propellors of the cruise ships could disturb the sediment the wreck is sitting in, affecting its stability.

Another option could therefore be to completely relocate it.

"It's a very intact wreck. It's very sturdy, so there's always the possibility that it can be removed... I think it's feasible although I don't know the costs," he explained.

The team of researchers, led by Prof. Richards and Bradley Rodgers from the university's department of Maritime Studies, spent six days in Bermuda earlier this month, measuring, photographing and filming the vessel which lies in the Great Sound.

They believe it was constructed between 1880 and 1900 and sunk between 1890 and 1930.

The project was organised in collaboration with Custodian of Wrecks Phillippe Rouja and the Maritime Museum, with the $27,000 cost met by Correia Construction Company, which has the contract for the terminal project.

According to Dr. Edward Harris, Director of the Bermuda Maritime Museum, this may be the first stage of a long-term collaboration between the museum and East Carolina University to document all Bermuda's iron ship wrecks, of which there are nine in St. George's Harbour alone.

The full report from the university team is expected in around a month. It will be sent to stakeholders including Government, the Historic Wrecks Authority and the Maritime Museum.

Plans for the first phase of the new cruise ship terminal were approved by the Development Applications Board earlier this year, despite objections from parties including the National Trust and the Historic Wrecks Authority.

A Government spokesperson has previously said that no work will be carried out in the vicinity of the wreck until the full results of the archaeological survey are known.

**The Royal Gazette**
**28 December 2007**
**Page 2**

The Daily Reflector





# Professors lead research team in Bermuda

■ Students and professors used underwater cameras to study a shipwreck.

**The Daily Reflector**

A research team led by East Carolina University Maritime Studies professors Nathan Richards and Bradley Rodgers traveled to Bermuda this month to help officials there determine the origin and history of a shipwreck in Bermuda's Great Sound.

While the main aim of the archeological survey was to determine the impact of a proposed cruise ship terminal off Ireland Island, Richards said that the shipwreck is useful to his growing body of research about iron ships and shipbuilding traditions.

"There is an 'applied' aspect to this project," Richards said, "but this is a part of our ongoing research, and is sort of a follow up to the work we'd done in Hawaii."

This fall, Richards and Rodgers led a group of graduate students to the Hawaiian island of Kauai to conduct fieldwork on the shipwreck Ivanhoe.

## ECU Notes

Along with ECU Communications professor Michael Dermody, Richards, Rodgers and two students conducted the work in Bermuda through Dec. 20, utilizing underwater cameras and surveillance tools to document the 65-foot-long iron vessel, believed to be one of the original tugboats used to build parts of the Royal Naval Dockyard in the late-19th century.

Dermody, working with ECU alumnus Kevin Wells, is producing a short documentary on the research conducted by the team.

The Bermuda Maritime Museum paid $27,000 in expenses for the ECU film and underwater archeology teams. ECU graduate students Joseph Hoyt, of Maritime Studies, and Coastal Resources Management doctoral candidate Mark Keusenkothen, is assisting with the study.

*Daily Reflector* December 24, 2007, p. B1

ECU researchers Dr. Nathan Richards (Maritime Studies), Mark Keusenkothen (Diving and Water Safety) and Mike Dermody (Communications) pause at their safety stop following a dive to 50 feet. The three were taking part in a survey to help analyze a shipwreck off the coast of Bermuda. (Contributed photo)

# ECU Team Assesses Ship in Bermuda

**By Erica Plouffe Lazure**

BERMUDA — A research team led by East Carolina University Maritime Studies professors Nathan Richards and Bradley Rodgers traveled to Bermuda last month to help officials there determine the origin and history of a shipwreck in Bermuda's Great Sound.

While the main aim of the archeological survey was to determine the impact of a proposed cruise ship terminal off Ireland Island, Richards said that the shipwreck was useful to his growing body of research about iron ships and shipbuilding traditions.

"There is an 'applied' aspect to this project," Richards said, "but this is a part of our ongoing research, and is sort of a follow up to the work we'd done in Hawaii." This fall, Richards and Rodgers led a group of graduate students to the Hawaiian island of Kauai to conduct fieldwork on the shipwreck "Ivanhoe." Richards had received a $40,000 grant from ECU's Research and Graduate studies for the fieldwork.

ECU Communications professor Michael Dermody, Richards and Rodgers and two students conducted the work in Bermuda from Dec. 14 through Dec. 20, utilizing underwater cameras and surveillance tools to document the 65 foot long iron vessel,

continued on page 12

## Team Assesses Ship in Bermuda

continued from page 1

believed to be one of the original tugboats used to build parts of the Royal Naval Dockyard in the late 19th century.

Dermody, working with ECU alumnus Kevin Wells, produced a short documentary on the research. Richards noted that the group tested out a new tool that would enable them to build – underwater – a three-dimensional model of the site. The three-dimensional virtual model will allow non-divers to view and interact with the site, he said.

Through a cruise ship consortium fund, the Bermuda Maritime Museum paid $27,000 in expenses for the ECU film and underwater archaeology teams to conduct the research and produce the documentary. ECU graduate students Joseph Hoyt, of Maritime Studies, and Coastal Resources Management Ph.D. candidate Mark Keusenkothen, assisted with the study.

No matter what the archaeological assessment means for the building of the cruise ship terminal, Richards said the material they produced could be included in exhibits in the Bermuda Maritime Museum or on the Internet, and could lead to future ECU field schools being held in Bermuda.

*Pieces of Eight,* 25 January, 2008, pps. 1, 12.