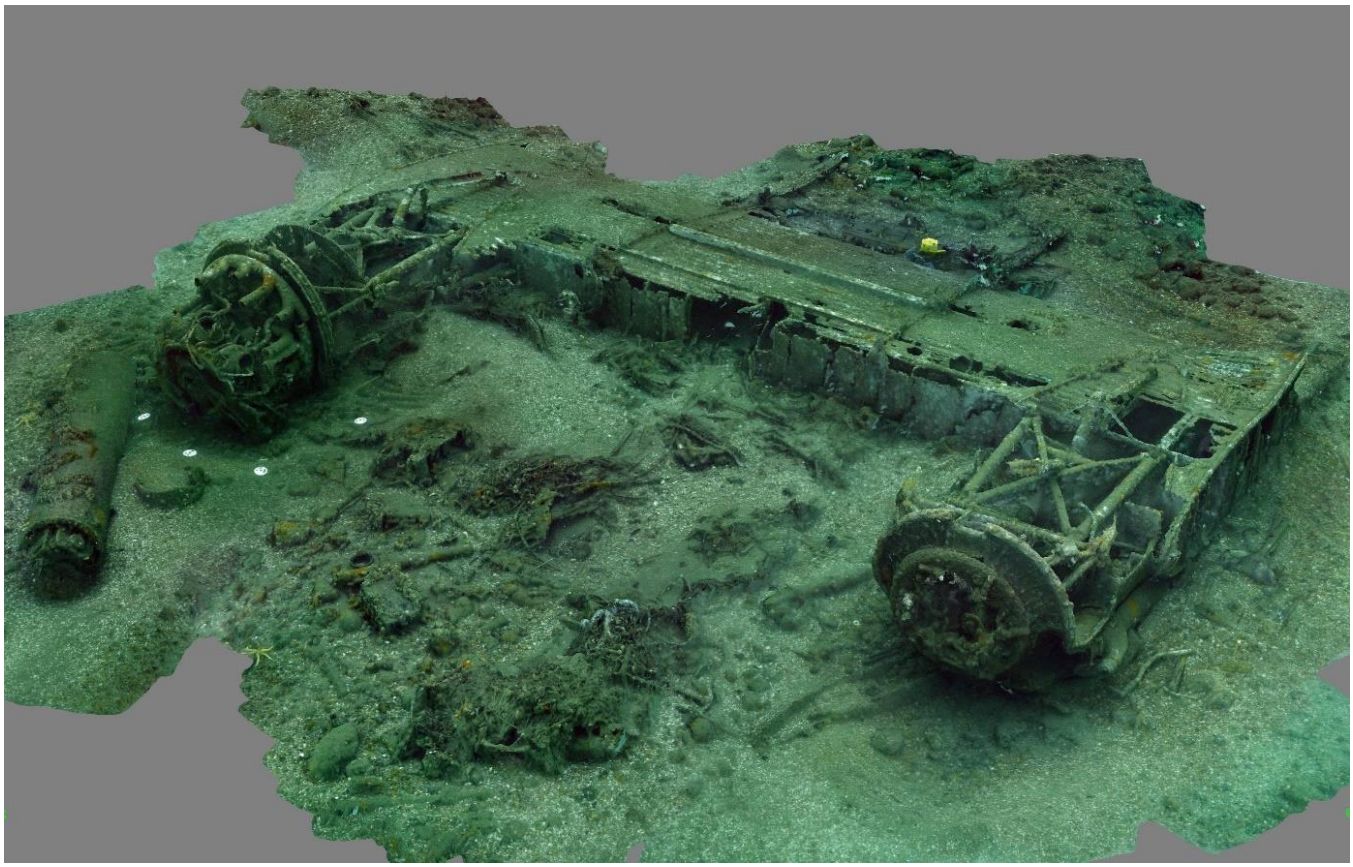
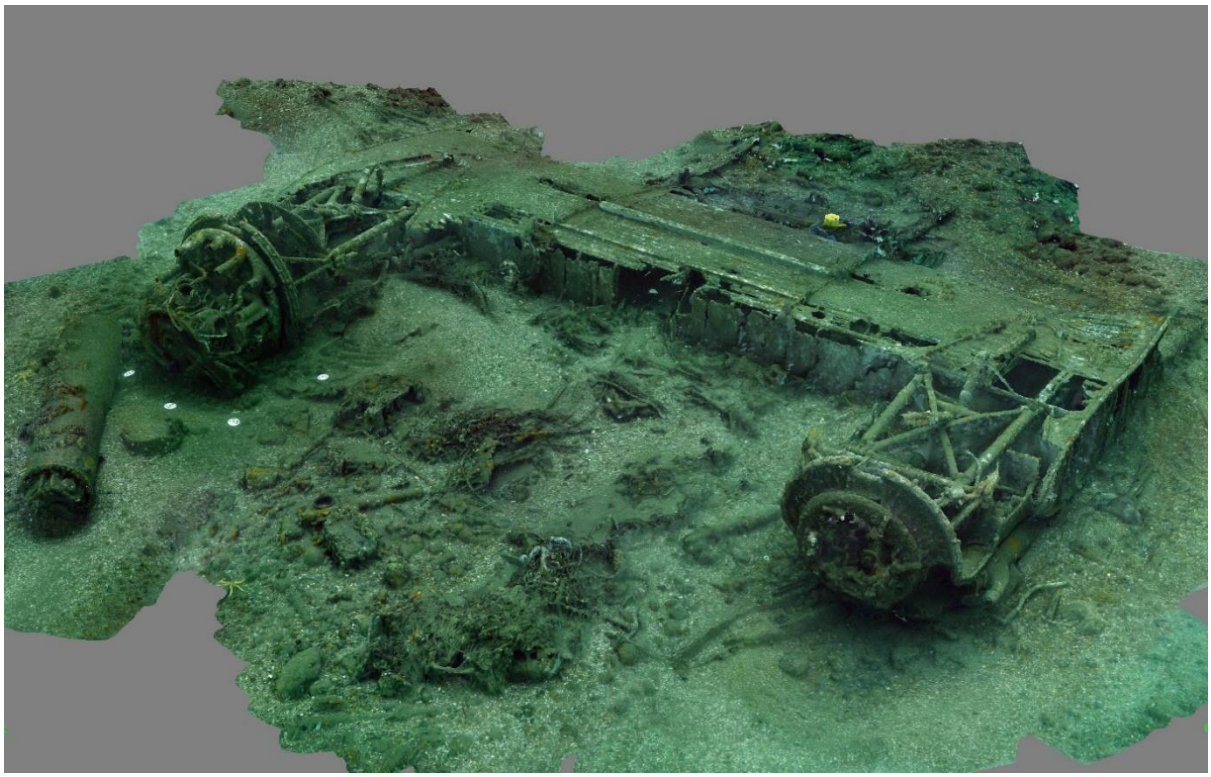
OPERATION DAKOTA



The British Sub-aqua Jubilee Trust

OPERATION DAKOTA



REPORT WRITTEN

BY

D.M.MCELVOGUE

(September 2018)

For the

British Sub-aqua Jubilee Trust

Contents

1 Table of Figures

2 OPERATION DAKOTA 2017-18

2.1 SUMMARY

In 1997 divers located the site of a plane and identified it as a possible DC3/C-47. It is 21 years since this initial identification, but still there has been no positive identification of which individual DC3/C-47 it is. It was this projects intention to relocate and record the plane over several weekends to produce a baseline 3D photogrammetric survey by:

- recording the exposed archaeology
- recording the flora and fauna

As an underwater site few people can see the remains of this plane. This project will help to facilitate none specialists and interested divers as well as none divers to access the site. A licence for surveying was not required as the project diving was on a “look but don’t touch” basis.

This report should be read with the accompanying 3D PDF of the photogrammetry of the site.

Figure 1 General view of site taken form 3D photogrammetry.

2.2 Acknowledgements

This project could not have been successful without the financial support of the British Sub-aqua Jubilee Trust. The support of the volunteers divers are acknowledged as is the skill and support of Martin Davies Southsea BSAC’s Diving Officer. Wessex Archaeology are acknowledge for giving permission to use images from their reports.

3 PROJECT INTRODUCTION

3.1 Project Aim and objectives

This project proposed to produce a baseline 3D photogrammetric survey of a plane lost in Sandown Bay, Isle of Wight. This would define its;

- current state and condition,
- identify any changes to the site from an earlier survey in 1997.

This aim has been achieved by completing the following objectives.

> Objective 1: record through digital photography and direct measurements any exposed surface archaeology on the site.
>
> Objective 2: record any flora and fauna seen whilst diving on the site.
>
> Objective 3: produce a report on the archaeology of the flora and fauna.
>
> Objective 4: produce a 3D survey of the site to facilitate non-diving access and to act as baseline survey of the site for its future management.

These objectives were facilitated by funding from the British Subaqua Jubilee Trust (BSAJT or Jubilee Trust) which facilitated *Operation Dakota*. The Jubilee Trust funding allowed a team of BSAC volunteer divers, including ex-Navy and Army personnel, to relocate and record this significant site. The financial support of the Jubilee Trust has allowed volunteer divers to work in conjunction with experienced archaeological surveyors within a single team, learn the latest in 3D photogrammetry skills and marine identification for surveys of the site.

3.2 Applicants Role

The applicant, Douglas M^{c}Elvogue, was tasked to organise the project diving with the aim of relocating the Dakota and completing a 3D Photogrammetric survey of the site. The applicant was also tasked to teach team members in the use of 3D photogrammetric photography and modelling. This entailed:

- planning all diving
- co-ordinating all divers with the dive times and free boat space
- liaising directly with volunteer divers for training in 3D photogrammetry
- ensuring all required photographs are taken and to plan further visits when required to complete the surveys
- presenting all field work and research in a report format.

3.3 Site Location

The site lies off Sandown Bay along the southern part of the Isle of Wight. It lies at an average depth of 18 metres on a low neap tide and lies on a bearing of 060 degrees.

C-47 Skytrain Position		
Latitude	**Longitude**	**Datum**
50.38.453	**001.06.322**	**WGS 84**

Table 1 C-47 Site position

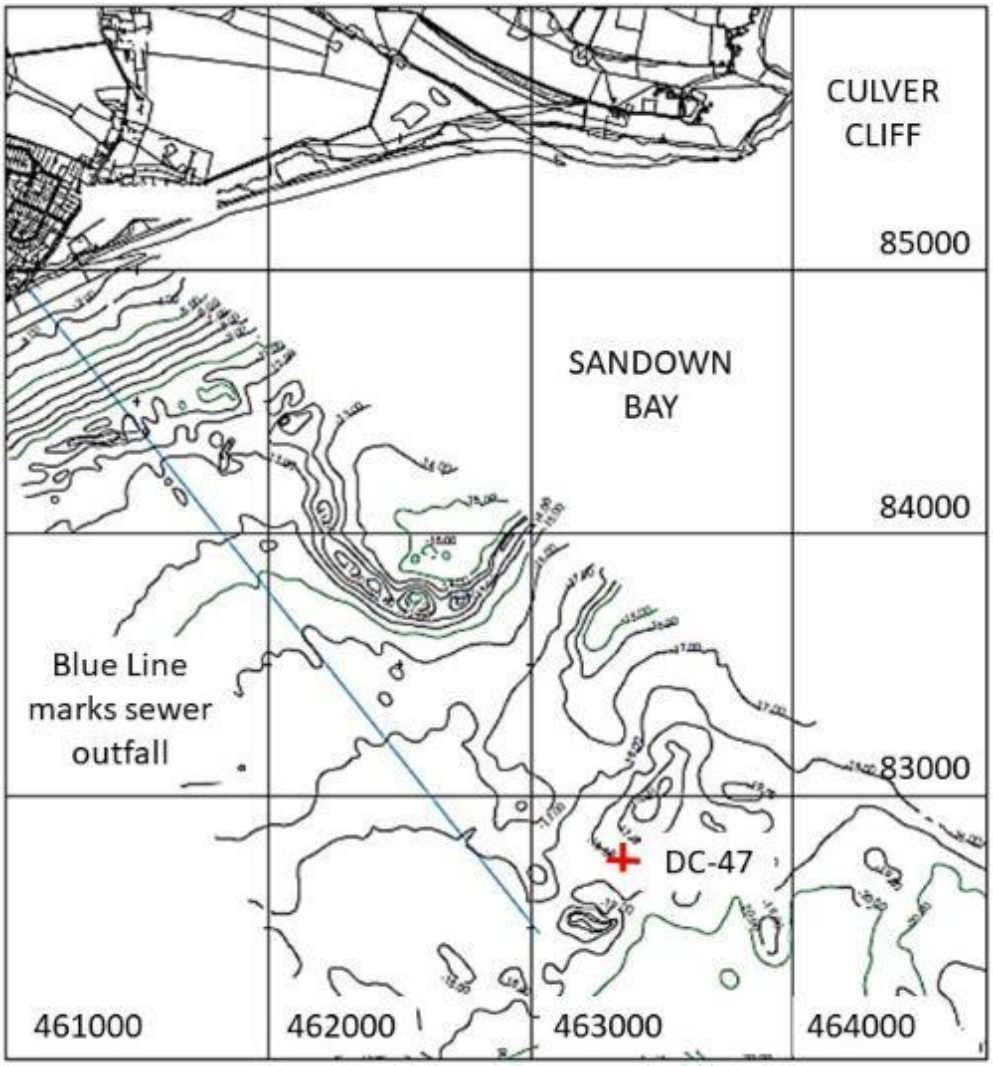


Figure 2 *Site Location map off Sandown Bay Isle Of Wight.*

3.4 Human Remains

As a plane the site was assumed to be a crash site, and as such the wreck is automatically protected under the Protection of Military Remains Act 1986 (See below). This prohibits unauthorised tampering, disturbance, removal etc on site. A further consideration was the possibility for the survival of human remains. A C-47 had five members of aircrew. These consisted of a pilot, co-pilot, navigator, radio operator and aerial engineer. In addition to aircrew the C-47 could transport up to 28 troops with their equipment (Cacutt 1988). Therefore, there could be a high possibility of human remains on site. No human remains were found during the September 1997 investigations (WA 1997b:10) nor subsequently. It is considered highly unlikely that the site contains any human remains.

3.5 Legal and administrative matters relating to diving the aircraft

As the project intended to record a known possible military crash site certain legal and administrative considerations had to reviewed, and diving on the site carried out to adhere to these legal frameworks.

3.5.1 Ownership

Crashed UK military aircraft and their equipment are the property of the Crown, unless the Ministry of Defence (MoD) has transferred ownership. Crashed US military aircraft are the property of the US Government; although the MoD acts on their behalf within UK territorial waters.

3.5.2 The Protection of Military Remains Act 1986

The Protection of Military Remains Act 1986 applies to any aircraft which has crashed whilst in military service. The act applies whether personnel were killed or not, and it is not necessary to demonstrate the presence or probability of human remains. Under the Act there are two forms of protection:

- all crash sites are automatically 'protected places',
- they may be designated as a 'controlled site'.

Various activities at 'protected places' and 'controlled sites' are prohibited unless they are carried out under the terms of a licence. It is prohibited to dive, salvage or excavate at a protected site if these activities will or are likely to tamper with, damage, move, remove or unearth any aircraft remains. A licence is required to dive on a controlled site.

The MOD issues and administer licences for activities which are otherwise prohibited. Licences are granted to a named person who must be present during investigations. Licences are generally granted for one year and may be amended or revoked.

MoD guidance for crashed military aircraft (PMA 1997) emphasises the dangers of unexploded ordnance and pyrotechnics (flares etc.). Licences are automatically suspended if ordnance/pyrotechnics are found until clearance has been obtained from the MoD to continue works. The discovery of firearms, ammunition and explosives is also subject to the Firearms Act 1968, and any such material must be notified to the police.

MoD guidance also emphasises concern for the discovery of human remains. If human remains are discovered a licence is automatically suspended and the MoD must be informed immediately. The guidance also states that it is the MoD's responsibility unless otherwise advised to trace and notify next of kin. The guidance continues to state that no account should the investigating group divulge the possible identity of aircrew to the media.

3.5.3 Civil Aviation Act 1982

Under the Civil Aviation Act 1982, crashed aircraft may constitute 'wreck' for the purposes of the Merchant Shipping Act 1995 (see below).

3.5.4 The Merchant Shipping Act 1995

Under the Merchant Shipping Act 1995 artefacts recovered from the aircraft constitute 'wreck' and therefore must be notified to the Receiver of Wreck. Furthermore, the RAF Personnel Management Agency must be notified of any items considered to be the personal property of the aircrew.

3.5.5 The Protection of Wrecks Act 1973

Aircraft are not considered wrecks under the terms of the Protection of Wrecks Act 1973 and cannot be designated under that Act.

3.6 Operation Dakota Diving Code of Practise

With the legal and administrative constraints known a set *Op Dakota* specific diving rules was formulated. This meant:

- All diving on site had to adhere to the "look but do not touch" rule.
- No objects or part of the wreck were to be disturbed and nothing was to be recovered.
- The site would be shot from down tide and the first divers had to swim up tide towards the site. The shot could then be placed carefully so as not to interfere with the site.
- For diver safety, especially in low visibility, divers could deploy a thin ground line on a reel attached to the shot to help orientate the divers back to the shot. This would not interfere with or damage the site. The ground line was recovered by the divers after each dive.
- All dives were to be conducted in buddy pairs.
- Photography, video and non-intrusive direct measurements was all that was allowed. Any other measurements could be taken from the 3D photogrammetric model.

4 BACKGROUND

4.1 Wessex Archaeology Investigation

In 1997 Wessex Archaeology (WA) was commissioned to carry out a seabed site survey of two possible wrecks off Sandown, Isle of Wight (WA 1997a), in advance of Southern Waters construction of the long sea outfall. This seabed survey was done at the request of the local County Archaeologist. Wreck A (NGR 46294 08317) was identified as a localised greensand reef standing 1.5 metre proud of the seabed (WA 1997a:2). Wreck B (NGR 46335 08274) was identified as a plane (WA 1997a:2).

Wreck B was originally identified as a wreck during a hydrographic survey in 1989 by *HMS Gleaner*. The WA diver survey between 4th and 6th July 1997 established that the "wreck" was a twin radial engine aircraft, most likely a DC3 or C-47 Dakota (WA 1997a:10-15). The site consisted of a central wing section with two engines, lower fuselage and associated fixtures plus the undercarriage and propellers (Figure 02 Wessex Archaeology site plan).

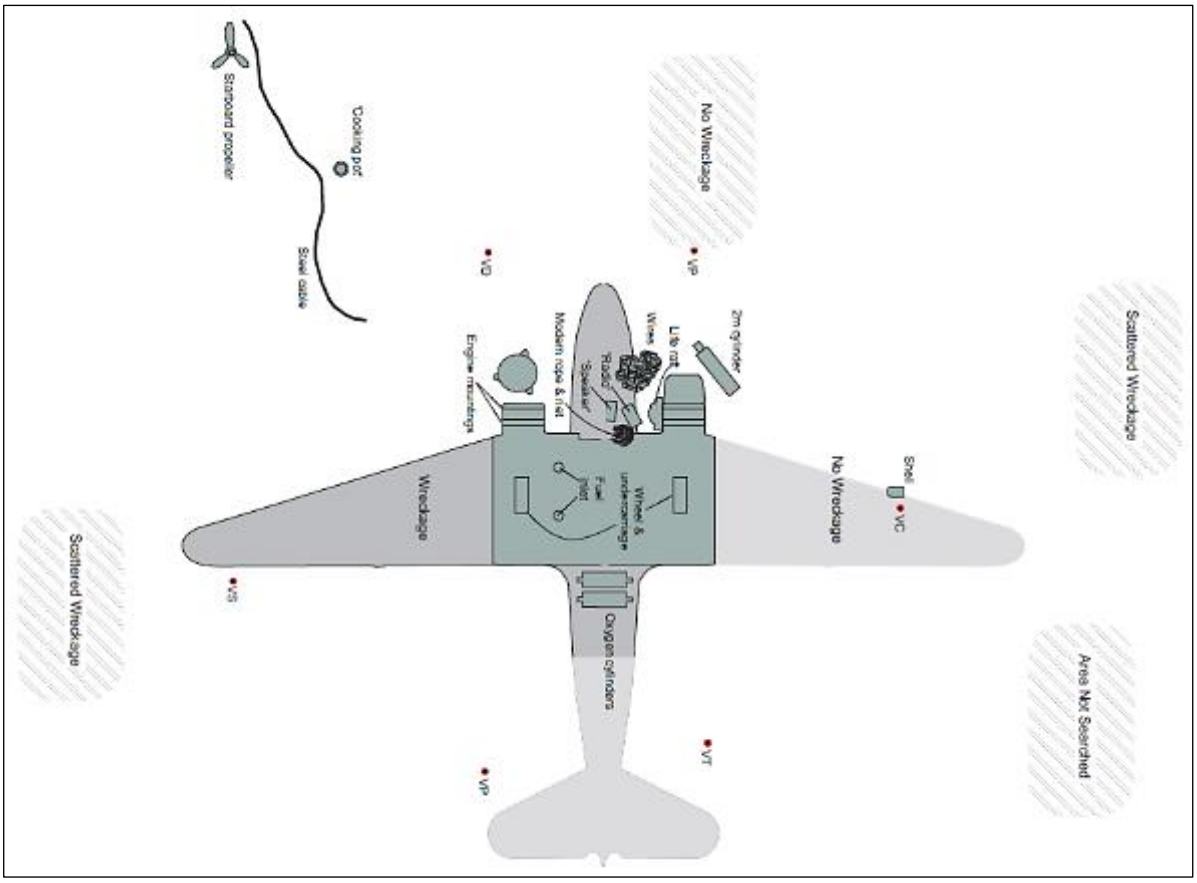


Figure 3 *Wessex Archaeology site plan (Reproduced with kind permission Wessex Archaeology)*

Following the initial phase of investigation, in the hope that further wreckage might be highlighted, the site was subject to a side-scan sonar survey by the Department of Oceanography, University of Southampton. The site was identified within the side scan sonar,

however the character of the surrounding seabed precluded clear imaging of any outlying wreckage and therefore did not provide additional direct evidence of the wreck (WA 1997b:6). Disturbances to the north and east of the wreck were noted and may be additional wreck material, but no firm conclusions could be drawn.

4.1.1 Preliminary Identification

The site was identified as a Douglas C47, the military transport aircraft version of the civilian Douglas DC-3 airliner. The Douglas C-47 was also known by the designations "Skytrain" (American Airforce) or "Dakota" (RAF). The C-47 was extensively used by the Allies during World War II and remained in front line service with various military organisations after the war (Chant and Batchelor 1980).

4.1.2 Human Remains

No human remains were found during the September 1997 investigations (WA 1997b:10).

4.1.3 Recovered artefacts

A few artefacts were removed to help identification. The artefacts underwent conservation treatment to prevent deterioration. Recovered artefacts are listed below

- 1 circular rubber seal (Ø c. 0.2 m)
- A metal tube from wreckage
- a piece of textile
- hollow copper tube with wire wrapped around ends
- truncated solid rubber cylinder returned to seabed

4.1.4 Survey pins

WA placed six steel road pins around the site to act as survey datums. They were labelled VC, VD, VP, VR, VS and VT. The pins were linked together by a groundline. The pins were used as centres for circular searches by divers out from the site to examine the surrounding seabed for further wreckage. Any outlying features were positioned by bearing and distance from the relative datum pin. The form and dimensions of each feature was measured (WA 1997b:7-8). WA left the labelled pins and groundlines on site so that they could serve as a basis for future monitoring. WA did not have time available to produce a measured survey of the extent of the remains of the wreckage, therefore their illustrations indicate the approximate layout of features on site and should not be taken as precise locations. The illustrations however proved to serve for locating parts of the site and as a comparison between 1997 and 2018 (see Figure 02). Pin VD has been found still *in situ*.

4.1.5 WA description of site features

The below descriptions are taken directly form the WA 1997(b) report.

"*To port, sections of wing - possibly the tip of the port wing - and other scattered wreckage were found lying adjacent to datum VS. Datum VS was located 8 m outboard of the centre wing to outer wing joint (see Fig. 4 L-I); the outer wing section would have extended 10.8 m*

from the joint. The seabed in the vicinity of VS consists of relatively soft and deep sediment, so some wreckage may be buried in this area. Swing searches during the initial diving investigation reported the presence of scattered wreckage beyond VS." (WA 1997b:8)

"*No wreckage was found starboard of the centre wing section with the exception of a ferrous object 250 mm in diameter, shaped like an artillery shell, located adjacent to datum VC on a featureless stone and silt seabed.*"(WA 1997:8)

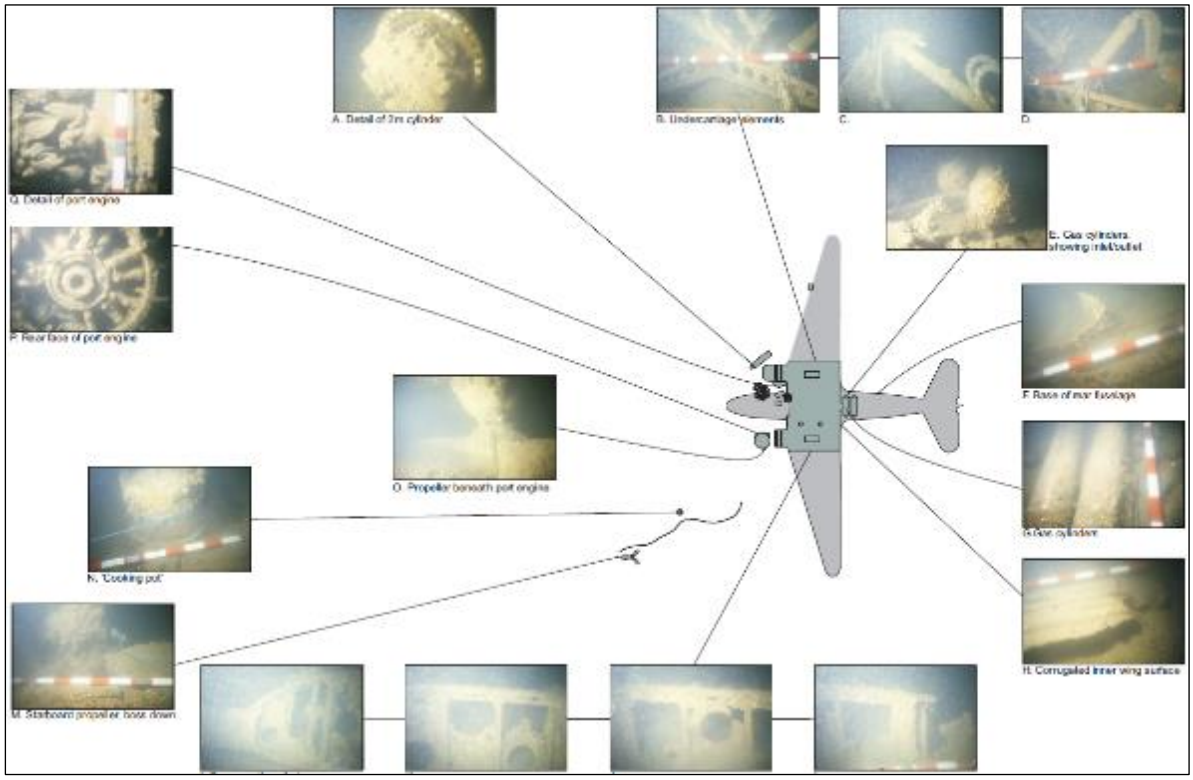


Figure 4 *WA site plan with photographs of features on site (Reproduced with kind permission Wessex Archaeology).*

4.2 2001-2006 dives

The author was part of the original 1997 WA dive team and was the first diver from that team to dive the site on 4th July 1987. As such the author continued to dive the site. This maintained a monitoring presence on the site, with a view to possibly identifying it as and when a diagnostic feature revealed itself. Throughout this period, visibility was never conducive to underwater photography nor further survey work. It was noted that the site remained unchanged. The author never revealed the position of the site to other divers nor did he advertise the site, or his monitoring work.

4.3 2007 Site Discovery Announcement

In 2007 the author dived the site in the mid-summer. Whilst underwater a local dive boat took a fix on the authors dive boat to gain the position of the wreck. It was common knowledge

that a “Dakota” had been found in Sandown Bay, but its position was not known by local dive clubs, charter dive boats or dive shops. The local divers then dived the site and announced their new “discovery” in the local press at the end of the summer. The publicity from the discovery was used to advertise local dive charters and a diving retail business. The below quote is taken from Isle of Wight County Press, September 15th, 2007.

“*Divers discovered a rare wreck of a Dakota aircraft off Sandown Bay. The exact location of the aircraft was kept secret while plans were formulated to identify the aircraft’s history. It didn’t take long for divers to find the undercarriage and its two engines, and they planned to record the engine numbers, which would enable them to identify the plane. The Dakota was the backbone of wartime transport and most RAF versions had been retired or sold off by 1950.*”
(http://www.iwcp.co.uk/news/16106026.looking-back-at-the-isle-of-wight-september-15-2017/)

4.4 2008-2017 Diving

The site has been visited by local diving clubs since 2007. This includes the BSAC Southsea Dive club which are known to have dived the site since 2008. In 2015 the Club dived the site. It is noted in photographs from then that the port engine was missing as well as the two air cylinders (Martin Davies Personal Correspondence 2018).

5 DIVING OPERATIONS

Diving operations were carried in 2017 and 2018 as part of *Operation Dakota*. The method of diving utilised Self Contained Underwater Breathing Apparatus (SCUBA) with two divers working together. All diving was conducted using open circuit SCUBA, with all team members carrying an Alternate Air Source (AAS) in the form of a 3 litre pony bottle or similar, or twin set with isolating valve. All diving equipment used was the individual's personnel kit, and was checked to be within service (2017 / 18).

Nitrox was used to extend dive times at an O2 percentage of either 36% or 34%. This ensured that all diving was no decompression diving, requiring no stops. This was an added safety feature for those requiring additional time for photogrammetry surveying.

All diving was conducted according to the BSAC Diving Code of Practice and Rules, and the *Operation Dakota* specific Diving Code of Practice and Rules. Furthermore, all diving conducted with the Southsea BSAC Club followed the Southsea BSAC Diving Code of Practice.

Diving operations were conducted from the dive support vessel *WestWood-Hoo* in 2017 (Figure 05) and *Southsea Explorer* in 2018. The international code flag Alpha was displayed during all diving operations.

Figure 5 *Westward-Hoo*

To ensure the site was not damaged or interfered with the shot line with a marker buoy was deployed on the edge of the site before diving commenced. This enabled divers to access the site safely without impacting on the site itself. The shot was removed at the end of each dive.

5.1 2017 Dives

The Op Dakota Team carried out initial dives on the site in 2017. These were planned to coincide with the 20 year anniversary since the initial finding and identification of the wreck site. These preliminary dives relocated the site and a subsequent dive allowed for visual observations of the current state of the site. A third dive was planned to start photogrammetry, but visibility proved too poor for such work. The 2017 dives suggest the

general condition of the site has deteriorated slightly over the last 20 years, but surprisingly allot of the site remains as it was in 1997. The most significant difference is that the port engine and its propeller is no longer in situ. This will be confirmed with further survey work planned in 2018.

5.2 2018 Dives

The Op Dakota team joined forces with the local BSAC club, Southsea BSAC. It had come to both party's attention that they had an interest in the site. In 2015 the Southsea BSAC Club had attempted to carry out a photogrammetric survey of the site. Therefore, a decision was taken to join forces to complete a 3D photogrammetric survey of the site and additional onsite observations. A single echo sounder survey to pin point the site was done in March followed by two dives on site when visibility reports suggested the best conditions for photogrammetry. The 3D photogrammetric plane of the site originates from these dives.

Figure 6 *Southsea BSAC club divers on Southsea Explorer before diving the C-47.*

5.3 Dive Times

The best dive times for diving the site are on neap tides, 1 hour before high water Portsmouth. This ensures the shallowest depth for longer bottom times, and empirical observations suggest the underwater visibility is always a few metres better.

Dive times for each day are as follows:

Operation Dakota Dive Times			
Year	**Month**	**Time**	**Depth**
2017	June 4th	45 / 35 /46 /36 minutes	17.3 - 18 m
2017	June 10th	43 /45 /35/ 36 minutes	18.2 - 19.1 m
2017	July 8th	54 /56 minutes	17.5 m
2017	July 22nd	Cancelled due to sea state	cancelled
2017	September 11th	Cancelled due to weather	cancelled
2018	March 26th	None diving survey	N/A
2018	2nd August	31 / 32 / 53 /53 / 30 /30	19.3 - 20 m
2018	7th September	60 / 60 / 45 /48 / 20 /22	17.2 - 18 m

Table 1 Operation Dakota Dive Times (dive times are only those carried out on site)

5.4 Underwater Diving Conditions

Diving conditions on the C-47 are variable and range from the very unpleasant to the idyllic. Diving is severely constrained by tidal conditions and the amount of 'slack' water that allows for safe diving on site. The position of the site, on the southern face of the Isle of Wight, means it is exposed to the prevailing wind from the south west and tidal flow up channel. This exposed nature also means the combined effect of tide and weather can cause difficulties for the dive boat. This is especially true when transiting to the site across open water when wind is against tide. This makes for very choppy waters giving the effect of a greater sea state then predicted by wind conditions alone. Several dives were cancelled due to higher sea states then predicted by weather forecasts. It also meant anticipated slack water times are shorter than anticipated.

Diving is best left until late June at the earliest or better still mid-July and August. This is after any plankton blooms have dissipated, and during the summer months when rain and runoff from the shore, and fewer storms should mean less turbidity in the water.

The site though is noted for having poor visibility, so whilst other off shore sites were experiencing good visibility the C-47 was still had poor underwater visibility. September is noted as being variable for weather and October, whilst offering days of good visibility was notably darker underwater.

Figure 7 Divers experiencing poor visibility on site.

5.5 Photogrammetric Survey

The 3D photogrammetric survey was carried out over two dives in 2018. Each survey took over 1500 photographs. The 3D photogrammetric surveys used up to 650 photographs each to produce their 3D models. The main area of the site was captured and has proved invaluable to interpret the site. This has shown that there is more of the C-47 between the engine mounts then can be seen whilst diving. It also highlights the linear nature of the features on the seabed.

Figure 8 *Diver Martin Davies carrying out a photogrammetric survey in good visibility.*

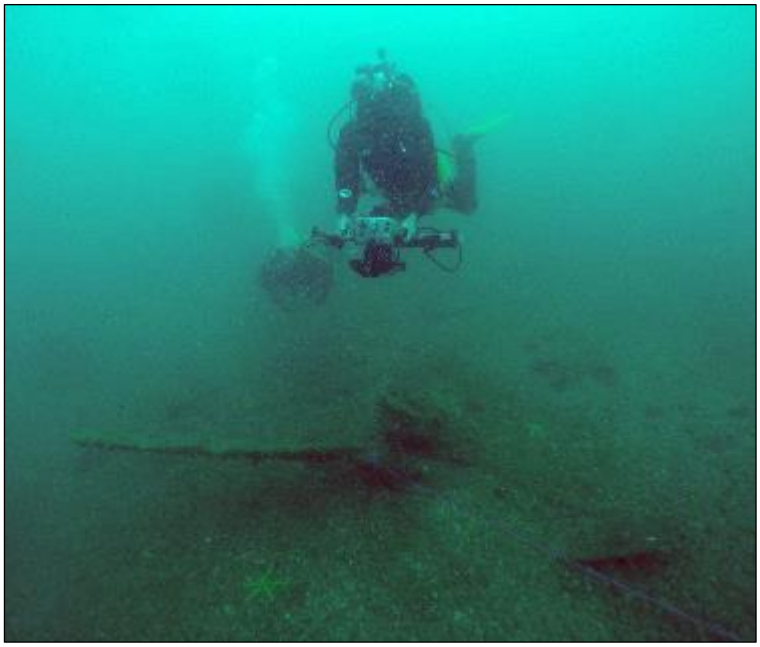


Figure 9 *Diver Martin Davies carrying out a photogrammetric survey in good visibility.*

In 2019 it is hoped to extend the area of the 3D photogrammetric survey to include areas over the port and starboard wings, the after fuselage and forwards towards the remaining propeller.

6 PHOTOGRAMETRY PRODUCTS

The photogrammetric survey produced a 3D model of the site. This is a fully interactive model allowing the user to zoom in and out of the model as well as around it. This has been sent as a sperate 3D PDF to be used alongside this report. The below screen shot has been taken from the 3D PDF model.

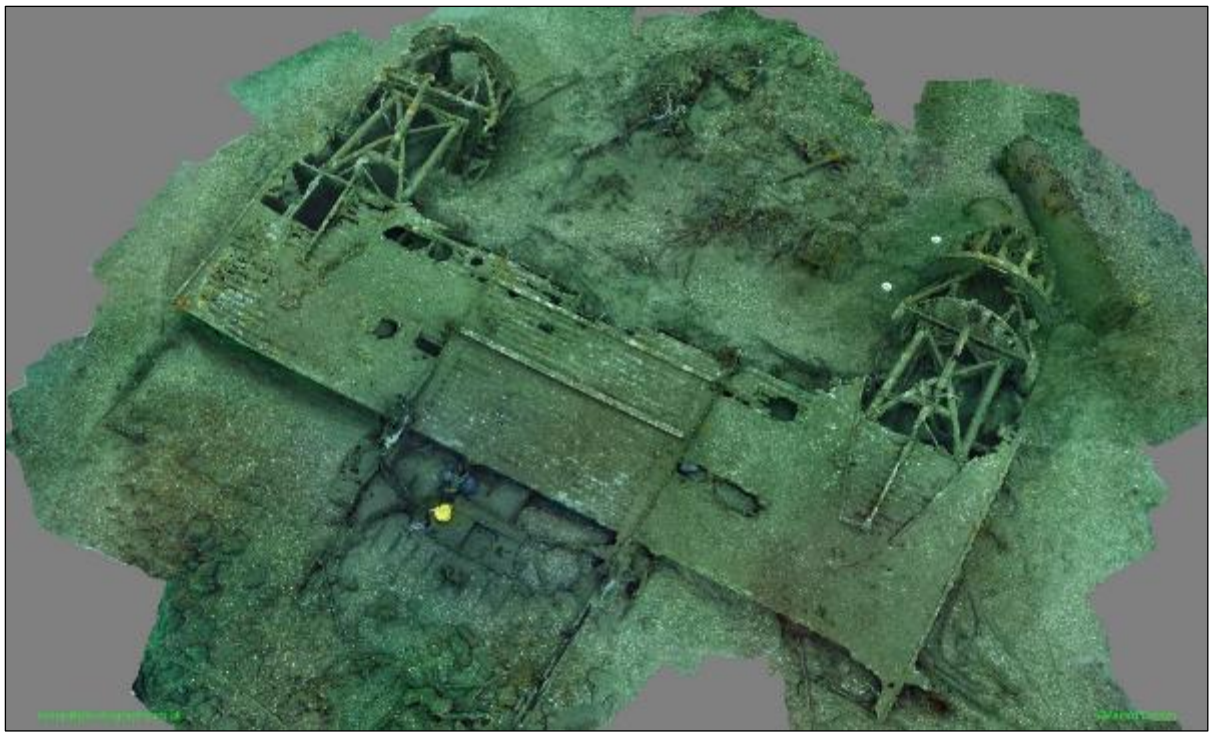


Figure 10 *Screen shot from 3D photogrammetric model of a plan view of the central wing section.*

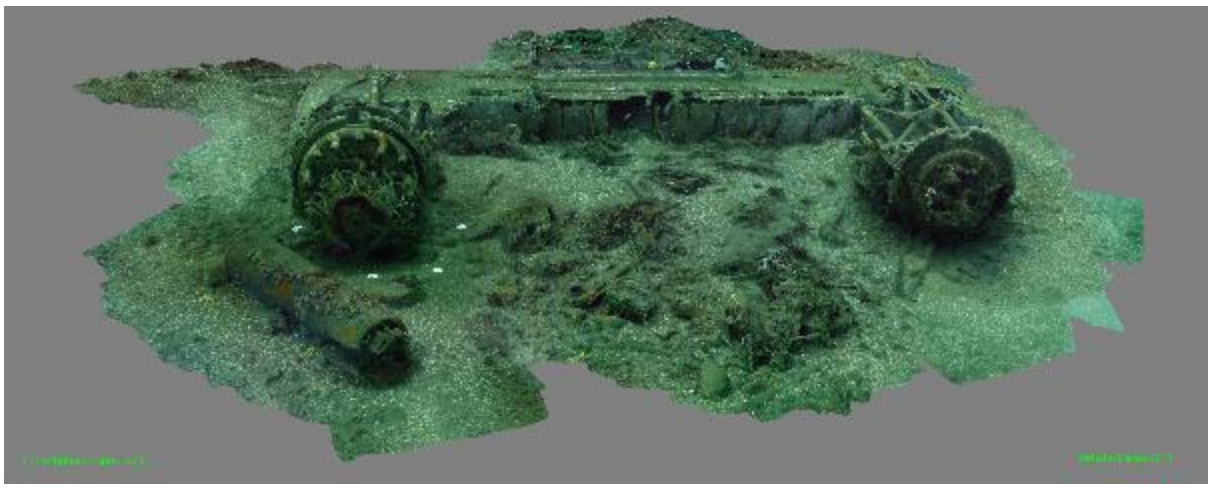


Figure 11 *Screen shot from 3D photogrammetric model of the central wing section looking forward of the engines back towards them.*

7 SITE DESCRIPTION

7.1 Seabed

The seabed generally comprises greensand out crops interspersed by small boulders and cobbles within an area of soft sediment, fine silt and sand. The seabed and some parts of wreckage are buried within this fine sediment to a shallow depth. As the site could not be disturbed, estimates of depth of sand are based level of burial. Visible wreckage is covered with marine growth (see below), and in areas has been buried up to an estimated 100 mm in sand.

7.2 Flora and Fauna Onsite

Note: A qualified marine biologist was not part of the team. Therefore, all identifications are general and not specific to subspecies.

The site is an oasis within a relatively barren seabed. This was confirmed by swimming 30 metre ground lines laid on transits running North, East, West and South from the main site. These dives were carried out in 2017 when visibility was poor, and photogrammetry was not viable. Abundant fauna was not noted more than 10 metres from the site, whilst the flora was limited to those species that grow on isolated rocks.

7.3 Fauna

Species seen on site and identified with certainty include:

- *Pandalus montagui* - Pink shrimp
- *Homarus gammarus* - Common lobster
- *Pagurus bernhardus* - Common hermit crab
- *Cancer pagurus* - Edible crab
- *Necora puber* - Velvet swimming crab
- *Conger conger* - Conger Eel
- *Trisopterus minutus* - Poor-cod
- *Trisopterus luscus* – bib / pout
- *Labrus bimaculatus* - Cuckoo wrasse
- *Parablennius gattorugine* - TomPot Blenny
- *Asterias rubens* - Common Star Fish

Off interest are the three large conger eels living near to each other on site. They are proof of the site acting as an oasis within what would otherwise be a barren sea bed. The existence of the conger eels also suggest that divers do not regularly visit the site.

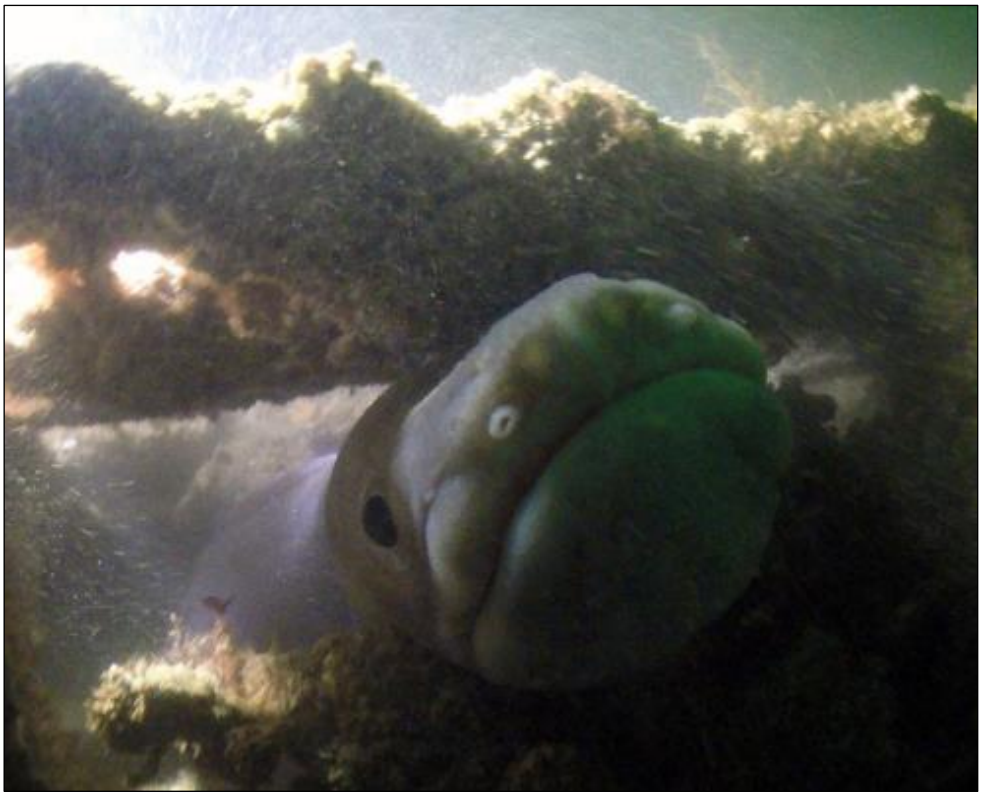


Figure 12 *Close up of Conger Eel 2 as it came out of its hole to inspect the camera.*

7.4 Fauna

Note: The Op Dakota Specific Diving Code of Practice and Rules forbid the taking of samples for further identification.

Due to the depth of the site there is no kelp and very little heavy growth of fauna. The aircraft its self is covered in a concretion which appears to have prohibited growth on the planes structure. Fauna seen and recognised in situ are listed below:

7.4.1 Seaweeds and angiosperms

- *Plocamium cartilagineum*
- *Corallina offcinalis*
- *Lithophyllum crouanii*
- *Phytomatolithon purpureum*
- *Delesseria sanguinea*
- *Drachiella spectabilis*
- *Callophyllis laciniata*

Figure 13 *Seaweeds growing on site.*

7.4.2 Sponges

- *Suberities domuncula* – Sea-orange or sulphur sponge
- *Myxilla fimbriata*

7.4.3 Anemones

- *Actinothoe sphyrodetaI*
- *Alcyonium digitatum* – Dead-man's fingers

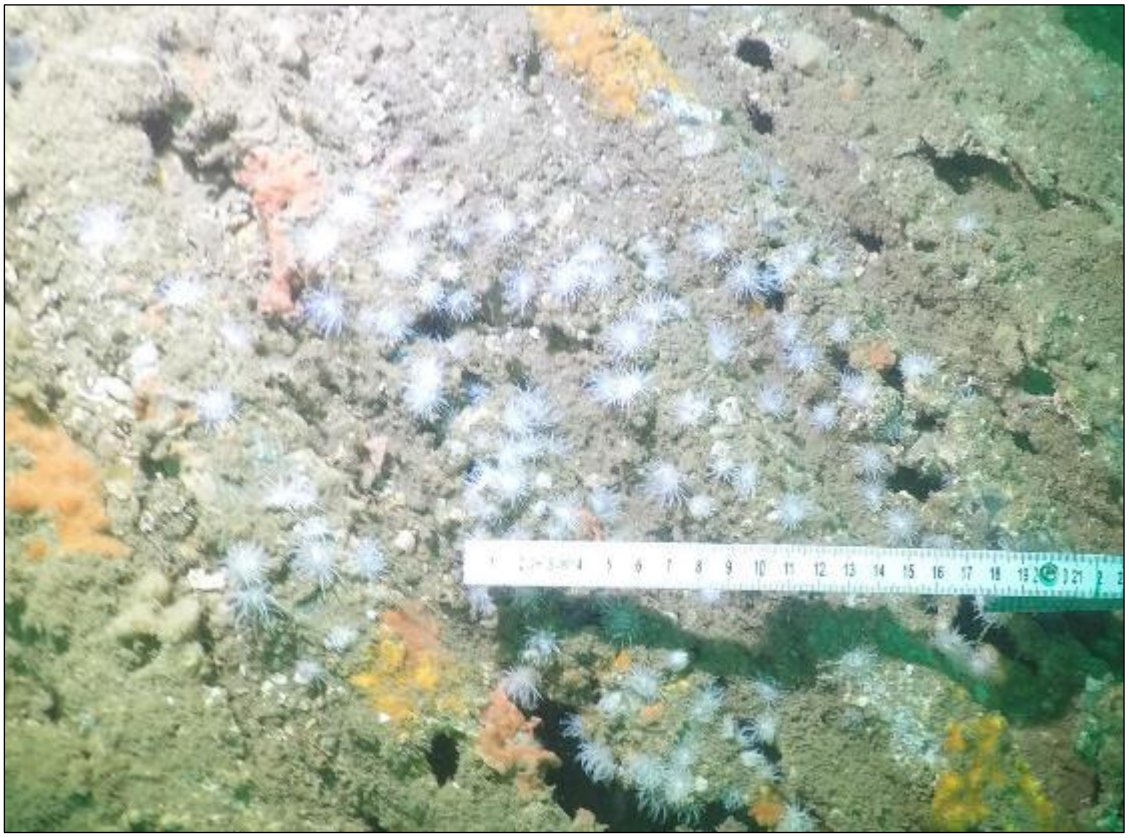


Figure 14 *Anemones growing on the corrugated inner skin of the C-47.*

7.5 Site Remains

The main cohesive part of the site consists of the centre wing section of a C-47, from the bulkheads either side of the two engine mounts (see Fig. 10). These bulkheads represent the joints at which the port and starboard outer wing sections were once attached. There is no further fuselage apparent between the engine mounts, such as the cockpit area. The engine mounts are 5.650 m apart between its centres whilst it is c. 8.250 m long from bulkhead to bulkhead. These measured dimension compare with those form 1997 (WA 1997a and b)

7.5.1 Aircraft Skin

The smooth outer skin of the wing section does not remain. Instead the corrugated sheet metal of the inner skin remains. (seen in figure 14). The corrugations run perpendicular to the leading edge of the wing of the aircraft and runs the entire width of the wing section. Just inboard of the port engine fairing are two holes. They are 0.772 m from the leading edge and 0.942 m between their centres. These had rubber seals/grommets in situ when first found. These were recovered by WA in 1997. The diameter of the grommets is 200 mm (WA 1997a).

7.5.2 Bulkhead

The outer edge of each wing comprises a longitudinal member over 4.252 m long and 0.653 m high at its highest point. This corresponds to the joint at which the outer wing was attached by bolts (Figure 15). The portside joint is perforated by a series of circular holes which follow the series from the leading edge aft as; single, single, single, single, double, single, single, double, single, single, single, single. The starboard wing is more corroded but has similar features. Other longitudinal members are visible in the top surface of the wing section, as is at least one transverse member.

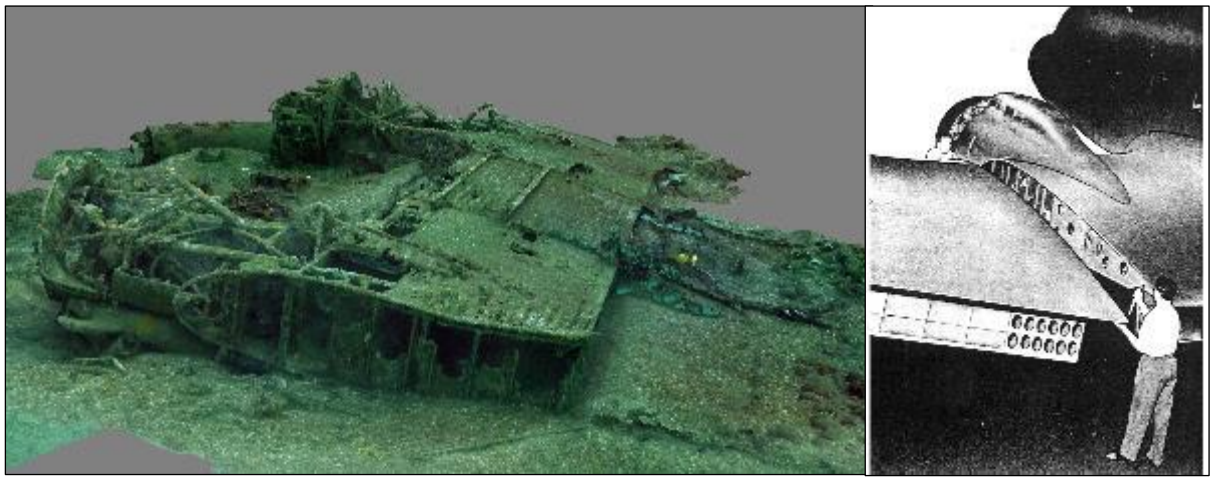


Figure 15 *Comparing the C-47 on site with the maintenance manual.*

7.5.3 Outer Wings

The outer wings are not visible as a coherent structure. There is evidence within the seabed sediments either side of the bulkheads for the lower part of the wings. This consist of light aluminium struts and partial pieces of corroded sheets (Figure 16).

Figure 16 *Parts of the outer wing struts uncovered in 2015.*

7.5.4 Engine Mounts and Struts

Both engines resided in mounts. These mounts remain in situ and comprise two circular 'flanges' which extend a distance out from the wings leading edge on tubular struts. The topmost struts run along the upper surface of the wing. The cowlings that would have surround the engine mounts and engines no longer survive.

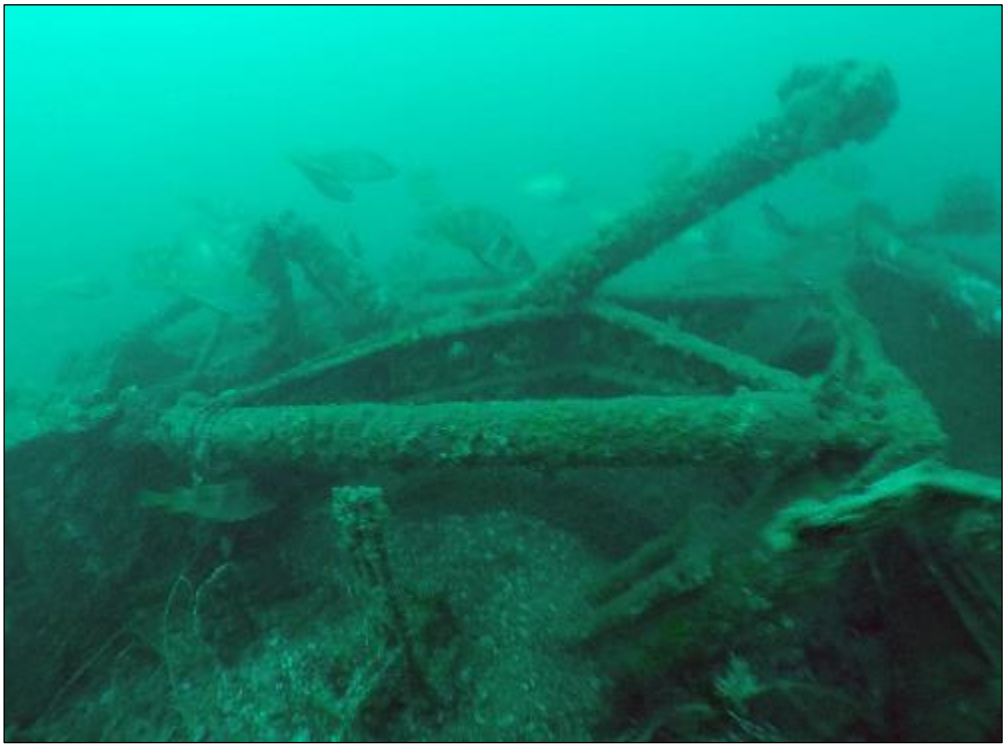


Figure 17 *The long hydraulic jack within the engine mount, and behind it a shorter hydraulic jack. The X shaped metal cross brace is also visible.*

Aft of each flange, and within the struts, are several diagnostic features. These include the aircraft's landing gear which comprises of a wheel, surrounded by elements of its undercarriage. Only the top of the tyre is visible. Its maximum visible dimensions are 0.804 m length and 0.402 m wide. The undercarriage consists of a long hydraulic jack projecting upwards towards the back of the engine mount, and behind it a shorter hydraulic jack projecting up towards the trailing edge. An X shaped metal cross brace is also visible (Figure 17).

7.5.5 Engines

The starboard engine is still in situ on its mount (Figure 17). Its propeller is detached and lies 25 metres forward of the port engine. The port engine in no longer on site (see conclusion), though was noted to lie in front of the port engine mounting in 1997 and 2007. When first found the engine stood upright in front of its mounting. The port engines three bladed propeller was still attached, and it was this that it stood upon. Both engines were radial engines and consist of two banks of seven cylinders each, making a total of fourteen cylinders.

Figure 18 *Starboard Engine still lying in situ.*

7.5.6 Propellers

The blades of the propellers are 1.66 m long. The port engine propeller is on longer on site having disappeared along with the port engine. WA reported that it did not appear to be feathered and had no visible sign of damage. The starboard engine propeller lies forward of the port engine. It is partially buried but still intact with all 3 blades serving. It lies boss-down (Figure 18). The boss and two of the propeller blades are partially buried whilst the third blade projects upwards at an approximate angle of 30 degrees. Lying on the seabed by the propeller

is a small piece of aluminium sheet and some angle bar and represent parts of the wreckage. A steel wire 15 mm in diameter runs from the main part of wreckage past the propeller and continues out in a loop. The end of this wire was not located.

Figure 19 *Starboard propeller lying on the seabed.*

7.5.7 Tail section

There is no evidence for the tail section on the seabed. Fuselage structure would suggest parts of it may survive buried un the sediments. It would be expected that a large piece such as the rear landing gear would be viable if it survived in situ. Therefore, it is considered that the tail section was detached upon sinking.

7.5.8 Radio Equipment

Lying inside of the starboard engine is a rectangular object measuring 0.50 m by 0.25 m. Inside the rectangular object are two hollow open-ended cylinders and a reel. On its upper surface can be seen a series of brass/copper cylinders (Figure 19) These look like a belt of machine gun ammunition. They are upon closer inspection hollow cylinders with wire wrapped around one end. The object is most probably the remains of the planes radio equipment. Nearby this possible 'radio' is another box-shaped object 0.605 m by 0.302 m. Its uppermost face has a shallow oval recess made from a concreted material which is reinforced inside by interwoven wire. It is possible it a speaker.

Figure 20Figure 19 *Possible radio equipment lying in situ (left is the top right is the side)*

The location of this equipment corresponds to the radio operator's position within the aircraft (see C-47 cutaway, item 28 in Cacutt 1988: 198-9).

7.5.9 Air Cylinders

When found in 1997 there were two air cylinders which lay 5.50 m beyond the centre part of the trailing edge of the central wing section, perpendicular to the centreline. Evidence for neither cylinder has been seen since 2007. The cylinders were of the same size being 1.10 m long and with a diameter of 0.48 m round-ended with threaded necks at both ends. Fitted within formed recesses along the cylinders were three transverse bands and three longitudinal bands. In 1997 cleaning revealed a yellow coating over metal (WA 1997b:9). The cylinders resembled gas cylinders and appeared to be made from welded plate. This would suggest they were low pressure air cylinders rather than modern extruded high-pressure cylinders. Their position within the plane fuselage (see Figure 02) would suggest they had been fitted internally and possibly connected to the planes internal low-pressure constant flow system described in the C-47 Maintenance Manual: '*Two yellow-lacquered cylinders, Army Type J-1, are placed on the floor opposite the main cargo door and are held in position by temporary straps*' (Section IV Para 20: 595-6).

This formed part of a low-pressure constant flow oxygen system for long range flights or when carrying troop personnel. As the C-47 Maintenance Manual states the oxygen systems, '*are furnished only when the cargo compartment is used for troop personnel or when a long range flight is anticipated*' (p. 596).

7.5.10 Hollow Cowling

A hollow circular metal object 480 mm in diameter and 300mm high is located forward of the port engine flange. It is open at the bottom and has a flange protruding from its outer rim (Figure 20). The upper face is convex with a small central hole whilst the outer edge is crenelated. The function of this object is open to interpretation, but it might from part of the cylinder lying beside the starboard engine (see below).

Figure 21 *Cowling on seabed forward of the main wing section.*

7.5.11 Cylinder

Lying on the seabed outside and in front of the starboard engine is a metal cylindrical object (Figure 21). It is 7 ft 6 inches long and 20 inches in diameter. Certain features can be seen at either end of the cylinder including:

- a rubber seal tacked to a rim,
- square projections protruding from one face,
- on the projection circular Bakelite boxes held in place with brass bolts
- wires from the Bakelite boxes to the main body of the cylinder,
- a ferrous plate on the main body of the cylinder,
- circular features in the other ends face, most probably inspection hatches.

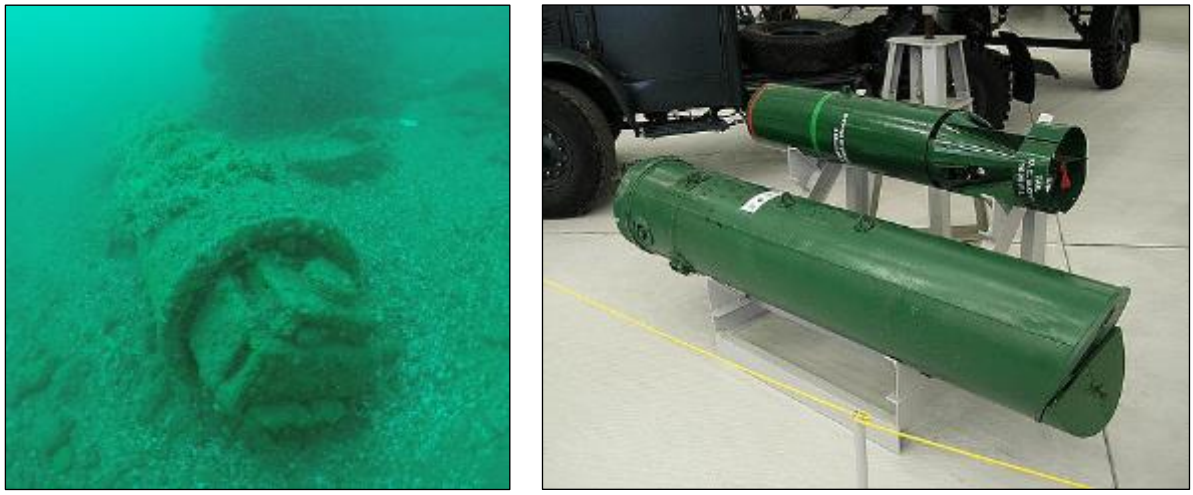


Figure 22 *Possible Mark V Anti-Shipping mine in situ and on display at IWM Duxford.*

The function of this object is unknown. It has been suggested that it might be an external parachute delivery pack or a mark 5 air deployable sea mine.

7.5.12 Debris

The main section of wreckage is surrounded by a debris field consisting of small pieces of corroded metal sheet. This extends up to:

- 9 m outwards from the port and starboard wing bulkheads
- 11 m behind the trailing edge.
- up to 30 m in front of the wreckage towards and past the starboard propeller.

Immediately in front of the wing to 3.50 m distance out the debris is a mass of 3 mm diameter wire. This mass consists as individual wires, twisted pairs, and twisted pairs in shielding with terminations. These terminations consist of “Amphenol plugs”, the recognised standard cable termination within the aviation industry.

Figure 23 *Mass of wire with Amphenol plug evident in the middle.*

Behind the centre wing section, the debris appears in a coherent linear pattern in line with the expected line of the missing fuselage. This suggests the base of the fuselage could still survive buried beneath the sediment.

Figure 24 *Cloth including webbing-like material with a herring bone pattern weave.*

All around the site there is evidence for cloth including webbing-like material with a herring bone pattern weave. This noted in 1997 and 2018. In 1997 a sample of cloth was taken from material protruding from the seabed by the starboard wing section (WA 1997a). The material consists of very fine pale threads and is thought to possibly be parachute silk. More of this material was noted to lie in and around the wreckage, including a large mound 7.5 m to the back of the plane and a conspicuous pill intermingled with the mass of wire.

Near the cowling / cooking pot is a steel wire, approximately and at least 25 m long. It runs out away from the centre of the wreck towards the surviving propeller. Here it continues along the seabed in loop.

Throughout the site there is modern debris, primarily the remains of fishing net, fishing weights and rope. Due to amount of fauna observed on site it should be expected that it is a known fishing area.

Figure 25 *Side view of C-47 taken from the 3D photogrammetry. Note the possible Mark V mine in the foreground, starboard engine hanging off its mount and large debris field between the two engine mounts.*

8 PLANE IDENTIFICATION

The site has always been identified as a C-47 Dakota from the later part of the Second World War. This is partially due to the large number of aircraft losses during that period and that any post war losses would have bene well reported and known. Individual diagnostic features noted on the wreck were compared by visual observation and direct measurement to two primary sources:

- G-DAKK – an aircraft still in flying order based at Bournemouth International Airport,
- and the C-47 Maintenance Manual.

8.1 Diagnostic features

Features noted in situ on the wreck that support its identity as a C-47 include:

- the distance between the centres of the two engines 5.6 m
- the breadth of wing at c. 4.25 m
- a corrugated inner wing surface
- the inner wing section to outer wing section bulkhead being perforated by series of round holes identical to those expected on a C-47
- the 14-cylinder radial engines in two banks of 7 cylinders
- size and shape of surviving propellers
- the position and form of the fuel inlets with their associated rubber Grommets.
- the perforated X-shaped cross brace for the undercarriage
- the undercarriage short jack,
- the long undercarriage retraction jack
- the pair of low-pressure cylinders observed behind the centre wing section

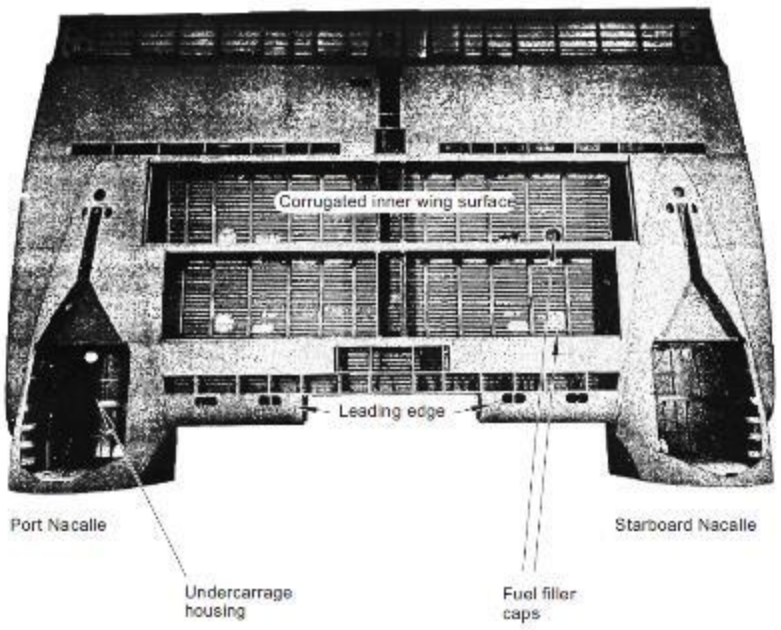


Figure 26 *Comparison to the C-47 maintenance manual diagram of the central wing section.*

8.2 Individual plane identity

The MoD maintains an index of military air crashes. It is probable that this C-47 is referenced within the index. However, searches can only be carried out using the:

- Aircraft Number
- Date of Loss
- or Name of Casualty.

Unfortunately, searches cannot be conducted using geographical location or aircraft type. To date the aircraft cannot be identified from this data.

To identify an individual plane, it is usual to look for the aircraft's manufacturers name plate containing the model number, the factory serial number, the military contract number, and the date of acceptance by the customer. For a C-47 the main manufacturers name plate should be riveted to the cockpit bulkhead. This bulkhead does not survive, and no trace of the name plate has been found in the debris field between the engines.

Engine nameplates were riveted to the forward case of each engine. No serial numbers have been seen on the surviving starboard engine. The propeller has also been inspected for any identifying marks. None have been seen. Other identifying numbers were stencilled onto the aircraft fuselage, which does not survive.

Without a manufactures name plate historical research is the only path to identify the plane. To do so, consideration needs to be given as to the plane's history.

8.3 Plane Type History

8.3.1 Douglas DC-3

The Douglas DC-3 was a fixed-wing propeller-driven aircraft built in the 1930s and 1940s. It had a cruising speed of 207 mph (333 km/h), capacity of 21 to 32 passengers or 6,000 lbs (2,700 kg) of cargo and a range of 1,500 mi (2,400 km). Compared to previous aircraft it was fast, had good range and could operate from short runways. Furthermore, it was reliable, was easy to maintain and was fitted to carry passengers in greater comfort then before, including a 24-bed long haul version. As such it revolutionised the airliner industry. Civilian DC-3 production ended in 1942 with a total of 607 aircraft. The civilian aviation market was flooded after the war by surplus ex-military C-47s (Cacutt, L. (ed.) 1988). This resulted in the failure of an upgraded DC-3 which was then superseded by more advanced aircraft. There are no pre-war reported DC-3 crashes off the Isle of Wight (WA 2008).

8.3.2 Douglas DC-47 Skytrain

The military version of the DC-3 was designated the C-47 Skytrain. A total of nearly 13 000 DC-3s/C-47s were built not only in the USA but also in Russia and Japan. They continued in US Military use until the late 1960's and in converted civilian use until present day. There are still

nearly 700 C-47 in use in a civil and military configuration (Cacutt 1988). There are several C-47 reported lost in the English Channel.

8.3.3 Dakota

The RAF took delivery of nearly 2,000 C-47s Skytrains under the lend-lease arrangement. These planes flew throughout British and Commonwealth service. The RAF's designator for the DC-47 "Skytrain" was "Dakota", probably inspired by the acronym "DACoTA" which stood for the **D**ouglas **A**ircraft **C**ompany **T**ransport **A**ircraft (Cacutt, L. (ed.) 1988).

8.3.4 Dakota II

The RAF ordered nine C-53 Skytroopers under the lend lease scheme. These planes were specifically designed to carry troops (Cacutt, L. (ed.) 1988). They differed from other RAF Dakotas as they lacked wide cargo doors and a reinforced floor.

8.3.5 World War II

The C-47 was used throughout world War II in all major theatres from Europe to the Far East and Pacific (Flintham 1990). Its abilities, particularly to operate off short runways, its speed and range were instrumental to the success of many Allied campaigns, especially in the Far East. Campaigns in which the C-47 operated include but are not limited to:

- Guadalcanal
- New Guinea
- Burma
- the Battle of Bastogne
- flying "The Hump" from India into China
- the invasion of Sicily
- Operation Overlord, Para troop drops in support of the D-Day Landings
- Operation Market Garden in support of the invasion of Germany
- And immediately after the war the Berlin Airlift.

The ubiquitous nature and use of the C-47 throughout World War II makes it one of the most significant transport aircraft ever produced. However, despite this there was only one operation which would account for the location of the Sandown C-47, Operation Neptune and the troop deliveries by parachute in support of the D-Day Landings. All other C-47 operations within the European theatre saw C-47's flying east out over Kent, Essex and East Anglia (Figure 27) not Dorset, Hampshire and the Isle of Wight (see Figure 28).

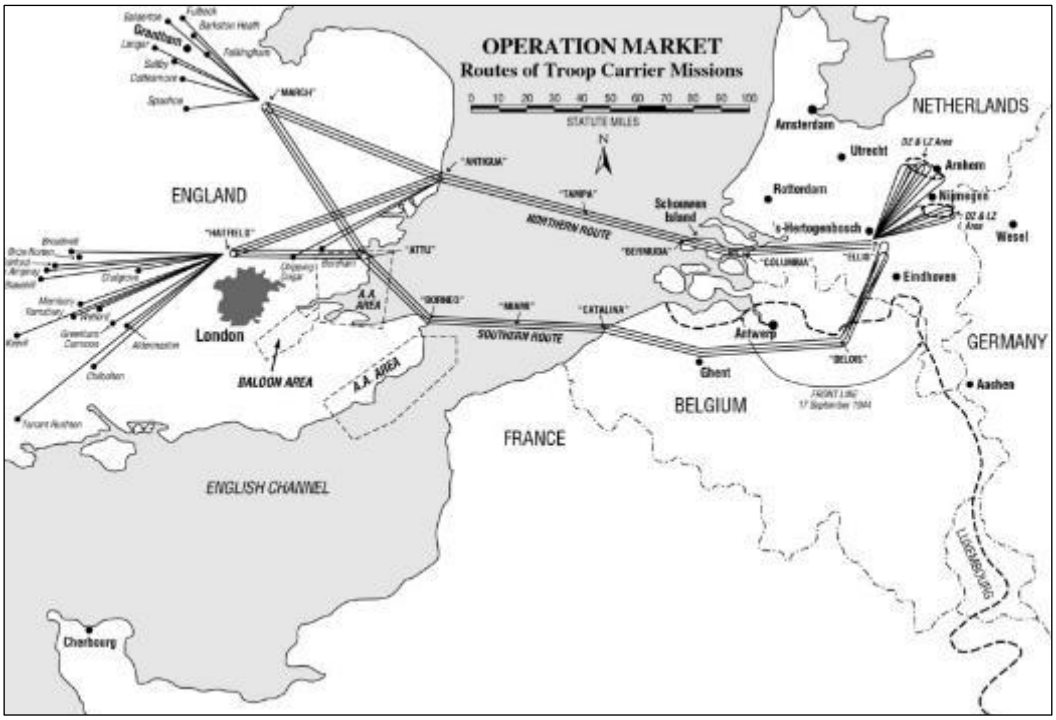


Figure 27 *Flight paths of troop carriers for Operation Market Garden (17–25 September 1944)*

8.3.6 Post-war era

The United States Air Force's Strategic Air Command maintained Skytrains in service from 1946 through to 1967. The US Air Force's 6th Special Operations Squadron flew C-47's until 2008 (Flintham 1990). It is unlikely this C-47 is the remains of a post war era plane, as any crashes would be noted and reported.

8.3.7 Operation Neptune

Operation Neptune was the precursor of Operation Overlord, the Battle of Normandy. It was the Allied operation to gain a bridgehead in Europe to launch the invasion of German-occupied Western Europe. The operation was launched on 6 June 1944 with the Normandy landings (commonly known as D-Day). During Neptune, a 1,200-plane airborne assault preceded the amphibious assault, involving more than 5,000 vessels, on the Normandy beaches. The assault on 6 June carried up to 160,000 troops across the English Channel and resulted in more than two million Allied troops landing in France by the end of August.

The D-Day landings are commonly associated with a seaborne assault. The airborne assault is often forgotten or its significance is not fully realised. Research utilising the original post war report on the air operations confirms no loses over the channel on the way too Normandy (Warren 1956). All loses occurred over Normandy during the drops or as the C-47s returned home having delivered their cargos. All loses have been researched and 2 possibilities have been identified;

- one plane returning from D-Day landings with damage, reported lost off the channel.

- one plane returning from a supply run “lost of Portsmouth”.

Further historical research will be needed to inform the project which of these two plane is most likely the C-47 off Sandown Bay. Historical research in the UK and USA will be conducted over the winter of 2018 / 2019 to hopefully positively identify this C-47 for the first time since it was found.

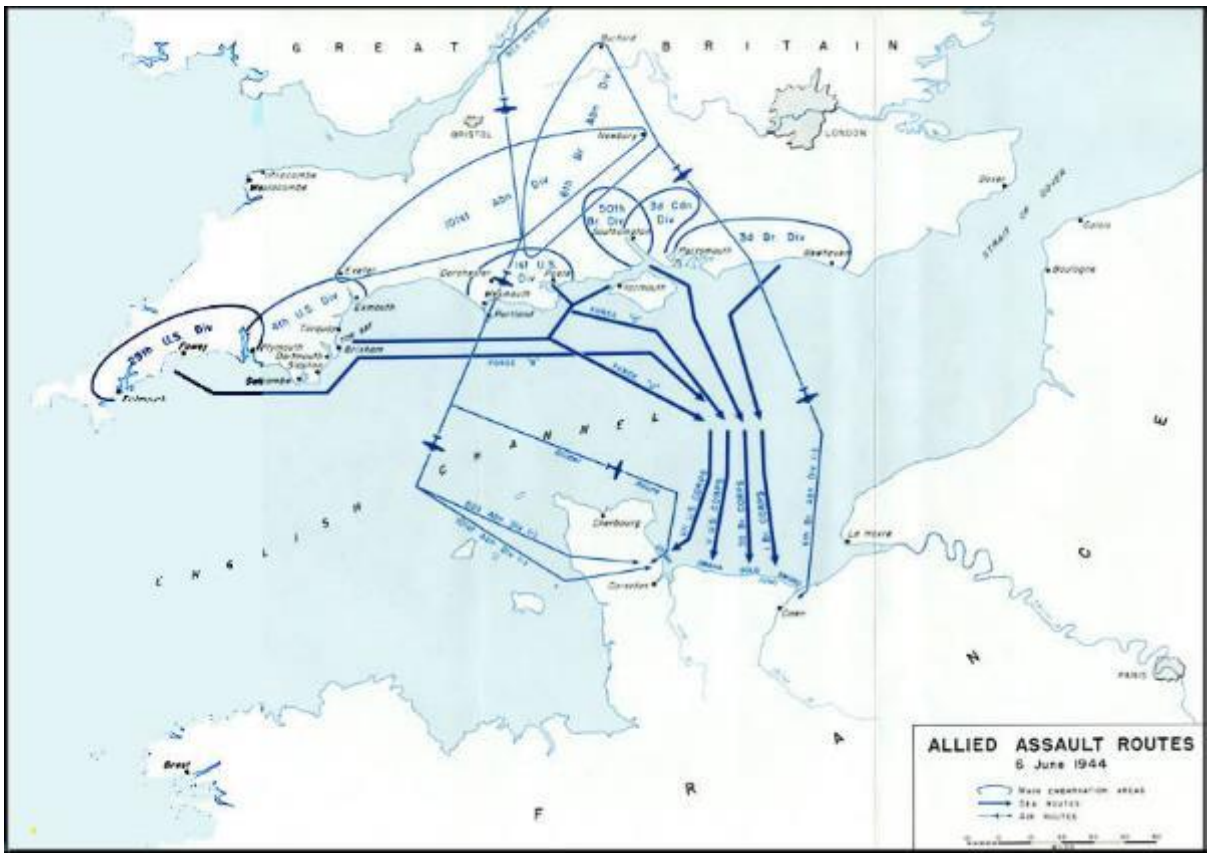


Figure 28 *Operation Overlord Sea (Thick blue lines) and Air (Thin blue lies) routes. Note the return routes are not identified.*

8.4 INTERPREATION OF CRASH SITE

It is unlikely that the wreck site represents a catastrophic crash site, either by catastrophic failure, being abandoned in fight by parachute or descending out-of-control. In such situations it is unlikely that the central wing section with its engines and propellers would have survived. The Pilot Training manual for the C-47 (issued to pilots in wartime) contains advice for ditching an aircraft at sea which can help to interpret the site. To ditch a plane at sea the manual states the following instructions (authors underlining):

- 3. <u>Keep landing gear up</u> and ditch with fuselage parallel to the water. Because of its construction your airplane has admirable water landing characteristics.

- 6. Keep your wings level or parallel to the water. If a wing hits, the airplane is likely to disintegrate and sink in a few seconds.
- 9. Lower landing gear after landing to add stability in rough water. Proceed on the principle that the airplane will sink in 30 seconds, but don't hurry so fast that you leave emergency equipment behind.

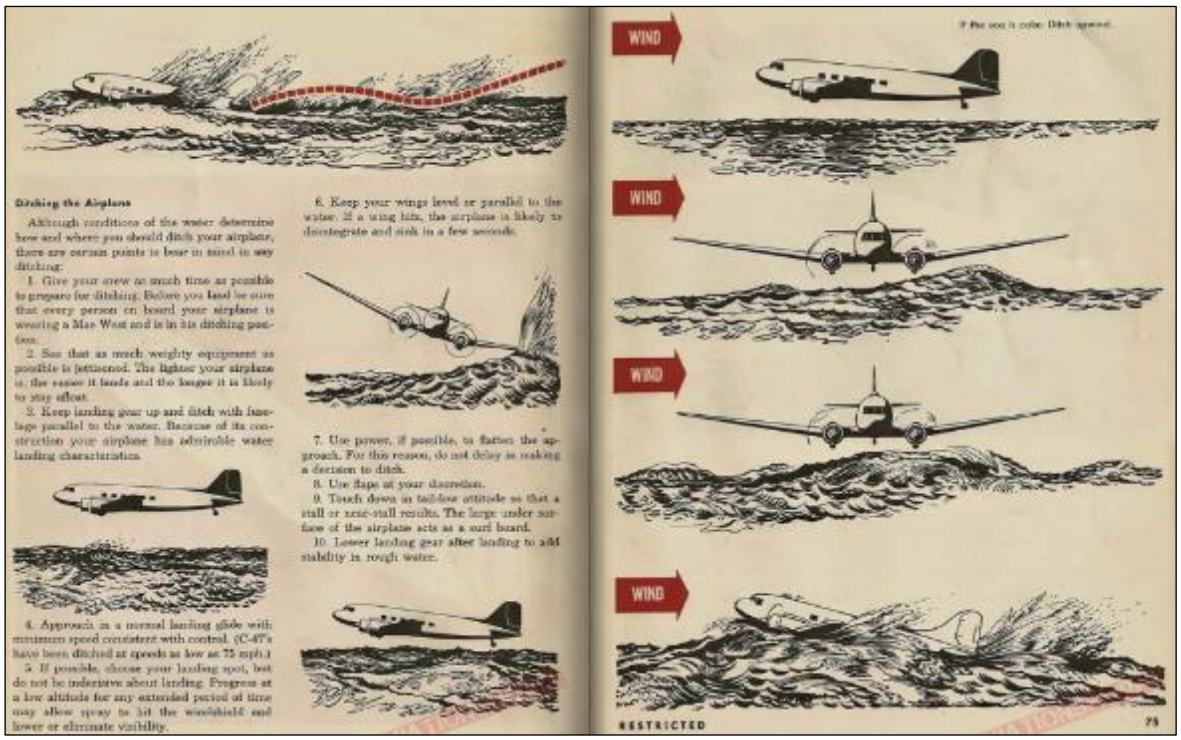


Figure 29 *Page from The Pilot Training manual for the C-47.*

Note: C47 airplanes were known to stay afloat for long periods. In the Pacific a DC-3 stayed afloat while passengers and members of the crew who had jumped into the water drowned. (Headquarters, AAF n.d.)

Taking the above instructions, it is reasonable to assume that the plane managed to ditch in a relatively controlled manner. The undercarriage was up (as per instruction 3), and the plane did not disintegrate (noted in instruction 6) so must have landed relatively parallel to the water. We know the plane did not disintegrate as evidence for the outer wings and aft fuselage are noted on site (see Figure 16). Furthermore, the air cylinder and fabric lie along a line that would suggest they were within the fuselage when the plane hit the bottom. The fabric would only survive if held within the planes structure.

When interpreting the single remaining propeller, it is obviously bent backwards along two blades (Figure 30). This would suggest the engine was stopped and the blades were not rotating as they hit the water, leaving the upper blade unbent. Unfortunately, the second propeller does not survive on the seabed to help further this interpretation. The WA 199b report does however states "…the port propeller, which has straight blades…" suggesting that

they were intact and straight. The only published image of the propeller is not detailed enough to discern whether it was bent. If this interpretation is correct this further supports the identity of this C-47 with the plane returning damaged from D-Day.

Figure 30 *Bent blade on starboard propeller.*

The initial survival of the second engine standing upright on its propeller suggests the C-47 sank nose first into the seabed. This could hint at it having lost integrity of its hull shortly after landing and therefore flooding quickly, further supporting the premise that the plane was returning damaged. The fact the undercarriage has not been lowered could confirm this (note 3 above). The impact site might be where the first propeller lies, and hence why it lies solid in the seabed, having not been moved by the tide in over 20 years. The tide would then have rotated and tipped the plane over into its current position, down tide of the now separated propeller. If this is the case, then the C-47 would have been on an original bearing towards the low-lying Sandown Bay, before having to ditch in the sea.

8.5 Conclusion and further work

The financial support of the Jubilee trust is acknowledged in facilitating the recording and continued research into the Sandown Bay C-47. This assistance has now been depleted, however surveying and research will continue in 2019. The support of the Jubilee Trust will continue to be acknowledge during 2019. Further work will consist of:

8.5.1 Winter 2018 / 19

- Interrogation of The MoD index of military air crashes using information on the two suspected planes in particular,
    - Date of Loss
    - Name of Casualty
- Requesting Aircraft loss reports from the US Airforce
- Report to the MoD on the possible identity of the plane
- Report to the MoD and Police on the possibility of ordnance on site
- Apply for a licence to continue work on the site including possible limited shallow excavation between the engine mounts to search for a manufacturers name plate.

8.5.2 Summer 2019

If permission is granted to continue diving on the site, then it is intended to:

- Extend the 3D photogrammetric survey to cover the whole known debris field
- Carry out intrusive searches in known areas where identify plates would b or where there is a high probability of their survival.

9 Summer 2019 Report Update

9.1.1 Positive Identification of the Munitions

After this report was submitted (September 2018), the munitions were reported to the Hampshire Police and the Southern Diving Unit 2 of the Royal Navy, based at Horsea Island, Portsmouth. The mine was positively identified as a UK MOD A Mark XII Air-launched anti-submarine warfare mine. This was developed in 1953-6 and therefore postdates the loss of the plane, as no known C-47 were lost in this area during that period. The mine and shell have now been removed from the site. They were inert. It is suspected that the mine was a training mine from the training area near to the plane wreckage.

9.1.2 Operation Memphis

Operation Memphis was a resupply mission the day after the D-Day landings. The 440th Troop Carrier Group took part in the airborne assault prior to the seaborne assault of the D-Day landing operations. The following night they facilitated the resupply mission. Under the auspices of operation Memphis. 62 C-47A from 440 troop carrier in serial 42 flew to drop zone E, to drop supplies at 0632 on 7th June 1944. Carrying loads of gasoline, ammunition and food stuff to be dropped by parachute, the group left RAF Welford to congregate in their V of V formations before heading south over the channel via Portland Bill (See figure 31). Fighter escorts were provided for the mission, but no Luftwaffe were encountered, however light flack was two miles north of the Drop zone behind the Normandy beaches. Out of the 62 C47A's to leave RAF Welford only 3 did not return to the airfield by 0828, on 7th of July.

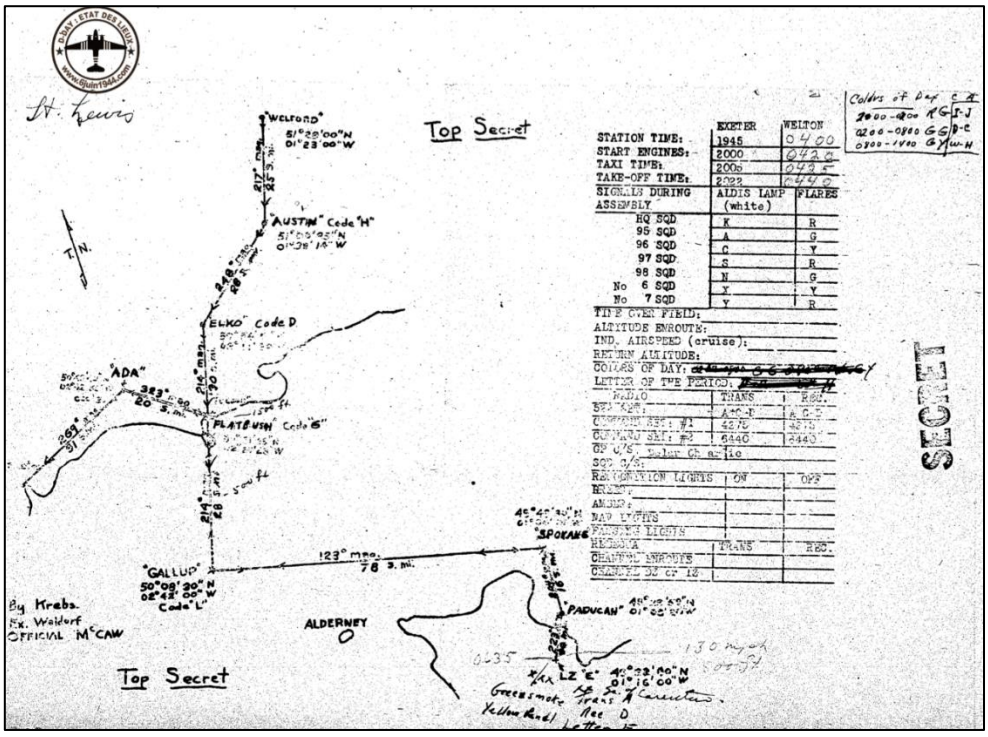


Figure 31 *Route map of Operation Memphis.*

Ship No. 735 was seen leaving the drop zone, but then seen over the channel and on fire. Ship No. 078 was also noted lost over the channel. The crews of both C47's were picked up by rescue ships. Ship No. 902 of the 95th squadron (No. 11 in serial 42) did not return.

Later on, the 3 crew members who survived the mission, Pilot John P. Goodwin, Co-Pilot Cyril G. Wire and Navigator Richard P. Umhoffer, reported on their experience. Lt Goodwin (Pilot) stated:

"We were nearing the French Coast and were out about 300mi. when things began to happen. It was just dawn and everything was quiet. All of a sudden out of the clear sky I felt a terrific explosion and jolt. The windows as well as the roof of the cockpit were blown out. The concussion even put my helmet up through the roof. The next thing I knew, we were down ahead of the formation.

As the engines were still good, I started to pull back up in formation to complete the mission. Just as I was back in, the right engine went out … I was forced to pull back out and now we headed over the coast. I made a 180° turn and headed back home on one engine. The ship started slowing up and settled to the sea – even with left engine wide open … there was nothing to do but "ditch" or crash land. The rudder was also blown to pieces and I had to dip a wing to go straight. This forced me to cut off the one good motor just before we hit.

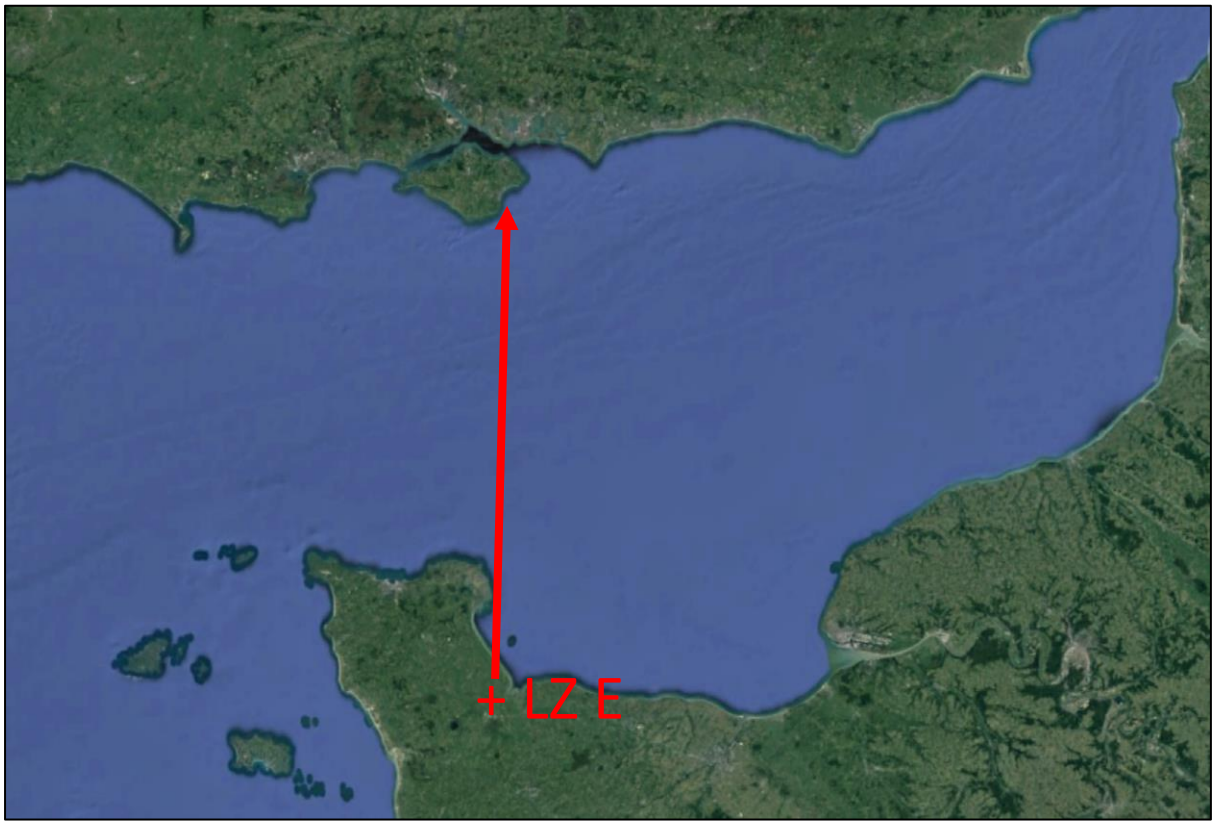


Figure 32 *Route back to England as defined by Lt Goodwin.*

I felt about six waves and then we stopped with a jolt. The cockpit seemed to fill with water and I held my breath and unfastened my safety belt. As Lt Wire and I popped up through the escape hatch, the plane seemed to pop up too through the water. The left wing was burning and a lot of gasoline on the water … Lt wire and I took off our parachutes and inflated our "Mae Wests" while kneeling on top of the plane… The waves washed us off. We managed to cling to anything that we could … while being about half way back on the top of the plane I had a chance to look around. Doing so, I saw the most horrible sight I have ever seen. I looked down through the hole blown by the explosion. The whole was about 10ft long and from one to four feet wide. At the time of the hit, Sgts Bair [Crew Chief Harold G. Blair] and Schrull [Radio operator Paul L. Schrull] (members of the crew) the drop master [James L. Barnes] and a war correspondent [Irving MacDonald] were all in the cabin of the plane. Looking down through the hotel I saw Sgts. Bair and Schrull lying there. There was a mess of unrecognisable debris all over the floor. Lt WIRE saw the correspondent's body sink into the sea but could not help him. All of this happened in about 20 minutes on Wednesday morning the 7th of June 1944."

Pilot Goodwin's description of his ditching concurs with the archaeological interpretation of the planes ditching at the time of discovery. That the starboard engine was off and feathered due to damage, and that the port engine (Left) had been switched off just before ditching, as Lt Goodwin states. The assumed damage to the tail also concurs with Goodwin's report. There is no report as to where Goodwin thought he had "Ditched" his plane. All we know is that he headed 180 degrees back out over the channel. A separate report from the Isle of Wight noted a damaged C47 passed over the island after 0800 on 7th June. The report as described in "Battle in the Skies over the Isle of Wight" (Leal, 1988,75) states that a C47 was seen in the morning and that it was badly shot up by A.A. gunfire with a large hole in the fuselage just forward of the tail section. It continued to state, the starboard engine was stopped, and the propeller feathered, as described by Goodwin and evidenced on the wreckage. Heavily damaged and flying on one engine the C47 nevertheless was maintaining its height, or as Goodwin states "… settled to the sea". The noted damage to the tail section also concurs with its absence on the seabed. The Isle of Wight is due north from the Memphis landing Zone E (See Figure 32), the flight path Goodwin stated he took back to England.

Taking all the evidence to hand it is beyond probable there is clear and convincing evidence that the Sandown C47 is that one flown by Lt Goodwin on Operation Memphis in support of the D-Day Landings. Before however a positive identification beyond reasonable doubt can be given further research and diving on the site will have to be undertaken.

10 REFERENCES

Cacutt, L. (ed.) 1988 *Classics of the Air: an illustrated history of the development of military planes from 1913-1935*. Foulis/Haynes,: Sparkford.

Chant, C. and Batchelor, J. 1980 *Piston-Engined Airliners: seventy years of air Transportation*. Phoebus: London.

C-47 Maintenance Manual. 1945-46.

C47 Pilot Training Manual. 1942.

Flintham, V. 1990 *Air Wars and Aircraft: A Detailed Record of Air Combat, 1945 to the Present*. New York

Gibson, R. Hextall, B. & Rogers, A. 2001 *Photographic guide to the sea & shore life of Britain and North-wet Europe.* Oxford.

Headquarters AAF (no date) *Pilot Training Manual for the C-47* reprinted in Morgan, L. (1964) *Famous Aircraft: the Douglas DC-3*, Morgan: Dallas.

Historic England (formerly English Heritage) 2002 *Military Aircraft Crash Sites Archaeological guidance on their Significance and Future Management.* Swindon.

Leal, H.J.T. *Battle in the Skies over the Isle of Wight.* Newport. 1988

Personnel Management Agency (PMA) (1997) *Ministry of Defence - Crashed Military Aircraft of Historical Interest: notes for guidance of recovery groups*, PMA: RAF Innsworth.
Protection of Military Remains Act 1986.

https://aviationshoppe.com/manuals/c-47_pilot_training_manual/douglas_c-47.html

Warren 1956 *Airborne Operations in World War Two. European Theatre*. USAF Historical Division.

Wessex Archaeology 1997a *Sandown Long Sea Outfall, Marine Archaeological Investigation.* Report Ref. 43626.01 July 1997 Salisbury.

Wessex Archaeology 1997b *Sandown Long Sea Outfall, Marine Archaeological Investigation.* Report Ref. 43626.02 October 1997 Salisbury.

Wessex Archaeology 2008 *Aircraft crash Sites at Sea. A scoping study archaeological desk-based assessment: final report*. Salisbury.

11 TEAM MEMBERS

A list of team members is given below (Some member redacted for GDRP compliancy)

Name	Dive Qualification	Association
Douglas McElvogue Project Leader	BSAC Advanced Diver	NAS Tutor
Stephen Westwood (Former Marine)	BSAC Dive Leader	BSAC and PADI
	BSAC Dive Leader	BSAC and PADI
	BSAC Sports diver	BSAC
	PADI Dive Leader	PADI
	PADI Open Water/	PADI
	Power Boat Level II	
	PADI Open Water	PADI
	BSAC / Diver Cox	Southsea BSAC
	BSAC	Southsea BSAC
	BSAC	Southsea BSAC
Martin Davies	BSAC	Southsea BSAC
	BSAC	Southsea BSAC
	BSAC	Southsea BSAC
	BSAC	Southsea BSAC
	BSAC	Southsea BSAC

Project Budget

The following budget breakdown details the project costs that the Jubilee Trust helped towards, the most significant being the cost fuel for the dive boat.

Total Project Budget: June 2017 – October 2018

Boat Fuel	**Per Day**	**Days**	**Cost**
Per round trip 2017	£155	4	£620
Per round trip 2018	£ 72.50	3	£217.50
Travel per trip	£ 25.00	4	£100.00
Air	£5.25	16	£84.00
		Total Cost	**£1,021.50**

Note: costs do not include photogrammetry training or use of TrenDive computers, software and cameras, which were being given free of charge to the project.