OCS Study
BOEM 2021-076

Battle of the Atlantic

A Catalog of Shipwrecks off North Carolina's Coast from the Second World War

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Bureau of Ocean Energy Management

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US Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

US Department of Commerce
National Oceanic and Atmospheric Administration
Office of National Marine Sanctuaries

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This report is available via the US Department of the Interior, Bureau of Ocean Energy Management website at https://marinecadastre.gov/espis/#/ and at the National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Maritime Heritage Program website at https://sanctuaries.noaa.gov/maritime/

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ABOUT THE COVER

American tanker *Byron D. Benson* burns after a torpedo strike from U-*552* (NARA).

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Perhaps the most defining element of this overall project, and certainly the reason for its successful execution, is the collaborative nature by which it operated. A great number of partners and collaborators came together to share resources and accomplish goals that would have been unachievable on our own. As such, there are a large number of organizations and individuals that the authors would like to acknowledge for their unique contributions to this project over the last several years.

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List of Abbreviations and Acronyms

3D	three-dimensional
ABPP	American Battlefield Protection Program
ADUS	Advanced Underwater Surveys
AIVL	Advanced Imaging and Visualization Laboratory
ALS	Ahead-Looking Sonar
ARL:UT	Applied Research Lab: University of Texas
ASDIC	Anti-Submarine Detection Investigation Committee
ASW	anti-submarine warfare
ATLAS	Autonomous Topographic Littoral Area Survey
AUV	autonomous underwater vehicle
BAREG	Battle of the Atlantic Research and Expedition Group
BOEM	Bureau of Ocean Energy Management
CESF	Commander, Eastern Sea Frontier
CIOERT	Cooperative Institute for Ocean Exploration Research and Technology
ComFive	Commandant Fifth Naval District
COMINCH	Commander in Chief, United States Fleet
DOE	Determination of Eligibility
DP	dynamic positioning
DSLR	digital single lense reflex
ECU	East Carolina University
ESF	Eastern Sea Front
EWT	Eastern War Time
ft	feet
GIS	geographic information system
GOM	Gulf of Mexico
GPS	global positioning system
GUE	Global Underwater Explorers
HD	high-definition
in	inch(es)
INS	inertial navigation system
kHz	kilohertz
KOCOA	Key terrain, Observation and fields of fire, Cover and concealment, Obstacles, and Avenues of approach/retreat
KTB	Kriegstagebücher (u-boat war diary)
kts	knots
LBL	long baseline
LORAN	long-range navigation
m	meters
MBS	multibeam sonar
MCAS	Marine Corps Air Station
MHP	Maritime Heritage Program
MHz	megahertz
mm	millimeters

MNMS	Monitor National Marine Sanctuary
MOA	Memorandum of Agreement
NARA	National Archives and Records Administration
NAS	Nautical Archaeology Society
NCCOS	National Centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NHHC	Naval History and Heritage Command
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
OER	NOAA's Office of Ocean Exploration and Research
OMAO	NOAA's Office of Marine and Aviation Operations
ONMS	Office of National Marine Sanctuaries
ONR	Office of Naval Research
PI	Principal Investigator
RDF	radio direction finding
RG	Record Group
ROV	remotely operated vehicle
R/V	Research Vessel
SAS	Synthetic Aperture Sonar
SCUBA	Self-Contained Underwater Breathing Apparatus
SLS	Side Looking Sonar
SONAR	Sound Navigation Ranging
SRC	Submerged Resources Center
SRI	SRI International
TSC	The Shipping Controller
UNC-CSI	University of North Carolina's Coastal Studies Institute
UNCW	University of North Carolina at Wilmington
USBL	ultra-short baseline
USCGC	United States Coast Guard Cutter
US Coast Guard	United States Coast Guard
US Navy	United States Navy
USSB	United States Shipping Board
WHOI	Woods Hole Oceanographic Institute
WWI	World War I
WWII	World War II

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1 Introduction

1.1 Background

The footprint of the Second World War, or World War II (WWII), stretches across the globe. The impacts of this conflict are lasting not only in the social and geopolitical reshuffling of world powers that resulted, but also in the physical evidence of the war that remains in our midst. This physical evidence is a grisly hallmark of warfare in the twentieth century, where conflicts fail to stay confined within traditional boundaries and instead spill out, absorbing and overlapping the populations, economies, and cities of all involved (Schofield 2004:2). As a result, the material vestiges of WWII remain in a global landscape marked with the direct effects of war as seen in scarred cities and battlefields, but also in the infrastructure of nations who prepared for war via land, sea, and air. These nations retooled their economies to support the war and prepared against the threat of attack, and in doing so left a material legacy related to munitions production, shipping, defensive fortifications, communications infrastructure, and more.

The United States was likewise drawn into this landscape of war. WWII looms large in the collective memory and is an event that impacted Americans, soldiers, mariners and citizens, in direct and lasting ways. Despite this, for many Americans the war was something that was engaged at the convenience of geographic distance; it was something that happened *over there*. That is until the war came to American soil with the attack on Pearl Harbor, on December 7, 1941. Following that catastrophic attack, the war continued to silently creep to the United States, eventually reaching deep into the waters of the eastern Atlantic seaboard and the Gulf of Mexico.

The Battle of the Atlantic encompasses the enormity of Germany's multi-pronged and protracted efforts to disrupt Allied war supply lines throughout the course of the war. This extended engagement pitted German Unterseebootes (U-boats) not against military assets in a traditional sense, but rather against civilian and merchant vessels of numerous nationalities carrying oil and other raw materials to the European theater. This calculated and deliberate effort by Germany to chip away at American industry and merchant shipping lacked the singular surprise and devastation of Pearl Harbor, but it was nonetheless part of the largest continuous military campaign of the war. For much of WWII and without the knowledge of many Americans, the war was, in fact, *over here*. It came within eyesight of Atlantic coastal towns and ports, into the Chesapeake Bay, and to the very mouth of the Mississippi River.

The shipwrecks and other material remains associated with the Battle of the Atlantic off our nation's coasts are not entirely a secret. Some of the sites are well known by local communities, and there is no lack of historical documentation, photographic evidence, or living survivors to attest to the immediacy of these engagements. However, despite this wealth of information the incredible story of how WWII came to our nation's door has not gained traction in our collective memory of the war. This is influenced in part by the lack of visibility and accessibility of these sites to those not trained in Self-Contained Underwater Breathing Apparatus (SCUBA) diving. The lasting remains of the Battle of the Atlantic are invisible to those looking across the vast open ocean and the general public does not readily encounter these resources during their day-to-day experience. An additional challenge to the study of the Battle of the Atlantic is that its significance and extent is not easily recognized when faced with one or two individual sites. The importance of this story resides in the sum of the parts, in the interplay of merchant vessels and U-boats, in the Allies' convoys and the Axis wolf packs, and a prolonged naval engagement that covered vast expanses of the Atlantic Ocean and beyond.

Because the Battle of the Atlantic is best understood as a battlefield spread over an enormous geographic area, it is particularly suitable for the application of archaeological approaches. Global awareness in the contribution of archaeology to a deeper understanding of WWII has been growing, and more specifically the field of underwater archaeology has provided invaluable perspectives on the study of the submerged material remains of the war. In such examples as the work of the National Park Service (NPS) at the USS *Arizona* memorial and Pearl Harbor National Historic Landmark (Lenihan et al. 2001); the study of the archaeological sites and their role in heritage tourism in Saipan (McKinnon and Carrell 2015); and research into the WWII maritime landscape off the shores of the United Kingdom (Firth 2014; McCartney 2015), the recent underwater archaeology of naval battlefields has emerged as a prolific subject of investigation and constituted part of the research focus of the present study.

This report details the results of a multi-year, collaborative research effort headed by the Bureau of Ocean Energy Management (BOEM) and the National Oceanic and Atmospheric Administration (NOAA) to identify and investigate archaeological sites associated with the Battle of the Atlantic off the coast of North Carolina. The report serves as a compendium of research and fieldwork conducted between 2008 and 2016. The goal of this research was to develop an inventory of Axis and Allied merchant and military vessels lost during this engagement and to consider National Register of Historic Places (NRHP) significance of these sites, both individually and collectively, as part of the Battle of the Atlantic. This project achieved the challenging first step of developing a complete inventory of sites. It is the intent of the authors that this inventory will foster further research, long-term monitoring, public outreach, and educational efforts in support of a holistic historical and archaeological assessment of the Battle of the Atlantic.

1.2 Federal Partnerships

The Battle of the Atlantic project was born out of the overlapping information needs of BOEM and NOAA regarding archaeological sites on the Outer Continental Shelf (OCS) offshore of North Carolina. It was realized by both agencies that this information would be applicable to the mission of each and that working in partnership would create efficiencies, reduce expenditures, and provide needed data to inform sound decision-making. NOAA's interest in WWII heritage resources began in 2008 and BOEM and NOAA formally committed to a multi-year partnership to document WWII casualties offshore North Carolina through an Interagency Agreement executed in 2010 and extended annually through 2016.

The research project was designed to leverage existing resources such as survey equipment, vessel time, and scientific expertise. The success of the research effort is due, in great part, to the collaboration and sharing of resources among the project team. This team also has included other federal partners such as the NPS Submerged Resources Center; state partners, including the State of North Carolina, the University of North Carolina Coastal Studies Institute (UNC-CSI), and East Carolina University's (ECU) Program in Maritime Studies; and citizen scientists, such as the Battle of the Atlantic Research and Expedition Group (BAREG). The model of partnership and collaboration that served as the backbone for the project is further discussed in the Research Design (Chapter 2) and the contributions of various partners are further detailed in the Annual Summaries (Chapter 4).

1.2.1 NOAA's Mission and Interest in Collaboration

The National Marine Sanctuary Act of 1972, reauthorized in 2000, establishes a federal program for delineating areas of "conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or aesthetic qualities as national marine sanctuaries…." NOAA's Office of National Marine Sanctuaries (ONMS) manages these sanctuaries and also supports a systemwide Maritime Heritage Program that is responsible for cultural resources within sanctuary sites.

NOAA's Monitor National Marine Sanctuary (MNMS) protects a one-mile radius area off the coast of North Carolina containing the remains of the Civil War Ironclad USS *Monitor*. Researchers at MNMS have long recognized that this region is host to thousands of additional maritime heritage resources, some of which represent significant historical events in American history, including resources related to the Battle of the Atlantic. As such, at the request of its Sanctuary Advisory Council, MNMS conducted further archaeological research in the larger sanctuary region, popularly known as the "Graveyard of The Atlantic," in support of the Council's interest in potentially expanding the area to apply sanctuary management approaches for additional nationally significant resources (MNMS 2013). Research conducted within these areas is of interest to both agencies, making formal collaboration an effective means to share resources and enhance partnerships for mutually beneficial goals.

1.2.2 BOEM's Mission and Interest in Collaboration

As a Department of the Interior agency, BOEM is tasked with managing 1.76 billion acres of the OCS within US waters as per the OCS Lands Act. BOEM's mission is to preserve the environment while ensuring the safe development of the Nation's offshore energy and marine mineral resources. In 2009, the US Department of the Interior announced the final regulations for the OCS Renewable Energy Program, which was authorized by the Energy Policy Act of 2005 (EPAct). These regulations provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of renewable energy sources, including offshore wind, ocean wave energy, and ocean current energy.

BOEM has undertaken planning efforts for the consideration of commercial wind energy development on the OCS offshore North Carolina (see: http://www.boem.gov/North-Carolina/). An inventory and assessment of WWII vessel losses offshore North Carolina is necessary to assist BOEM in considering the effects of its undertaking on historic properties under Section 106 of the National Historic Preservation Act (NHPA). Partnerships through Interagency Agreements allow BOEM to pursue its mission of collecting data regarding historic properties along the OCS with other federal agencies engaged in similar work.

Additionally, BOEM's interest in the Battle of the Atlantic extends from the study of WWII shipwrecks identified as a result of oil and gas permitting activities in the Gulf of Mexico (GOM). Beginning with the discovery of the German U-boat, U-*166*, off the mouth of the Mississippi River in 2001, BOEM has supported archaeological investigations of 12 of these historic shipwrecks in the Gulf of Mexico; a total of 54 were lost in the Gulf during WWII (Church et al. 2007). These investigations have been conducted through BOEM's Environmental Studies Program. Three additional vessels were investigated in the GOM during a BOEM study in 2010 (Evans et al. 2013).

1.3 Report Outline

The Battle of the Atlantic report comprises over 600 pages of text and imagery, best approached by understanding the context of respective chapters. Chapter 2 presents the research design that frames the goals and objectives of this multi-year, collaborative effort and Chapter 3 documents the overarching methodologies employed for conducting background research and field investigations under the study.

As the Battle of the Atlantic project evolved over the years, an increased level of sophistication was applied both from an interpretive and methodological perspective. Chapter 4 summarizes the activities of 8 years of continued research and field operations with a brief accounting of the chronological progression of operations these developing methodologies and technologies employed. It also highlights the partner institutions that have contributed to this effort.

Chapter 5 provides an environmental and historic context necessary for understanding the individual sites offshore North Carolina that were identified and studied by the project. This chapter places the Battle of the Atlantic off the east coast, and North Carolina specifically, into a broader historical context of the war.

Chapters 6 through 9 present the results of the project as an inventory of sites identified. Ninety-one individual vessel losses constitute all the known (both located and historically reported) casualties off the North Carolina coast during WWII. Comprising these 91 vessel losses are 79 merchant vessels (Chapter 1), 8 Allied military vessels (Chapter 1), and 4 German U-boats (Chapter 9), documented in detail using historic and underwater forensic photography, multibeam bathymetry, side scan sonar acoustic imaging, and other technologies. All vessels are listed alphabetically within the appropriate chapter, by name, at the time of their sinking.

Chapters 10 and 11 also present the results of the project relating to other vessels. Chapter 10 is a catalogue of ships lost during the Battle of the Atlantic that are believed to be more than 150 miles offshore of North Carolina state waters, and thus out of scope for the present project. Chapter 11 presents the team's remote sensing discoveries within the geographic extent of the project that were determined to be unrelated to the Battle of the Atlantic, and thus non-associated sites.

Finally, Chapter 12 provides conclusions and outlines recommendations for future Battle of the Atlantic research.

2 Research Design and Theoretical Approach

2.1 Battlefield Archaeology

Though a relative newcomer within the maritime discipline, battlefield archaeology represents a robust sector of research focused upon understanding human behavior during warfare, arguably one of the most ubiquitous human activities (Conlin and Russell 2006:21). According to Phillip Freeman (2011:149), archaeologists have approached the research of battlefields in three ways:

> “The oldest, and most commonly deployed, is to use archaeology to embellish the accepted story of the events that has been derived from written sources that are, in turn, based on eyewitness accounts. Where there are several accounts of the same battle, certain sources are often emphasized over others. Here, archaeology is used to clarify details or add to the historical framework. A second use of archaeology is to illuminate poorly reported engagements while the third approach is a halfway position. In this middle ground, archaeology is used to reconcile the problematic aspects of an engagement, or to correct conventional interpretations.”

All three approaches, arguably, are fraught with problems for a researcher, and can be critiqued based on the degree to which preconceived notions of one sort or another may seep into the process of research design. Part of this relates to the degree to which we can determine the “bias” or “cultural construction” of historical documents and archaeological interpretations (Conlin and Russell 2011:42). Another reason is because battlefield archaeology, a relatively new field of study, has until recently been of “limited theoretical inclination” (Scott et al. 2009a:1) and has been defined by antiquarian or culture-historical (particularist) approaches focused on the description of battlefields, the paraphernalia of conflict, experimental/forensic analyses of weapon capabilities and site formation, and the reinforcement of established historical chronologies (see Mandry 2009; Scott and Haag 2009; Sivilich 2009; Scott 2011).

When thoughtfully applied, however, one of the most useful aspects of this sub-discipline is when “the archaeological record is viewed as an independent data set that can be compared to historical documents, participant accounts, maps, and other sources” (Scott et al. 2009b:429), then the conception of a particular battlefield can be greatly enhanced, and perhaps even altered in light of material evidence. In combination with historical research, battlefield archaeology offers the ability to greatly enhance the understanding of conflict and warfare. Furthermore, “combatants fight as they are trained and under the rules of that culture’s perception of warfare behavior” (Scott et al. 2009b:433), and as a result, battlefield archaeology illuminates patterned human behavior during a ubiquitous human activity. Conlin and Russell (2011:39) further expand upon the comparative and anthropological potential of naval battlefields:

> Battlefield archaeology is fundamentally about looking beyond individual sites and small-scale activity areas to larger contexts. These larger contexts encompass a series of events and human behaviors that may have a very short time span but that typically involved larger areas than most archaeologists consider when looking at sites. This fact is particularly interesting when looking at the archaeology of naval battlefields, since underwater archaeologists have traditionally focused on the tightly constrained “time capsule” nature of individual shipwrecks instead of looking at broader patterns of wrecks considered as groups.

Recent research, in fact, points toward one set of explicitly theoretical approaches with potential to infer behavioral aspects of conflict, and in turn assist in reconstructing or redefining the strategies and tactics utilized in combat. These approaches can be seen as increasingly idealist – focused on how battlefields and the residues of battle are as much a reflection of the ideas of combat as they are the actions associated with warfare. This focus on the strategic-psychological aspects of combat, to a large degree, propels battlefield archaeology toward more anthropological approaches to the study of conflict, and significantly curtails the potential of nationalistic interpretations.

Embracing the recent movement toward increasingly comparative and behavioral trends in research, a group of battlefield archaeological and operational military theories already utilized in numerous terrestrial battlefield studies, ECU students John Bright (2012) and Stephen Sanchagrin (2013) built upon John Wagner's (2010) theoretical approach and applied a unique battlefield archaeological approach in coordination with MNMS. Similar to how archaeologists frame human behavioral analyses within terrestrial battlefields, Bright integrated the NPS' ABPP method of systematic analysis of key terrain, observation and fields of fire, cover and concealment, obstacles, and avenues of approach/retreat, abbreviated as KOCOA (Lawhon 2002:36). Only one other maritime battlefield study (Babits et al. 2010) had included these terrain analysis parameters, and those focused upon a series of War of 1812 battles that occurred very close to land. The Battle of the Atlantic off the North Carolina coast was dramatically different than the 19th century naval actions described by Babits et al. (2010) in that they involve, in addition to surface craft, both submarines and aircraft, large tracts of open ocean, modern weapons, and far more complex tactical, strategic, and command structures.

As such, Bright's study applied the theoretical developments of archaeological battlefield study to the analysis of a specific naval action that occurred off North Carolina in July 1942. To make the theory applicable to the study, many of the terrain assessment principles were adapted for the marine environment. MNMS, in consultation with ECU, presented the KS-520 convoy battle as a case study for this research drawing upon survey data collected by MNMS-led expeditions in 2009-2012. Since this naval action took place along the open ocean—with some limited interaction with terrestrial features—the landscape or terrain was essentially a flat ocean surface, to the naked eye, that is. Since naval activity at this time proceeded within three-dimensional (3D) space—the air, surface, and sub-surface realms—a unique visualization and recreation methodology was needed. Thus, Stephen Sanchagrin (2013) undertook the task of digitally rendering elements of the landscape/seascape as well as the movements of combatants within the area as the battle progressed. Together, these two studies completed a comprehensive review of the KS-520 attack including complete archaeological assessment of human decision-making during the engagement as well as a suite of two- and three-dimensional renderings of the battle.

Individually, each of these studies was noteworthy for being among the first to navigate the comparatively immense complexity of mid-20th century naval battlefields containing submarines and aircraft. Their results, however, were also integral to the larger Battle of the Atlantic survey in so much as they provided a highly refined geospatial model that made searching for two of the battle's casualties—*Bluefields* and U-*576*—a feasible effort. As a result, NOAA and BOEM dedicated resources from the 2011, 2013, and 2014 expeditions to search for their remains, which were ultimately discovered and identified in 2014.

Other studies, focused on comparative and behavioral trends, included illustrating how non-military fishing trawlers were modified for military use. Utilizing data collected on HMT *Bedfordshire*, HMS *Senateur Duhamel*, and YP-*389*, Will Sassorossi (2015) compared the modifications and adaptations made that changed the operational working structure of commercial fishing vessels into anti-submarine patrol and escort vessels. Each of these vessels was designed for commercial use prior to the outbreak of WWII. Following the United Kingdom's entrance, and later the United States, into the war, a great need for anti-submarine patrol vessels was realized, with few resources available to construct purpose built naval vessels quickly. A solution to this problem was to acquire fishing and other working vessels, and undergo a quick modification process to adapt them for military use. HMT *Bedfordshire*, HMS *Senateur Duhamel*, and YP-*389*, all underwent certain modifications to alter the vessel from commercial to military use, including increasing crew space, modifying the internal arrangements, and outfitting each vessel with depth charges and deck guns. The information collected from the Battle of the Atlantic expeditions when compared with historical commercial information, allowed Sassorossi to construct visual, 3D renderings of this conversion process. In doing so, the behavioral reuse of commercial vessels during war was better understood. Studies by Kara Fox (2015) and Mitchell Freitas (2016) focused research on smaller components of the battlefield. Davis applied 3D modeling techniques to visualize site formation processes that affect WWII shipwrecks in the region. Using *Caribsea* as a case study, this work built upon data collected during the course of this survey and may have applicability to other similarly situated vessels. Freitas focused his work on revalutaion and assessment of defensive minefields used in American water, with the Cape Hatteras Minefield as a case study.

2.2 Introduction

Conducted over the course of 9 consecutive years, the archaeological approach and theoretical framework underlying this research was dynamic and varied. The objective in the first year was simply to record the remains of 3 known U-boats in the region, with the end goal of preparing a nomination to the NRHP and providing baseline documentation of the resources for potential future monitoring. No broader theoretical questions were applied during the initial effort, and thus no broader connections were being made. In truth, the team at that time did not anticipate subsequent research to be undertaken.

This, however, quickly changed, as the limited documentation efforts of the first year's survey invited more complex research questions. As the range of historical research expanded and a better grasp of the archaeological remains was realized, the team's focus turned towards understanding the connectivity between these resources, the geographical landscape, and the larger Battle of the Atlantic. Understanding why North Carolina seemed to be of particular focus for U-boat activity and characterizing these resources as one interconnected collection of sites meaningfully deposited in the landscape became the overarching topic of inquiry. These connections may be appreciated at a variety of scales, including individual actions, distinct convoy battles, or broad military action or sinking patterns over the course of a campaign. While the overarching goal was to characterize and conceptualize these resources as a related collection, there still remained the practical need to carry out the identification, documentation, and baseline assessment of these sites. These practical activities were critical, as the basic identification and documentation of these sites informed and enabled the broader research goals of the project, as well as providing the information needed by federal agencies to assist their obligations under the NHPA and other mandates.

In the end, this study applied a range of theoretical approaches to WWII cultural resources, mainly through leveraged partnerships, to develop more in-depth conceptual frameworks. While individual sites may have been approached in method and study from a particularistic angle, this information was also used for broader interpretation. In many cases, the documentation and research on an individual site basis continued in parallel to deliberate landscape- and battlefield-based interpretive approaches.

2.3 Research Design

The Interagency Agreement between BOEM and NOAA established a framework that outlined the goals of the project and ensured continuity throughout the life of the effort. The research design included three interrelated objectives:

- develop an inventory of WWII wrecks along the North Carolina OCS,
- provide baseline documentation of located sites, and
- evaluate the sites' NRHP significance.

The overarching objective of the study was to identify all shipwrecks associated with the Battle of the Atlantic off the North Carolina coast. This task involved historical research to compile information regarding vessel casualties and their potential locations and field investigation of both previously known sites and new sites identified through remote sensing survey. Each potential site identified was subjected to a level of investigation sufficient to provide evidence of diagnostic attributes to determine the identity of the vessel and its association with the Battle of the Atlantic.

For each site identified, baseline documentation was gathered. This included acoustic imaging, diver investigation, photographic and video documentation, and creation of a site plan. This information was gathered to:

- provide baseline data for use in follow-up inquiry and future monitoring at the sites;
- document site preservation and site formation processes;
- assess historical significance and archaeological integrity of selected sites to inform consideration of National Register eligibility;
- assess which sites are regularly visited by the recreational diving community in order to identify outreach priorities; and,
- evaluate each site's potential hazards and environmental risks (e.g. leaking fuel, unexploded ordnance).

Baseline documentation was restricted to exterior examination of sites and recovery of artifacts was not included as part of the research design.

The final objective was to consider NRHP eligibility of the sites identified and to complete National Register nominations, when appropriate. This objective includes the evaluation and nomination of individual sites, but also consideration of the sites collectively as contributing components to the broader events of WWII activities offshore the nation's coasts. This would be achieved through development of a NRHP Multiple Property Documentation Form that ties together the themes and trends of the Battle of the Atlantic (Marx and Delgado 2013e).

Accessing the sites to ground-truth locations and collect baseline data permitted researchers to collect numerous types of data (e.g. archaeological measurements, photography, and video) that in turn provided valuable outreach products and spurred numerous innovative methodological developments. High resolution and 3D video, 3D photogrammetry, and an array of acoustic mapping techniques were developed during the years of field operations. These individual projects, though not mandated by the Interagency Agreement between NOAA and BOEM, utilized data collected under its auspices and, reciprocally, provided information from other segments of the Battle of the Atlantic expedition that enhanced the quality of the shipwreck survey conducted along the OCS off North Carolina. Thus, though primarily aimed at developing a robust inventory of shipwrecks associated with WWII along the OCS of North Carolina, the Battle of the Atlantic project leveraged a large and multi-disciplinary cadre of researchers to broaden the use of all archaeological data collected under the Interagency Agreement.

2.4 Multi-Scalar Approaches: Landscapes, Battlefields, and Individual Sites

Beyond the requirements of the research design outlined above, several additional archaeological studies were nested within the Battle of the Atlantic survey. In coordination with MNMS, focused academic studies were developed and carried out by ECU researchers from the Program in Maritime Studies and the Department of Geography, with assistance and support from UNC-CSI, NPS, and an array of local and academic grant programs. These studies utilized data collected from site-specific investigations and exploratory surveys to inform broader lines of inquiry, while also providing information back into the NOAA/BOEM study to strengthen subsequent search and documentation efforts. Taken as a whole, the

Battle of the Atlantic research further developed the WWII element of the maritime cultural landscape, which augmented a broader and ongoing landscape study of the region.

These additional studies, under the direction of Dr. Nathan Richards, resulted in the publication of six Masters' theses centered on the Battle of the Atlantic:

- John Wagner's (2010) *Waves of Carnage: A Historical, Archaeological and Geographical Study of the World War II Battle of the Atlantic in North Carolina Waters*;
- John Bright's (2012) *The Last Ambush: An Adapted Battlefield Analysis of the U-576 Attack Upon Allied Convoy KS-520 Off Cape Hatteras During the Second World War*;
- Stephen Sanchagrin's (2013) *A View Through the Periscope: Advanced Geospatial Visualization of Naval Battlefields*;
- William Sassorossi's (2015) *Defending the East Coast: Adapting and Converting Commercial Ships for Military Operations*;
- Kara Fox's (2015) *Matters of Steel: Illustrating and Assessing the Deterioration of the World War II Merchant Freighter Caribsea;* and
- Mitchell Freitas' (2016) *Reassessing the Cape Hatteras Minefield: An Examination of North Carolina Coastal Defenses During the Second World War.*

Additionally, ECU, in partnership with MNMS, was awarded a NPS American Battlefield Protection Program (ABPP) grant in 2011 which resulted in the publication of a battlefield survey report as a deliverable under the grant agreement (Bright et al. 2012). Through these various studies, the scope of research questions applied to the survey dataset expanded from contextualizing and assessing National Register significance, to distinct, theoretical reviews of individual shipwreck sites (Sassorossi 2015; Fox 2015), battlefields (Bright 2012; Sanchagrin 2013) and the North Carolina Coast as a theater of operations within the broader Atlantic conflict (Wagner 2010; Freitas 2016).

The theoretical approaches used within these various studies could be broadly classified as exemplifying the "multi-scalar explanatory approach" discussed by Conlin and Russell (2011:41). Under this approach multiple scales or scopes of research are used to connect components of a site or event (the shipwrecks themselves) with the historical context surrounding the event, with broader patterns of similar or interrelated events, and then with broader generalizations regarding human behavior; in this case human behavior within the context of naval warfare. Taken a step further, the generalist review of the Battle of the Atlantic off the North Carolina coast can be integrated into a larger maritime historical or archaeological dataset of seafaring activity along the North Carolina coast to inform a landscape-level approach.

The first of these studies was John Wagner's (2010) regional survey of naval activity within the entire North Carolina area during the war. The theoretical framework underlying his study was the first transition away from the site-specific approach that characterized the Battle of the Atlantic survey. This line of research pursued a generalized, comparative, geographical analysis of the Battle of the Atlantic events off North Carolina. While much of the information covered in the study was revealed through the site- and artifact-specific studies common to maritime historical particularism (Richards 2008:38), it required an expanded theoretical avenue to pursue the more general and regional observations required by the research questions. For this reason, the study considered the battle as an entire entity of historical events and activities to inform and enlarge a general view of humankind's relationship to the maritime environment, especially with respect to voyaging and matters of commerce, warfare, and other relevant factors (Gould 1983:5).

Specifically, the study made broad observations about the battle and the events occurring during it, where the underlying social factors of the battle were analyzed to provide far more information about the engagement in North Carolina waters than a site-specific survey of one wartime casualty ever could. Furthermore, this comparative study synthesized the individual site surveys into the larger framework of anthropology and history; this broad approach proved especially applicable to lost watercraft since their collective archaeological value can be far greater than what is often learned from particularistic study alone (Price 2006:10). Although the study followed a generalist approach towards understanding the Battle of the Atlantic in North Carolina, it differed from many previous generalist studies including Murphy (1983), Price (2006), and Richards (2008), which focused on the idea of the ship as a single artifact that can be compared in numerous ways to other ships, also viewed as singular artifacts.

Instead, this study focused on historic battle events and features ranging from attack locations, to survivor rescues, to shipping routes, and minefield locations as artifacts, or pieces of intangible heritage of human and social interaction. By treating the intangible characteristics of the vessels involved in each event as attributes of that historical artifact, it accomplished broad observations and generalizations about the battle. Similarly, treating the events as part of an interrelated social network helped to better understand the battle. This closely follows Murphy‘s (1983:85-86) view that:

> “when considering ships as part of a cultural system, it may be profitable to view them as similar to hunting-gathering or trading parties. These groups are organized and sent out for the benefit of the parent society and are normally composed of, or at least led by, individuals experienced in and prepared for the task. The advantage of the hunting-gathering/trading analogy is that it focuses on the social nature of the effort and forces corollary considerations such as the interrelationship of the parent and satellite groups. The materials and labor efforts expended by the parent group stem from conscious decisions and should naturally reflect the technical and economic capabilities and goals of the society, as well as its organizational concepts.”

By viewing battle-related events as expressions of the goals of combatants, a wider behavioral understanding of the war was obtained. In order to adhere to a generalist approach to the battle and obtain this broad understanding, the study necessarily maintained strong connections to the theoretical underpinnings of the emergent sub-discipline of battlefield archaeology. By taking into account the theoretical orientation of a dedicated battlefield study, this approach laid the groundwork for several additional studies focused on specific battle events reviewed in greater detail. Likewise, comprehensive spatial analysis of the area provided data products useful to both BOEM and NOAA managers in terms of understanding the distribution and density of cultural materials from WWII arrayed along the OCS.

2.5 Maritime Cultural Landscapes

The final and most recent archaeological research initiative to enter the Battle of the Atlantic survey is to describe the maritime cultural landscape encompassing all of North Carolina’s coastal geography and maritime-related properties and archaeological sites. Having compiled a detailed inventory of shipwrecks associated with WWII, MNMS has made a substantial stride into surveying and inventorying the broader array of historical properties along the North Carolina coast, recognizing that Battle of the Atlantic resources represent only one element of the cultural landscape. Beginning with elements relating to the variety of cultures living in the area prior to European contact, these other categories include lighthouses, US Life Saving Stations, historical waterfronts, and historic buildings, as well as other period shipwrecks within the region dating to the First World War, the Civil War, or other coastal exploration and commerce-related activities. These cultural features are then related to the diverse coastal geography of North Carolina, composed of a complicated system of inland waterways, sounds, barrier islands, shoals and sand bars, and large oceanic currents offshore. The maritime cultural landscape approach is further detailed in NOAA’s *Graveyard of the Atlantic: An Overview of North Carolina’s Maritime Cultural Landscape* (Hoyt et al. 2014).

3 Methodological Approaches

3.1 Introduction

Given the breadth of archaeological resources studied (e.g. numerous vessel types of varying degrees of structural integrity in diverse geographic locations, water depths, and environments) a wide array of methodological approaches were used to engage with this dataset. The methods ranged from 'low-tech' diver operations to advanced remotely operated vehicle (ROV) and autonomous underwater vehicle (AUV) surveys. In some instances, the same site was the focus of many different data collection techniques, whereas other sites may have had only a single dataset collected. While the overarching approach of the project was to gather data at all sites associated with the Battle of the Atlantic, there were varying questions asked of particular sites, which dictated the chosen methodology. Likewise, the annual funding cycles and supplemental grants received from outside partners to augment the research efforts changed the scale and complexity that could be reasonably executed each year given available resources, and also re-shuffled site prioritization from year to year.

Five broad methodological categories were employed throughout the project and are outlined below. These approaches were applied at different times throughout the course of the project, as further detailed in the Summary of Annual Operations (Chapter 4). The first category is a basic research methodology, which consisted of background and historical research. Second is a focus on diver-based survey, which included traditional archaeological mapping and recording techniques as well as photographic and video documentation. The third category consists of remote sensing survey including multibeam sonar and side scan sonar. The fourth category addresses ROV investigations. The fifth category describes the methods and archaeological approach implemented to identify the KS-520 convoy battlefield which included use of an AUV to conduct both wide-area regional survey and subsequent high-resolution imaging, and 3D modeling of sites. Each one of these survey techniques has strengths and weaknesses, and understanding the approach and limitations of each was essential to interpreting the final results.

To ensure that the goals of the basic research design and broader research initiatives discussed in Chapter 2 were met, each year of the Battle of the Atlantic Project researchers developed and implemented an annual field plan and project outline. Relevant partners would collaborate by providing input that was codified in an internally approved document prior to the commencement of operation and research activity. This document would identify the overall approach, specific goals, methods, partnerships, personnel roles, and schedule for each expedition.

3.2 Background and Historical Research Methodology

Numerous secondary sources were compiled and reviewed to inform the project. These include sources that focus on the general conflict during WWII (Gannon 1990, 1998; Howarth and Law 1994; Hughes and Costello 1977; Ireland 2003; Macintyre 1961, 1971; Morison 1947; Syrett 1994; White 2006; Williams 2003); sources that detail the development and operations of German and Allied craft (Blair 1996, 1998 Brown 2007; Frank 1955; Grove 1997; Hague 2000; Hoyt 1984, 1987; Kaplan and Currie 1997, 1998; Kemp 1997; Miller 2000; Scheina 1982; Showell 2002, 2006; Watson 2006; Westwood 2003; Wiggins 1999; Willoughby 1957); and sources that deal specifically with the eastern seaboard and the North Carolina Coast (Cheatham 1990; Gannon 1990; Gentile 1989; Hickam, Jr. 1989; Hoyt 1978; Stick 1952). Other sources consider German and Allied naval technology, tactics, and training (Cheatham et al. 1994; Willoughby 1957). Finally, the concentration of historically significant and recreationally accessible wrecks has attracted divers to the area since the 1960s. As a result, numerous popular dive guides were written for divers in North Carolina, often containing research into individual vessel histories and positional information (Bunch 2003; Farb 1985; Galecki 2005; Gentile 1992, 1993, 2006).

Several archives were accessed for primary documents during this project. The National Archives and Records Administration (NARA) maintains multiple repositories with documents relating to the Battle of the Atlantic. The National Archives Building, in Washington, D.C., houses records of the United States Coast Guard (US Coast Guard) in Record Group (RG) 26 including vessel logs and operational reports. The National Archives II in College Park, Maryland, houses analogous records for the United States Navy (US Navy). These holdings include:

- RG 19: the Bureau of Ships;
- RG 24: Naval Personnel Records (including deck logs);
- RG 38: Chief of Naval Operations;
- RG 74: the Bureau of Ordnance; and
- RG 181: Naval Districts and Shore Installations.

Furthermore, Archives II houses still photography and cartographic records for the US Navy and US Coast Guard, including maps, and photographs of ships, installations, and miscellaneous operations. The National Archives Mid-Atlantic Region facility in Philadelphia, Pennsylvania, contains records from the Philadelphia and Norfolk Navy Yards, in addition to records from the Fifth Naval District, as part of its holdings within RG 181. Of particular interest are merchant ship files regarding the manning and provisioning of armed merchant vessels.

Research was also conducted at The Mariners' Museum Library in Newport News, Virginia. This facility holds a vast collection of vessel plans, photographs, a complete run of *Lloyd's Register of Shipping* and other primary source materials that were useful for this study. Likewise, the Greenwich Maritime Museum in the UK also provided ship plans for a number of sites. Additional archives were accessed that included primary sources such as plans, newspapers, and photographs. These included the Steamship Historical Society of America in Warwick, Rhode Island; the University of Wisconsin Data Collection in Madison, Wisconsin; the Historical Collections of the Great Lakes from Bowling Green State University in Bowling Green, Ohio; Aberdeen Maritime Museum in Scotland; Bedfordshire and Luton Archives in Bedfordshire, United Kingdom; Hart Nautical Collections at Massachusetts Institute of Technology, Massachusetts; the National Museum of the Royal Navy in Portsmouth, United Kingdom; the Merchant Marine Academy Library in Kings Point, New York; and Das Bundesarchiv in Germany.

In addition to the aforementioned archives, there are a number of private web-based databases that were utilized for historical research. Uboat.net is perhaps the most comprehensive web-based source for information. It is maintained by Gudmundur Helgason and based in Reykjavik, Iceland. This site contains information on individual U-boats as well as Allied warships and merchant vessels that were attacked by U-boats. Likewise, the site uboatarchive.net, run by Jerry Mason from Vancouver, British Columbia, also has a great deal of primary source documents available. These include transcripts of interrogation reports from U-boat commander survivors, official after-action reports and copies of German U-boat operations logs, or kriegstagebucher (KTBs), and the Eastern Sea Frontier War Diary. Much of this information is sourced from archives such as NARA but is curated and digitally accessible via this site. As useful as these records were to ongoing research efforts, primary source material is cited as often as possible within this text, though much of the information could likewise be found digitally in these online collections.

3.3 Methodology for Diver Based Survey

Generating archaeological site plans of Battle of the Atlantic shipwrecks was a major component of diver based activities. Traditional recording techniques and on-site observations allowed for incredibly thorough site evaluations. The final plans generated were useful not only as an archaeological baseline for tracking potential impacts to the site over time, but also as critical information to develop NRHP nominations and additionally serve as useful outreach tools. While in many ways this was by far the most detailed method for surveying a site, it was also the most time-consuming, labor intensive, and often the most costly. As such, it was not practical to survey all the sites in this study to this level of detail. Where possible, all of the military sites (U-boats, and Allied warships) were surveyed in this manner unless inaccessible due to depth. In addition, training and utilizing skilled recreational diving volunteers allowed for this level of recording on a handful of select merchant vessels.

Beyond detailed site plans, the diver-based survey methodology consisted primarily of documenting the sites by generating photomosaics and photogrammetric models, recording diagnostic hull features, intensive video and photo documentation, and documentation of ordnance and artifacts *in situ*. Due to the dynamic environment of the sites and the nature of this non-invasive survey, permanent baselines were not established at the sites, though temporary tapes were carefully installed and removed by non-invasive means. When possible, measurements were taken from known structural features on the sites and then compared to historic engineering plans from the original construction. Given constraints of bottom time at depth, a hybridization of methods was often used to generate the site plans. A combination of video, scaled drawings, original design plans, and scaled photographs were combined to generate a detailed exterior survey of each wreck site along with measurements taken on site.

To generate site plans, divers were assigned specific sections along each site referenced to either port or starboard of an established baseline to collect scaled measurements in each section, which were then compiled to create an overall site plan. Simultaneous with the site mapping, a photographic/video survey would be conducted to create photomosaics and to document artifacts, ordnance, and diagnostic features of the site. The photographic/video documentation includes the outer hull structure, diagnostic structural features, any damage or degradation to the hull structure, as well as artifacts and *in situ* munitions. At no point during any survey was the hull structure or any feature of the wreck sites altered. The U-boat wreck sites were respected as war graves and survey team members did not penetrate the hull or otherwise disturb the sites in any way. Liveboating procedures were likewise utilized whenever possible to alleviate the need of the diving platform to anchor to the archaeological remains themselves, as even the most careful anchoring on a site can significantly degrade and damage site components over time.

All survey methods were designed to recover data necessary to document the sites and support their nomination to the NRHP. Some sites were documented using all of these techniques, whereas only a selection of methods were applied at other sites. The methodology followed for in-water documentation and site assessment is outlined below.

In-water documentation included:

1. Document site by generating detailed site plan and recording diagnostic features.
    a. Identify and record diagnostic structural features such as deck machinery, hatches, armaments, etc.
    b. Identify and record hull damage due to the sinking event.
    c. Identify and record hull damage caused to the site post-sinking due to natural and/or man-made causes.
2. Identify and record all exposed artifacts within the immediate vicinity of the site.
3. Identify, record, and determine the extent of hazardous material and ordnance remaining on the site while maintaining all safety protocols.
4. Create scaled photomosaics of the site by generating plan and profile photomosaics and supplement with hull measurements.

a. Conduct plan view photomosaic survey by video-documenting sites using the photomosaic sled as a platform coupled with digital sonar to maintain a minimum of 9.1 m (30 ft) above the subject.
b. Conduct profile and oblique photomosaic surveys by video documenting site using the photomosaic sled as a platform, coupled with digital sonar to hold a constant distance from the site, and depth gauge to hold a constant depth; move from bow to stern.
c. Combine photomosaic data with the diver generated site plan.

5. Intensive video and photographic documentation of the hull and diagnostic features.
   a. Video record and photograph hull and diagnostic hull features from all angles.
   b. Video record and photograph diagnostic artifacts from all angles with scaling device.
6. Identify and document areas on the site to monitor hull and structural degradation over time.
   a. Select features on the bow, amidships, and stern that would best illustrate hull and structural degradation over time.
   b. Document the extent of the feature's degradation.
   c. Clearly identify the features on the site plan for future reference.
   d. Document the site's orientation on the seafloor by calculating the degree of angle with a clinometer to determine the current pitch and roll of the hull.
7. Document artifacts, any hazardous material, and ordnance *in situ*, showing their spatial relationships with respect to the rest of the shipwreck.
   a. Video record and measure exposed artifacts, hazardous material, and ordnance *in situ*, and document their relation to the rest of the site.
   b. Identify artifacts with diagnostic features and makers' marks or other unique identifying features.

Assessment included:

1. Identify the sites and make recommendations for future management.
   a. Identify site name and/or type.
   b. Assess if historical accounts coincide with archaeological interpretations.
   c. Assess whether additional fieldwork is needed.
   d. Nominate the site to the NRHP.
   e. Make suggestions for public interpretation.
2. Determine if artifacts are threatened and/or have historical significance.
   a. Identify artifacts of historical significance or unique type.
   b. Identify artifacts of duplicative objects.
   c. Evaluate danger to artifacts if left undisturbed.
3. Determine if there are environmental hazards or ordnance remaining at the sites and make recommendations for their possible removal or neutralization.
   a. Identify environmental hazards at the site and contact the appropriate federal government oversight agency (i.e. US Coast Guard).
   b. Identify ordnance at the site and contact the US Navy, German Consulate, and NOAA General Consul.
   c. Make recommendations that balance public safety with preserving the historical significance and integrity of the site.
4. Determine site stability and integrity of each U-boat and make recommendations for its long-term preservation.
   a. Assess site damage and determine if it was caused by the sinking event or post-sinking.

b. Evaluate post-sinking hull damage/alterations and determine causes based on environmental and cultural considerations.
c. Evaluate long-term hull integrity and make recommendations for site preservation.

In planning for factors beyond control (e.g. inclement weather, equipment breakdown, personal illness, poor visibility on the site, etc.) the methodology presented above was designed to provide flexibility and adaptability. Dive tasks could require a single dive or multiple dives, but each task related to a discrete objective. The tasks were prioritized, and some tasks could not be conducted until others had been completed. Ultimately, the documentation and assessment objectives outlined above in tandem with consideration of diving limitations and environmental conditions guided each site survey. Insofar as consistency was possible, employing a uniform approach to site documentation and assessment was essential for creating comparative products, and will aid in potential long-term monitoring of the site.

3.3.1 Technical Diving Operations

The type of diving operation used to conduct these surveys in most cases would be considered 'technical' diving. This means that the divers conducting the in-water assessments utilized helium-based or oxygen enriched gas mixtures and planned staged decompression to allow for longer dives at deeper depths over conventional scuba diving. Typically, this involved highly trained personnel and the use of 'trimix', a breathing mixture of various parts oxygen, helium, and nitrogen using open or closed circuit breathing systems. Broadly, technical diving is considered any activity taking place beyond the range of typical SCUBA diving, which is accepted by most training agencies as 39.6 m (130 ft) deep and shallower with no required decompression.

Using breathing mixtures specifically blended for each dive would allow the research team to stay on site as long as possible, while maintaining safe parameters for decompression and limiting the effects of nitrogen narcosis at depth. Elevated partial pressures of nitrogen at depth can induce a narcotic effect on divers, which can impair their ability to complete complex tasks, and reduces safety. Likewise, oxygen at high partial pressures becomes toxic to the diver and can induce life-threatening seizures if not kept at appropriate levels. Helium is introduced as a non-narcotic inert gas that can sufficiently suppress the oxygen level to a safe point in a breathing gas without impairing the mental acuity of the diver. Likewise, helium saturates body tissues at a faster rate than nitrogen, so striking a balance between these three gases for any particular dive profile was imperative, always seeking to maximize bottom time while keeping divers in safe limits.

Decompression procedures were also used to allow divers to spend more time on the sites. Depth and time are the two greatest factors determining the possibility of decompression sickness. Even at sites that could be accessed without required decompression these techniques were still used to increase bottom times. For example, a dive to a site in 36.6 m (120 ft) of water breathing air could be accomplished without decompression by limiting the time to only 15 minutes. By planning staged decompression this time could be increased a great deal, perhaps 45 minutes to one hour. This increased bottom time dramatically increases what is achievable during any given fieldwork window.

In accordance with NOAA technical and decompression diving procedures, a number of safety requirements were met. During any dive requiring staged decompression a hyperbaric chamber and qualified technician were on board. To facilitate safe live boating and in-water decompression, an auxiliary emergency chase boat was on standby to support split teams if required. Typically, a bottom team of divers consisted of two scientific divers conducting research and one bottom safety support diver. All divers carried the entirety of their primary, bailout (emergency) and decompression gasses on each dive. Two in-water support divers with additional gases would meet bottom divers and remain with them for the entire decompression process. Topside staffing included a NOAA-approved technical diving supervisor, a dive medic capable of operating the hyperbaric chamber and two tenders/support divers. Enough emergency oxygen for two divers to be transferred ashore was carried on board at all times.

Utilizing these methods, the research team was able to safely access sites in water depths up to 76.2 m (250 ft) deep. This greatly increased the range of targets that could be accessed in person and allowed for detailed data collection.

3.3.2 Volunteers and Citizen Science

In addition to collaboration with non-governmental organizations (NGOs) and academic, state, and federal partners, MNMS also worked with avocational volunteers to gain additional detailed information on select sites. MNMS, through a license agreement with the Nautical Archaeology Society (NAS), conducts training programs for members of the public that have an interest in underwater archaeology. NAS is an internationally recognized program with a robust curriculum for training divers and non-divers in techniques that contribute to archaeological research. MNMS has built a large base of skilled divers through the NAS program, and has hosted several expeditions utilizing volunteer divers to collect useful data on sites. This approach led to the completion of detailed site plans for this study on the sites of *Ashkhabad*, *Caribsea,* and *Dixie Arrow*.

The quality and level of detail obtained on these sites is evident in the site plans, and was collected under the same methodological approaches outlined above for diver based surveys. Conducting surveys in concert with the NAS volunteers had the added benefit of participation and engagement with the local community. This allowed meaningful work to be accomplished at the same time as enriching participants' experience with these resources and building local buy-in to the archaeological process and protection of archaeological sites. This was true not only for those volunteers that chose to dive, but also allowed non-divers the opportunity to be involved via historical and archival research as well as drafting and data processing.

3.3.3 Photographic Documentation

Wherever possible, extensive photographic and video documentation were performed on each of the sites, including imaging the exterior hull, structural features, and artifacts utilizing a wide range of imaging techniques. Particular attention was given to capturing imagery of any damage or degradation of the site, to be used as baseline data for future site monitoring. The images generated from the project were catalogued and indexed with metadata on each of the sites, providing a searchable database of shipwreck sites, features, and artifacts.

Divers used a variety of photographic techniques to record the shipwrecks including overall site imaging using natural and artificial light (underwater strobes), artifact photography performed *in-situ*, photomosaic imaging, and photogrammetry. Modern digital single lens reflex (DSLR) cameras were used in most cases, housed within machined aluminum underwater housings. Cameras used for documentation in the project included: Nikon D70, Nikon D300, Nikon D7000, Nikon D800 and Nikon D4, all used in conjunction with Aquatica aluminum housings.

A variety of lenses and focal lengths were used while photographing the sites. Individual lens choices varied based on the goals of the photographic documentation. Ultra-wide angle and fisheye lenses were used for overall site documentation with focal lengths ranging from 10.5 millimeters (mm) to 24 mm. The wide field of view of these lenses allowed divers to capture expansive exterior hull shots. The ultra-wide view, coupled with the minimal focus distances of these lenses, ensure sharp images of large features by allowing the divers to get closer to the subject while reducing the amount of water the diver has to shoot through. Wide-angle rectilinear lenses with focal lengths ranging from 11 mm to 24 mm were used in the creation of photomosaics and photogrammetric models. The lack of barrel distortion found in these lenses make them well suited for accurate underwater scientific photography. In addition, these lenses were used when photographing structures, features, and artifacts using scale bars. Macro lenses were also used in 60-mm and 105-mm focal lengths. These close focus lenses are suitable for use when photographing medium to small artifacts, and could be used in poor visibility, due to their ability to focus very close to the subject.

3.3.4 Photomosaics

Photomosaics are large-scale images created by digitally combining many overlapping small area photographs together into a larger, detailed picture that covers a wider field of view. Due to the optical characteristics of water and the unpredictable nature of water clarity, it is often difficult or impossible to get one image of an entire shipwreck site. The photomosaic process allows divers to capture the entire site, even in relatively poor visibility conditions. Photomosaics were created for many sites in both plan and profile view, using DSLR cameras and wide-angle rectilinear lenses. To create a photomosaic, divers take many photographs in succession, either above or alongside the shipwreck, maintaining a known distance and orientation relative to the shipwreck. After processing, the images are stitched together in sequence, using Adobe Photoshop or a similar photo editing software with image stitching capabilities (Figure 3-1).

Figure 3-1 Profile view photomosaic of *E.M. Clark*.
Source: NOAA

3.3.5 Photogrammetry

Photogrammetry is a scientific process in which photographs are used to create detailed and measurable 3D models. Photogrammetric models were created on several of the shipwreck sites, yielding accurate 3D models that are valuable for research, education, and outreach. The photogrammetric process is similar to creating a photomosaic. Divers using DSLR cameras equipped with wide-angle rectilinear lenses in underwater housings take photographs of the shipwreck site or feature in a systematic manner. Overlapping photographs are taken in succession, capturing the subject from all angles. After image color correction and processing, photographs are exported into high-resolution .jpg or .tiff files, and are imported into the photogrammetry software.

Agisoft's Photoscan Pro was used to process the photogrammetric models created on the project. After importing the photographs, Photoscan Pro aligns the photos in 3D space, matching similar features in each of the photos and assigning X,Y, and Z coordinates to the images. In addition, a sparse point cloud is produced creating a rough 3D image.

After images are correctly aligned, the next step in model construction is the creation of a dense point cloud. The point cloud is created in 3D space, based on the aligned photos, and their matching features. The resulting dense cloud is made up of numerous points, often as many as several million, each with their own RGB (Red, Green, Blue) and luminance value. Following dense cloud creation, the next phase of the workflow includes building the model mesh, or wire frame. Connecting the dense point cloud into a series of polygons creates the mesh. The polygons create a solid surface on which the photo texture can be applied. Edits of the mesh including mesh decimation of outlying mesh and closing of mesh holes can be done at this stage.

Finally, after all steps have been executed, a photo texture is applied and wrapped over the solid surface. The high-resolution photo texture is created from the aligned photos provides accurate photorealistic detail on top of the 3D model. If gaps in the data are observed, they can be re-photographed on subsequent dives to ensure total coverage.

Once a 3D model is created, accurate measurements of the site can be taken after producing a digital scale bar from a known measurement or a physical scale bar within the photos. The ability to take measurements and compare meshes between models made in different times allows one to track site change over time and is a valuable tool in site monitoring and management. 3D photogrammetric models also are valuable education and outreach tools, as they provide an accessible way for the public to experience the sites in an immersive and interactive 3 dimensional way. These models can be viewed with 3D software or online tools, and printed with a 3D printer. Online 3D modeling websites provide an intuitive interface for sharing models and for public access (Figure 3-2 through Figure 3-5).

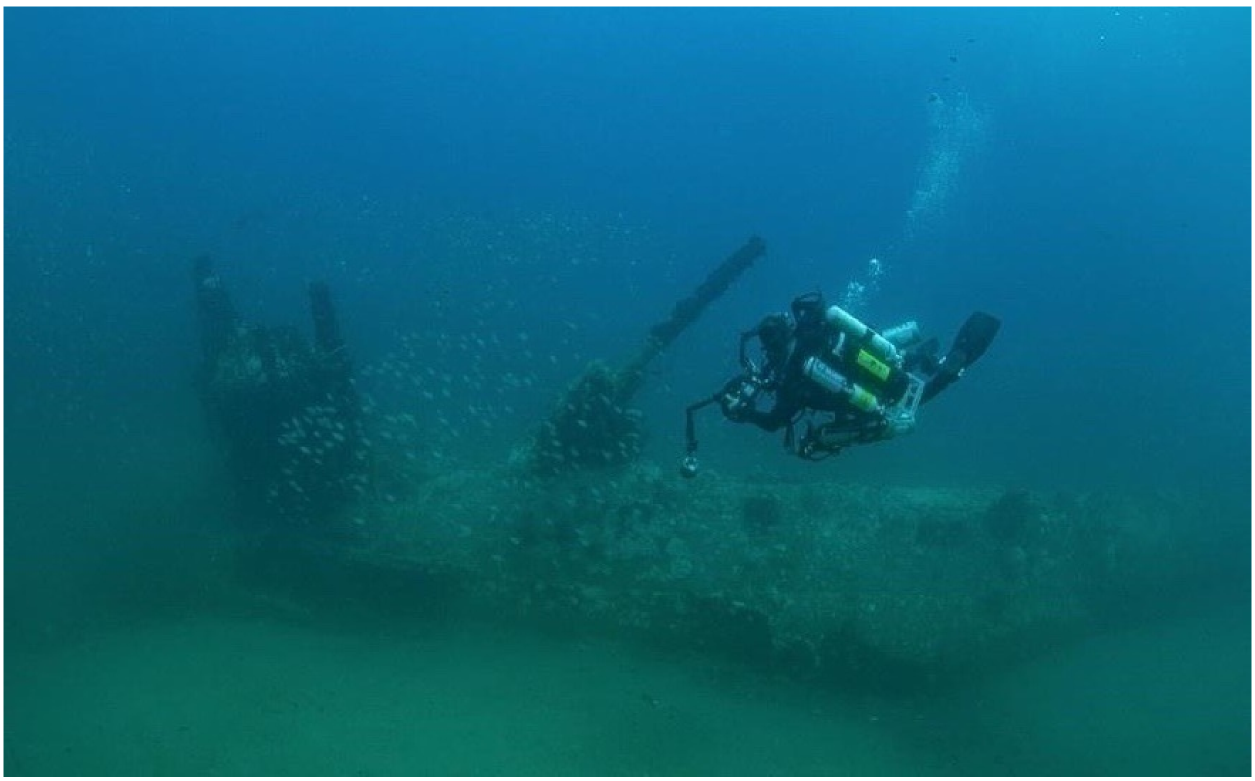


Figure 3-2 Diver shooting photos of U-*85* for a photogrammetric model.
Source: UNC-CSI

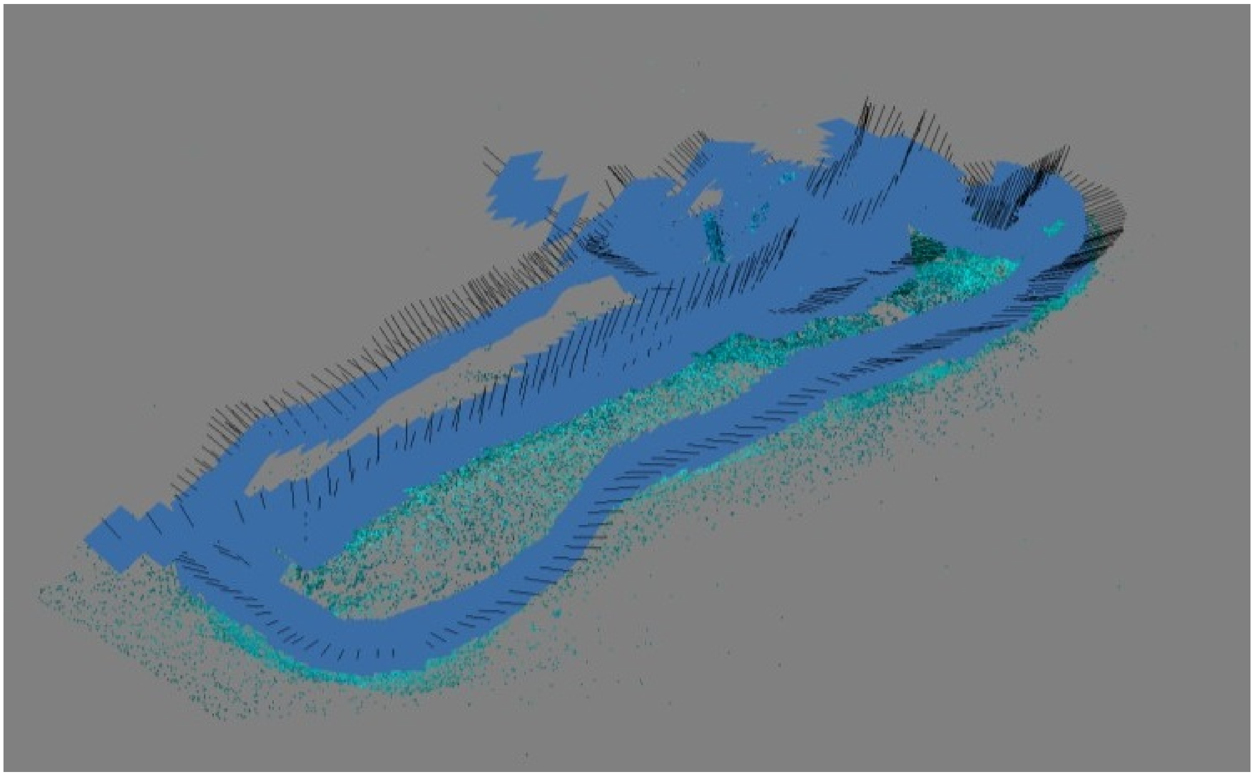


Figure 3-3 Photo alignment and spare point cloud of U-*85*.
Source: UNC-CSI

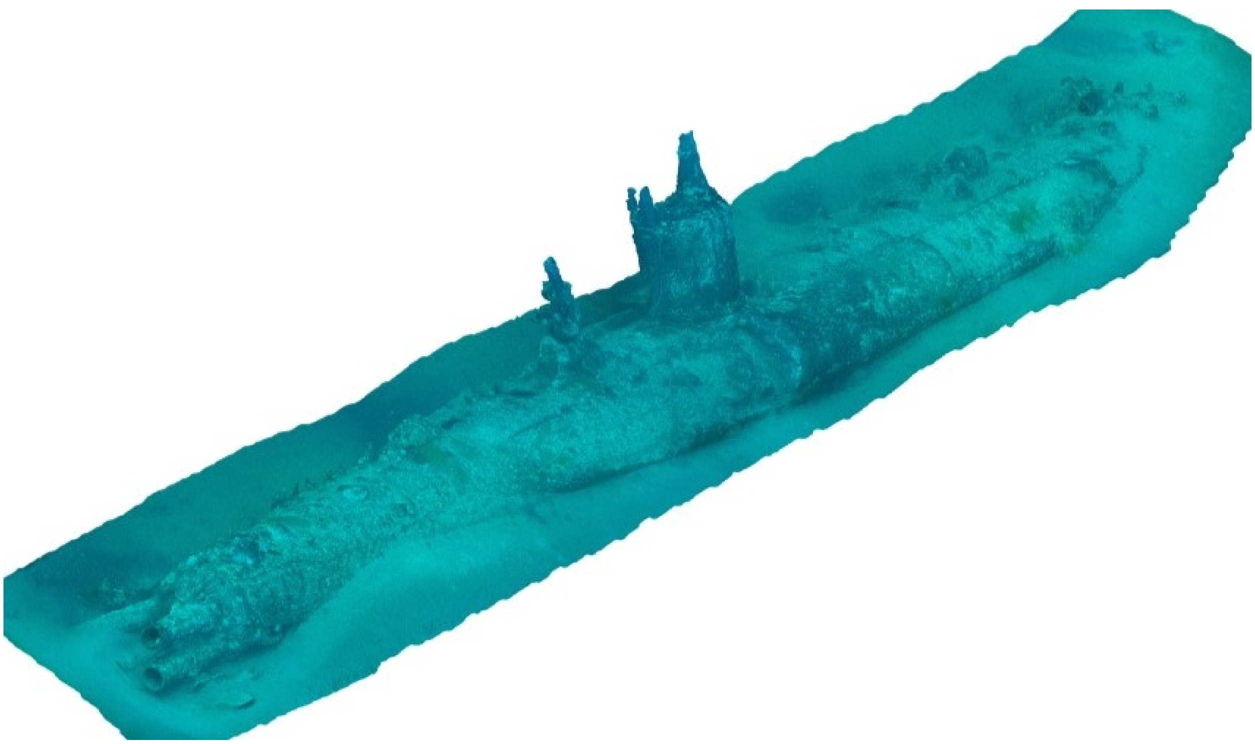


Figure 3-4 Dense point cloud of U-*85*.
Source: UNC-CSI

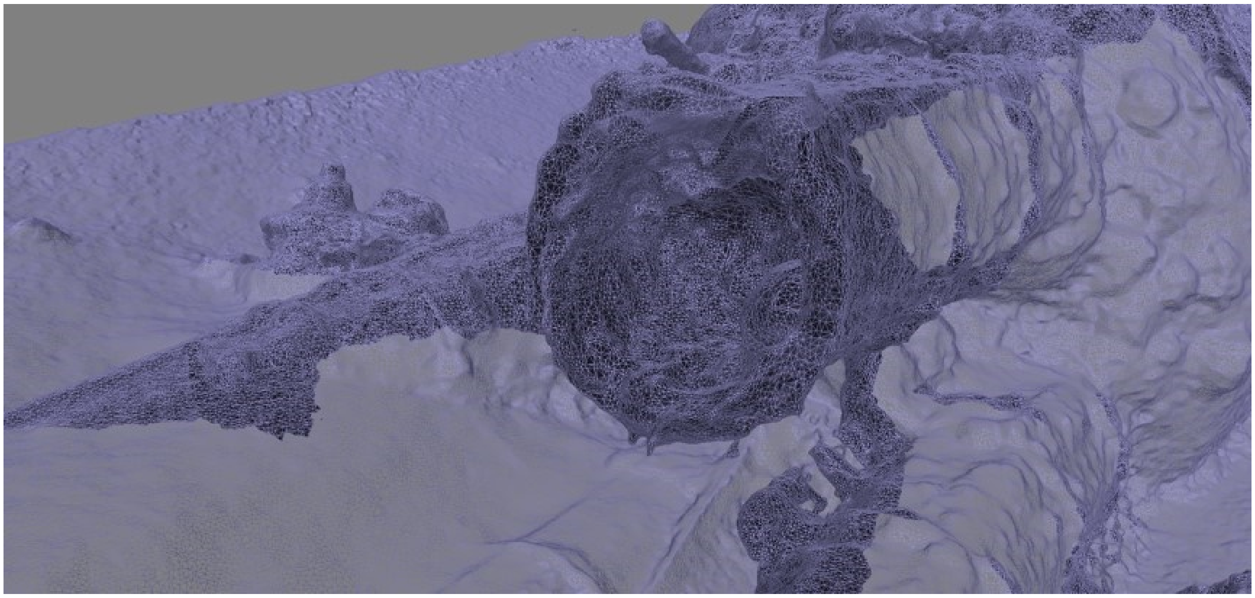


Figure 3-5 Close-up (see Figure 3-4) of torpedo tube wire frame of U-*85*.
Source: UNC-CSI

3.3.6 Videography Documentation

Video documentation was used to record the shipwreck sites and features, and illustrate archaeological methods used during the project. Attention was given to documenting the state of the sites, recording existing degradation and damage, and creating a baseline for future monitoring. Professional level high-definition (HD) and ultra high-definition cameras and lighting systems were used topside and in underwater housings. Cameras used on the project include:

- GoPro Hero, GoPro Hero 2, GoPro Hero 3+, GoPro Hero 4;
- Sony HC-3 HD camera in Light and Motion Housing;
- Sony PMW-Ex1r HD camera in Gates Housing;
- Red One Digital Cinema 4k camera in Gates housing;
- Red Epic Digital Cinema 5k camera in Gates housing; and
- Red Dragon Digital Cinema 6k camera in Gates housing.

Significant post processing of the footage was performed, including color grading, transcoding, and editing.

In addition to HD and ultra HD videography, 3D stereography was employed on several of the sites, including U-*701*, *E.M. Clark*, USS *Monitor,* and *Dixie Arrow*. Three dimensional video stereography is a technique that creates the illusion of depth to an image, by using two cameras synced side by side. The slightly offset camera views can be processed with 3D software and, through the use of 3D displays and the appropriate glasses, give the perception of 3D depth. This footage was obtained through a partnership with the Advanced Imaging and Visualization Laboratory (AIVL) at Woods Hole Oceanographic Institute (WHOI) and was captured during the 2011 Battle of the Atlantic Expedition. After capture, the footage was processed in partnership with UNC-CSI. During processing, the left and right eyes of the footage are synced and combined to create the 3D stereography effect when viewed with 3D glasses on a 3D monitor or projector. The footage is used both for interpretation and outreach (Figure 3-6).

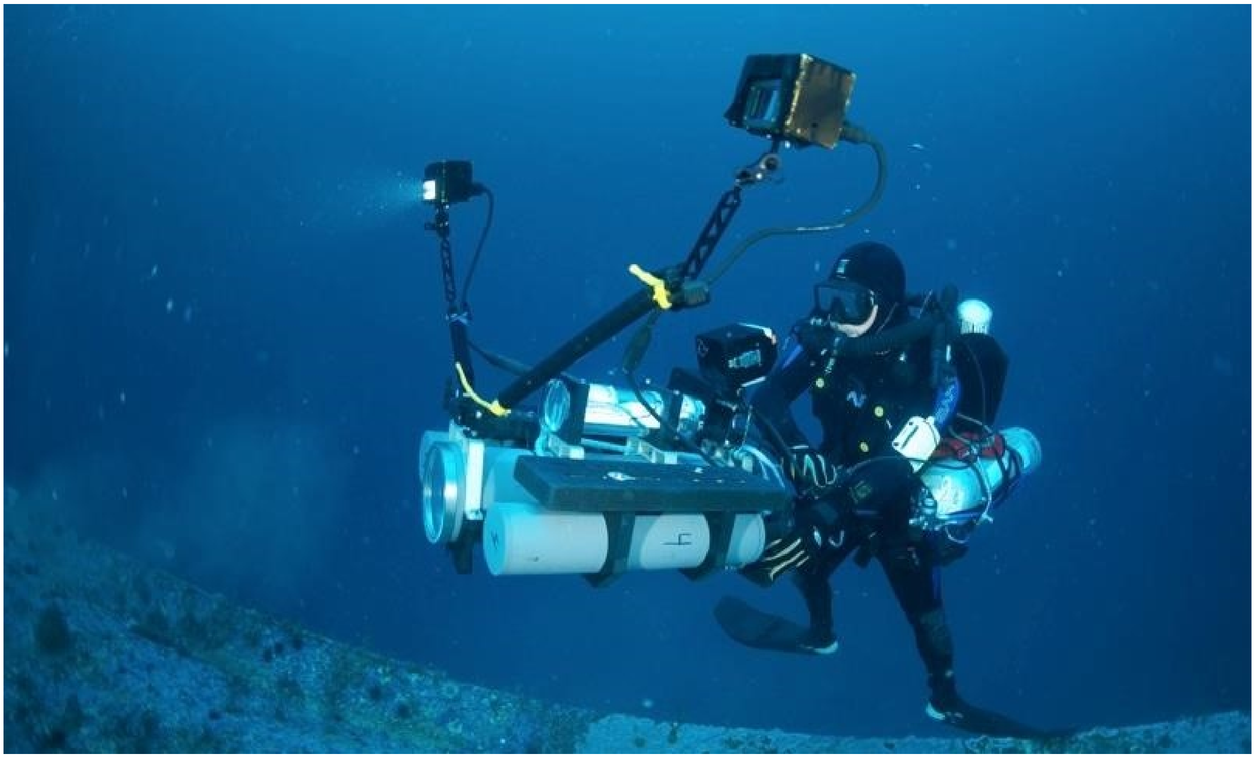


Figure 3-6 3D stereography video system.
Source: Becky Kagan Schott, WHOI

3.3.7 Manned Submersibles

Some targets in this study were beyond the reach of conventional diving techniques but significant enough to warrant direct investigation by archaeologists. For such targets, manned submersibles allowed researchers to visually inspect the sites, served as a platform for photographic and video documentation, and carried a remote sensing payload.

Through a strategic partnership with Project Baseline and Brownie's Global logistics, two Triton 1000/2 submersibles were fielded during the 2016 survey (Figure 3-7). The vessel *Baseline Explorer* served as a delivery system for the research crew and the manned submersibles. The Triton 1000/2 submersibles were capable of operating at 305 m (1,000 ft) in depth and could carry two passengers, consisting of a pilot and a researcher. Additionally, they are certified by the American Bureau of Shipping for safety (a rating recognized by NOAA and ONMS Marine Operations). The systems had an operational capacity of 10-hour dive durations per day and could achieve a speed of 3 knots (kts).

The submersibles are each affixed with a manipulator arm and are capable of a 450-pound payload for external oceanographic equipment, with thru-hull connectivity via several ports, which allowed for seamless integration of selected sensors. Having two submersibles operating in conjunction added a level of safety inasmuch as the other submersible may assist if one becomes entangled or inoperable. Likewise, dedicating each submersible to a specific recording task increased operational efficiency. While one submersible collected video and still imagery for photogrammetric purposes, the other conducted laser line scanning survey of the sites. Verbal communication and telemetry between submersibles and topside is continuous. External camera systems were affixed to the submersible and controllable via a Teledyne pan-and-tilt system, operated by one of the occupants. In addition to external photography and video recording, images could also be taken through the acrylic sphere itself (Figure 3-8).

Figure 3-7 Triton sub Nemo prepares for launch above the wrecks of U-*576* and *Bluefields*.
Source: John McCord, UNC-CSI

Figure 3-8 A researcher inside a Triton 1000/2 documents the remains of U-*576* in just over 213.3 m (700 ft) of seawater.
Source: Robert Carmichael – Project Baseline

Dives with this system were conducted in depths up to 243.8 m (800 ft) and typically lasted over 5 hours in duration. The length of time researchers could spend on site was a significant advantage over conventional SCUBA and allowed for the detailed collection of photos and video as well as the execution of comprehensive laser scanning surveys. The research team had planned to conduct two complete dive rotations per day for a total of four dives. Variable current conditions were such that the navigation time required for the subs to locate the target after launch did not leave adequate battery reserve to be able to safely conduct subsequent dives. As such, one dive rotation per day was executed.

3.4 Remote Sensing Methodology

Two goals guided remote sensing operations. The first goal was locating sites reported in the historic record for which no known position existed; essentially un-located sites. This task necessitated a wide area survey approach to systematically cover large areas and identify potential targets. The second goal involved surveying targets with known locations at high resolution. Targeted surveys were generally much more detailed and focused on capturing the best imagery possible of a given shipwreck site. The variance in tools and methods used for the remote sensing methods described below is a result of the fact that while the in-water assessments were conducted 'in-house' by the project team, many of the remote sensing surveys required external partners or contractors, which fluctuated on an annual basis.

3.4.1 Multibeam Sonar Acquisition from NOAA Fleet

NOAA's Office of Marine and Aviation Operations (OMAO) operates a fleet of large, state-of-the-art oceanographic research vessels to service NOAA program areas and fulfill the agency's mandate. These vessels are equipped with multibeam sonar operated by full time survey technicians. In coordination with the commanding officers of individual ships, as well as coordination facilitated through NOAA's Office of Ocean Exploration and Research (OER), several surveys were conducted on behalf of MNMS as part of the Battle of the Atlantic project. Over the course of this effort, NOAA R/Vs *Nancy Foster*, *Pisces*, and *Okeanos Explorer* contributed invaluable data to this study.

Hull-mounted multibeam was the primary survey tool for the R/V *Nancy Foster* cruises. Use of the Simrad EM-1002 multibeam (95 kilohertz (kHz), 20-m to 1,000-m range) onboard required the Chief Scientist to coordinate with the Commanding Officer, Operations Officer, and Survey Technicians to conduct the systematic survey. Planned survey lanes were exported into HYPACK or applied to the survey management software compatible with the Simrad system. The Chief Scientist coordinated with the Operations Officer to ensure that effective monitoring of the data stream took place continually on a 24-hour basis. A rotation for science team members was established for periodic relief. Additionally, the operating area for the Battle of the Atlantic project is fortunate in the fact that many of NOAA's research vessels transit the area *en route* to other projects. Consequently, MNMS was often afforded the opportunity to request small-scale site surveys from various NOAA assets that happened to be in the area.

This has allowed for generally low-resolution surveys of known sites, which provided high accuracy positioning and data on site distribution and extent. The NOAA R/V *Pisces* provided surveys to this level of detail on *Malchace*, *Manuela*, *Liberator,* and other non-WWII sites. The NOAA R/V *Okeanos Explorer*, in coordination with OER, was also made available for a few days of survey to cover a larger area off Cape Hatteras. This area was a deeper-water portion of the potential location for the KS-520 Convoy Battle Site. Leveraging these NOAA assets provided a value-added benefit to the vessels' primary operations objectives, and allowed for economical acquisition of bathymetric data that would otherwise have been complicated and costly to collect (Figure 3-9 through Figure 3-14).

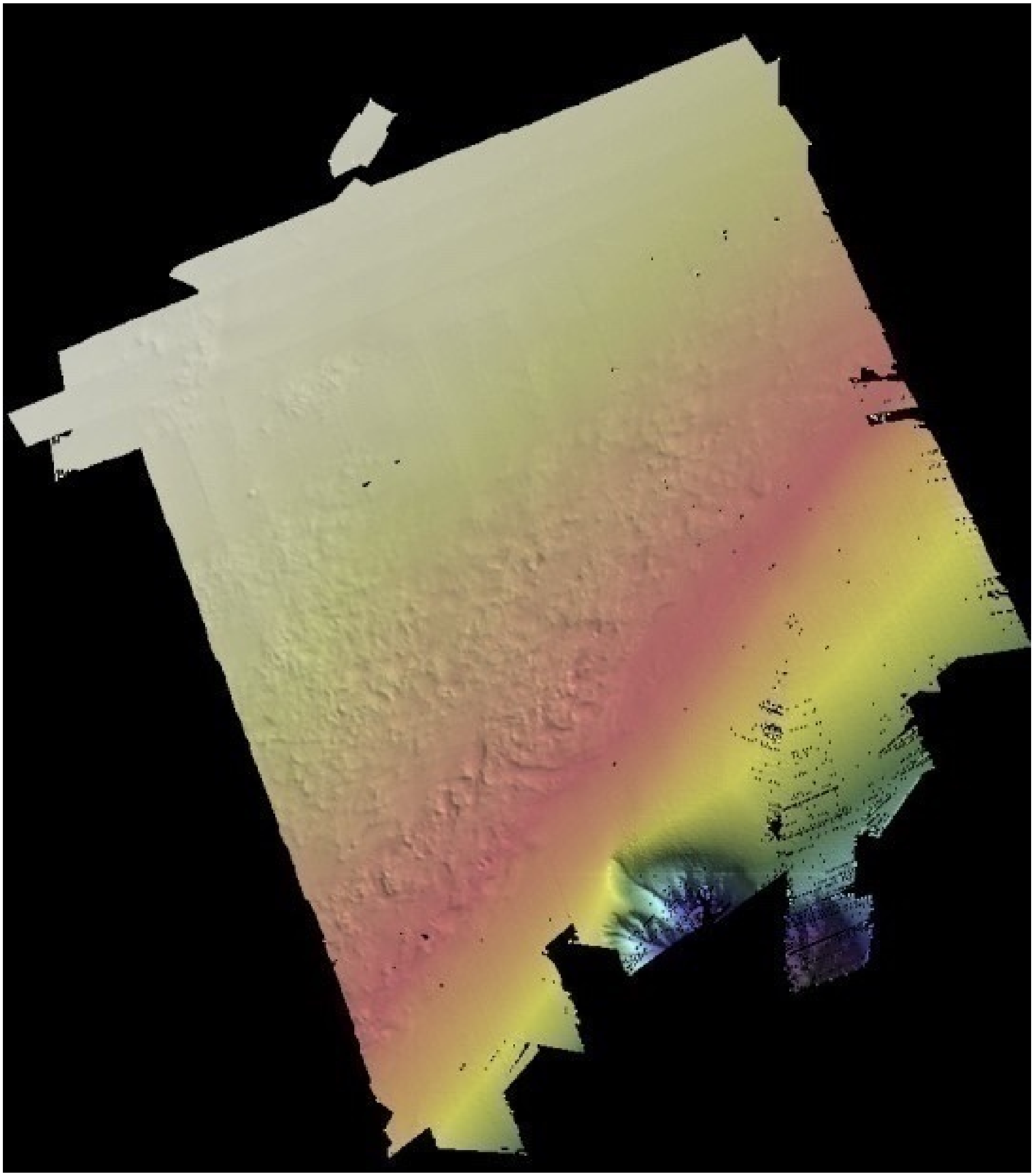


Figure 3-9 Survey area covered in search of U-*576* and *Bluefields* on NF-09-12.
Source: NOAA

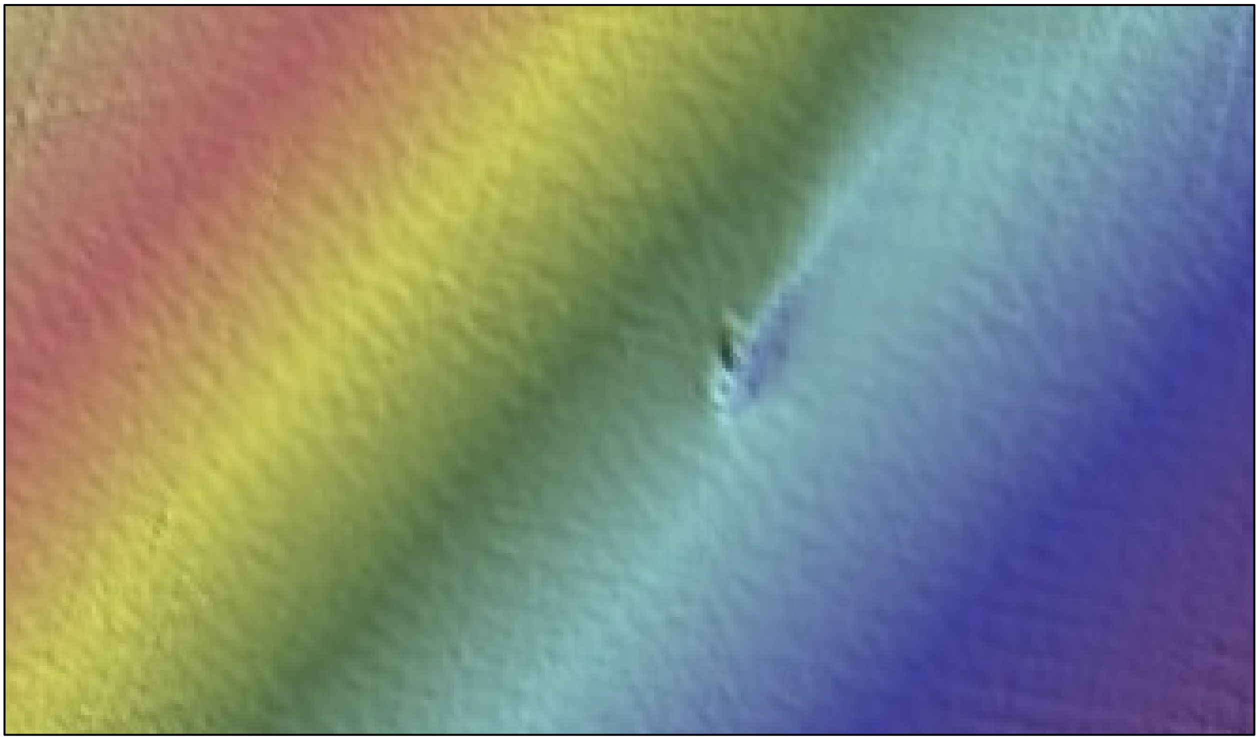


Figure 3-10 Example of unknown wreck site surveyed during NF-09-12.
Source: NOAA R/V *Nancy Foster*

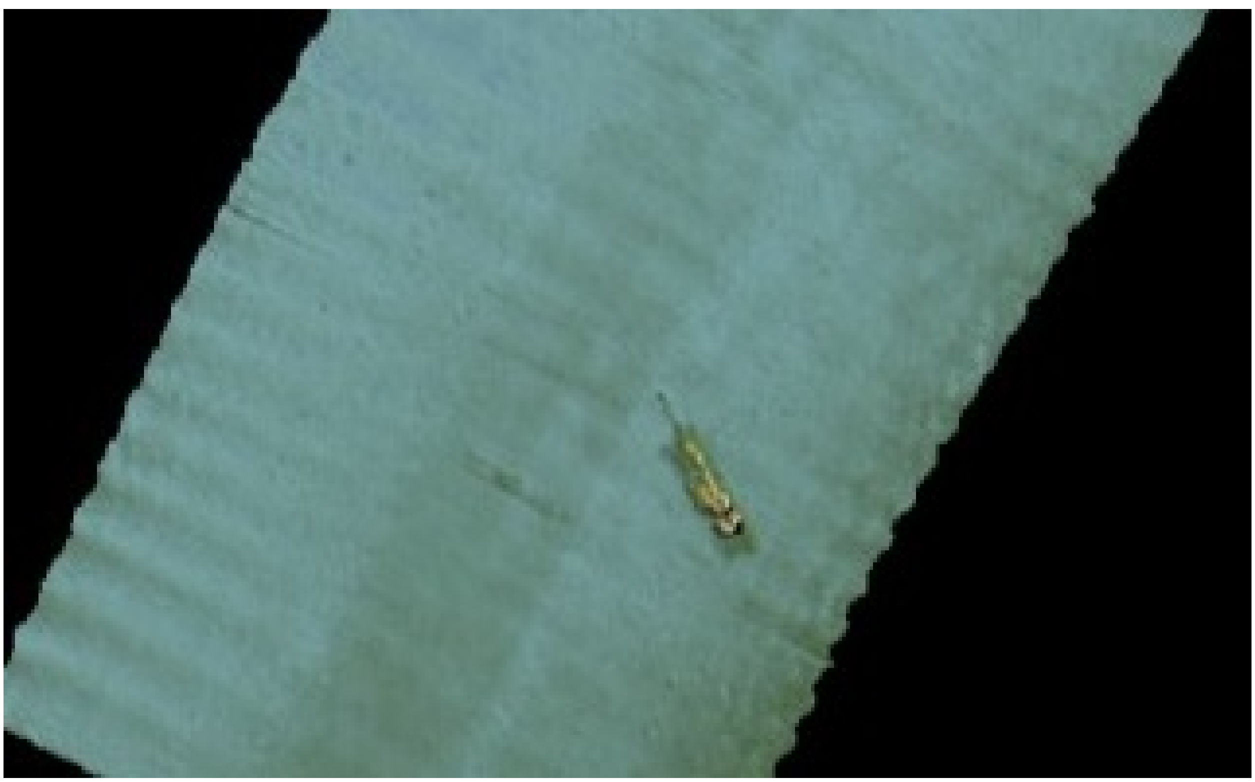


Figure 3-11 Example of unknown wreck site in Onslow Bay, North Carolina.
Source: NOAA R/V *Nancy Foster*

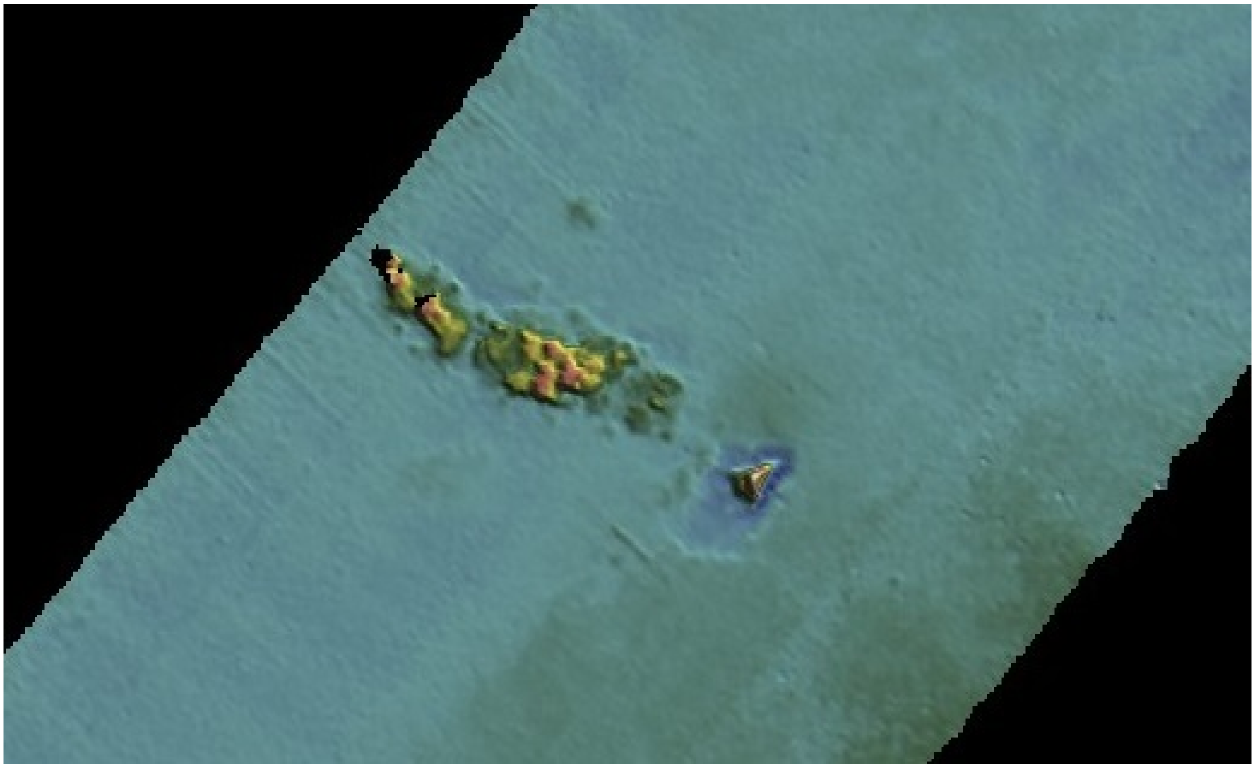


Figure 3-12 Example of WWII-era wreck *Cassimir* in 1 m grid.
Source: NOAA

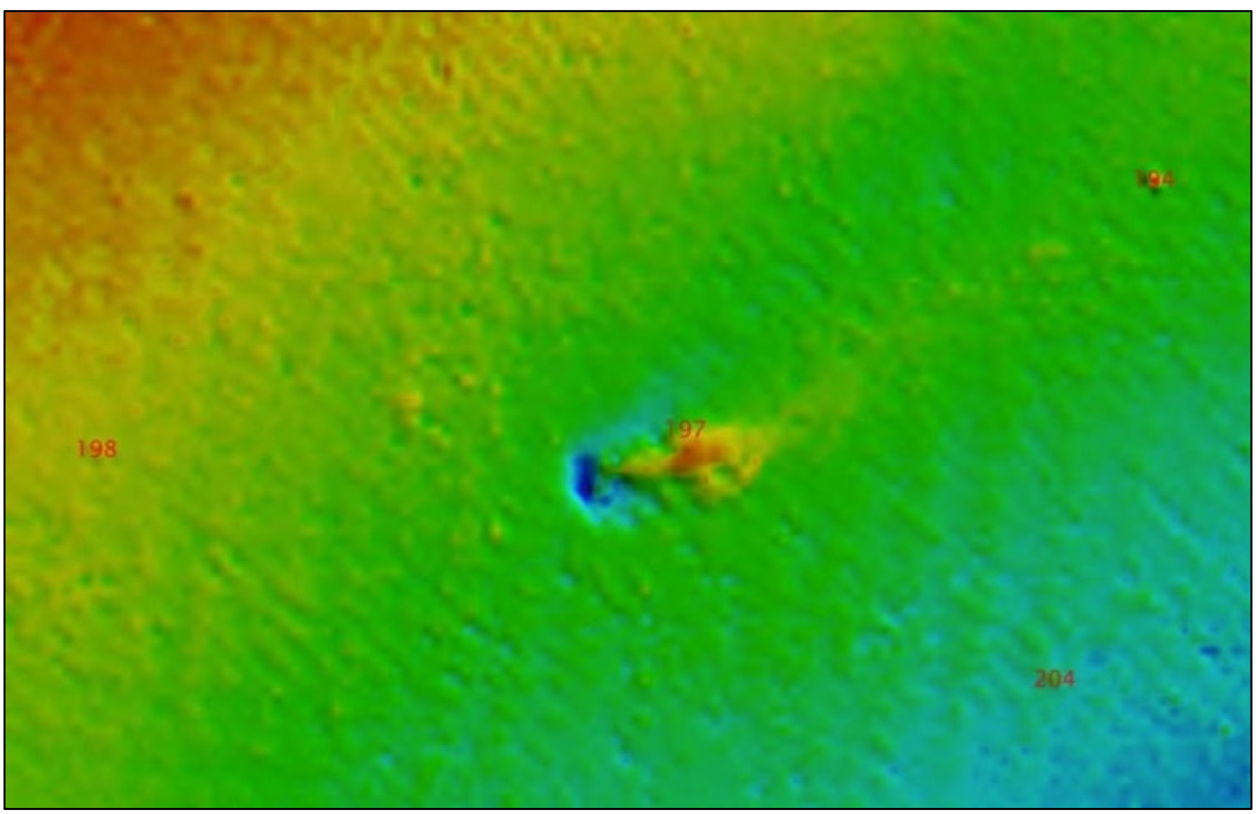


Figure 3-13 Example of the level of detail from survey results of the Diamond Shoals Lightship.
Source: NOAA R/V *Pisces*

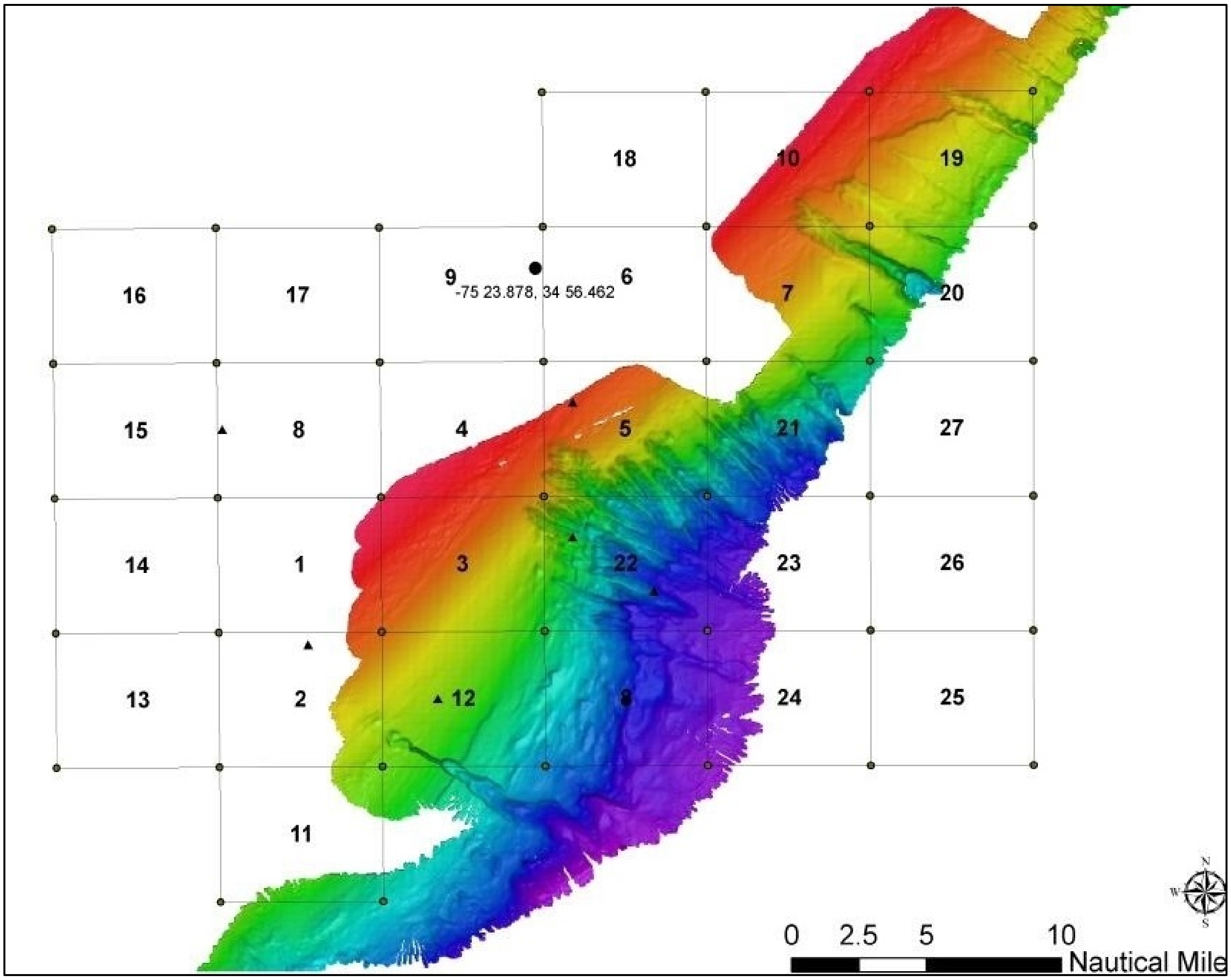


Figure 3-14 Deepwater multibeam SONAR data collected by NOAA R/V *Okeanos Explorer* near Hatteras Canyon within KS-520 probability area.

Source: NOAA

3.4.2 Side Scan Sonar Methodology

While much of the project focused on various types of multibeam sonar survey, a great deal of data were collected via side scan sonar. The survey utilized both Klein 3000 and 3000H dual frequency sonars, utilizing 100/500kHz and 445/900kHz respectively. Data were collected using SonarPro and post processed in either SonarWiz or HYPACK. Generally, side scan sonar surveys were focused on collecting imagery of the highest possible resolution on known targets to serve as preliminary datasets upon which some interpretation or further mapping could be based.

Side scan operations were often undertaken as a compliment to dive operations. Whereas diver-based survey could only be conducted during daylight hours, sonar operations could occur at night just as effectively. Remaining on station 24 hours a day was more economical for the primary research vessel SRVx *Sand Tiger*, as daily transits to the survey area required additional fuel. As such, executing dives during the day and conducting sonar survey at night allowed for more data to be collected and maximized the efficiency of the platform.

Unlike the hull-mounted multibeam sonar systems or the free-swimming AUV systems, side scan sonars were operated via a towed sensor pulled behind the survey vessel at a pre-determined distance off the seafloor. The proximity of the sonar sensor to the bottom and targets of interest allowed for a more focused acoustic image, with much higher grazing angles to accentuate the features of archaeological objects—the characteristic acoustic shadows of a side scan image—for more thorough interpretation. Likewise, the ability to lower the acoustic sensor below the surface mitigated many of the thermo-induced and wave-generated effects that stratified water columns have on boat-mounted systems. Yet, the towed sensors were also subject to mid-water currents that can push the sonar off the longitudinal axis of the survey platform and corrupt some of the navigation data. Likewise, lower frequency signals have the ability to cover larger areas of swath, but produce imagery of lower resolution. By contrast, higher resolution systems provide excellent detail, but a very narrow area of coverage, in some instances making it difficult to fit the entirety of a site in a single image. Thus, an inherent trade-off exists between the side scan systems – capable of detailed, higher resolution imagery – and boat-mounted multibeam systems – capable of very large coverages at lower resolutions (Figure 3-15 and Figure 3-16).

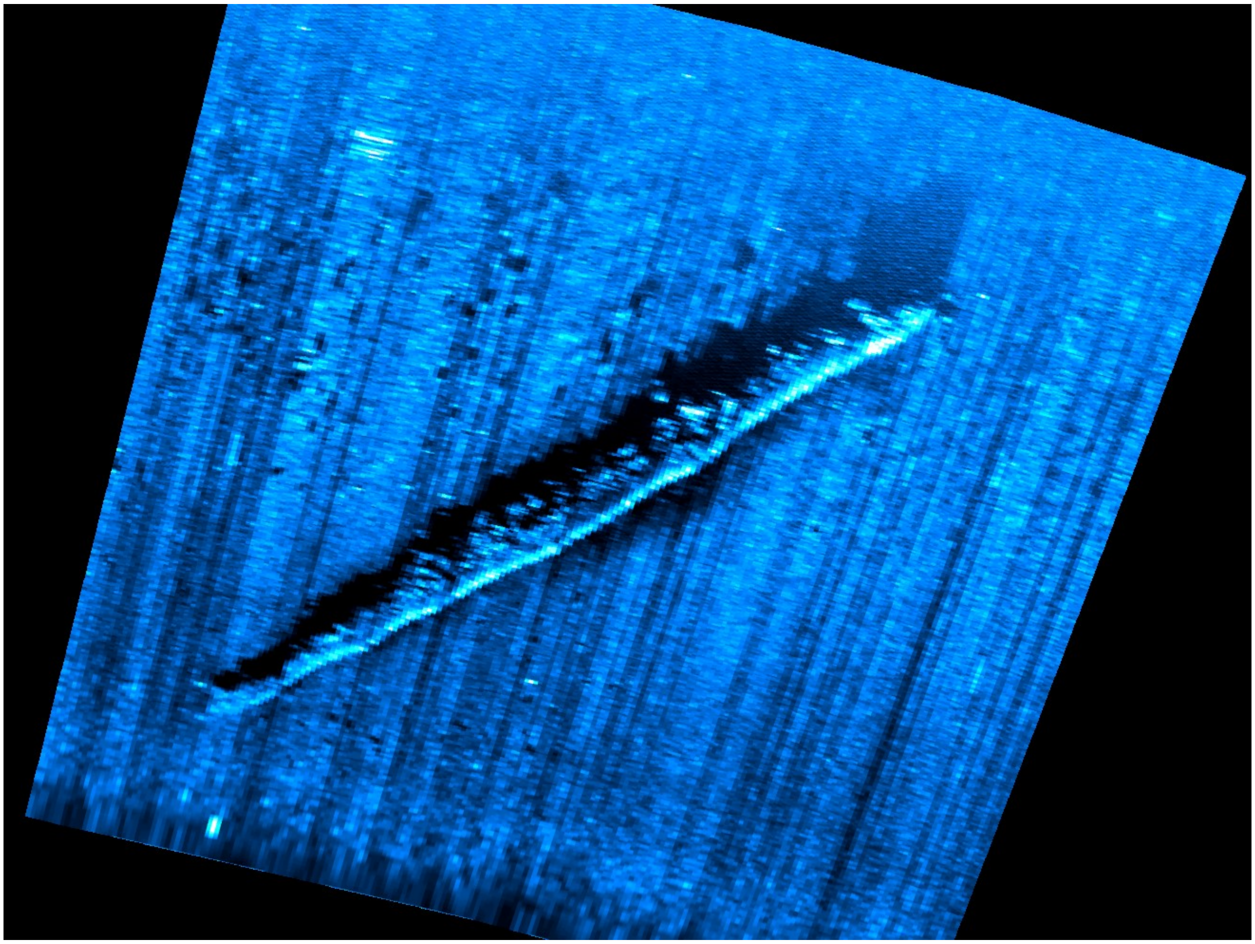


Figure 3-15 Example of low-frequency sonar image of *Tarpon* site.
Source: NOAA

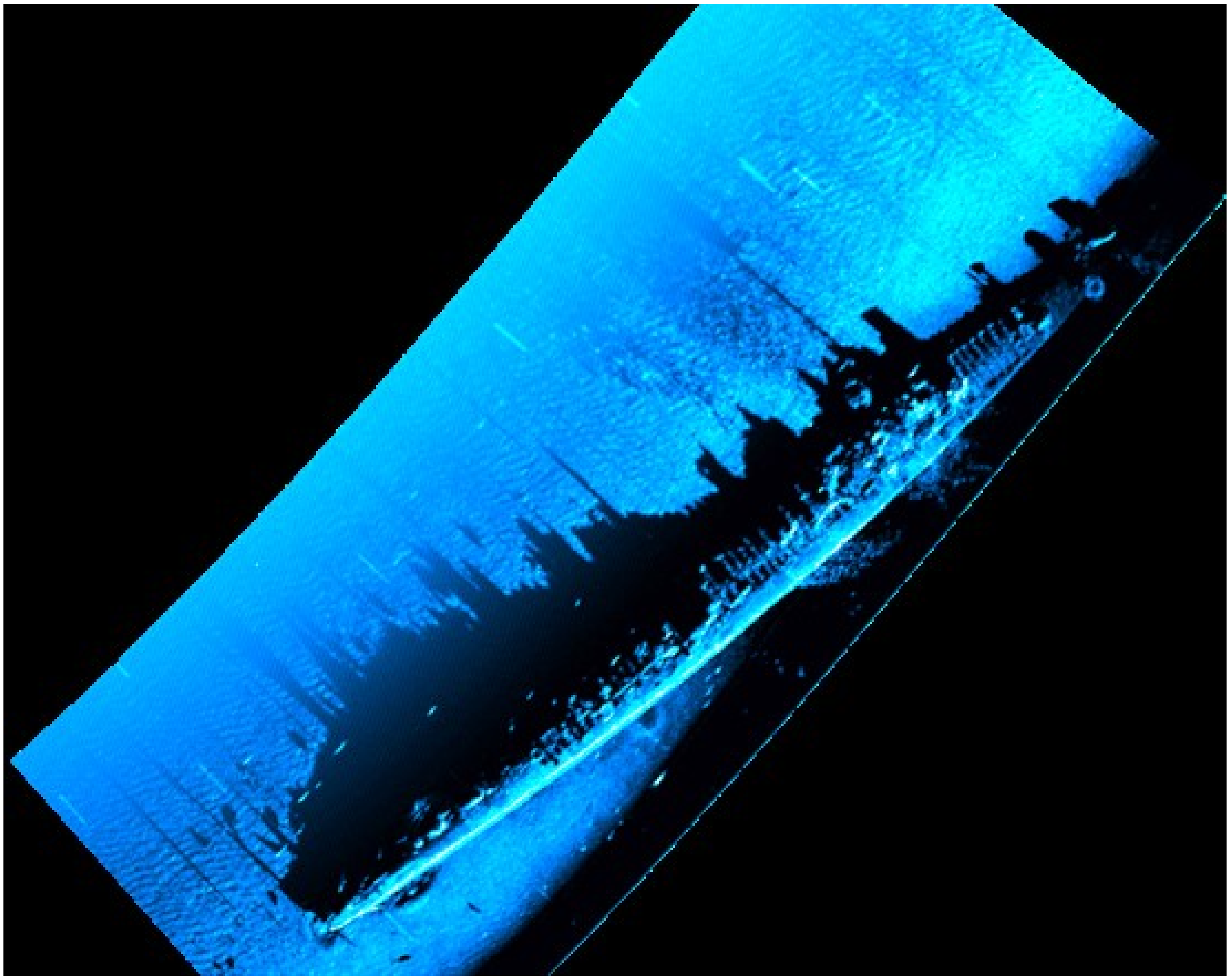


Figure 3-16 Example of high-frequency sonar image of *Tarpon* site.
Source: NOAA

3.4.3 Laser Scanning Methodology

While multibeam bathymetry can provide incredibly accurate survey data, the level of resolution that can be achieved with a laser scanning system is much higher. High quality and reliable underwater laser line scanning is a new technology, certainly in application on underwater archaeological sites, and particularly in deep water focusing on large scale documentation. NOAA's ONMS conducted a pilot project in shallow water in Lake Huron with 2GRobotics, to understand the technology's potential application for underwater archaeology. The results were point cloud models with less than 1 mm of accuracy.

For this survey the 2GRobotics ULS-500 was selected. The ULS-500 projects a line of laser light onto the target object. Based on the light reflected from this line, the scanner calculates a high-resolution 2D profile of points in 3D space. In profile mode, the laser line is moved by vehicles such as AUVs, ROVs, or submersibles. By accumulating a series of profiles, the scanner is able to obtain a 3D point cloud representation of the surface of the target object. The effective operating range of the ULS-500 is 1.15 m to 10 m from the object to be imaged. The coverage area of the ULS-500 is defined by the 50 degree fan beam emitted from the scanner (Figure 3-17). At just 45 pounds the ULS-500 system integrated easily into one of the submersibles, which was dedicated solely to that purpose.

In order to make use of the sub-millimeter accuracy of the laser scanner when the sensor is in motion, equally accurate positioning must be applied. For this, the research team partnered with Sonardyne to establish a long baseline (LBL) positioning system on the site that could communicate with an inertial navigation system (INS) and Doppler velocity lock (DVL) affixed to the submersible. This was achieved by deploying a series of acoustic beacons on the seabed, encompassing the sites to be surveyed (Figure 3-18). Once the navigational environment was established and calibrated, the submersible could traverse through the environment with its positioning resolved to extreme accuracy relative to the beacons. This allows the full resolution and image quality of the laser data to be realized (Figure 3-19).

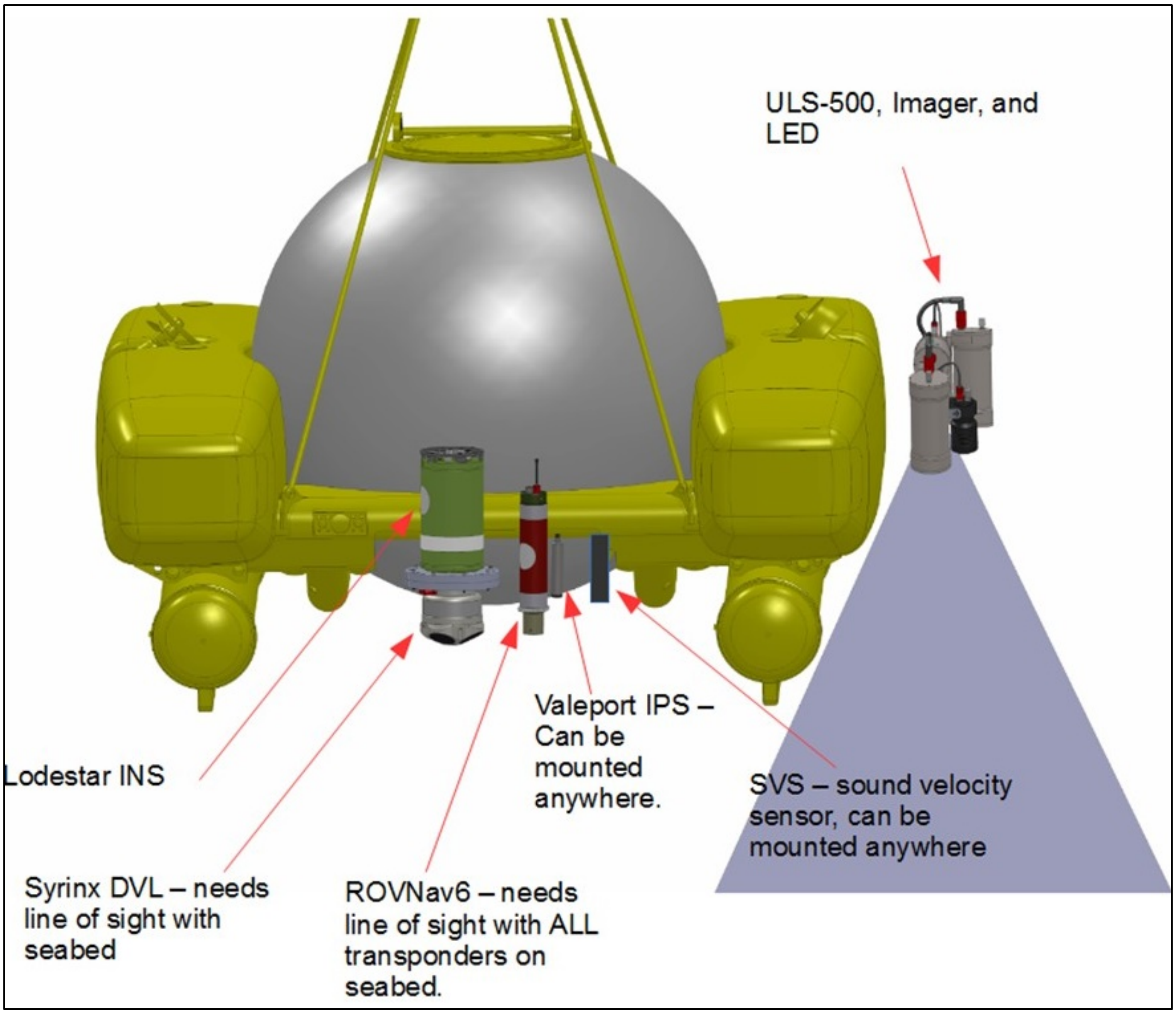


Figure 3-17 Configuration of positioning system components and laser scanning system integrated into the Triton 1000/2 submersible.
Source: 2GRobotics/Sonardyne.

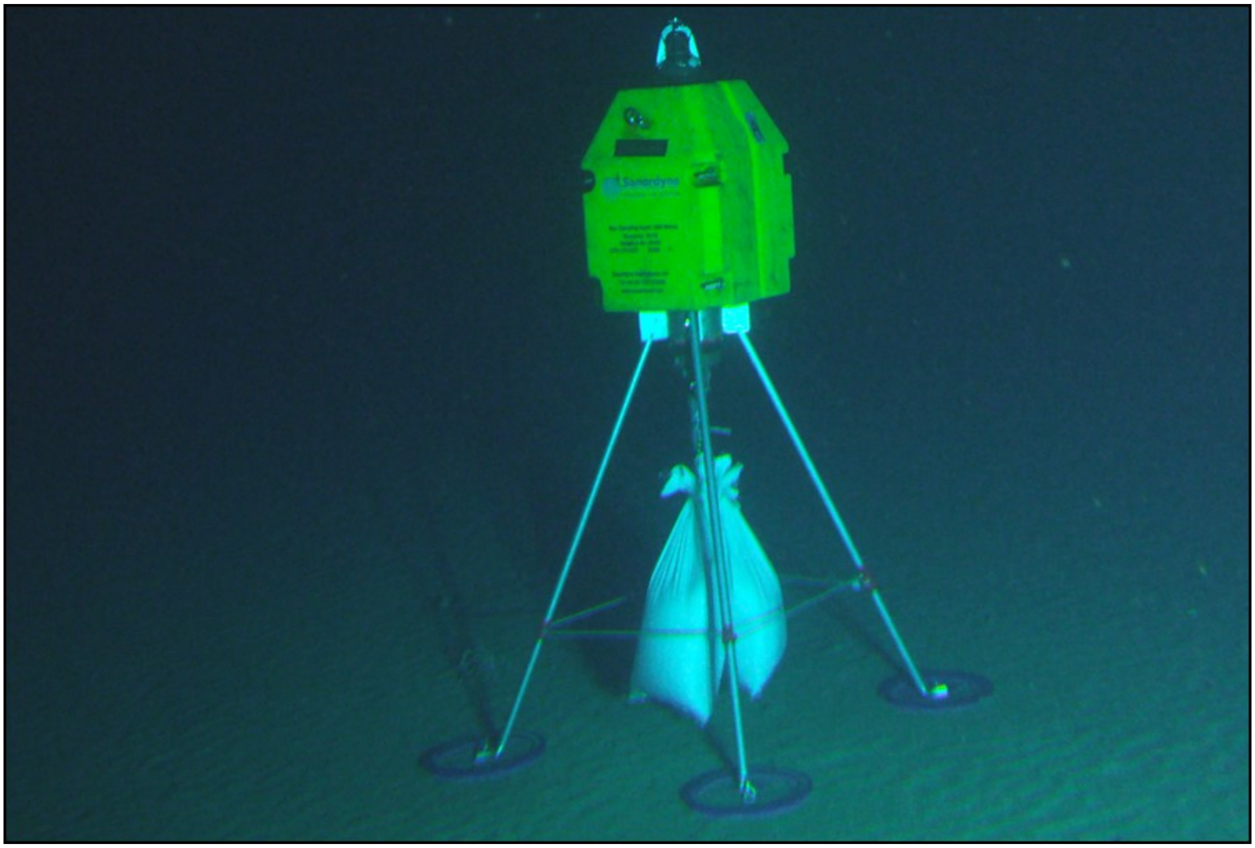


Figure 3-18 One of six acoustic beacons comprising the LBL setup.
Source: Sonardyne

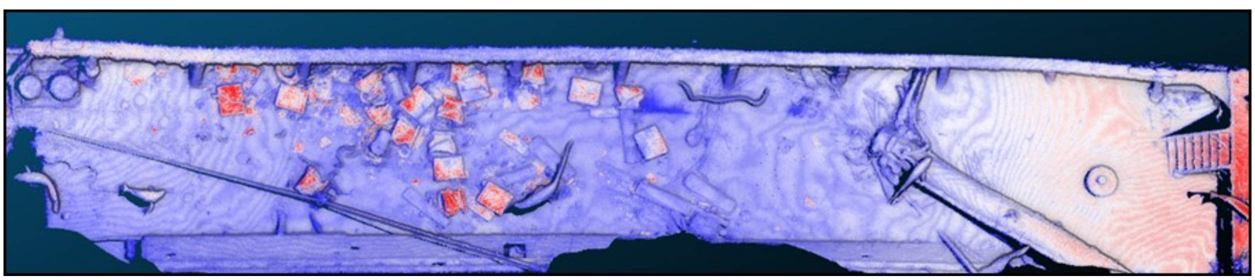


Figure 3-19 Sampling of a single pass of ULS500 data on the wreck of *Bluefields* (2GRobotics/Sonardyne).
Source: 2GRobotics/Sonardyne

3.5 Methodology for ROV Operations

ROV operations (Figure 3-20 and Figure 3-21) were conducted from the NOAA R/V *Nancy Foster* in 2009. These operations utilized a Deep Ocean Engineering Phantom S-2 system, depth rated to 305 m (1,000 ft). The ROV, 335.3-m (1,100-ft) tether, down weight, and hydrophone pole were set up on-deck near the vessel's port J-Frame. The ROV Control Console, Navigation Console, Video Console, and support equipment were set up in the Wet Lab. The HYPACK navigation screen showing vessel position and heading, as well as the ROV's position, were fed to the bridge monitor.

During ROV Operations, radio communications were maintained between the ROV pilot, back deck tether handlers, and the bridge. The ROV pilot discussed ship positioning with respect to wind, currents, and weather with the bridge for safe launch and recoveries. Typical operations used the dynamic positioning (DP) capabilities of the ship with the "down-weight" deployment method for safe and efficient ROV positioning and tether management. Members of the science party assisted the on-deck tether manager during ROV launch and recovery operations. The ROV pilot consulted with the bridge regarding marginal sea conditions to determine whether or not to conduct operations.

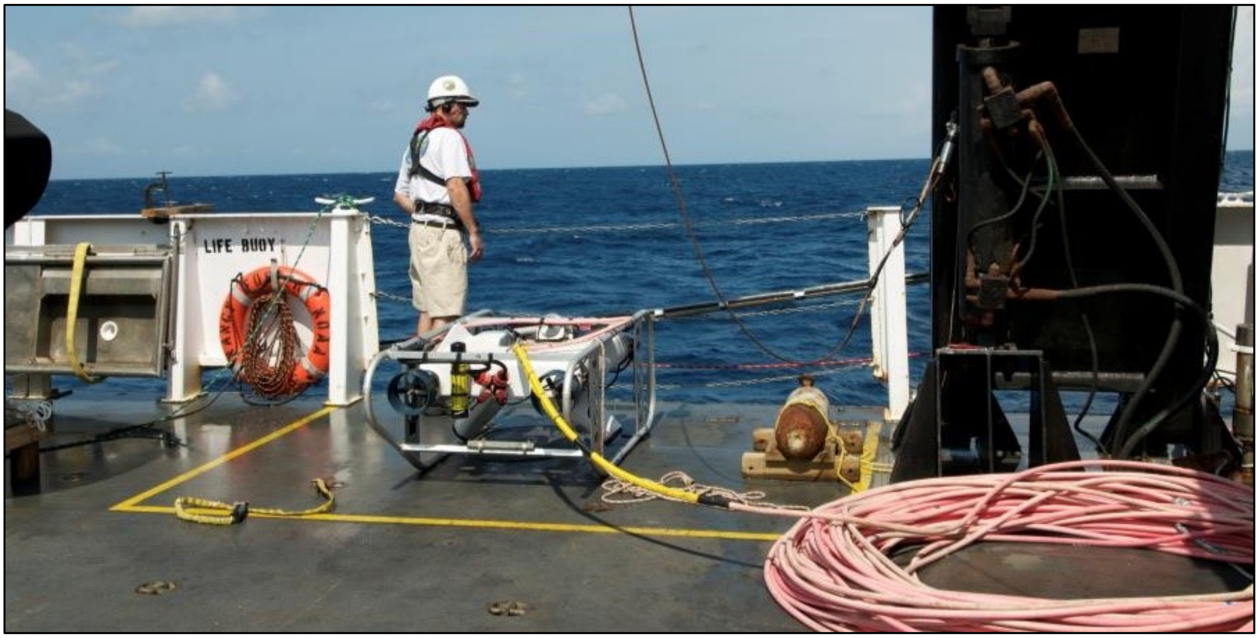


Figure 3-20 Phantom S-2 and pilot Lance Horn prep for a dive during a R/V *Nancy Foster* research cruise.
Source: NOAA

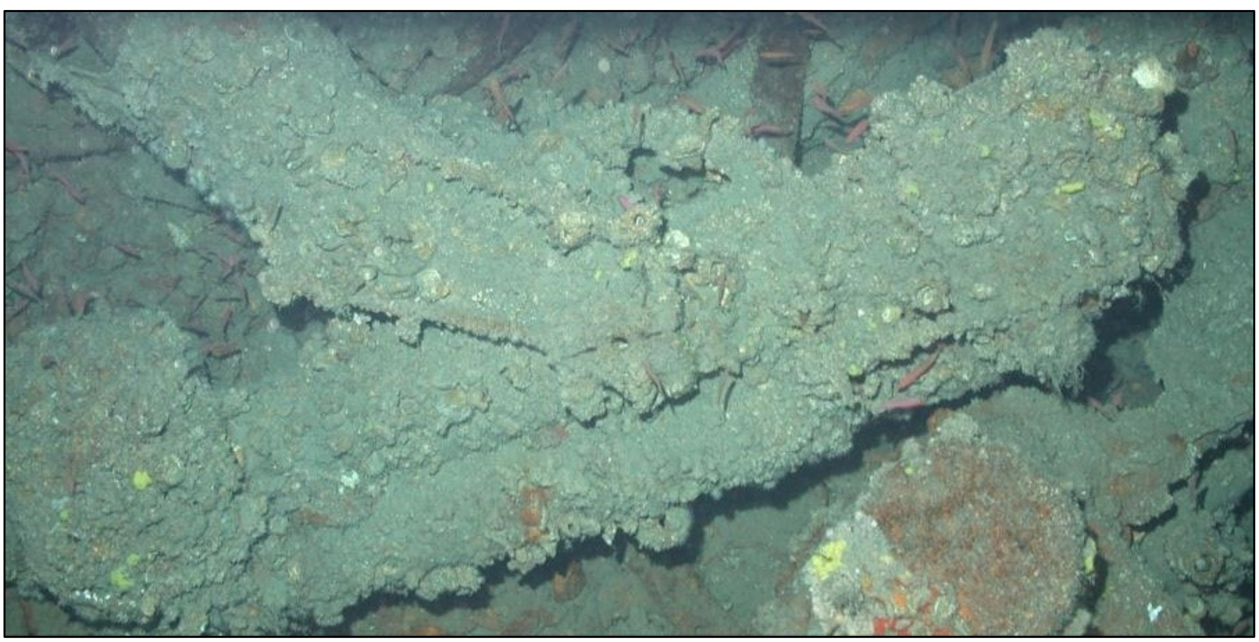


Figure 3-21 Three-inch 23-cal. deck gun as observed via ROV dive on YP-*389* during NF-09-12.
Source: NOAA

Still photography was captured in a .jpg format and video was saved on DVD. The ROV was equipped with the following photographic and video equipment:

- video: Sony High Resolution 1/3" IT CCD color camera; 410 X 380 pixels; 768 horizontal X 484 vertical picture elements; resolution: 460 lines;
- lens: 12 X Zoom, autofocus, F 1.8 to F 2.7; diagonal angle of view in water = 79º;
- digital still camera: Insite Tritech Inc. Scorpio Plus - Nikon Coolpix 995;
- lens: 4X Zoom-Nikkor, f 8, 32-mm; focus range 4" to ∞;
- sensor: 1-1/8" high density CCD; 3.34 million pixels;
- strobe: Insite Tritech Inc. 62 watt seconds; TTL auto flash;
- lights: 2 x 250 watt tungsten-halogen; and
- lasers: Harbor Branch Oceanographic: output power 8.6 mW – spacing 10 cm.

3.6 Methods for KS-520 Convoy Search and Survey

One focused survey within the Battle of the Atlantic Project was the search for archaeological remains associated with the KS-520 Convoy Battle, which took place 15 July 1942. During this attack by U-*576*, both the U-boat and its victim were lost and potential archaeological remains from this distinct battle were believed to be in close proximity of one other (Blair 1996). Of all the German U-boat casualties off the North Carolina coast during WWII, the KS-520 engagement constitutes the only battlefield site to include the archaeological remains of both Axis and Allied assets.

The methodology for the KS-520 survey involved a combined historical and archaeological approach analogous with terrestrial battlefield survey. As with established terrestrial battlefield survey methods, historical data were collected from various primary and secondary sources, as described above. Once gathered, these data were imported into GIS and analyzed by adapting known military principles and conducting KOCOA analysis. In large part, this analysis and historical review were conducted in collaboration with the ECU Program in Maritime Studies and Department of Geography under the auspices of a NPS ABPP grant (see Bright et al. 2012; Bright 2012; Sanchagrin 2013).

3.6.1 Methods for KS-520 Convoy Search and Survey

This methodology follows one utilized by NPS maritime archaeologists during their examination of the *H.L. Hunley* and *Housatonic* sites in Charleston Harbor, South Carolina, and the work of archaeologists studying naval engagements in the Chesapeake Bay during the War of 1812. This approach includes: 1) documenting "the relative position, orientation, spatial organization, and level of integrity of … major site components"; 2) identifying and controlling for site formation processes; and 3) comparing "archaeological data to historical documents to illuminate specific events documented by participants and observers during the course of battle" (Conlin and Russell 2011:43; Babits et al. 2010).

3.6.2 Predictive Modeling and Data Management

Despite the wealth of available primary source data such as vessel logs and after-action reports, as well as numerous secondary analyses, the locations of all vessel casualties were not known. Thus a major component of the effort to identify the remains of the KS-520 battle would require remote sensing survey. So while the historical inquiry provided the necessary information to reconstruct what this engagement would have looked like tactically, it also provided the significant information to develop a predictive model to systematically define a search area.

Collecting and managing the volume of historic information, GIS modeling – and ultimately the survey data itself, by necessity – needed to flow through a well-structured process for data management (Figure 3-22 and Figure 3-23). Search areas were determined according to the following data stream:

Data acquisition included:

- Collection of primary source historical data (transfer of coordinates from historical records into x, y coordinates, which were then imported into ArcGIS as point features). These data were annotated with tabular information relating to the events of the battle such as vessel name, position, date, and historical source.
- Conversion of previously refined data from Wagner's (2010) dataset (convoy route lines and event points were imported into ArcGIS). These exported polylines (shapefiles) were separate files including route location of vessels involved in the KS-520 convoy.
- Collection of open-source government-owned data (bathymetry, North Carolina boundaries, and geo-rectified NOAA charts). These sources served as basemaps upon which later models would be placed.

Data processing included:

- NAD1927 projection. All datasets were projected according to the map datum used by the American Navy during 1942-1944 operations off North Carolina.
- Sorting. Data were sorted by route points or attack events. The route points were then merged into line features using a Hawth's Tool's extension. Line features were merged with route lines. Each line represented a hypothetical vessel route based on various historical sources.
- Line Density Analysis. Data were subjected to a line density analysis. This analysis outputs as a raster image coded by proximity of lines to one another. Areas of higher density were presumed more likely to represent the actual area of the attack and were thus used to prioritize search areas.
- Prioritization. Attack events were overlaid as point features on the density map to guide the placement and prioritization of search grids.
- Determination of search grids. Search grids of 5 x 5 nautical miles were drawn, and placed in a matrix according to two factors: proximity to most reliable attack-related positions and density map areas, and bathymetric profiles situated within operation limits of remote sensing instrumentation.

Reprojection included:

- Reprojection of the data frame of the ArcGIS map into the most recent geographical datum (WGS 84). This datum was used during all phases of the actual field survey efforts.

The search area ultimately determined through this analysis was an area 30 by 30 nautical miles, with individual grids comprising a total of 675 square miles. Following the development of the probability model, practical considerations for offshore work were applied. With the recognition that covering this area in its entirety was impractical due to time and financial constraints, the research team split the search area into prioritized grids (Figure 3-24). This base search area was the focus of multiple years of repeat investigation. All of the individual survey layers were compiled into a single GIS map to depict the total area covered (Figure 3-25).

With the search area established, a tiered approach to surveying sites within the area was developed, which included four stages: wide area survey, targeted survey, high-resolution multibeam survey, and finally 3D visualization. All of these approaches have benefits and limitations, particularly as they relate to depth, range, and resolution. Ultimately, due to the depth in which the KS-520 remains were finally located, only stages 1 and 2 were applicable to those resources and the resources of stages 3 and 4 were refocused towards characterization of shallower known targets.

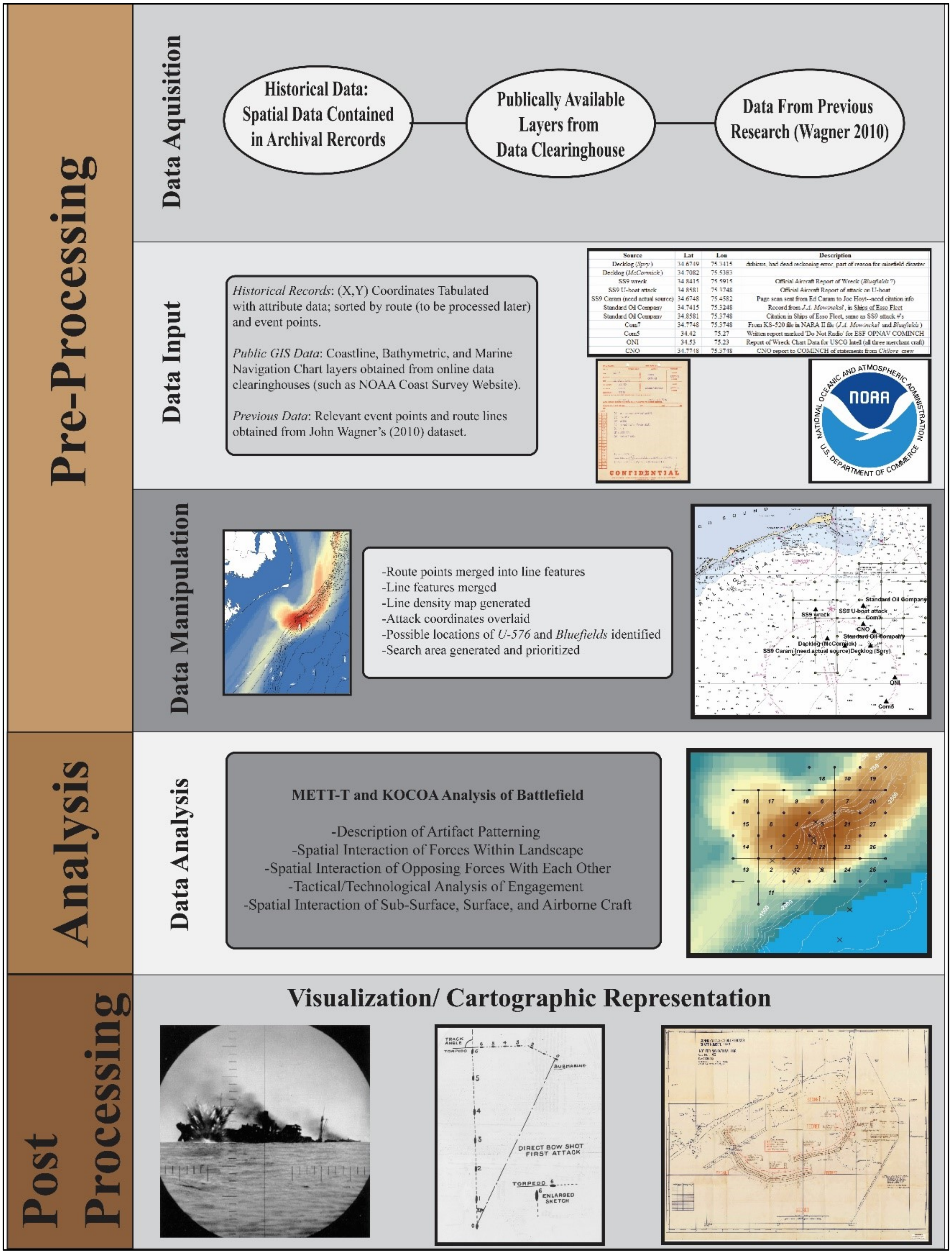


Figure 3-22 Data stream for digital recreation of KS-520 convoy battle.
Source: Bright et al. 2012

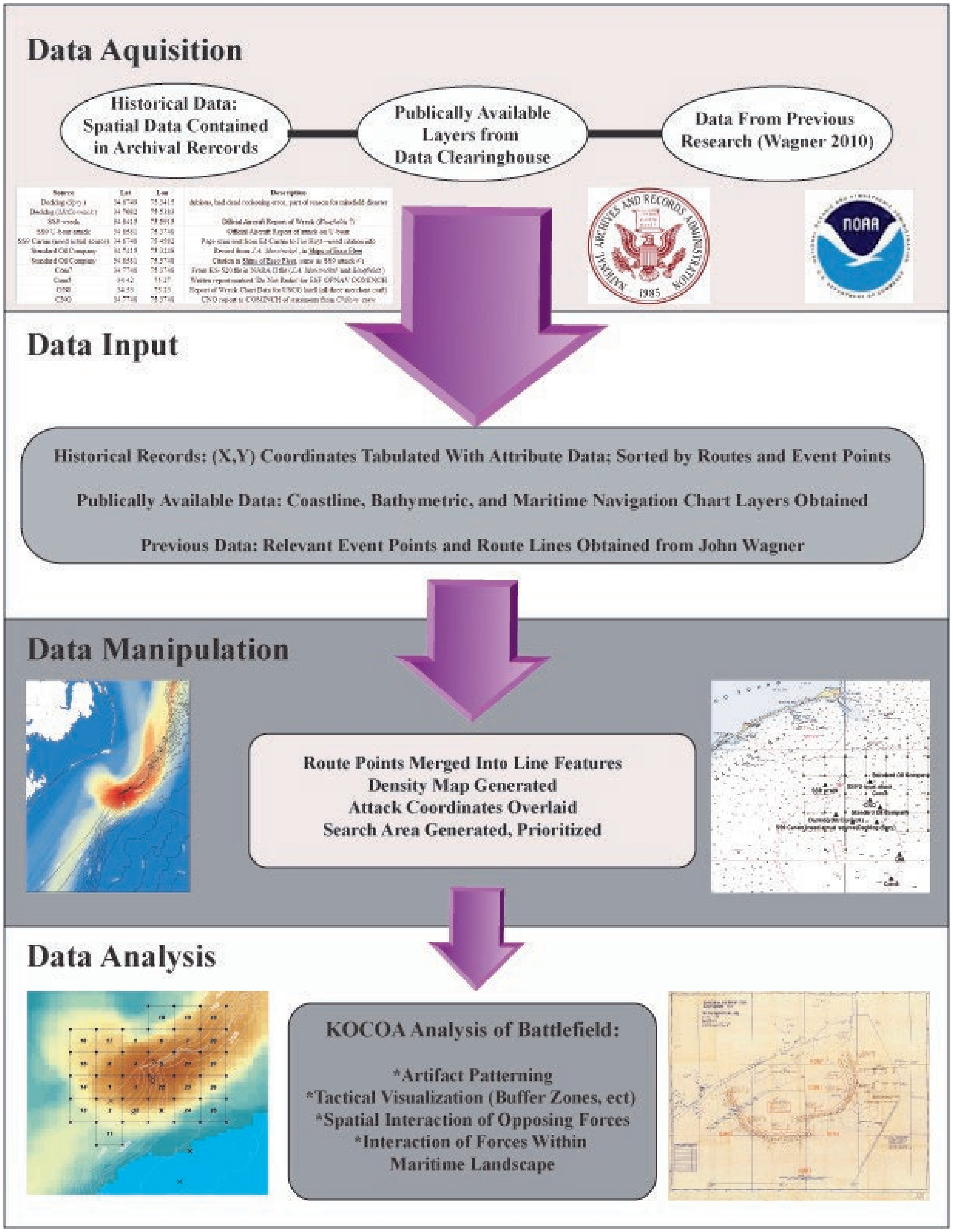


Figure 3-23 Data flow for management of survey data related to KS-520 Convoy.
Source: J. Bright, NOAA

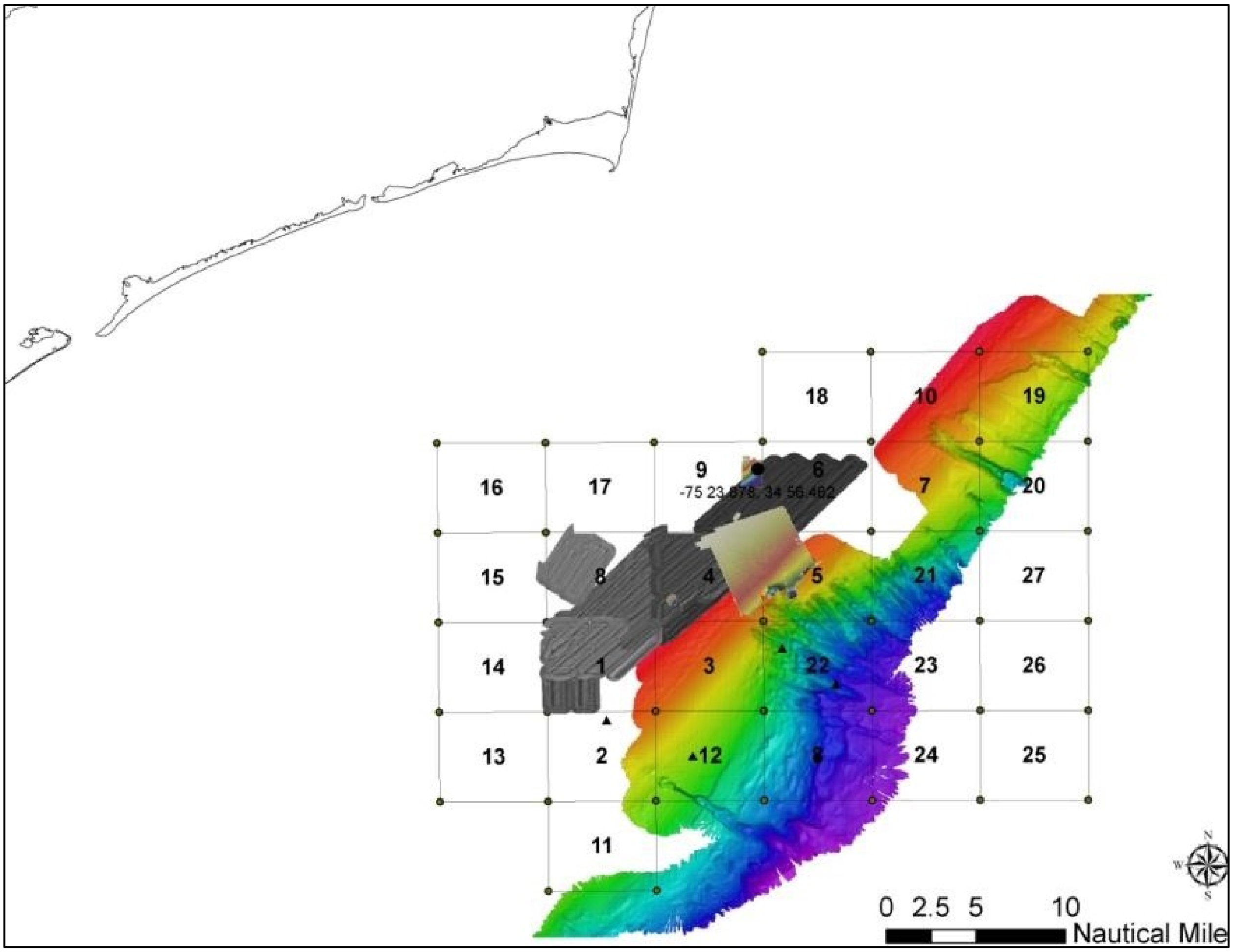


Figure 3-24 Complete coverage map of surveyed area between FY09 and FY13 data.

Source: Image by the authors from the Applied Research Lab, University of Texas (ARL:UT) and NOAA data; grid numbers correspond to priority assessments determined in Bright 2012.

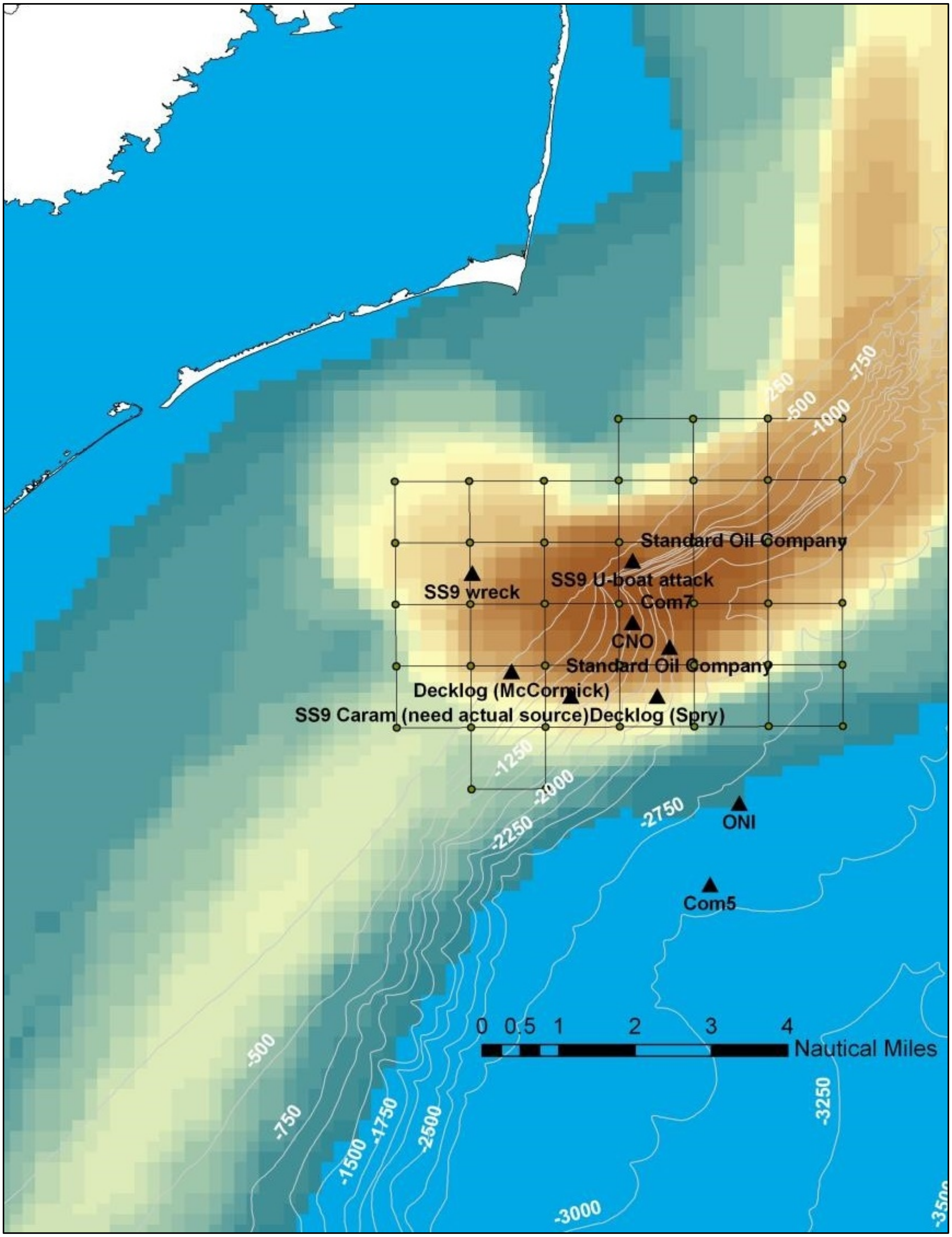


Figure 3-25 GIS-based probability model used to prioritize survey areas to locate remains associated with KS-520.

Source: Bright 2012

3.6.3 Wide-Area AUV Survey

The wide-area survey utilized an Autonomous Topographic Littoral Area Survey (ATLAS) sonar from the Applied Research Laboratories at the University of Texas at Austin (ARL-UT). The ATLAS system is built into a 12-3/4" x 10' REMUS 600 AUV owned by the Office of Naval Research (ONR). It carries a high-frequency 1,200 mHz Marine Sonics Side Looking Sonar (SLS), a Kongsberg Synthetic Aperture Sonar (SAS) and an iPUMA ahead-looking sonar (ALS) (multi-ping).

This instrumentation suite allowed for the collection of bathymetric data, the coverage of large areas of seafloor, the detection of objects on the seafloor, and the creation of 3D terrain. At lowest resolution, the Wide Area Survey package can cover a 1,000-m swath (500 m/channel) with 100 percent coverage (no water column). The AUV has a battery life (endurance) of 10-20 hours and is rated to 600 m (1,800 ft) depth. As the vehicle traverses an area, objects that pass through the sensor's field-of-view are seen dozens to hundreds of time. In contrast, SLS have narrower swaths and only view an object from a single aspect angle. This allowed for very comprehensive coverage of a large area of seafloor at low resolution, with the option of returning to potential targets to acquire a higher resolution 600 kHz sidescan sonar image. The vehicle and sonar provide an autonomous search capability in a small package and can be launched from a ship or pier by crane. In current operations, the AUV's position and health are monitored during the survey via ultra-short baseline (USBL) to the support craft, which is stationed near the survey area (Figure 3-26 through Figure 3-28).

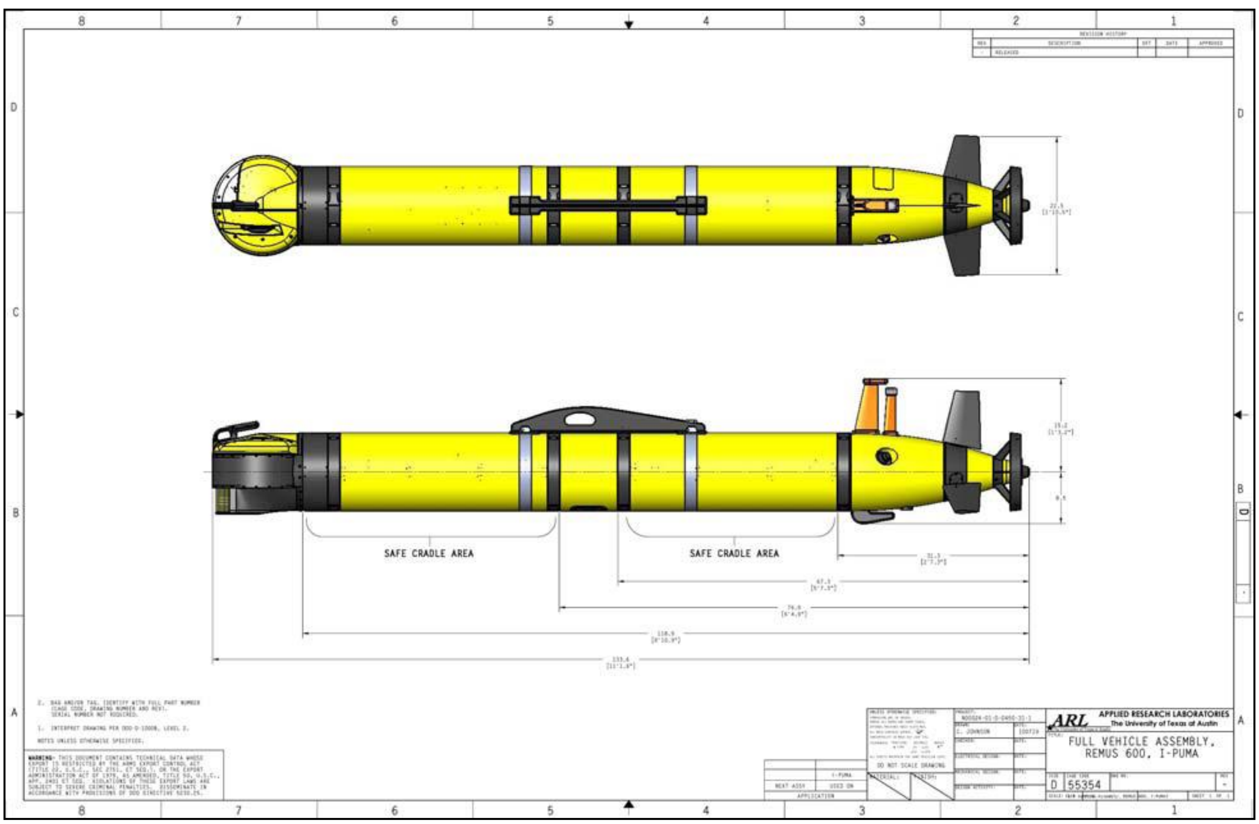


Figure 3-26 REMUS 600 AUV body outfitted with ARL:UT SONAR.
Source: ARL:UT

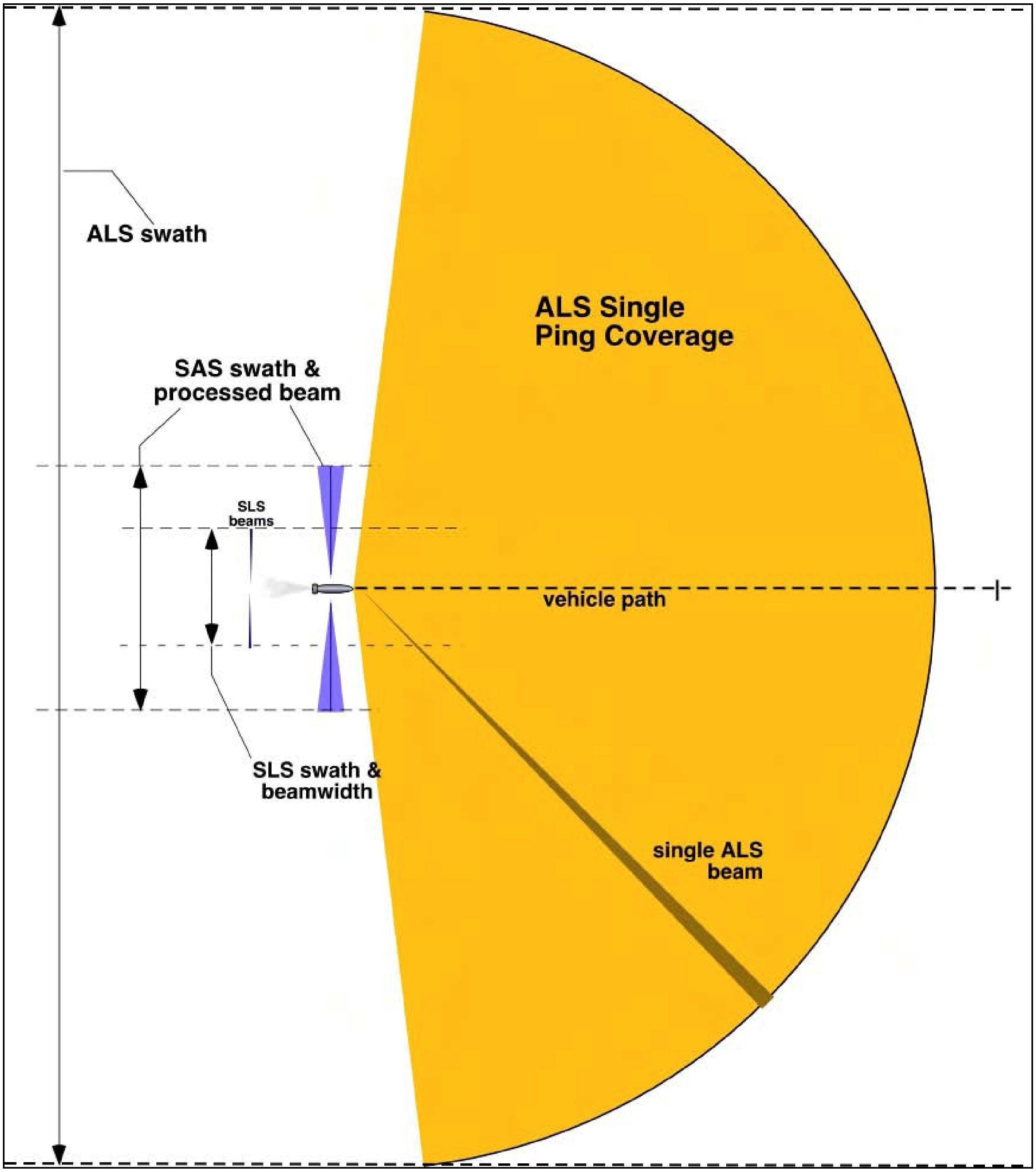


Figure 3-27 Graphic depicting Ahead-Looking SONAR swath width.
Source: ARL:UT

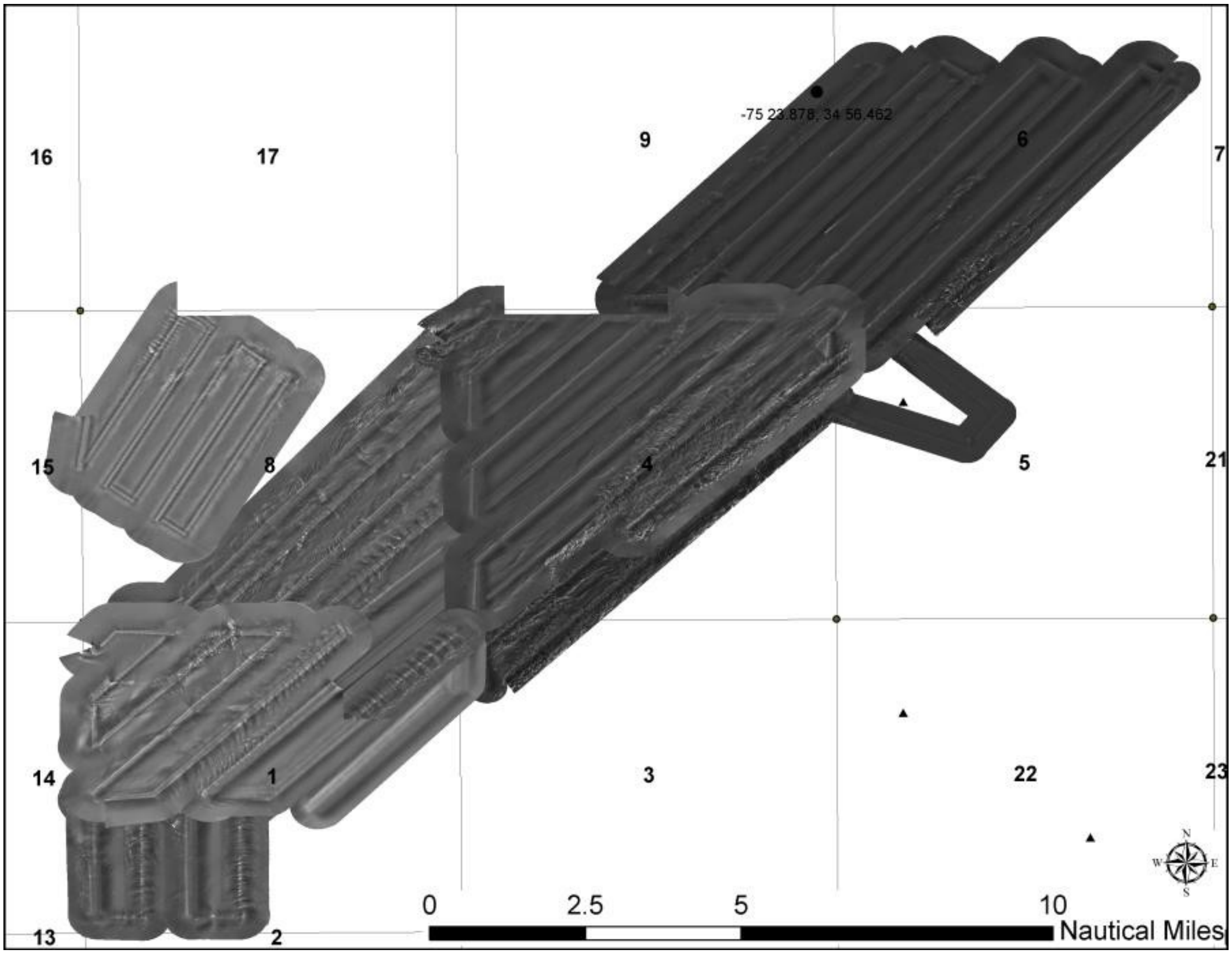


Figure 3-28 Complete coverage map of data collected with ARL:UT AUV survey.
Source: ARL:UT

During this stage the vehicle operated in water depth of 30.4 to 457.2 m (100 to 1,500 ft). With the configuration of batteries, the vehicle was able to run surveys for 8 to 16 hours per day and travel at 3-4 kts (3.5-4.6 miles/hour) for an estimated coverage of 28-46 miles per day. After each deployment, the research vessel SRVx *Sand Tiger* retrieved the AUV for data download and processing, battery recharging, and reprogramming. Imagery and bathymetry were then integrated into the project geo-database. The wide-area survey covered approximately 135 square miles and identified 47 potential targets. These targets were prioritized and assessed for further targeted survey.

3.6.4 Targeted AUV Survey

Following wide-area survey, fieldwork focused on the relocation of discovered targets and their characterization using a different set of instrumentation. Targeted survey relied upon the deployment of a remote sensing package integrated into a Bluefin AUV chassis (12-3/4" x 10') (Figure 3-29). SRI International (SRI) operated this platform and its components. The AUV followed transects across the target area with a 50 percent sonar overlap to ensure adequate coverage. The AUV was deployed two times on each target object for the purpose of characterizing the target and its general vicinity (approximately 500 m by 500 m). Dive one involved the deployment of an Imagenex Delta-T 260 kHz multibeam sonar for the purposes of collecting bathymetry and 3D images (0.5-1.0m resolution). Dive two utilized a BlueView MB1350 (1.35 mHz) multibeam sonar for the purpose of creating detailed 3D images. Multibeam data collected from wreck sites found during the survey was later combined into a single dataset (3D point cloud), which culminated in a 3D model of each target surveyed. Due to multiple deployment and retrieval events, a maximum of two sites per day were investigated.

For the initial site survey, to accurately locate a given wreck and to determine the extent of the debris field and maximum vertical relief, the AUV was operated at an altitude of 10-20 m above the maximum known relief of the shipwreck using the lower resolution but longer range Delta P sonar. For the following dive, assuming the preliminary dive data looked promising, the AUV was reprogrammed to fly at a reduced altitude of 5-10 m above the maximum measured vertical relief of the shipwreck using the much higher resolution imaging capabilities of the Blueview multibeam.

This approach produced sub-decimeter resolution data sets, which provided the ability to detect general shipboard structures. The AUV's calibrated inertial navigation system (INS) provided artifact locations geodetically accurate to within a few meters. For an individual shipwreck site, the data from all the multibeam sonar dives was combined into a single 3D point cloud data product. This provides an intuitive 3D model for viewing the area and determining the disposition of the wreck, detecting site artifacts, and providing surrounding bathymetry. Georeferenced images (Geo .tiffs and .jpgs with World files) and/or microbathymetric maps were also produced for use with various GIS programs (Figure 3-30 through Figure 3-38).

The SRI AUV payload and support system included the following components:

- low-frequency (260 kHz) Delta-T Multibeam sonar for initial site safety surveys;
- high-resolution, custom BlueView multibeam sonar to create microbathymetric maps and 3D scenes;
- sensor payload data logger and control module (including support for powering and logging of sonar data and powering and control of the SDS 1210 digital stills camera with an external strobe;
- calibrated USBL system with depth telemetry for precise underwater tracking and INS updates via acoustic modem;
- AUV safety systems, including acoustic modem, RF beacon, strobe, and drop weight;
- F190 global positioning system (GPS) positioning and attitude system for sub-decimeter topside support;
- Fledermaus software for sonar data processing and 3D visualization; and
- High-Resolution Survey Setup, which included:
  - fly at a constant depth of 130 m, 3 kts (10-m altitude safety);
  - utilize line spacing of 5 m (MB1350 swath 8 m);
  - conduct north-south survey of 100 m (N-S) x 150 m wide (E-W); and
  - operate at 3 kts (1.5 meters per second) for approximately 1.5 hours.

This method was employed through subsequent field seasons; because the area to be covered and number of targets was so large, it took a great deal of time to complete. In planning for additional wide area surveys, an older data set was reprocessed for avoidance purposes by SRI in effort to avoid high-altitude above seabed surveys that would be time consuming and not yield the level of detail desired. By utilizing bathymetric data available, valuable field operations time was saved.

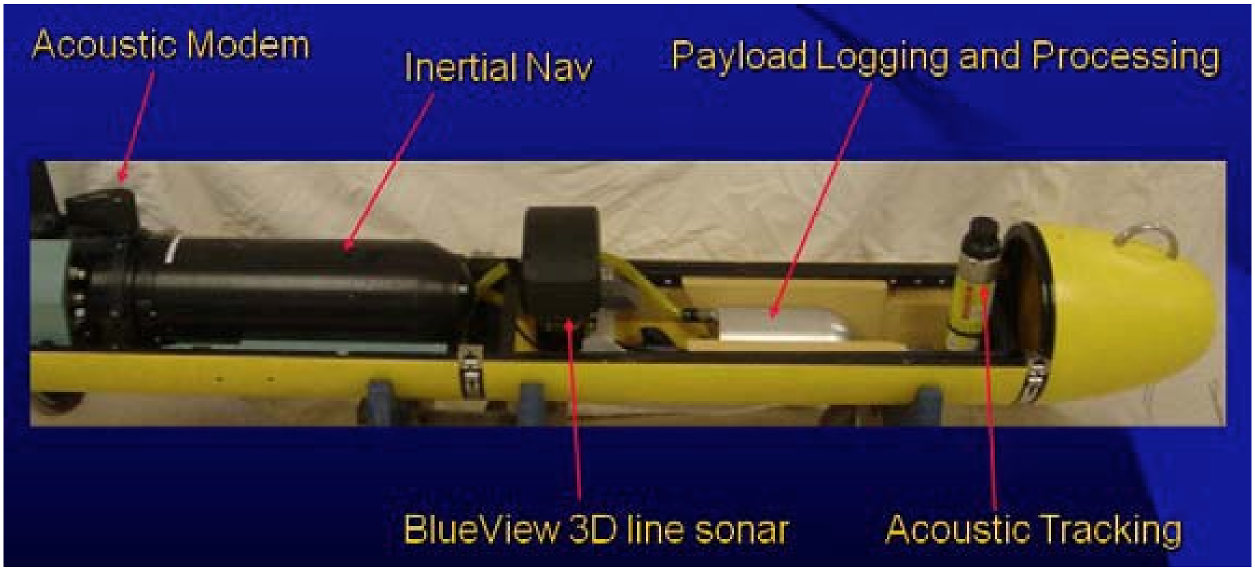


Figure 3-29 Blufin AUV outfitted with BlueView MB system.
Source: SRI International

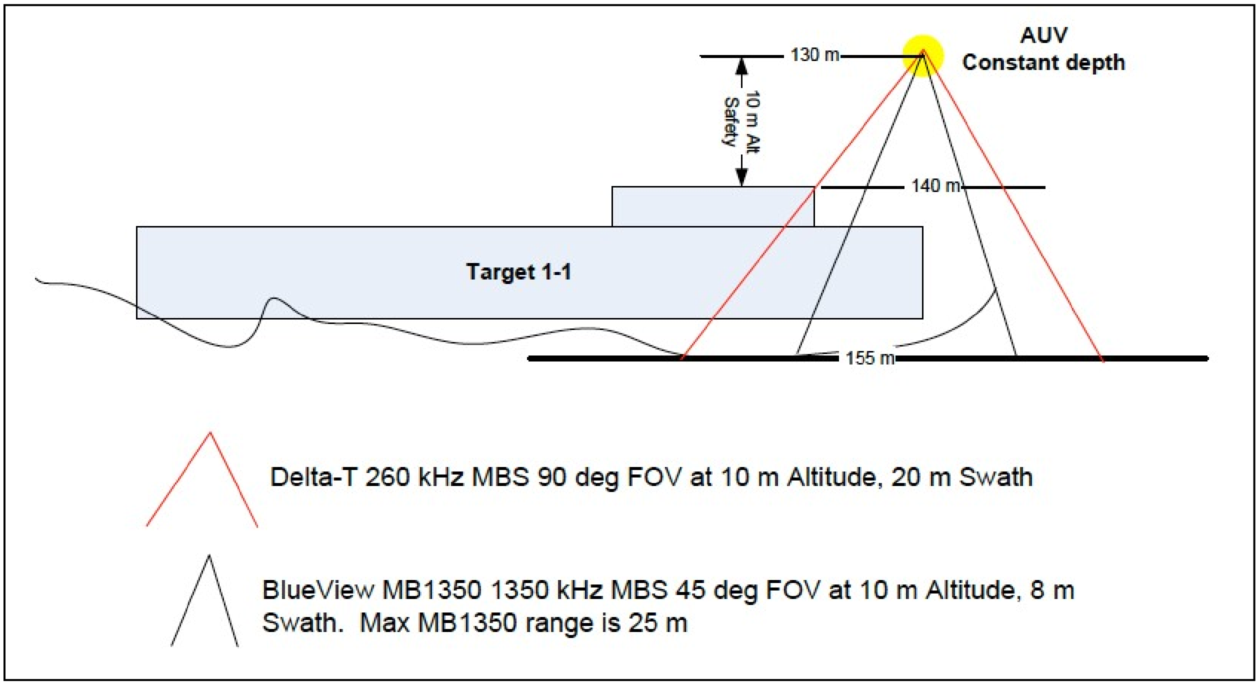


Figure 3-30 Illustration depicting the survey vehicle and instrumentation package relative to Target 1-1.
Source: Kloske – SRI

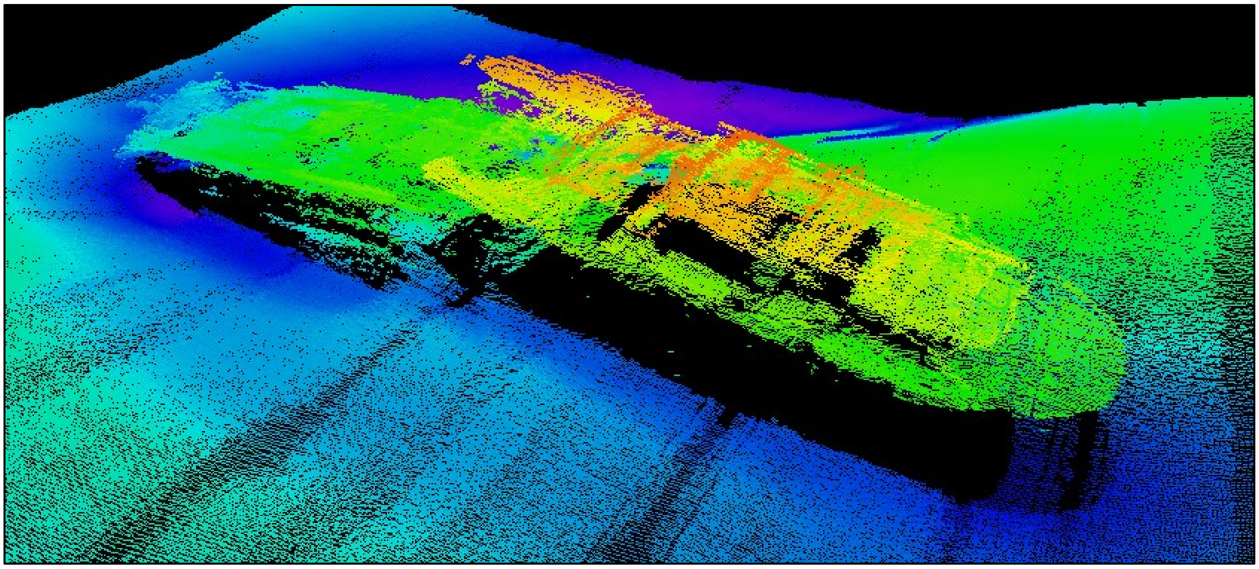


Figure 3-31 Processed 3D visualization of Target 1-1 port quarter. Example of imagery from BlueView MB1350 (1.35 MHz) multibeam sonar.

Source: SRI/NOAA

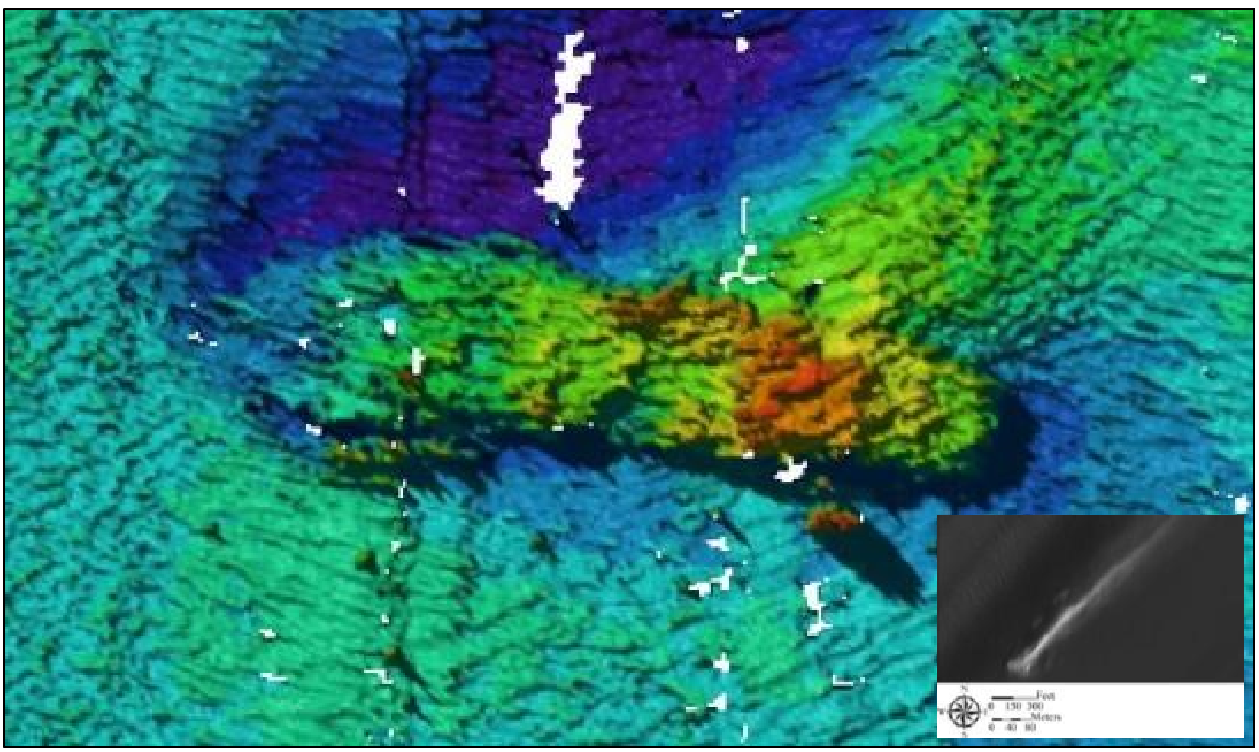


Figure 3-32 A comparison between wide-area and targeted surveys. 2011 Delta P (left) and ARL:UT (inset) images of Target 1-1.

Source: NOAA/SRI/ARL:UT

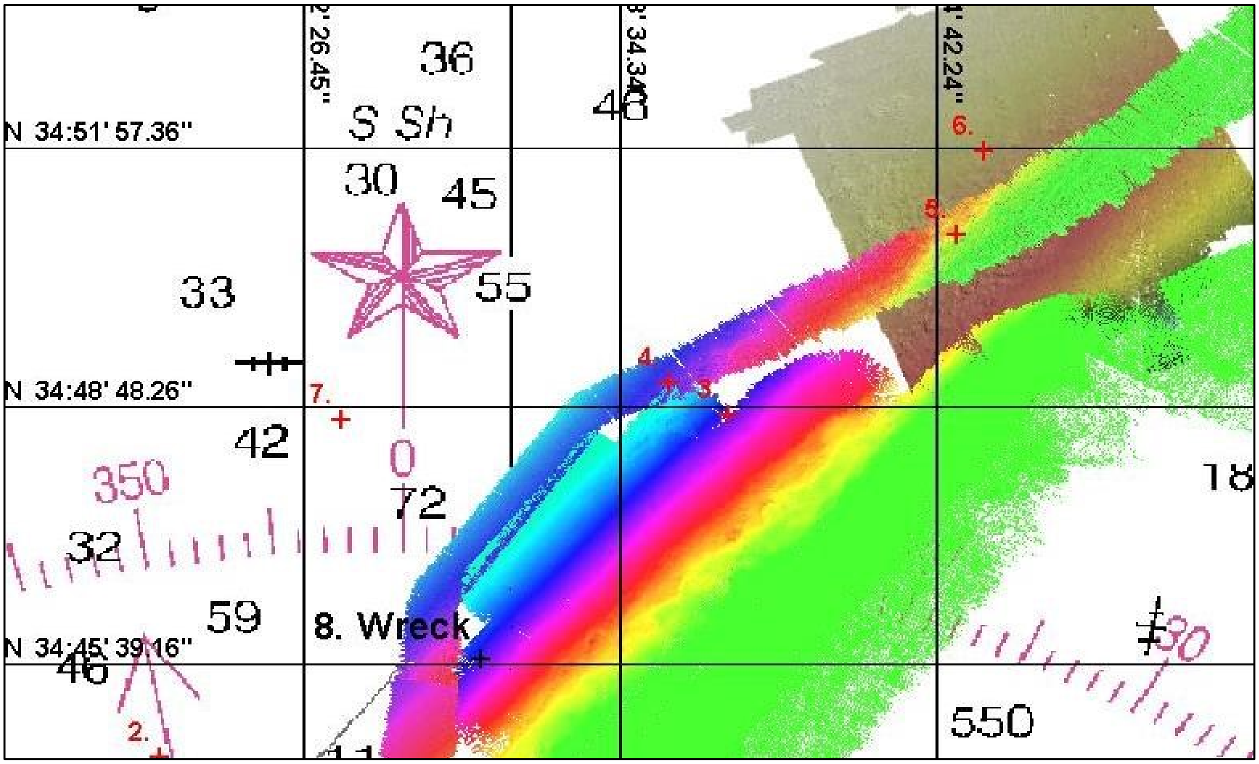


Figure 3-33 Multibeam survey containing potential wreck site, Target A.
Source: NOAA, OMAO; Map by SRI

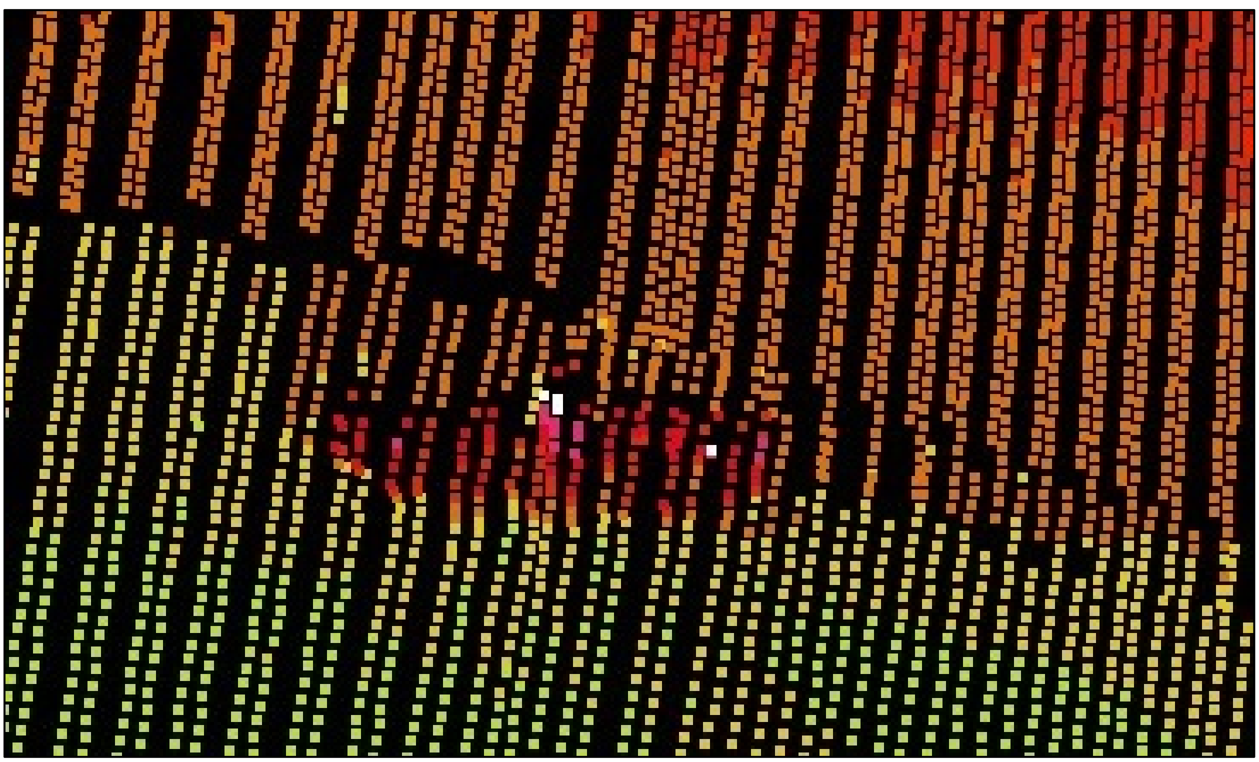


Figure 3-34 Reprocessed multibeam data showing Target A.
Source: SRI/NOAA

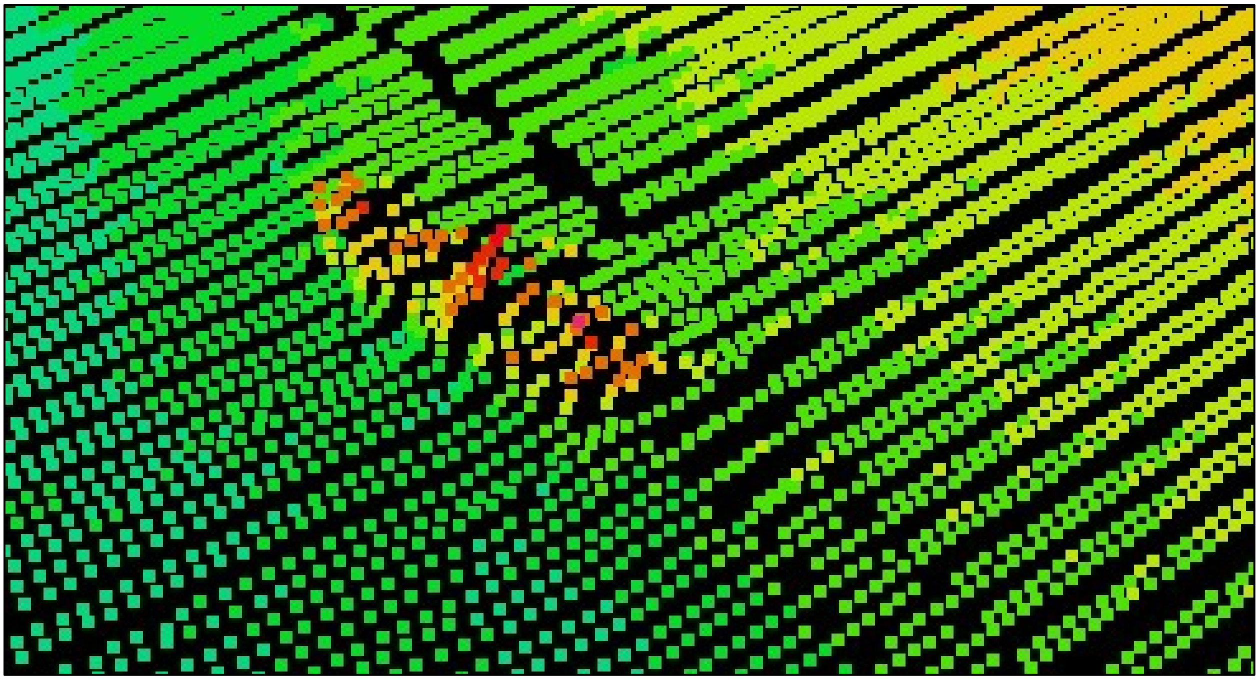


Figure 3-35 Alternative visualization of reprocessed multibeam of Target A site.
Source: SRI/NOAA

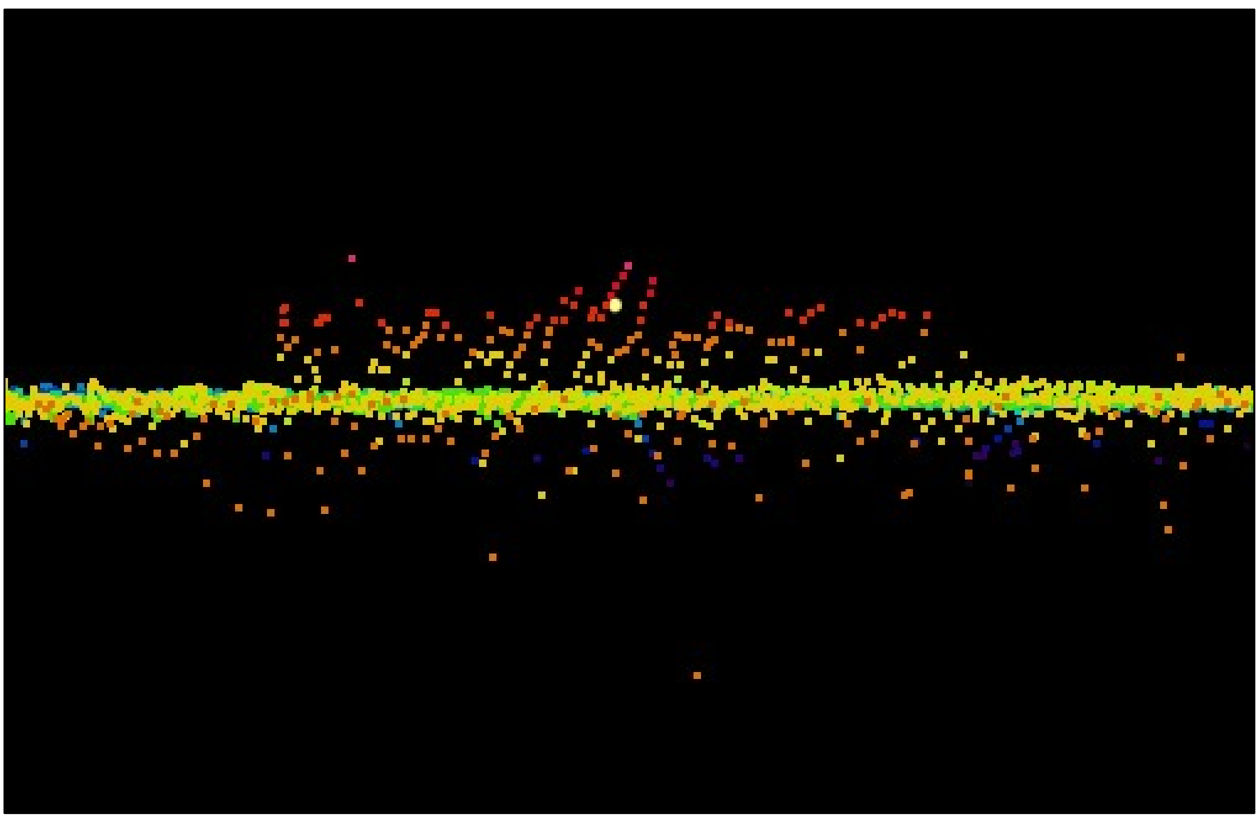


Figure 3-36 Point cloud data depicting the vertical relief of Target A.
Source: SRI/NOAA

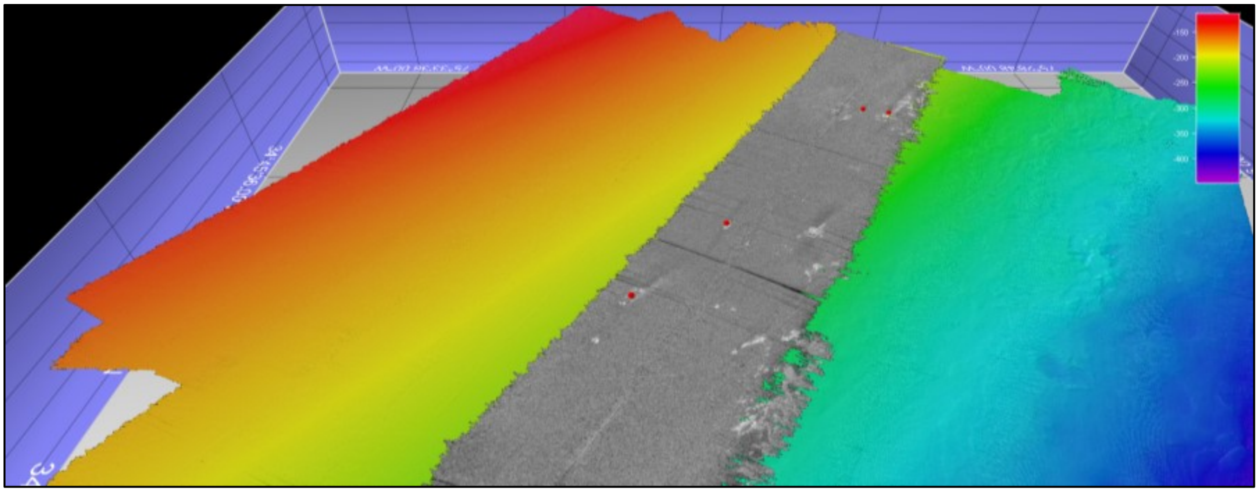


Figure 3-37 Overview of search area with color-coded bathymetry and one line of backscatter mosaic.
Note: Red points indicate targets of interest.
Source: Derek Sowers, NOAA R/V *Okeanos Explorer*

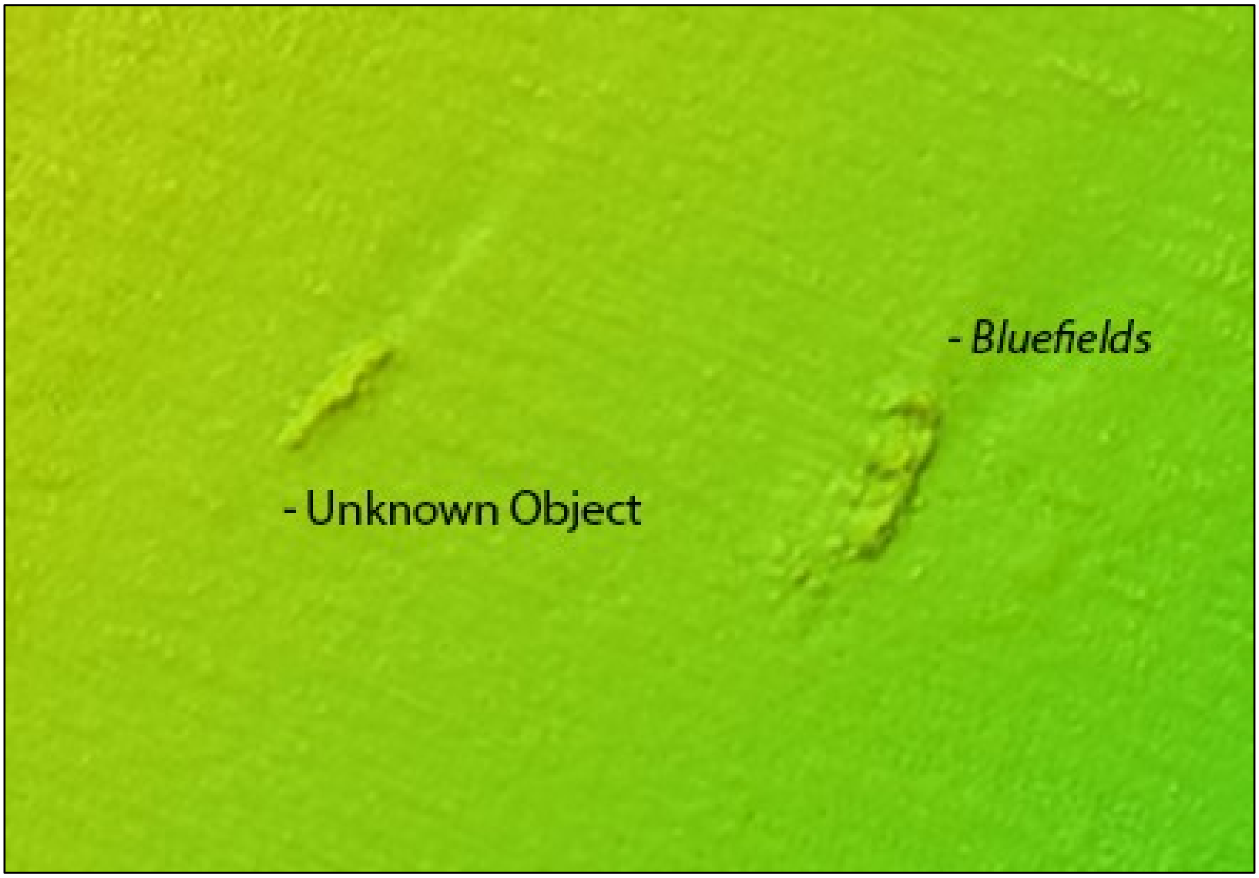


Figure 3-38 Close cropped multibeam image of two targets in the survey area. Target 2 is identified as *Bluefields* with an unknown object, now identified as the U-*576*, located approximately 200 m away.
Source: Derek Sowers, NOAA R/V *Okeanos Explorer*

3.6.5 3D Visualizations from High-Resolution Multibeam Sonar

Following the completion of wide-area assessments, the scientific team returned to selected targets for high-resolution site-specific multibeam survey. This system developed by Advanced Underwater Surveys (ADUS) allowed the survey team to collect data utilizing pole-mounted Reson SeaBat 8125, and then generate extremely detailed 3D point cloud models of the sites and render them in a visualization program that allows for 3D viewing and manipulation (6-mm depth resolution) (Figure 3-39 and Figure 3-40). The primary targets for detailed mapping came from a prioritized list developed for known targets for which the team had little data.

In order to gain extra depth from the fixed, pole-mounted system, the sensor was affixed to the base of a heavy duty stage lighting truss and rigged to be extended approximately 6 m (20 ft) below the keel of the support vessel. With this setup, the survey was limited to approximately 60 m (197 ft) of water; deeper sites had poor resolution.

These ADUS data served as the base for further diver-based assessments, but the level of detail from the sonar imagery alone is of a high enough resolution to make interpretive assessments and recommendations for National Register eligibility. Other acoustic datasets were typically collected for baseline information and positioning but would require much more detailed follow-up surveys.

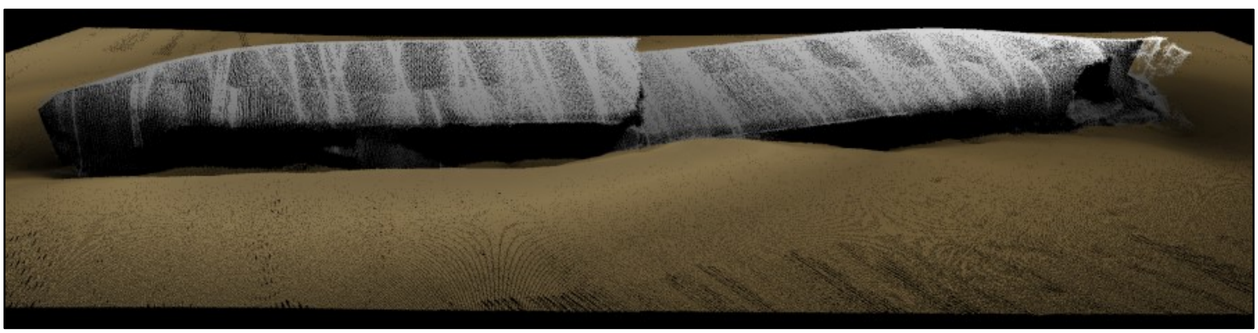


Figure 3-39 Example of high-resolution sonar visualization of the *Lancing*.
Source: NOAA/ADUS

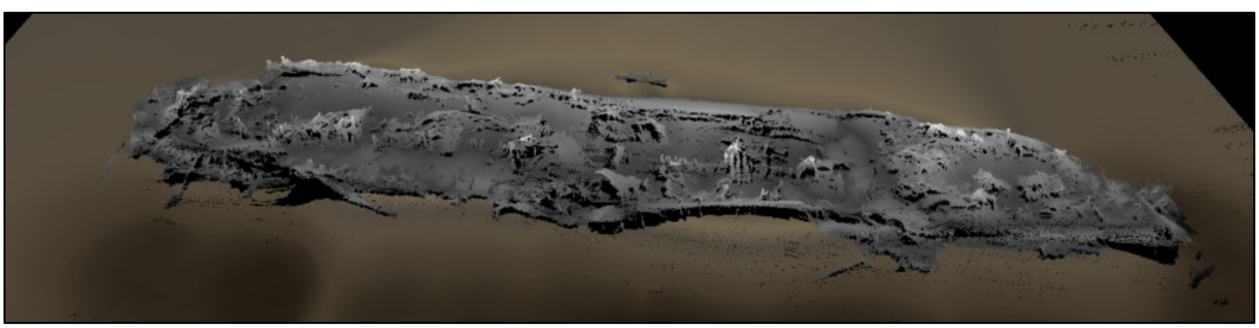


Figure 3-40 Example of high-resolution sonar visualization of the *Chilore*.
Source: NOAA/ADUS

4 Summary of Annual Operations

4.1 Introduction

As the Battle of the Atlantic project evolved over the years, an increased level of sophistication was applied both from an interpretive and methodological perspective. This chapter summarizes the activities of the nine years of continued research and field operations through a brief accounting of the chronological progression of operations. Various funding sources and partnerships from year to year allowed the research team to alter their approach and take advantage of available resources and emerging technologies on an annual basis. This chapter additionally highlights the partner institutions that have contributed to this research.

4.2 2008 Operations

The genesis for the Battle of the Atlantic project came after an outcry from the local diving community regarding looting of the German WWII U-boat, U-*701*. For nearly 15 years the site was known to only a small group of divers who purposefully left the wreck undisturbed. During this time the site was respected by the local diving community who recognized the resource's significance vis-a-vis the lack of disturbance upon the site, especially in relation to the two other frequented U-boat sites in North Carolina: U-*85* and U-*352*. Unfortunately, in 2004 the site became known more widely and unknown individuals illegally recovered artifacts off the site, outraging the local diving community, who had hoped to establish a preserve around the site (Allegood 2004; Cook 2004; Kozak 2004).

In early 2008, the MNMS Superintendent received reports of another group planning to illegally recover additional material from the site. This information demonstrated the need for a systematic approach to collect baseline data on the site. Subsequent requests for action from Thomas Prőpstl, Consul General at the German Embassy in Washington, D.C., further increased the necessity of carrying out an investigation using proper archaeological standards. Without a baseline record of the site's status, making a determination of impact would be difficult, if not impossible.

In addition to these critical cultural and political factors, natural forces also justified this project. The site of U-*701*, located near Diamond Shoals off Cape Hatteras, is in an extremely dynamic environment. It is believed that prior to Hurricane Isabel in 2003 the majority of the site was buried under sand. In 2008, however, the site was reported as uncovered to an extent rarely seen, offering a rare opportunity for investigation.

Consequently, MNMS in collaboration with ECU, NPS, BOEM, UNC-CSI, and the State of North Carolina initiated a series of field expeditions to examine the remains of these vessels. Initially, the focus was exclusively on U-*701* given its perceived threatened status. It quickly became apparent that conducting a survey of all U-boat targets in the area would provide the ability to cross-compare and understand elements surrounding site formation processes affecting U-boats off North Carolina. Ultimately, the sites investigated were U-*85*, U-*352*, and U-*701* (Figure 4-1 through Figure 4-3). These U-boats were sunk by US forces in engagements that proved to be critical, but largely forgotten parts of American history. The concern over impacts to these sites is based on the public's recognition of them as valuable cultural, historical, and economic resources for the United States and the state of North Carolina (Cook 2004; Farb 1985).

Figure 4-1 A diver surveying U-*85*, July 2008.
Source: Joseph Hoyt, NOAA (2009a)

Figure 4-2 Divers' investigation of U-*352*, July 2008
Source: Steve Sellers, NOAA

Figure 4-3 Video documentation at the site of U-*701*, July 2008.
Source: Steve Sellers, NOAA

The focus of the project in 2008 was to catalog the U-*701*'s significance and identify degrading impacts from both environmental and cultural factors. From this survey, a holistic historical and archaeological assessment of the three resources was obtained. This preliminary investigation may now serve as a baseline for monitoring all three sites as cultural and economic resources, as well as for future research.

It is important to note that this expedition has respected the sites of U-*85*, U-*352* and U-*701* as war graves. Despite the circumstances under which they were sunk, all parties involved in this project strictly exhibited the same respect for human remains as we would expect for American vessels sunk in foreign waters. As such, no penetration or invasive survey techniques were used during the project and all diving practices were undertaken with the utmost sensitivity.

During the course of field operations and associated research, it became evident these resources were threatened by a number of factors and that they represent a unique collection of maritime heritage resources. As such, MNMS made the decision to expand the investigation of the U-boat sites and to undertake a more comprehensive study of resources associated with the Battle of the Atlantic off North Carolina. Many of the WWII shipwrecks in the region, particularly merchant vessels, have very little protection. Many of these, either on individual merit or collectively, are likely eligible for the NRHP. Furthermore, MNMS recognized that this region represents a unique opportunity for understanding, interpreting, protecting, and memorializing this important event in American and World history.

As a direct result of the 2008 field operations, MNMS, in conjunction with the ONMS Maritime Heritage Program decided to incorporate the investigation of these sites into a larger multi-year study of the Battle of the Atlantic. The intent of the study was to look at material remains from the Battle of the Atlantic off the coast of North Carolina as a way to draw attention to the critical role this event had in history and specifically how cultural and geographic factors in North Carolina tie in to the broader story. The theoretical approach of this research aided in the delineation of a cohesive 'battlefield' site, or a broader understanding of the resources in relation to one another through a cultural landscape approach. Rather than looking at each site individually, the goal was to look at the resources of the region associated with this event and how they related to each other historically and tactically and how their disposition related to other external factors such as shipping lanes and geographic/oceanographic features. In this way, an individual sunken merchant vessel becomes a part of a larger story. Each shipwreck site becomes an artifact in a massive assemblage that collectively tells a more complete story of this significant period in American History. In order to make those broader connections, it was necessary to gather baseline data. The 2008 fieldwork and research was a first step towards that end.

4.3 2009 Operations

In 2009, Allied vessels lost during the Battle of the Atlantic became the primary objective of the study. During this year, MNMS was afforded the rare opportunity to have ship time aboard NOAA's OMAO R/V *Nancy Foster*, thanks to a partnership with NOAA's OER. The intent in the early stages of this research was to document the Allied military state-craft in detail.

Of primary interest for this expedition was definitively locating the site of a converted New England fishing trawler accessioned by the US Navy and placed into service as a yard patrol craft, designated YP-*389*. This patrol craft was sunk in an engagement with U-*701*. Identification of the vessels' final resting place had been unknown, though it had been postulated that an unidentified target, recognized as a trawler, located in a 1973 search for USS *Monitor*, may in fact be YP-*389* due to the location (Figure 4-4). This expedition sought to relocate the site discovered in 1973, and attempted to make a positive identification.

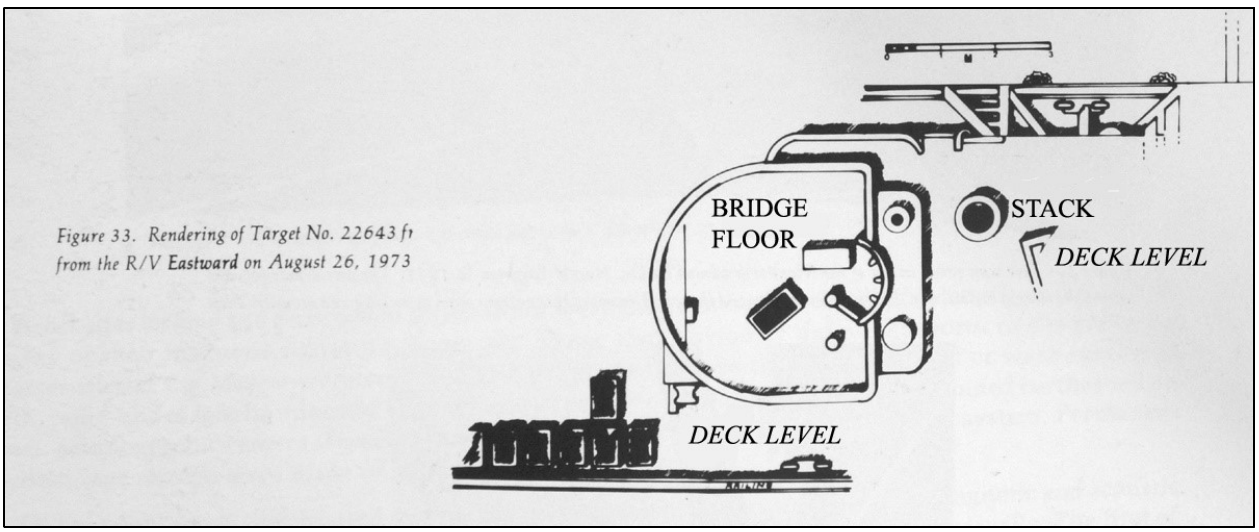


Figure 4-4 Artist rendition of plan view of Wreck #1 from 1973 R/V *Eastward* expedition.
Source: Investigating the Remains of the USS Monitor, G.P. Watts, 1981

In addition to YP-*389*, a secondary target was also of interest. The location of a fourth U-boat site and associated merchant vessel casualty were historically known to have been lost in the same area, but had never been officially located. Anecdotal identification and possible position information for these sites was provided to NOAA by a member of the public and positive identification of the target became an additional priority for the remote sensing portion of the R/V *Nancy Foster* research cruise.

Operations were broken into two distinct phases during 2009. Phase one was the R/V *Nancy Foster* survey, which consisted of remote sensing with low-resolution multibeam sonar and site investigations with an ROV (Figure 4-5). Phase two was a smaller scale operation from day boats to conduct diving operations on the wreck of HMT *Bedfordshire,* a British anti-submarine trawler lost off Cape Lookout, North Carolina in 1942. YP-*389* and HMT *Bedfordshire* were the only two WWII military vessels lost as a direct result of enemy action off North Carolina, whose identity and final resting place were known at the time of the survey.

Figure 4-5 University of North Carolina at Wilmington (UNCW) and NOAA personnel deploy an ROV from the deck of R/V *Nancy Foster*.
Source: NOAA

The destruction of HMT *Bedfordshire* was so abrupt and complete that no distress signal was sent. Of the 37 crewmembers aboard, there was not a single survivor. For several days, the Navy was not even aware of HMT *Bedfordshire's* loss because there were no witnesses, radio signals, or survivors. The first indication came when the bodies of HMT *Bedfordshire's* crewmembers began washing up on the shores of Ocracoke and Buxton, where they were subsequently buried. While many of HMT *Bedfordshire*'s casualties washed overboard, reports from local divers maintained that human remains were still observable on the site.

The interment of the crew at sites along North Carolina has become an important monument to celebrating and remembering this important part of WWII history and heritage. The gravesite on Ocracoke has received a great deal of attention and has become an important part of the identity of the Island. In 1976, as part of the state's bicentennial celebration, the site was leased in perpetuity to the Commonwealth War Graves Commission and still remains British Property (Naisawald 1997:80). The site is currently cared for by the US Coast Guard Station at Hatteras and Ocracocke, and an annual formal service is held at the site on 12 May (Figure 4-6).

Figure 4-6 The British Cemetery on Ocracoke Island, North Carolina.
Source: NOAA

In consultation with the British Embassy in Washington, DC, archaeologists from MNMS were asked to provide a report on the disposition of the wreck site and associated human remains still present at the site of HMT *Bedfordshire*. Conducting a full-scale site survey of this wreck therefore became the sole priority of the in-water documentation conducted by divers in 2009. In addition to diver-based mapping, sector scanning sonar data were also collected. Recording focused on the remains of the hull and all exposed features, with scaled drawing, still photography, and videography.

A concerted effort was made to locate and identify human remains, which had been reported by local divers. While many isolated bone fragments were located they could only be classified as potentially human. No samples were taken or disturbed. It is likely that periodic sedimentation may expose or obscure these remains intermittently.

The remote sensing survey aboard NOAA R/V *Nancy Foster* was successful in re-locating and positively identifying the remains of YP-*389*. The site rests in deep water and the survey utilized an ROV. Additionally, 2009 fieldwork successfully documented the site of HMT *Bedfordshire*. With the support of NOAA, researchers at ECU were awarded seed funding by ECU's Coastal Maritime Council for the proposal *The Battle of the Atlantic: An Archaeological Site Management and Environmental Risk Assessment Proposal* (Richards and Allen 2009). This award supported the research of John Wagner, and culminated in his 2010 MA thesis, discussed in Chapter 2. Wagner input archaeological and historical data into a Geographic Information System (GIS) and performed spatial analyses to delineate the battlefield area and centers of activity therein. The dataset collected by Wagner (2010) established a comprehensive database of WWII wreck sites off North Carolina that served as the foundation of subsequent field operations.

4.4 2010 Operations

While the first two years of the project focused on military assets, in 2010 the research team shifted focus towards the largest set of remains—merchant vessels sunk by U-boats. There are some notable distinctions in the study of these different vessel types. The military vessels tend to have more detailed history specific to their purpose as vessels of war and had characteristically more detailed accounts of engagements associated with the Battle of the Atlantic. They also are far easier to research as most of their associated records are kept in easily accessible locations such as the NARA. Conversely, the merchant vessels each have their own unique history spanning many decades, in some cases, the vast majority of which has nothing to do with the Battle of the Atlantic, with the notable exception of having being sunk as a result of it. Records of these vessels are peppered throughout various archives around the world and require a great deal more effort to uncover an often-smaller amount of material. As a result, the military vessels in this study represent a much smaller portion of the overall site collection, while having a disproportionately greater amount of information associated with them. By contrast the merchant vessels, despite being more numerous, have less immediately pertinent historical material available, as it relates to the Battle of the Atlantic.

The merchant vessels represent the material culture and heritage from 11 separate nations, in addition to the United States (Wagner 2010). It is this side of the story which makes this area globally significant as the effects of the Battle of the Atlantic and its focus on North Carolina's Outer Banks, have resulted in a diversity of nations having their heritage represented in these material remains. However, because the collection is so broad, the methodological approaches for documentation, as well as the theoretical approaches for interpretation, differ slightly from the approaches that formed the basis of the research expeditions in 2008 and 2009.

As the number of merchant vessels lost is so great (approximately 50 believed to be on the continental shelf), only a small number of sites could be surveyed during each field season. This third year of survey in 2010 aimed at cataloging site significance and identifying degrading impacts from both environmental and cultural factors upon a collection of WWII merchant vessels: *Empire Gem*, *E.M. Clark*, *Manuela*, *Malchace*, *Dixie Arrow*, *City of Atlanta,* and *British Splendour*, as well as the US Navy Tug *Keshena* lost off North Carolina.

The 2010 research expedition was successfully completed over a 3-week period between 8 and 30 June 2010. This research, conducted from the NOAA Research Vessel *SRVx Sand Tiger*, was distinguished by a technical diving segment and a shallower water segment. The team was operational for 15 days at sea; the remaining 6 days were consumed with mobilization/demobilization (3 days) and bad weather (3 days). Given the unpredictable nature of the environment (inclement weather, sea-state, wind, etc.), this proportion of operational time to inoperative time is considered excellent and allowed researchers to conduct a total of 139 dives (87 of which were technical mixed gas dives), and investigate in detail 8 different wreck sites. In addition to the 8 sites that were visited, several additional sites were positively located and their positions and depth profiles recorded. Most sites were recorded with a combination of high-definition video and still photography, as well as site sketches from diver observations. The US Navy Tug *Keshena* was documented with a full-scale traditional non-invasive mapping survey and photomosaics. This generated a detailed site plan in both plan and profile views. A catalog of imagery was collected at each site that may later be used to make management assessments or aid in the development of more in depth site-specific study.

MNMS also had the opportunity to partner with NOAA's NCCOS Beaufort Lab to conduct baseline ecosystem surveys of many of the wrecks visited. Following the diver led surveys, the two offices partnered to conduct a series of targeted multibeam surveys off the Cape Lookout area near Beaufort, North Carolina aboard NOAA R/V *Nancy Foster* on Cruise Number NF-10-10-LF from 3-10 September 2010. Data acquisition focused on known wreck sites using a mid-depth Simrad EM1002 System (95 kHz, 20 m-1,000 m). The level of resolution acquired was designed to provide MNMS with detailed and extremely accurate positioning, as well as provide insight into site distribution, and was considered limited in use beyond these parameters. Instead, the data were intended to be utilized for the purpose of developing more detailed and focused surveys in the future (Figure 4-7). The sites recorded during this phase included: *Cassimir*, *Esso Nashville*, *Ario*, *Naeco* (bow and stern), *Hutton*, *Suloide,* and U-*352*.

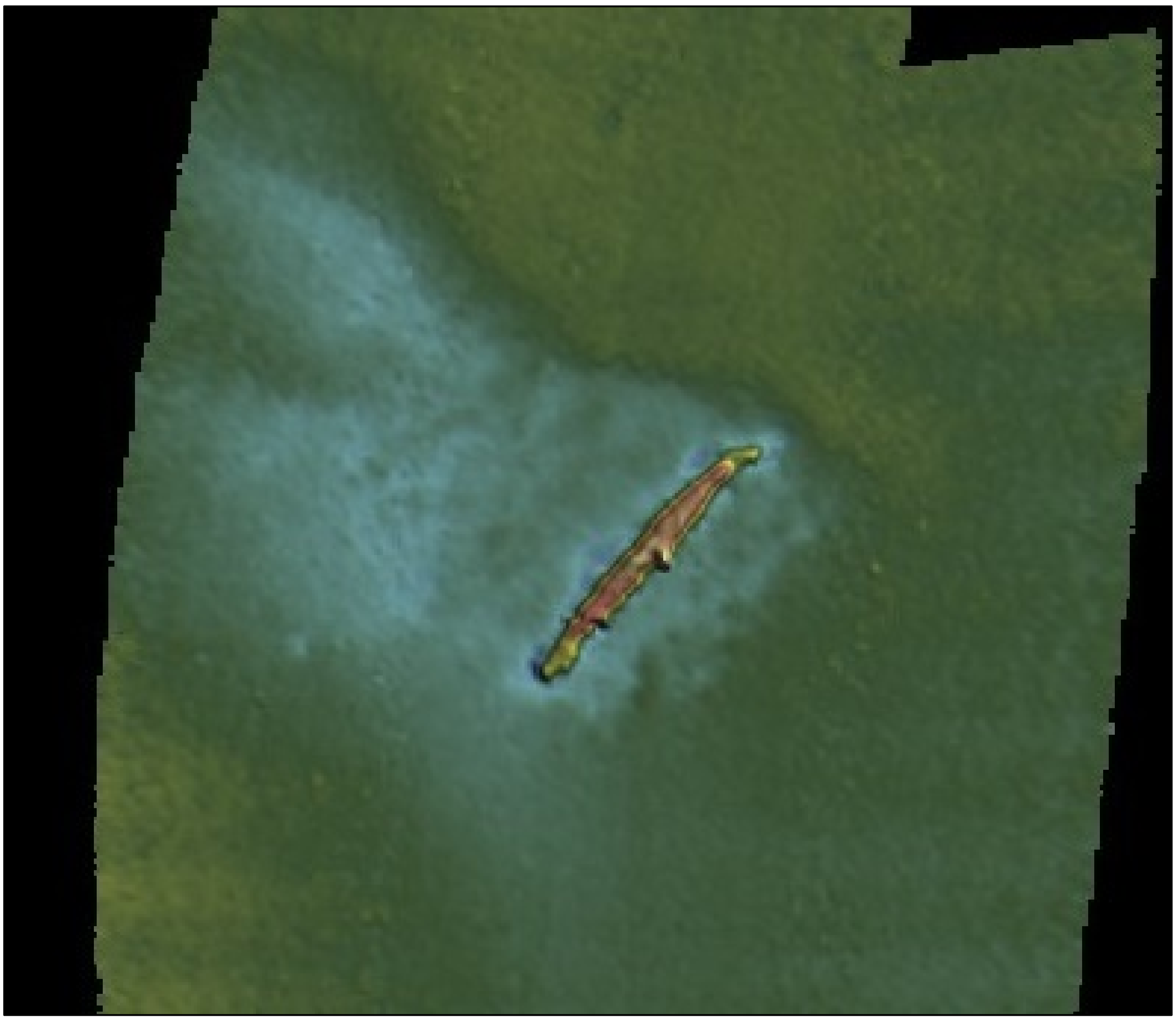


Figure 4-7 Example of Multibeam survey of the wreck of U-*352* with EM1002.
Source: NOAA

4.5 2011 Operations

Fieldwork conducted in 2011 was the most complex and ambitious to-date. Research undertaken by Hoyt, Richards, Allen, and Wagner led to the preparation of a proposal to NPS's ABPP, which proposed to extend Wagner's (2010) historical research via a theoretically explicit battlefield analysis of the North Carolina segment of the Battle of the Atlantic. The ABPP program focuses on the delineation of battlefield boundaries and as such this funding was used to develop and complete a wide area survey and GIS analysis. ECU was awarded the ABPP grant, which supported field operations and a graduate student, John Bright, to take on the battlefield analysis as an MA thesis topic, described in Chapter 2.

The primary focus of 2011 operations was surveying for the site of the KS-520 convoy battle. Constituting a single naval action of seemingly little consequence, KS-520, in fact, marks a shift in strategic initiative off America's eastern seaboard. In the seven months prior, U-boat operations had gone virtually uncontested in American waters, especially in the fertile U-boat hunting grounds off Cape Hatteras. With the passing of KS-520, however, the Allied institution of a strict and aggressive convoy system, accompanied by air escort, proved too dangerous to German U-boats. The significance of this shift would reverberate throughout the entire Atlantic.

The project followed the "multi scalar explanatory approach" endorsed by Conlin and Russell (2011:41-42) as well as the procedures outlined by Lowe (2000) and Babits et al. (2010:5) by utilizing the survey methods pioneered for analysis of terrestrial battlefield sites concerned with understanding the relationship of military theory and landscape features to the actions of opposing forces, as detailed in Chapters 2 and 3.

In addition to ABPP funding for a battlefield assessment, funding from additional sources allowed for additional work to be accomplished. In 2011, the expedition was composed of four separate phases. Funding sources for 2011 research came from:

- Phase 1: ABPP (NPS), BOEM, and the ONMS;
- Phase 2: CIOERT, NOAA OER, a grant from the Local Programming Development Initiative (GovEd TV, Dare County, North Carolina), and ONMS;
- Phase 3: NOAA ONMS, Maritime Heritage Program (MHP); and
- Phase 4: NOAA OE, NOAA ONMS, and CIOERT.

These funds were awarded to ECU, the UNC-CSI, and the MNMS. Additional significant in-kind support was provided by:

- Program in Maritime Studies, ECU,
- the UNC-CSI, and
- the Renaissance Computing Institute.

Leveraging resources from BOEM, OER, and ONMS allowed for a wide range of research on WWII casualties and the use of a complex array of marine science technologies such as 3D video survey (Figure 4-8). As such, this 3-month expedition identified 47 potential targets for future study, surveyed almost 300 square miles of seabed, and documented at least 17 WWII-associated shipwrecks (Figure 4-9). The large area survey produced so many potential targets that subsequent field seasons could focus exclusively on further investigations of identified targets. In these data, some targets were clearly discernable as shipwrecks, while other targets require further survey to determine whether they are man-made or geological.

To further document WWII shipwreck sites off North Carolina, the research team utilized technologies that could collect detailed useful data in a short amount of time. ADUS developed a method of acquisition and post processing of multibeam data that could quickly collect extremely high-resolution acoustic imagery and produce useful products in a short time window. The benefit of this system was the most time consuming component; the post-processing could be completed in the lab. In a short window of just 8 days of field time, the team was able to collect data on 15 sites. The resulting data provided georectified high-resolution multibeam images as well as 3D point cloud models that could be used for interpretation and outreach. These models are viewable through the WreckSight software program and allow the data to be viewed in full 3D, as well as in plan and profile view. Additionally, the software provides tools that allow for the measurement of features and depths. These individual shipwreck models are post processed by ADUS to imbed occlusion objects within the point cloud to allow better visual interpretation of the final product. The points are modified to different colors to differentiate cultural material from the surrounding seabed (Figure 4-10).

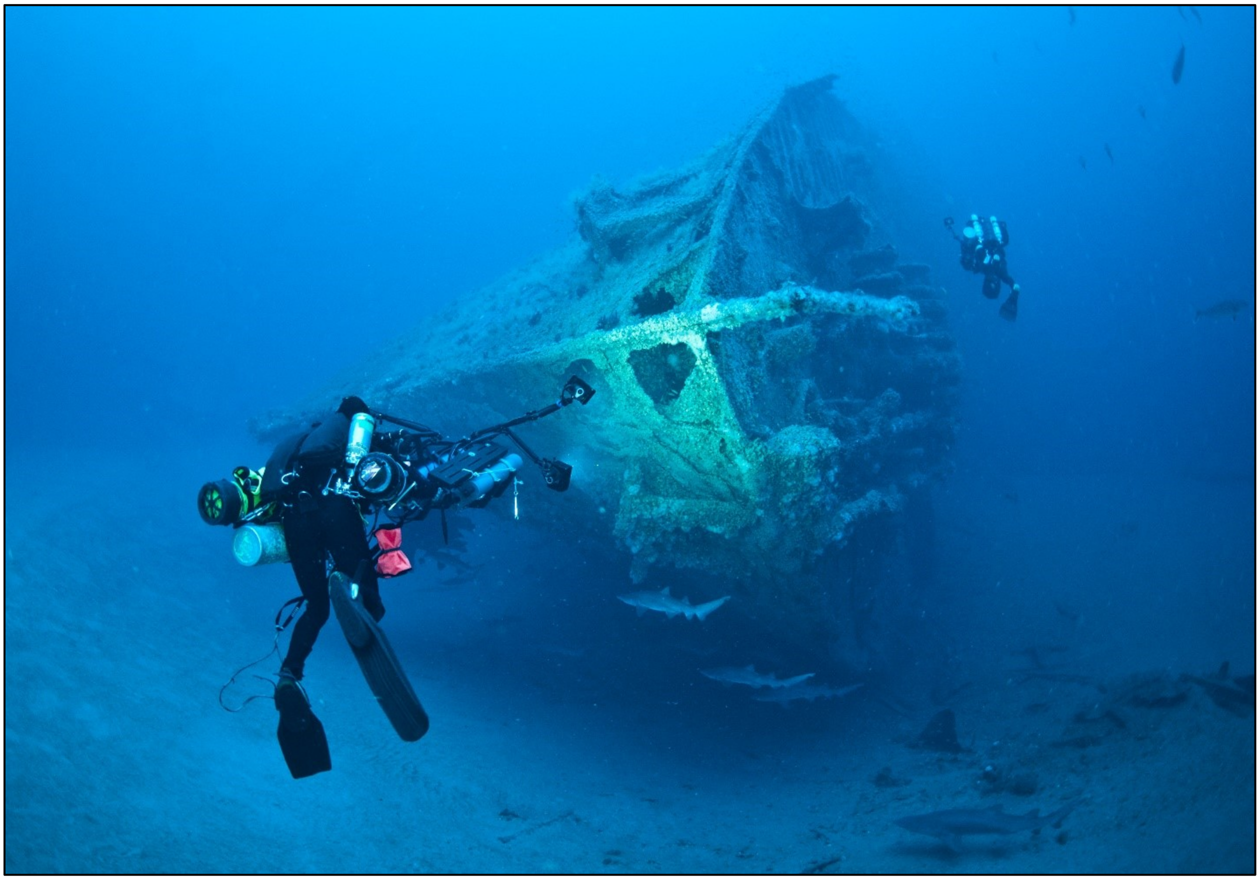


Figure 4-8 HD 3D video survey at site of *E.M. Clark*.
Source: Becky Kagan Schott, WHOI

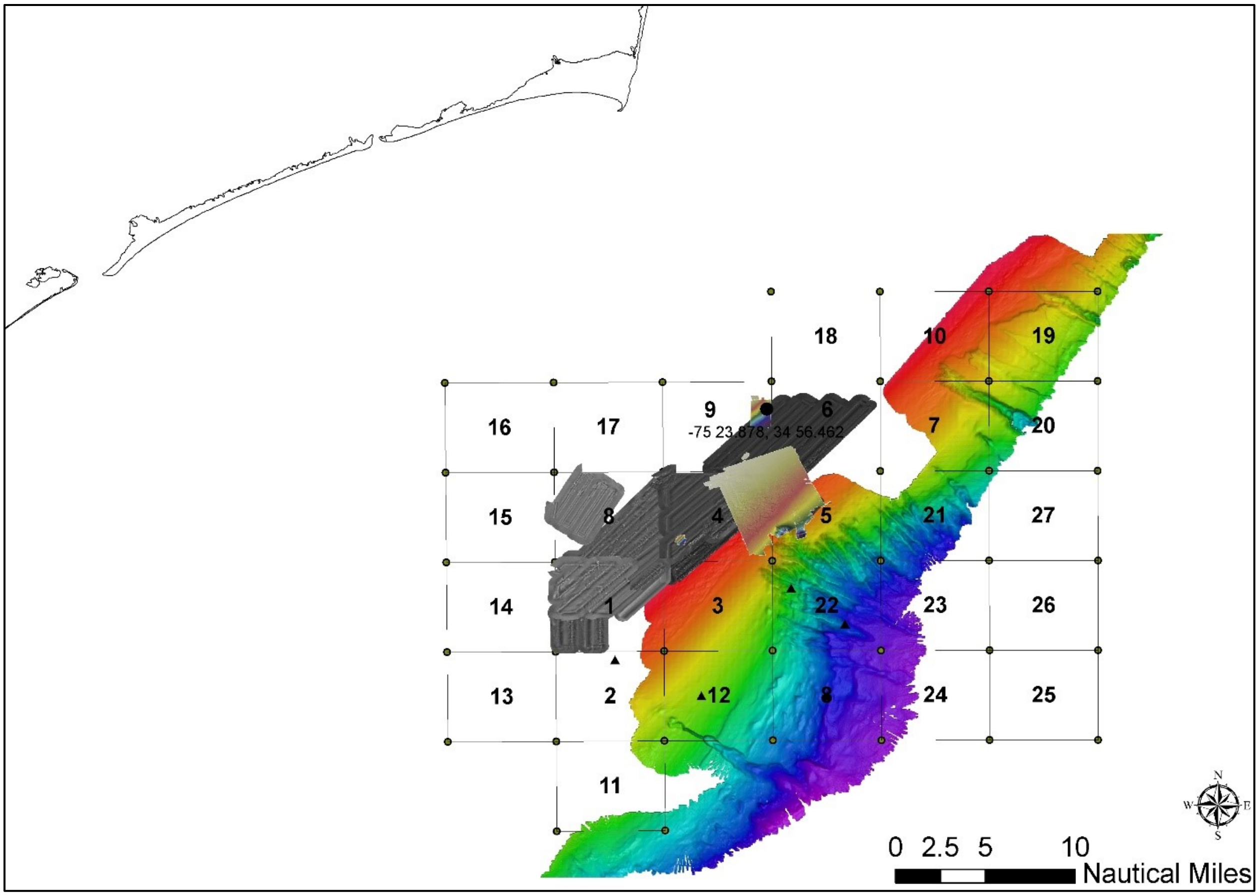


Figure 4-9 Coverage map of survey area from FY11 data.
Source: NOAA

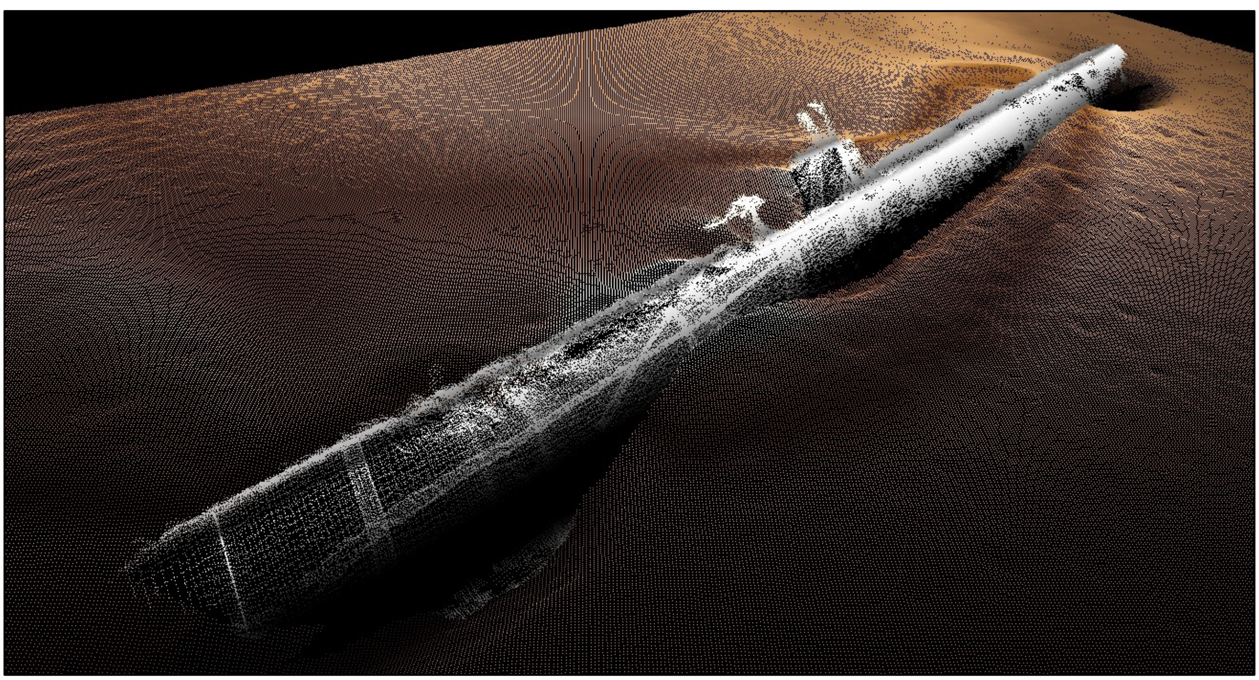


Figure 4-10 Isometric SONAR visualization of U-*701* wreck site.
Source: ADUS

4.6 2012 Operations

The 2011 field season was successful in surveying a wide area of seabed with low-resolution imagery resulting in the identification of 47 acoustic anomalies. Unfortunately, time constraints and equipment malfunctions permitted higher-resolution imaging of only one of the 47 targets; thus, the team intended to return to the 2011 survey dataset and conduct higher resolution surveys of the these anomalies in an attempt to identify shipwrecks, in particular *Bluefields* and U-*576*. As such, the approach and methodology used for the second portion of 2011 was effectively redeployed during the 2012 field expedition.

Furthermore, the team also sought to collect baseline data on WWII merchant vessels, which were omitted or only briefly visited in previous years. Since so many vessels were lost off North Carolina during WWII, the research team still had little or no data on several vessels. The focus, therefore, was on basic site characterization, predominantly via photography and videography, as well as the use of standard archaeological survey techniques outlined in Chapter 3. The goal for these in-water assessments was to gain as much data as possible on each site in order to verify identity and assess National Register eligibility.

Of the targets identified in 2011, seven high priority targets were selected and became the focus of additional survey efforts in 2012. An AUV, supplied by SRI International, was utilized to conduct targeted surveys of these select sites using high-resolution multibeam sonar. The goal was to determine if the sites were in fact wreck sites or natural geological features (Figure 4-11).

In addition to targeted multibeam surveys, the research team also conducted preliminary diving operations on two WWII wrecks lost off the Cape Lookout area in 1942. These sites, *Ashkhabad* and HMT *Senateur Duhamel* were assessed for their feasibility for more detailed documentation in the future. *Ashkhabad* would be the focus of a citizen scientists based survey sponsored by MNMS the following year.

This phase of the project focused heavily on WWII sites known or believed to be in the area in which the team had little or no data recorded. In some cases, locations and tentative identifications were posited and not confirmed. The intent of the expedition was to access as many sites as possible with the purpose of conducting a detailed assessment and continuing the development of a comprehensive GIS database of WWII wrecks. The sequence of accessing additional sites was adaptable based on prevailing weather conditions and various operational restrictions. Sites that were accessed for data collection during the 2012 field expedition were: *Ario, Ashkhabad, Atlas, Caribsea, W.E. Hutton, Naeco,* and HMT *Senateur Duhamel.*

Ultimately the in-water phase of the 2012 field expedition was successful in acquiring a robust dataset of still photographs and video. Video was utilized in ongoing outreach and education programs, as well as to develop heritage tourism promotional content. Additionally, researchers gained a firsthand understanding of individual sites and their conditions, which aided in the development of nominations to the NRHP and will also allow for tailored development of future archaeological surveys, which to date have been carried out on *Caribsea, Ashkhabad* and HMT *Senateur Duhamel* (Sassorossi 2015, and Fox 2015).

In addition to the field operations conducted off NOAA Vessel SRVx *Sand Tiger*, NOAA's OMAO augmented the acoustic dataset for the Battle of the Atlantic Project. In August 2012, NOAA R/V *Pisces* conducted multibeam surveys on additional targets within the study area. This resulted in acquiring data on two targets on which no previous data had been recorded. These sites were the tanker *Malchace* (Figure 4-12) and *Liberator* (Figure 4-13).

The most significant success of this field operation was a proof of concept for the methodological approach begun in 2011. The wide-area ARL:UT survey allowed for the coverage of a very wide area with low-resolution results. The fact that the research team was able to successfully identify and ‘ground truth’ some of these anomalies as wrecks or geological features in 2012 ensured that the 135 square mile coverage map collected previously was effective for the assessment of cultural remains. This may represent one of the more efficient and economical complete coverage rapid assessment methodologies available for locating and assessing cultural remains for large open ocean areas. Additionally, the requisite time and cost associated with the higher resolution targeted survey conducted in 2012 have led to the revision of the methodology by adding a time and cost saving recommendation for conducting a targeted magnetic survey of each anomaly prior to the deployment of the AUV system. This would allow for greater prioritization for targets with parity in both acoustic and magnetic returns.

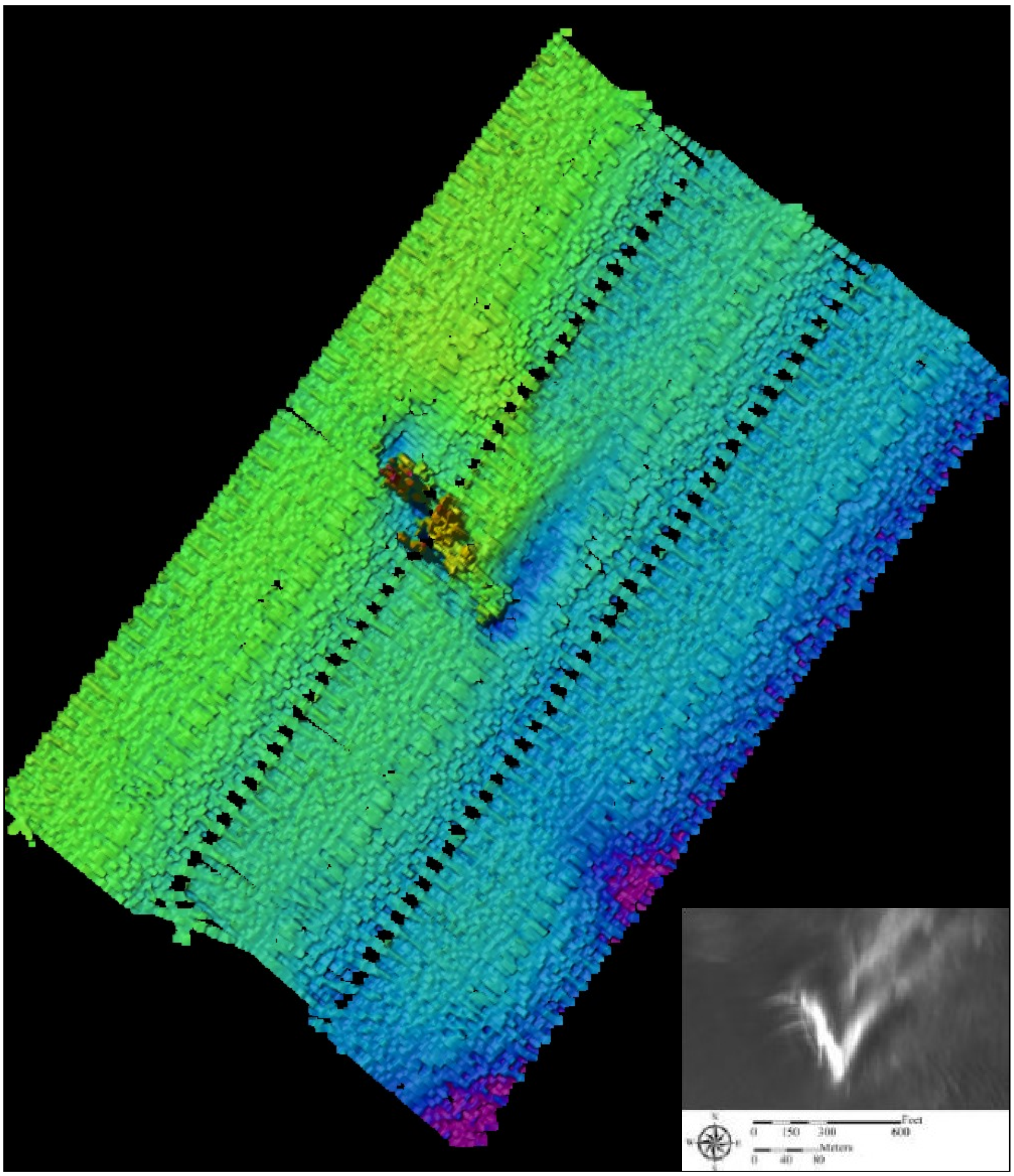


Figure 4-11 Example of the difference between low- and mid-range resolution from wide area to targeted survey. Target 2-1 Delta P survey results (large). 2011 ARL:UT data for Target 2-1 (inset).

Source: NOAA/SRI/ARL:UT

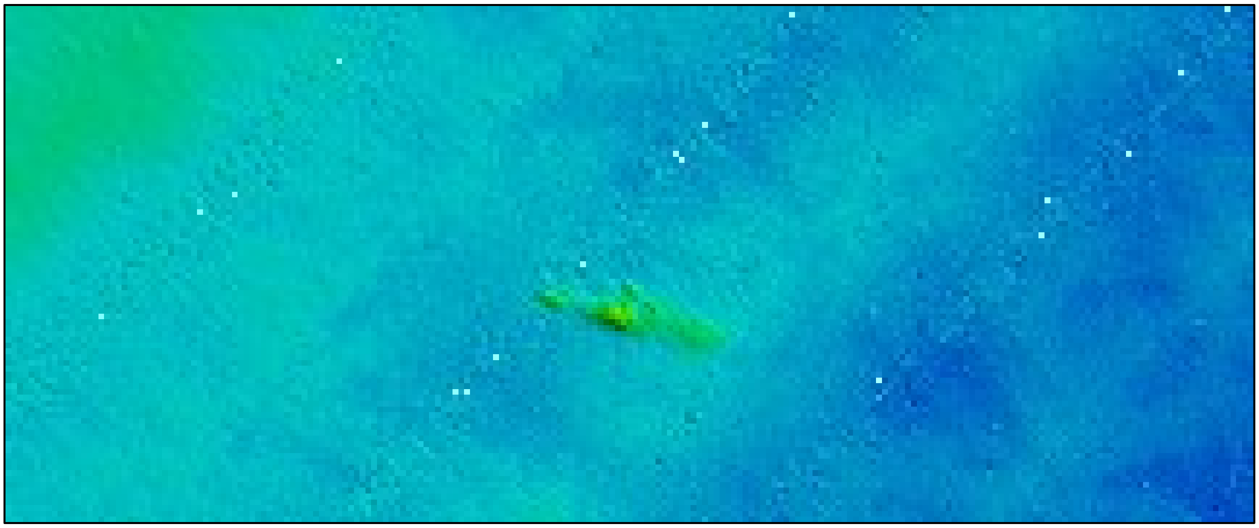


Figure 4-12 3-m resolution Geotiff of *Malchace* wreck site from R/V *Pisces* survey.
Source: NOAA

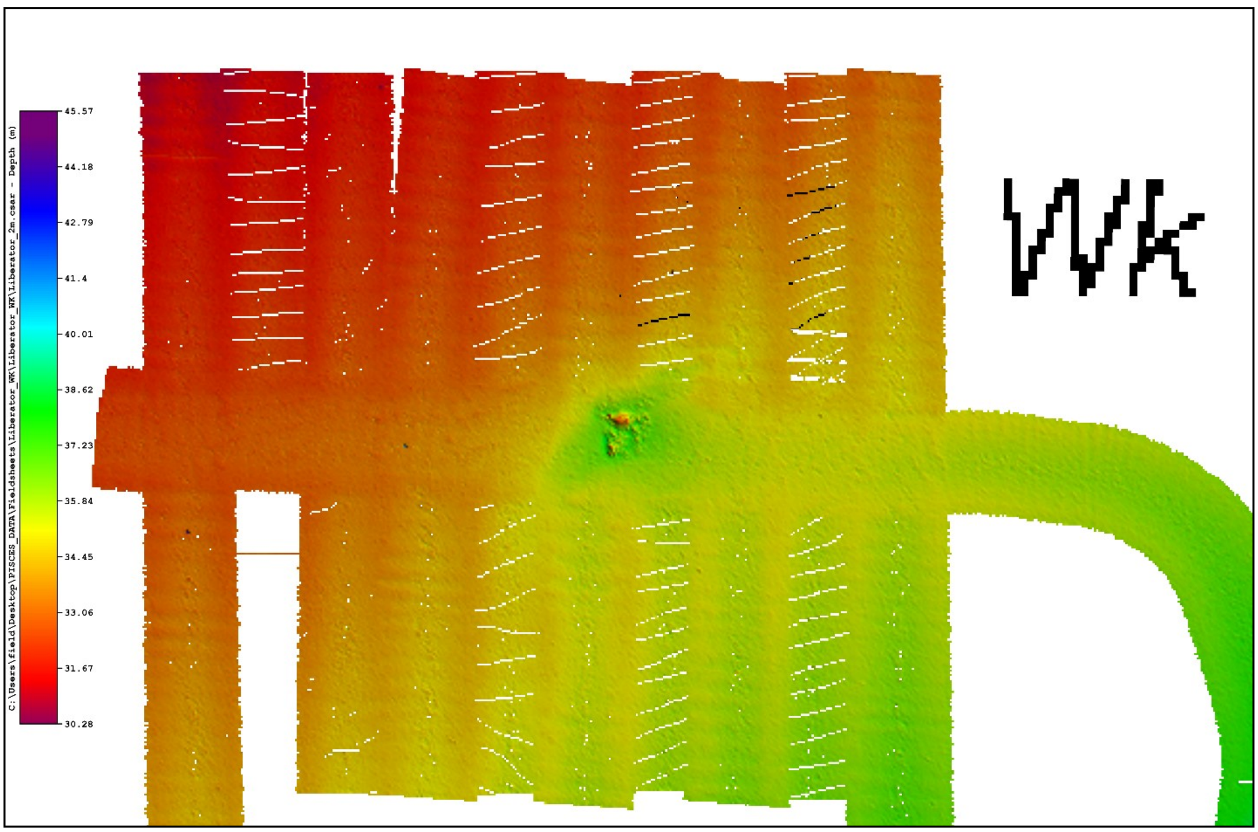


Figure 4-13 Multibeam survey of *Liberator* wreck site.
Source: NOAA

4.7 2013 Operations

The 2013 expedition focused on the characterization of additional WWII losses. By this stage in the ongoing research, the focus shifted back to completing a comprehensive assessment of sites associated with the Battle of the Atlantic off North Carolina. Many sites and locations were known to the research team but had not been observed. The approach for 2013 was to conduct a combination of remote sensing (principally via side scan sonar) and diver-based site assessments. NOAA and BOEM partnered with UNC-CSI and were able to survey 13 shipwreck sites; conducting remote sensing surveys during the night and diving operations during the day increased operational efficiency.

Whereas all of the sites visited in 2012 were within standard recreational diving depths (less than or equal to 39.6 m (130 ft) deep), 2013 efforts focused on gaining a greater amount of data on deeper sites by utilizing decompression procedures and closed-circuit rebreather diving to access sites in depths up to 76.2 m (250 ft) deep not previously surveyed. In addition to enhanced in-water operations, the 2013 field expedition also included additional remote sensing operations to collect baseline data on certain sites and evaluate survey targets discovered in 2011.

Research objectives on the 2013 Battle of the Atlantic expedition were an extension of the research themes guiding each of the previous years' work: the assessment of historical and archaeological significance of individual shipwrecks from WWII, the continued examination of remote sensing anomalies from the 2011 survey, and collection of baseline site condition data. Whereas previous years' expeditions incorporated additional archaeological themes such as the geospatial analyses and naval battlefield surveys, 2013 work was instead focused upon completion of a comprehensive site inventory and condition dataset, rounding out data collected on merchant casualties during 2010, 2011, and 2012. Data were intended to mainly encompass sites accessible to divers (76.2 m (250 ft) deep or shallower), though several deep-water targets were also investigated in the ongoing search for *Bluefields* and U-*576*.

Developing a completed site database required visiting known shipwreck sites—including those whose identity is ambiguous or contested—not visited in previous years' expeditions, as well as a continued investigation of 2011 remote sensing anomalies. Thus, as in years past, a multi-stage research program was employed, starting with dedicated remote sensing operations. Remote sensing, via targeted side scan sonar surveys of individual shipwreck sites, was conducted in conjunction with in-water diver surveys along a 24-hour operations schedule—diving during the day and remote sensing during surface intervals and at night.

The 2013 field season proved to be quite successful due in no small part to uncommonly favorable weather conditions. Out of 19 planned potential targets, the field team was able to collect substantive data on 12 sites, 3 of which represented previously unknown/unlocated shipwreck sites. In addition to the sites planned for survey, 2 additional maritime heritage sites outside the scope of Battle of the Atlantic were also surveyed opportunistically. Additionally, the methodological cadence of operations proved most efficient, with researchers alternating between dive operations and side scan sonar survey. This allowed the team to maximize sea time and respond more effectively to prevailing conditions. Being able to alternate between operational modes allowed for a greater utilization of sea-states. Conditions too severe for diving operations were often still appropriate for remote sensing. A detailed accounting of the data collected during the research cruise can be found in the individual site sections.

Perhaps the most significant observations of the 2013 expedition were made at the suspected site of the freighter *Bluefields*. The historical significance of this site has been the focus of much previous inquiry over the course of this multi-year project and was the subject of the research teams' report for the NPS American Battlefield Protection Program (Bright et al. 2012). This target was originally surveyed by NOAA, creating a dataset, which was later reprocessed for AUV avoidance in 2012 by John Kloske at

SRI, revealing a potential cultural anomaly (Figure 4-14). The location of the anomaly placed the target in the center of our highest probability area based on an amalgam of historic information. This fact made the target very appealing for further data acquisition.

The survey package assembled for this project consisted of a side scan sonar with 304.8 m (1,000 ft) of cable. The target of interest was located in 228.6 m (750 ft) of water. The rule of thumb for survey is to have 3 times the cable length for the depth of water in which the survey takes place. Despite not having enough cable for the depth of water, it was decided that since the position accuracy of the anomaly was so high, a systematic survey would not be necessary and valuable data and insight could potentially be gained from the effort. The objective was only to acquire a decent image of the target; several survey passes were attempted, which yielded useful data and confirmed the presence of a shipwreck at that location (Figure 4-15).

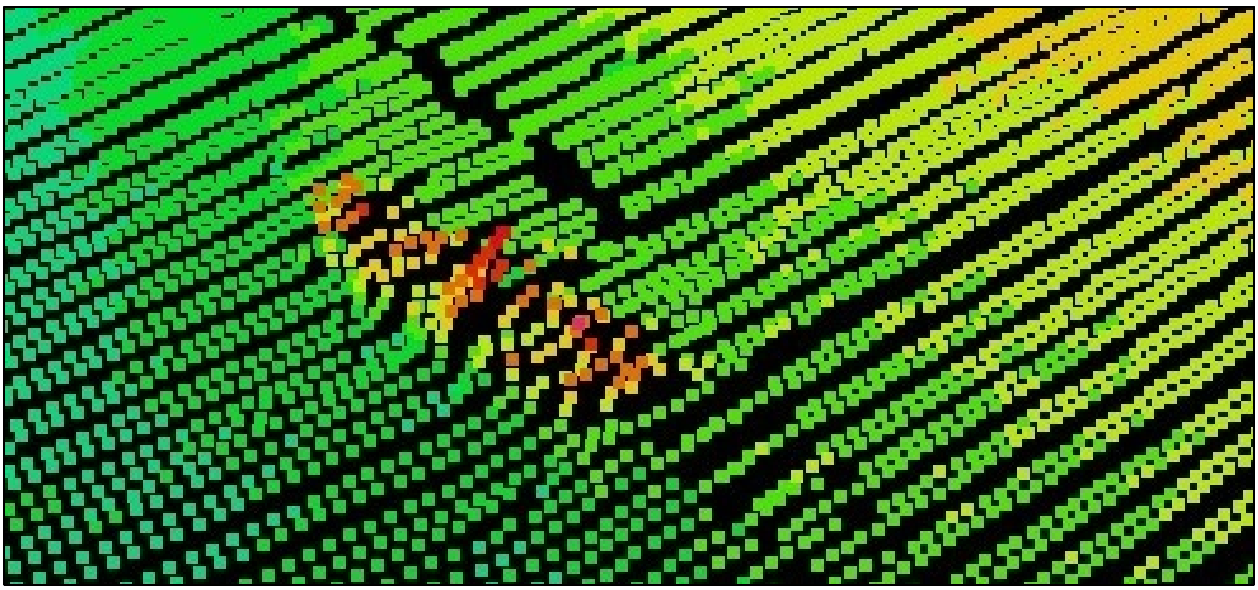


Figure 4-14 Alternative visualization of reprocessed multibeam of anomaly in KS-520 probability area.
Source: SRI/NOAA

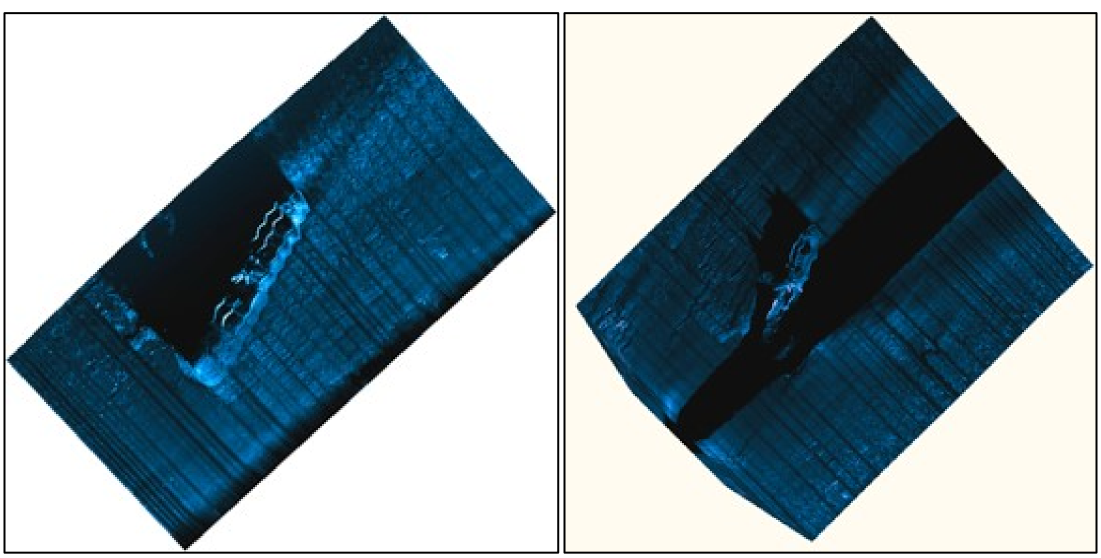


Figure 4-15 Sonar images of the suspected *Bluefields* site collected in 2013.
Source: NOAA

4.8 2014 Operations

Following the data collected in 2013, the survey area for the KS-520 convoy position was reassessed using the suspected position of *Bluefields* as the epicenter. In coordination with NOAA's OER, the NOAA R/V *Okeanos Explorer* was able to conduct a wide-area low-resolution survey around this target during their EX-14-03 expedition. The bathymetric data were gridded at a resolution of 2 m, which is as finely detailed as possible with the system used. This high-resolution gridding showed some small gaps in seafloor coverage and revealed motion artifacts due to the ship movement that occurred during the survey (Figure 4-16). The bathymetry and backscatter were examined to look for targets that might be interpreted as potential wrecks. Four targets were identified and evaluated. Two targets which appeared in the backscatter mosaics to represent potential wrecks, were subsequently determined to not be sites based on analysis of the bathymetry data (Figure 4-17). The other two targets exhibited a ship-like resemblance in both the bathymetry and backscatter (Figure 4-18). Target 2 was later determined to be the site of the *Bluefields*.

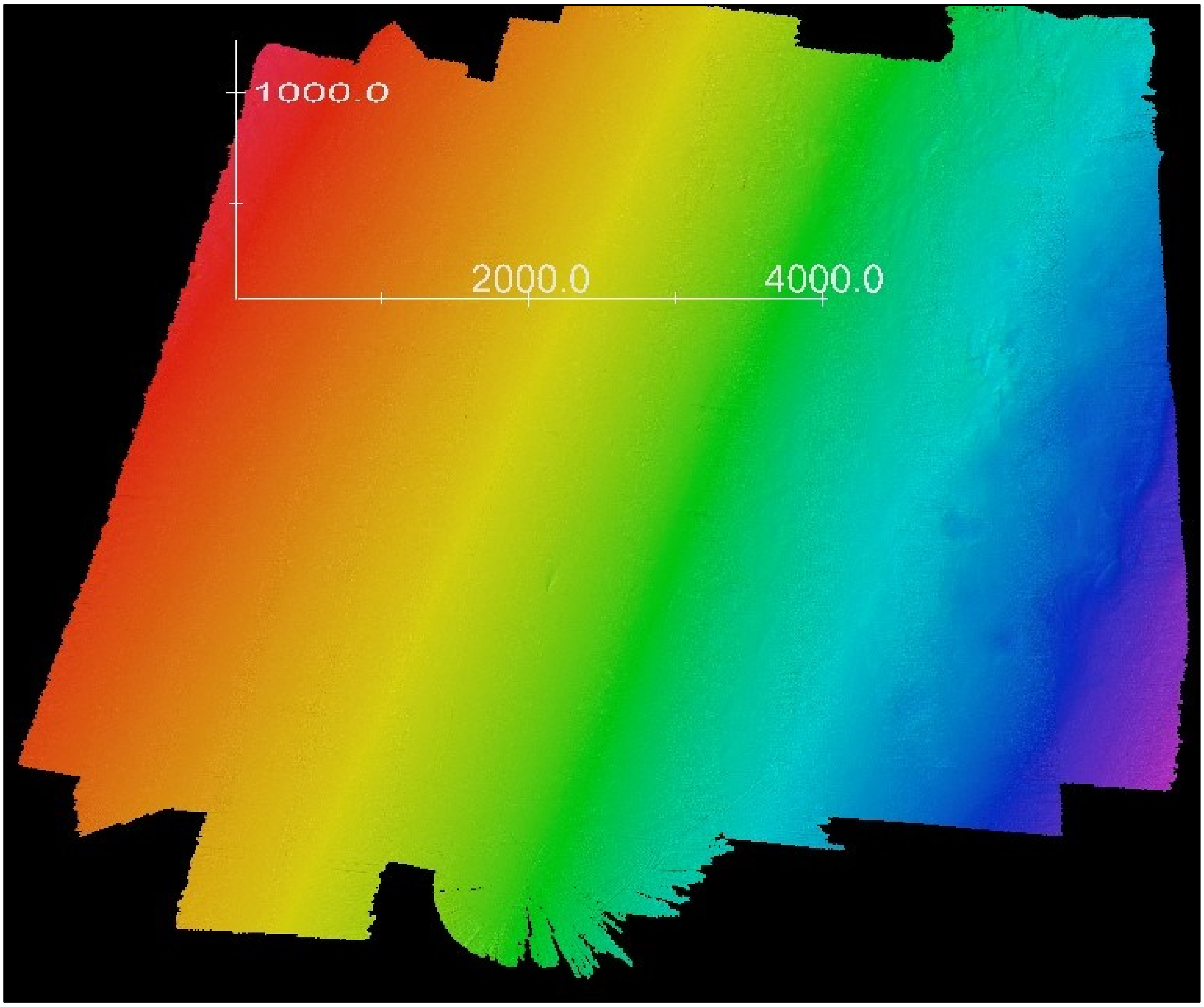


Figure 4-16 Search area covered by R/V *Okeanos Explorer* survey.
Source: Derek Sowers, NOAA

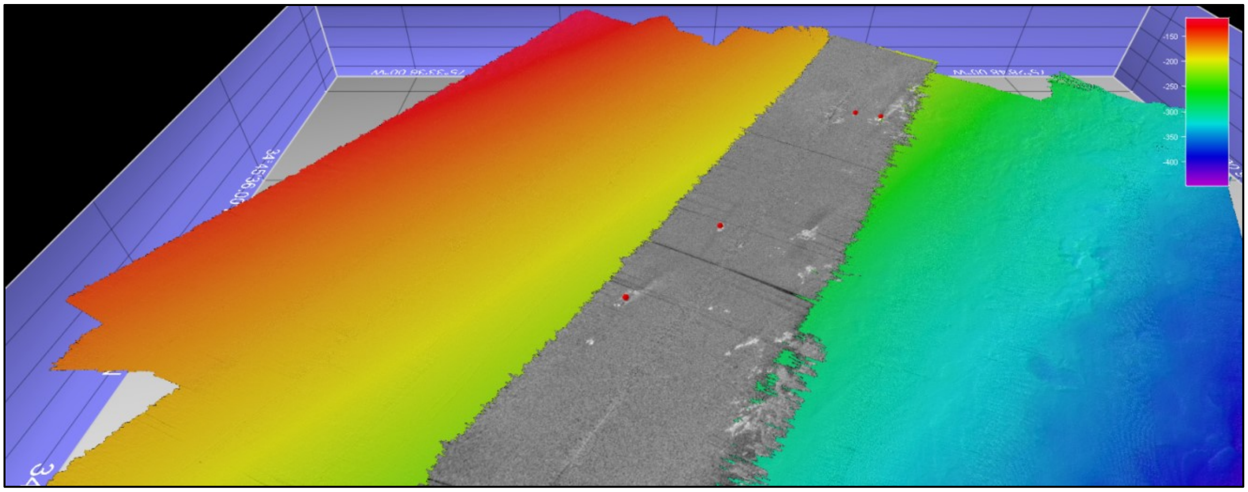


Figure 4-17 Isometric overview of search area with color-coded bathymetry and one line of backscatter mosaic.
Note: Red points indicate targets of interest.
Source: Derek Sowers, NOAA

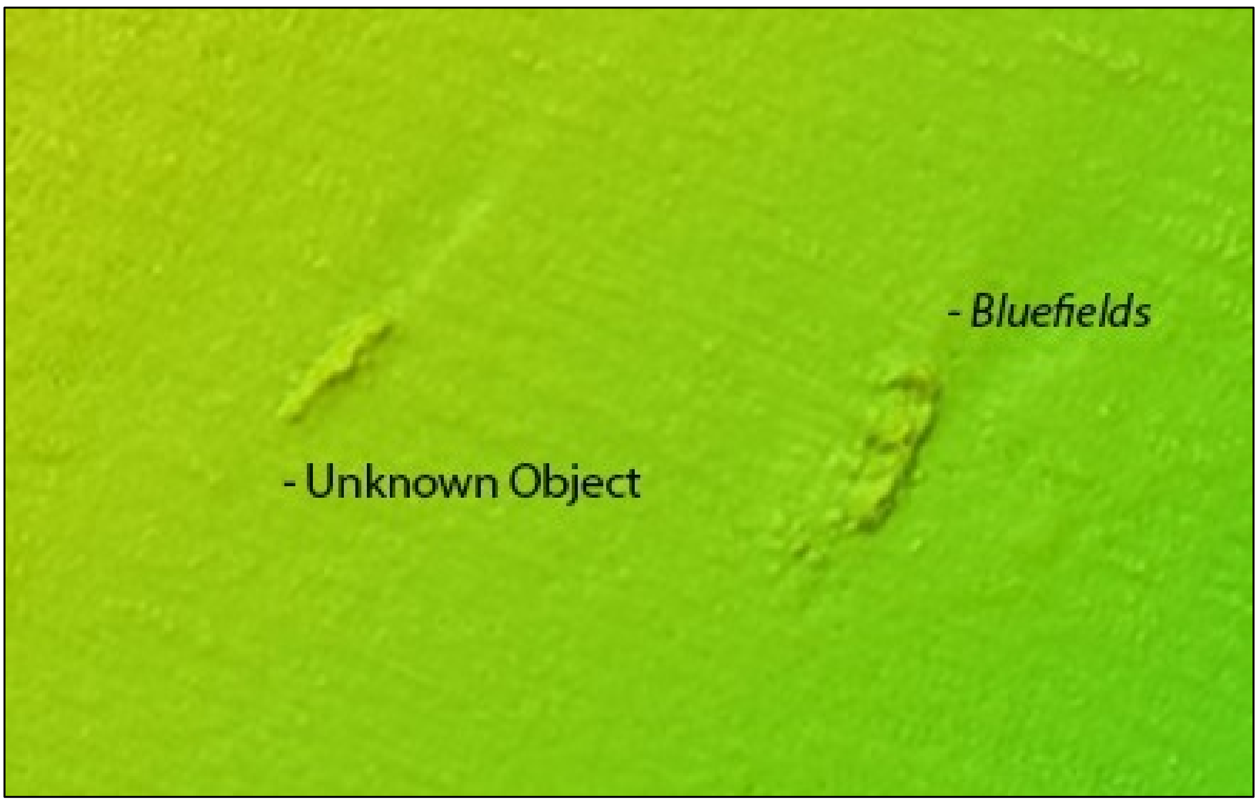


Figure 4-18 Close cropped multibeam image of two targets in the survey area. Target 2 is identified as *Bluefields*, with an unknown object later identifed as the U-*576*, approximately 200 m away.
Source: Derek Sowers, NOAA

The search area for U-*576* was subsequently mapped using SRI's AUV equipped with a 260 kHz multibeam sonar (MBS) and a Tritech SeaKing side scan sonar in addition to a Honeywell HMR2300 three axis digital magnetometer. Analysis by SRI concluded that a line spacing of 100 m with 2,000 m long transects aligned northeast to southwest (parallel to the Gulf Stream axis) would allow for the best opportunity for all of the sensors to detect U-*576*.

Prior to the search for U-*576*, the wide-area search AUV payload functionality was verified on a known target (the USS *Tarpon* that lies at a depth of 30 m) by conducting two 300 m x 300 m grid surveys with 25-m line spacing. These two 45-minute dives provided baseline data sets of how each payload sensor (magnetometer, 325 kHz side scan sonar, 260 kHz MBS and 1,350 kHz MBS) responded to an actual type VIIC U-Boat at the ranges expected during the search of U-*576*. These data would be extremely useful in the interpretation of the data collected during the search of U-*576*.

After the AUV was recovered, the sonar data from both the Delta-T MBS and the Blueview were downloaded and processed. By combining these data into a single 3D data product, an intuitive 3D model for viewing areas of interest was created and used to determine the disposition of the wreck, detect site artifacts, and provide surrounding bathymetry. Ultimately this approach led to locating and positively identifying the final resting place of U-*576* (Figure 4-19 and Figure 4-20).

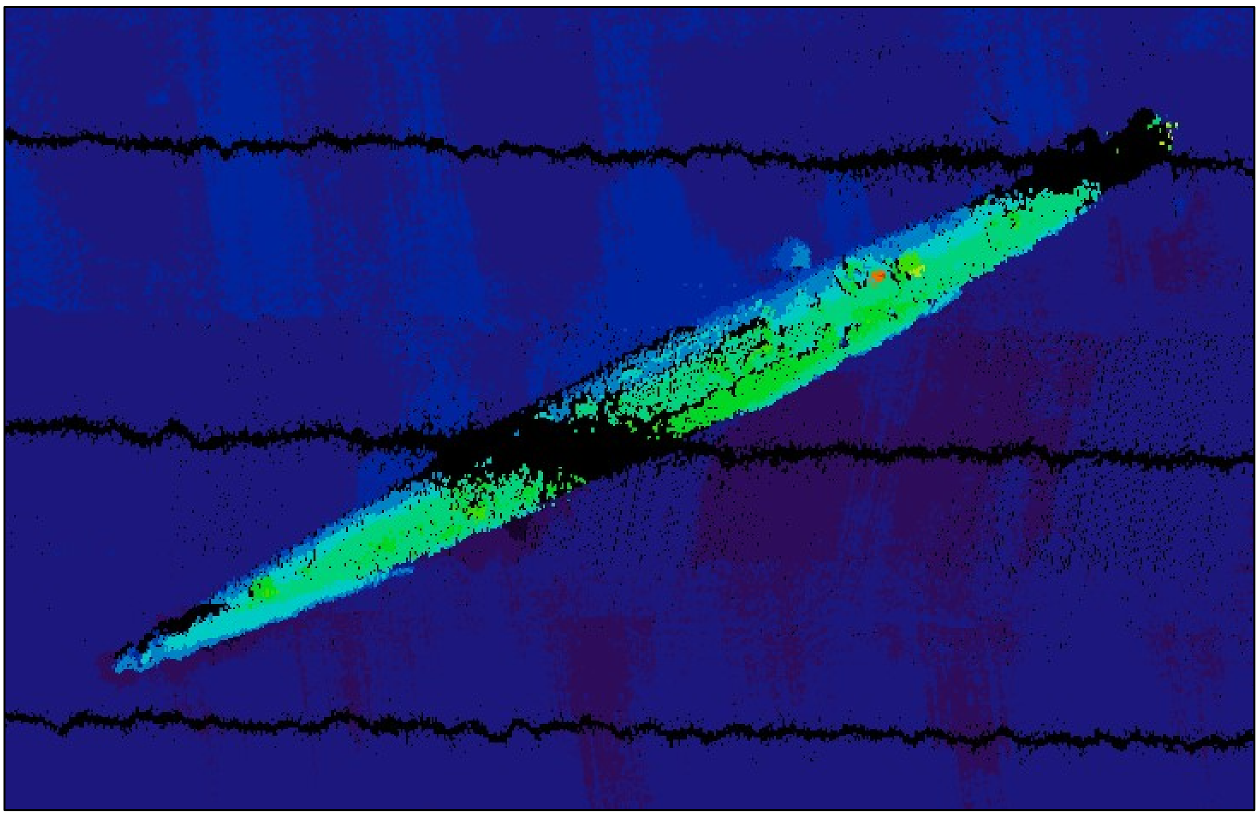


Figure 4-19 Multibeam image of the wreck of USS *Tarpon*, which was used as a calibration site for the AUV instrument payload.

Source: John Kloske, SRI

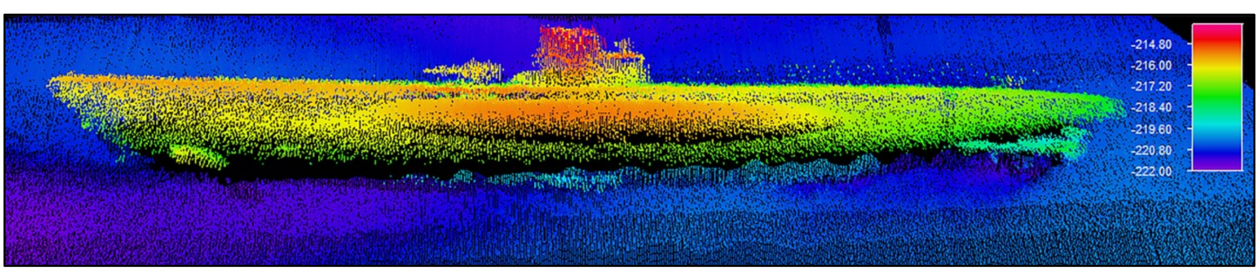


Figure 4-20 First processed multibeam image of U-*576* wreck site.

Source: SRI/NOAA

4.9 2015 Operations

2015 operations expanded the scope of research to explore World War I (WWI) resources in the area of operations to test the feasibility of developing future efforts to inventory and document these sites. This included preliminary investigation of the Diamond Shoals Lightship *LV-71* and *Merak*, both sunk by U-*140* on 6 August 1918 (Figure 4-21). In support of this, MNMS signed a Memorandum of Agreement with the US Coast Guard, the agency responsible for the lightship, to support management and interpretation of the wreck site.

All operations in 2015 were diver-based using staged decompression. An unidentified site fitting the description and location of *Merak* was surveyed by researchers from BOEM, NOAA, and UNC-CSI as well as avocational volunteers of BAREG. Detailed measurements and investigation of the site resulted in a positive identification of the target as *Merak*.

Figure 4-21 Bow of Diamond Shoals Lightship LV-*71*.
Joseph Hoyt, NOAA

4.10 2016 Operations

Operations in 2016 represented the final season of research under the Interagency Agreement and were perhaps the most complex attempted during this entire study. Additionally supported under a grant from NOAA's OER, the team returned to the KS-520 sites to conduct a high-resolution survey of U-*576* and *Bluefields*.

An interdisciplinary approach determined the methods selected to reach the project's goals. Data acquisition and survey payloads were chosen such that they would provide data that could be useful for both archaeological baseline characterization and for benthic habitat mapping. The project combined proven operational systems while testing novel and experimental approaches to recording and imaging deepwater shipwrecks. These efforts were intended to support developing a methodology that is operationally and financially beneficial to the needs of MNMS, National Centers for Coastal Ocean Science (NCCOS), and the broader marine archaeological and biological research communities.

The 2016 investigation was made possible via a strategic collaboration with Project Baseline, a non-profit environmental survey program that leverages the resources and network of Global Underwater Explorers

(GUE), and Brownie's Global Logistics. These organizations brought significant resources to bear to conduct this work, including the use of two Triton 1000 manned submersibles, one of which was outfitted for photographic and video documentation, the other supporting the 2GRobtics ULS-500 underwater laser line-scanning system and Sonardyne positioning detailed in Chapter 3. The entire project was based aboard Project Baseline's flagship research vessel *Baseline Explorer*. The investigation mobilized on 20 August 2016 and a 15-day window was planned to complete the goals of this survey. The team consisted of project Principal Investigators (PIs) from NOAA MNMS, NCCOS, and BOEM; Project Baseline staff and vessel and submersible crew; AUV technicians; laser line-scanning operators from 2GRobotics and Sonardyne; photographers and videographers from CSI; and NOAA education and outreach staff (Figure 4-22 and Figure 4-23).

Figure 4-22 R/V *Baseline Explorer* supports Nemo pilot Robert Carmichael as he takes BOEM archaeologist William Hoffman to the wreck of U-*576*.
Source: John McCord, UNC-CSI

The first submersible dives conducted on U-*576* and *Bluefields* consisted of still and 4K HD video documentation. In addition to image collection, a full systems test on the laser scanner was also conducted. Following the first exploratory dive, additional dives were made to continue still photography, video documentation, and laser scanning of the sites. On each dive, one submersible focused efforts on acquiring laser data, while the other focused on researcher observations and photographic documentation.

The project was successful in integrating laser-scanning systems into a manned submersible and demonstrated the applicability of this technology for use in archaeological investigation. As a result of these surveys, the research team was able to conduct a complete plan view survey of both U-*576* and *Bluefields* with the ULS500 laser scanner. The laser data quality has incredible detail and has been found to be very useful for the purposes of archaeological interpretation as well as benthic habitat mapping, as noted by the many fish clearly resolved in the data (Figure 4-24). The two primary targets of the expedition were surveyed over a series of 5 fully operational days, wherein each Triton submersible conducted a single dive per day of approximately 4-6 hours. This resulted in two submersible dives per day, for a total of 10 submersible dives for the operation before additional planned days were lost due to deteriorating weather from a tropical depression and Hurricane Hermine.

Concurrent with the operations from *Baseline Explorer*, GUE divers conducted technical diving operations on YP-*389* and completed a photomosaic of the site.

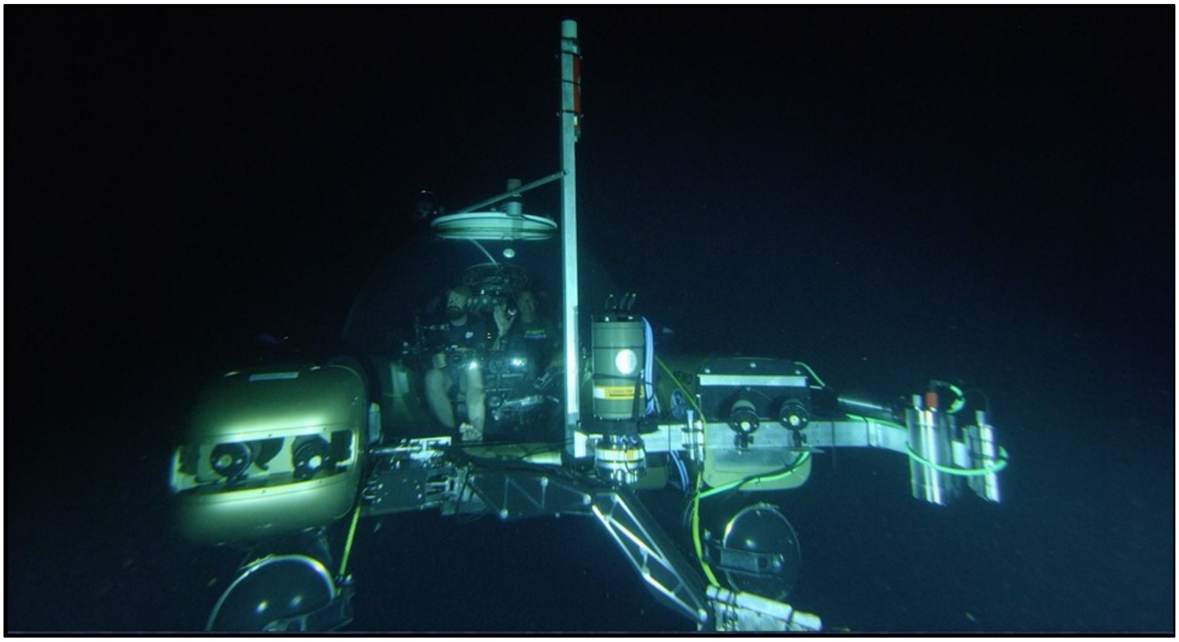


Figure 4-23 NOAA Archaeologist Joseph Hoyt and Nemo pilot Robert Carmichael on the wreck of Bluefields in 243.8 m (800 ft) of water.
Source: John McCord, UNC-CSI

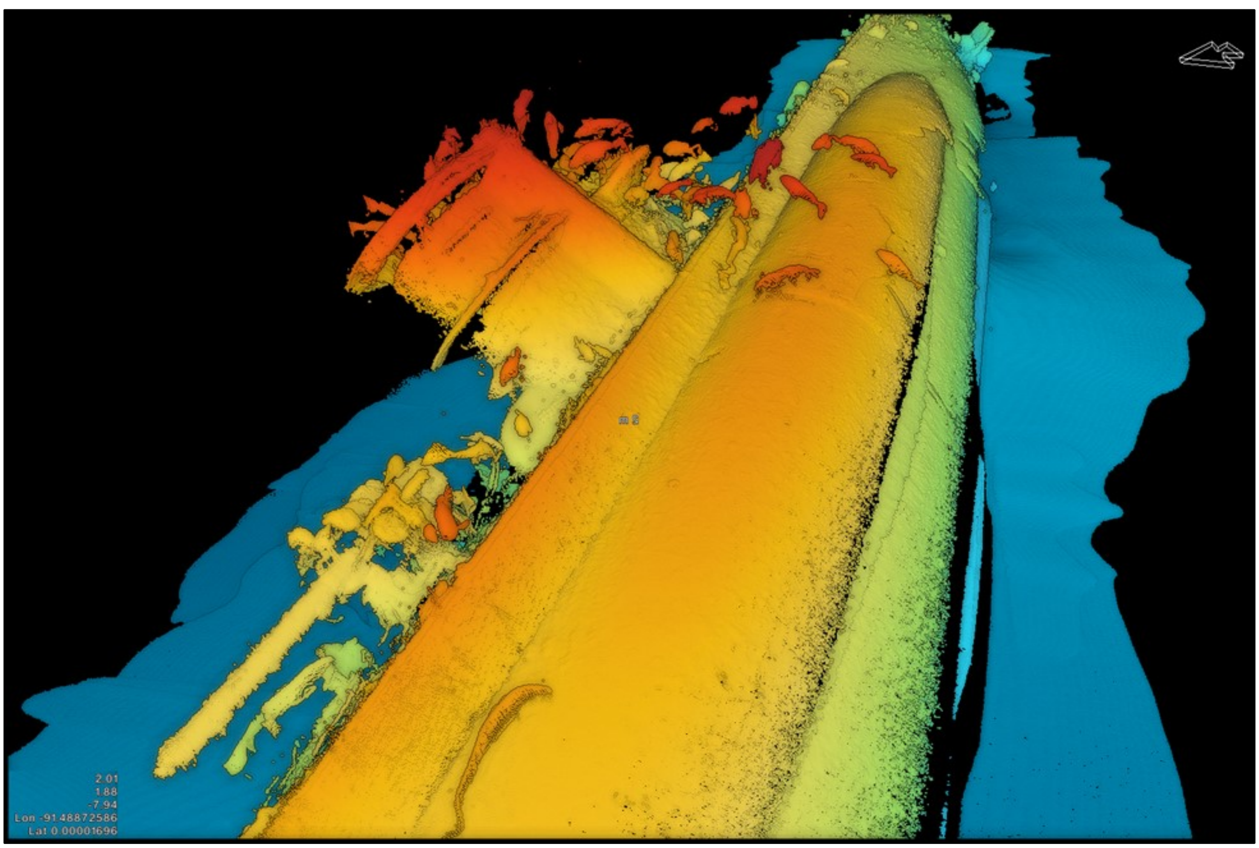


Figure 4-24 Sample of ULS500 laser data collected on U-*576*.
Source: NOAA/2GRobotics/Sonardyne

5 Historical Context

5.1 Introduction

The Battle of the Atlantic began mere hours after Britain declared war on Germany in September 1939 and would last until Germany's surrender in May 1945. This extensive naval engagement between Allied, Axis, and neutral forces constituted the longest single operation of WWII, and was the longest, largest, and most complex naval battle in history (Syrett 1994). Civilians, sailors, soldiers, marines and coastguardsmen engaged in combat, and in turn gave their lives, in a dire struggle for seapower in the Atlantic. Retired Royal Navy escort group commander, Donald MacIntyre (1961), wrote of the battle's importance to the entire Allied war effort:

> [as] an aspect of naval warfare, which on account of its often hum-drum nature is apt to be looked upon as a side-show, a back-water of the main stream of naval operations, yet which is in fact the whole purpose of seapower and in which an island power must either decisively win or be driven to abject surrender.

He could not have been more correct. The flow of war materials into Great Britain via the Atlantic was the lifeline of the Allied war effort against Germany, and Germany nearly severed it. Though the Battle of the Atlantic was not witness to spectacular fleet engagements like those fought in the Pacific, it was nonetheless of supreme strategic importance. At stake was the last bastion of resistance in Europe to Hitler's dreadful war machine.

Following America's entry into WWII, German U-boat raiders attacked merchant shipping off the United States' east coast with astonishing success. What ensued came to be known as the "American turkey shoot," with nearly 200 merchant vessels sunk between January and April of 1942 (Cheatham 1990). This was inaugurated by Germany's initial offensive, code named Operation Paukenschlag, or "Operation Drumbeat." This Atlantic "Pearl Harbor" was the prelude to nearly 5 months of unchecked German commerce raiding on the east coast (Gannon 1990). Slowly, though, combined Allied naval forces resisted, and ultimately forced withdrawal of German forces haunting American waters. Hard fought, yet far from over by the end of 1942, the Battle of the Atlantic all but left the eastern shores of the United States.

This chapter places the Battle of the Atlantic off the east coast, and North Carolina specifically, into a broader historical context. This context begins with consideration of the development of German submarine warfare and concludes with the KS-520 convoy battle off the North Carolina coast, both of which serve as bookends for framing the major east coast U-boat campaign. While underrepresented in popular history, meaning the average American tends to be unaware of this aspect of WWII or at least how close it came to the American coast, there is still a large body of work dedicated to the subject. As summarized in Chapter 3, a number of secondary sources discuss the Battle of the Atlantic in its totality, consider its tactics and technology, and provide regional histories or personal accounts (Morison 1947; MacIntyre 1961, 1971; Hughes and Costello 1977; Hoyt 1978, 1984; Gibson 1986; Hoyt 1987; Gannon 1990; Syrett 1994; Blair 1996; Kaplan and Currie 1997; Kemp 1997; Gannon 1998; Kaplan and Currie 1998; Wiggins 1999; Blair 1996; Hague 2000; Miller 2000; Showell 2002; Brennecke 2003; Ireland 2003; Westwood 2003; Blake 2006; Showell 2006; White 2006; Brown 2007; Williamson 2010).

Unlike previous studies, however, this chapter seeks to connect the larger strategic objectives and operations of the Battle of the Atlantic to the battlefield area off the North Carolina coast and segue into more specific review of the KS-520 convoy battle, often truncated or ignored in the literature. Though only a single naval action, KS-520 marks a significant shift in the strategic initiative off America's eastern seaboard. As demonstrated in both American and German naval records, the period of activity during which the KS-520 convoy was attacked marked the first occasion where German naval command was compelled to move U-boats out of the mid-Atlantic waters. In essence, the engagement marked the moment where American defenses and naval organization overcame the U-boat threat. As Germany shifted U-boat operations into the Gulf of Mexico and Caribbean, the countermeasures utilized along the Eastern Seaboard were simply extended, and once again succeeded in driving out U-boats. Thus, the significance of the initial movement of U-boats out of the Eastern Sea Frontier reverberated throughout the entire Atlantic. Once the Allies drove German U-boats from American waters, the effects of German initiatives in the Atlantic were substantially reduced.

Connecting this regional story to the broader narrative of the Battle of the Atlantic requires an overview of certain critical events leading up to the conflict. Throughout both world wars, Allies feared all U-boats for their ability to attack unseen and wreak havoc on vital shipping lanes. The usefulness of German U-boats and their danger to Allied shipping prompted the development of specialized anti-submarine warfare (ASW) techniques throughout the wars specifically to combat the increasing threat of U-boat attacks, as evidenced through the types of U-boats employed by the German Navy, the large-scale successes of U-boats, and the ultimate buildup of Allied forces and new tactics used against these German submarines. Due to the perception that submarines were a less noble weapon of war, they were, up until that point, not considered a major part of any navy. Though proven effective during WWI, many believed that submarines had run their course and were effectively neutralized. The German U-boat arm during WWII would expose the hubris and folly of such thinking and, combined with Japanese and American submersible activity in the Pacific, firmly root submarine warfare as an integral and indispensable component of modern navies the world over.

5.2 Development of German Submarine Technology

Germany’s effective employment of U-boats during the world wars was built on a long tradition of submarine technology and development both endemic to Germany and borrowed from other nations. The notion of creating a device to allow one to approach and attack an enemy vessel from under the cover of the sea is by no means a modern concept. Notable efforts, such as David Bushnell’s *Turtle* and Robert Fulton’s *Nautilus* in the late eighteenth and early nineteenth century, were operable but failed to attract any real and lasting interest in the employment of these devices (Ragan 2002:4). It was not until the latter half of the nineteenth century that significant effort was put into the development of submarines.

Construction of diving boats in Germany dates back at least to the fifteenth century when weapons designers from Nuremberg developed a diving boat in 1465. Various experiments took place until Germany’s most notable early contribution to submarine development came from Wilhelm Bauer. Widely regarded as the first German submarine engineer, Bauer designed and built the first fully-functional free traveling submarine vessel in 1850 (Rössler 1981). Bauer designed his vessel, *Brandtaucher* (Incendiary Diver), in response to a Danish Naval blockade of the German coast during the First Schleswig War. *Brandtaucher* measured just over 8 m long; was man-powered with a crew of three, and the vessel could achieve a speed of 3 kts. *Brandtaucher* sunk during testing, and effectively halted German submarine development for some time, though she possessed many attributes that would be expanded and later integrated into future submarine designs (Rössler 1981).

From the loss of *Brandtaucher* to 1900, very few submarines were developed in Germany. Several designs were proposed to the Navy, but none were funded or developed. Information on only two German vessels during this time is available. Friedrich Otto Vogel built a small submersible at Dresden in 1870, but it is believed to have sunk on initial trials. In 1897, a German torpedo engineer designed an experimental submarine in Kiel at the Howaldt Yard, though it is unlikely this vessel ever saw sea trials (Rössler 1981).

Despite the stagnant nature of submarine development in Germany during the latter half of the nineteenth century, many breakthroughs were taking place internationally. In the late 1890s the French Navy had developed several operational submarines, prompting Germany to establish the Torpedo Inspectorate, which eventually evolved into the U-boat Inspectorate. Despite this measure, the contemporary view was that Germany did not need submarines, and would better utilize resources by focusing on a traditional surface fleet. However, as surrounding nations such as France and Russia continued development, the Torpedo Inspectorate finally succeeded in procuring submarines built at Germaniawerft by 1904 (Rössler 1981).

Though German officials engaged in experiments with submarine technology, adopting U-boats as an integral part of the Navy with a significant allocation of resources was a slow process. U-boats were still viewed at this time as superfluous to a traditional navy. Germany began its undersea endeavors in earnest in December 1906 when they completed the first Unterseeboot, U-*1*. Work on U-boats progressed in spite of the modern German Navy's creator Admiral Alfred von Tirpitz stating, "Germany has no need of submarines… I refused to throw money away on submarines so long as they could only cruise in home waters" (Botting 1979). By 1908, U-*1* had completed a 600-mile circuit, convincing the German Naval command of its usefulness outside of home waters, and by 1909 Germany was quickly manufacturing submarines capable of 12 kts, equipped with four torpedo tubes and a gun. These were far superior to other nations' submarines, and Germany's technology was still increasing (Rössler 1981). Thus by 1913, German U-boats of class U-*19* were able to travel in excess of 5,000 miles because of improved engines and communications systems.

Following the development of U-*1*, the Torpedo Inspectorate for the German Navy continued to work closely with contracting yards, predominantly Germaniawerft and Kaiserliche Werft, to develop U-boats. During the time leading up to WWI, Germany continually constructed, tested, and redesigned their submersibles, as well as developed tactical procedures for their use (Rössler 1981). By the time war broke out, considerable advancements had been made by switching from paraffin to diesel engines, refining fuel storage, redesigning ballast systems, and improving safety. Approximately 45 U-boats were in service or under construction (Rössler 1981) at the start of the war. Naturally, a state of war called for additional development and a higher volume of U-boats.

5.2.1 World War I

Early in WWI, Germany recognized the importance of submarines and began building U-boats that were not merely attack submarines, but that could be used for various functions throughout the war. Larger U-boats for oceangoing missions, and smaller coastal U-boats as well as U-boats for specialized missions such as mine-laying, were developed. Some of the boats first acquired for the war effort, initially under construction for foreign Navies such as Norway and Austria-Hungary, were taken over by the Germans. Those commandeered were types UA and UD, and were larger vessels. The U-boat Inspectorate then approved the construction of types UB and UC, small coastal vessels intended for service along the Belgian Coast (Rössler 1981:39).

In 1916, Germany announced plans to build large cargo submarines capable of running the blockade England had imposed on Germany, thereby enabling Germany to continue trade with America. American businesses soon rented dock space in order to buy and trade the goods reportedly coming from Germany. Then, despite British incredulity, Germany landed the 2,000-ton, 91.4-m (300-ft) long submarine *Deutschland* in the docks of Baltimore on 9 July 1916. The U-boat crew was given a hero's welcome and the event was seen as the beginning of a German-American alliance (*Navy Times* 1962:55-56). To further display the effectiveness and usefulness of German U-boats, these merchant U-boats were left with the capability of being converted into attack submarines, and by the end of the war, all merchant U-boats had been converted into standard attack U-boats (Botting, 1979:37). As technological improvements changed and tactical needs developed, U-boats' designs changed to accommodate these needs (see Table 5-1).

Table 5-1 Types of U-boats in use during WWI, some of which were commissioned prior to the onset of war

Gasoline Boats	UA	U-1	U-2	U-3	U-5	U-9	U-16	U-17	
Number Built	*1*	*1*	*1*	*2*	*4*	*4*	*1*	*2*	
Diesel Boats	U-19	U-23	U-27	U-31	U-43	U-51	U-57	U-63	U-66
Number Built	*4*	*4*	*4*	*11*	*8*	*6*	*6*	*3*	*5*
U-Cruisers / Merchants	U-151	U-139	U-142						
Number Built	*7*	*3*	*1*						
Coastal Boats	UBI	UBII	UBIII						
Number Built	*7*	*3*	*1*						
Coastal Minelayers	UCI	UCII	UCIII						
Number Built	*15*	*64*	*16*						
Ocean Minelayers	UE1	UE2							
Number Built	*10*	*9*							

Source: Rössler 1981

U-boat strategy, tactics, and technology was not well developed at the time leading up to WWI. It was typical for many types to have only one representative example. As seen in Table 5-1, very few vessel types were produced in large numbers. This is indicative of the developmental nature of German U-boats and submarine warfare in general at the time. With the development of each vessel, the German Navy was learning and quickly incorporating design alterations and new technology. Additionally, Table 5-1 shows a heavy concentration of short range coastal U-boats with 70 percent of boats constructed for that service. This is illustrative of the needs of the war, as most of the U-boat offensive took place in German or nearby coastal waters.

Once England declared war on Germany in 1914, German U-boats wasted little time pursuing English Naval vessels; cruiser HMS *Pathfinder* was sunk by a German U-boat on 5 September 1914. Soon thereafter, U-*9* sank three more English cruisers: *Aboukir*, *Cressy,* and *Hogue*. This action demonstrated the true potential of the U-boat. In less than an hour, 36,000 tons of warships and 1,400 English seamen were lost (Brassey 1915:38-40; *Navy Times* 1962:41-43). As the U-boats continued to prove their usefulness, Germany recognized their ability to counter-blockade England. This type of warfare was what England had feared most, as Admiral Sir Percy Scott wrote to the *London Times* (Botting, 1979:19):

> All war is, of course, barbarous, but in war the purpose of the enemy is to crush his foe; to arrive at this he will attack where his foe is most vulnerable. Our most vulnerable point is our food and oil supply. The submarine has introduced a new method of attacking these supplies. Will feelings of humanity restrain our enemy from using it?

Then-First Lord of the Admiralty, Winston Churchill, echoed this sentiment as he declared, "I do not believe this would be done by a civilized power" (Botting 1979). Nevertheless, by early 1915, Germany recognized that the war would not be resolved quickly on land and the Kaiser decided the war must be won by sea. On 4 February, the plan for achieving this victory was announced. The German Admiralty claimed:

> All the waters surrounding Great Britain and Ireland, including the whole of the English Channel, are hereby declared to be a war zone…every enemy merchant vessel found within this war zone will be destroyed… Neutral ships will also be exposed to danger in the war zone… (German Admiralty (translated from the Reichsanzeiger) 1915).

This declaration heralded Germany's first, and notorious, unrestricted U-boat campaign. Despite this bold declaration to the British Naval blockade, Germany had less than 30 U-boats in service. This, no doubt, was the impetus for establishing new contracts with shipyards. Throughout the rest of the war, continual production and redevelopment would take place (Rössler 1981:47).

Soon after the declaration of a *guerre de course*, in March, the Germans torpedoed English steamer *Falaba*, with the loss of one American life. Then, on 1 May, two more Americans perished onboard *Gulflight*, the first American vessel sunk by German U-boat. Despite American diplomatic protests, Germany continued to sink any enemy ship found within English waters (*Navy Times* 1915:48). By the end of March 1915, the second month of Germany's unrestricted submarine campaign, they had sunk 45 vessels totaling 130,000 tons (Beyer 1999:xix). This type of unrestricted submarine warfare would lead to the greatest naval tragedy of WWI.

On Friday, 7 May 1915 the German submarine U-*20* was leaving the west coast of Ireland on its way back to Germany to rearm and gather new supplies when Lieutenant Walther Schwieger spotted a smoke trail on the horizon. Schwieger plotted a successful intercept course for this ship, putting U-*20* in the vessel's path. Slightly before 1410 hours, Schwieger gave the command to fire and U-*20* landed a bow shot from 700-m range. This torpedo sufficiently damaged the target such that another shot was not needed (Botting 1979 and *Navy Times* 1962:48-52). As Schwieger stated, "It seems as if the vessel will be afloat only a short time… Submerge to 24 m and go out to sea… I could not have fired a second torpedo into this throng of humanity attempting to save themselves" (Botting 1979:30). No one has yet determined if Schwieger knew that "throng of humanity" was actually passenger liner *Lusitania*, since he was killed in 1917 when his new command, U-*88*, was destroyed by striking a mine. Whether or not Schwieger knew which ship he was torpedoing, the destruction of the 32,000-ton *Lusitania* resulted in the deaths of 1,198 people, including 785 passengers, 94 of them children and infants, and 128 of them Americans (*Navy Times* 1962:48). The public outcry among the American and British public was great, and President Wilson sent a letter to Germany stating:

> The sinking of the British passenger steamer *Falaba* by a German submarine on March 28, through which Leon C. Thrasher, an American citizen, was drowned; the attack on April 28 on the American vessel *Cushing* by a German aeroplane; the torpedoing on May 1 of the American vessel *Gulflight* by a German submarine, as a result of which two or more American citizens met their death and, finally, the torpedoing and sinking of the steamship *Lusitania*, constitute a series of events which the Government of the United States has observed with growing concern, distress, and amazement (William Jennings Bryan 1915:Supplement 393).

Germany, however, considered the sinking of *Lusitania* a great success because the ship was carrying, in addition to its passengers, contraband war equipment and munitions. Despite the dangers the U-boats already presented, it would still take more destruction to bring America into the war (*Navy Times* 1962).

By the end of 1916, U-boats had wrought disaster on Allied shipping, claiming over 980 ships, weighing a total of 2,291,000 tons. The following year, 1917, was equally disasterous for Allied shipping, as 111 U-boats were operational and the counter-blockade of England was escalated. Furthermore, America was now only allowed to send one vessel per week through the blockade. This action finally forced President Wilson to sever diplomatic ties with Germany. In retaliation, the Germans sunk American steamer *Housatonic* nearly immediately. In February 1917, they torpedoed the 18,000-ton liner *Laconia* during a snow storm. While the losses from this sinking were few, the Americans, Mrs. Mary E. Hoy and her daughter, Elizabeth, froze to death in the lifeboats. This prompted Mrs. Hoy's son, Austin Y. Hoy, to write a letter to President Wilson urging him to bring America into the war. This letter, in conjunction with the shipping losses attributed to U-boats, climbing past half a million tons per month, convinced President Wilson to declare war on Germany on Monday, 2 April 1917 (*Navy Times* 1962:52-63). In his declaration of war before Congress, Wilson made sure to reveal that "submarines are in effect outlaws when used as the German submarines have been used…" and, therefore, the United States must "exert all its power and employ all its resources to bring the Government of the German Empire to terms and end the war" (Woodrow Wilson, War Messages 65th Congress, 1917:3-8).

Support from America could not have come at a better time. In April, U-boats had sunk 444 Allied vessels, totaling nearly a million tons. This prompted Admiral William S. Simms, commander of America's newly arrived warships in European waters, to cable Washington with the message, "I consider that at the present moment we are losing the war!" (Wilson, War Messages 65th Congress, 1917:64). In May, when another 549,987 tons of Allied shipping were sunk, the United States Ambassador in London, Walter Hines Page, agreed with Simms when he declared, "What we are witnessing is the defeat of Britain" (Botting 1979:58). With the arrival of American ships, however, came renewed interest in merchant convoys with naval escorts and the hopes of changing the tide of the war.

Initially convoy systems had been shunned by the British Admiralty who feared that the few escorts that could be offered to convoys would be useless in stopping U-boats from destroying a whole fleet of merchant vessels. As American vessels became available to escort convoys, however, the convoy system was initiated with good results. In July, shipping losses had dropped to 550,874 tons (*Navy Times* 1962:66). Similarly, by the end of August,

> Only 2 ships in 100 were being sunk when in convoy, compared with 1 in 10 ships sailing alone… By October, more than 1,500 merchant ships in almost 100 convoys had been brought into port with the loss of only 24 vessels, only 10 of which had been sunk while in convoy; the loss rate thus was 1 in 100… By the end of November 1917, shipping losses in tonnage had been cut to 259,521 tons (Botting 1979).

American involvement in the War prompted the attacks on merchant shipping to be expanded by the German Navy beyond their blockade of Britain-proper. In May of 1918, U-boats were for the first time dispatched to the East Coast of the United States, where they began effectively sinking merchant vessels. The first to arrive was Korvettenkapitän Heinrich Von Nostitz und Jackendorf in U-*151*, becoming the first enemy warship to enter United States territorial waters since the war of 1812 (Stick 1952:194). U-*151* was a converted oceangoing commercial submarine.

The impact on merchant shipping was detrimental to the United States. It limited supplies and made wartime logistics and the movement of materials a substantially more problematic undertaking. This prompted propaganda on the home front, as it would during WWII, encouraging domestic rationing and promoting secrecy regarding ship maneuvers.

Early on, North Carolina emerged as a targeted area. Von Nostitz succeeded in sinking several vessels on his first United States patrol. Many of which were off North Carolina, including steamer *Harpathian* which was his largest successful sinking in United States waters on the first patrol (Stick 1952). By the end of German operations in United States waters, they had succeeded in sinking a total of 10 ships off the coast of North Carolina alone. All told, Germany sent 7 U-boats to operate off the American coastline in WWI. One of these was the U-*155*, the very same converted commercial U-boat *Deutschland* that was received in New York with fanfare just a few years before.

5.2.2 Interwar Period

The twenty years between the end of WWI and beginning of WWII should have been a time when Germany had no U-boat activity. Germany's bitter pill, the Treaty of Versailles, severely limited the total tonnage of the German surface fleet and banned the construction of submarines altogether. In an effort to not lag behind or to waste acquired expertise in U-boat development, Germany began to supply construction drawings, personnel, and advisers to neutral and friendly nations. Indeed, German U-boat plans were sold to the Japanese and several submarines were constructed at the Kawasaki Yard in Kobe under the direction of Germaniwerft and Vulcan designers. Through these arrangements, German naval manufacturers exploited a loop hole in the treaty and set up a submarine design office in the Netherlands and a torpedo research program in Sweden. Likewise, high ranking members of the U-boat flotilla and naval engineers became civilian consultants for the Argentine Navy on the development of submarines. Similar situations arose in Turkey, Finland, and Spain. These satellite manufacturing facilities ultimately began building U-boats, training crew, and re-establishing the German submarine fleet under the guise of research (Rössler 1981; Showell 2006).

Germany began to build a battle-ready Navy via the Reconstruction Programme of 1932. On 16 March 1935, Hitler proclaimed military independence and began rebuilding the German U-boat fleet despite sanctions specified in the Treaty of Versailles (League of Nations, Treaty of Versailles, 1919:Part V, Chapter IV, Section III, Article 81; Bekker 1974:26). Three months later, Hitler was able to renegotiate the Anglo-German Naval Agreement with England allowing the German Navy to build a submarine force capped at 45 percent of the submarine tonnage of the British Commonwealth. The overarching tenant of the agreement specified that total German naval tonnage could not exceed 35 percent of the Royal Navy and that Germany was only allowed to extend capacity by building vessels in proportion to tonnage added to the Royal Navy fleet. The British viewpoint was that Germany, with a "balanced fleet," could be more easily defeated than a German Navy comprised of U-boats, light cruisers, and "pocket battleships" designed for commerce raiding (Herwig 1996:236). Nevertheless, the agreement heralded the rebirth of Germany's U-boat fleet and made way for the construction of new models of U-boats for which plans had already been drawn up. Most of these new submarines, the Type VII, would be medium sized and maneuverable with excellent endurance (Bekker 1955 and 1974:18; 26-27). Ultimately, Adolf Hitler renounced the agreement on 28 April 1939, when it began to hamper his aspirations for European dominance. While the agreement was in force for only a few short years, it likely slowed the Kriegsmarine's build-up of a commerce raiding force that would nearly cause the downfall of the Allied war effort during WWII.

5.2.3 Early World War II

At the outset of the war, Germany could not directly challenge the British Navy, so it used alternative tactics. As was amply demonstrated during the First World War, submarines could not only attack military vessels, but could also seriously disrupt the supply chain by sinking merchant shipping. "From the earliest days of hostilities, the U-boat war on merchant shipping, the 'Supply War,' as it has been called, was prosecuted in answer to the British blockade of Germany" (Busch 1955:3).

The ingenuity of German submarine engineers and U-boat applications evolved considerably throughout the Second World War; ultimately, Germany built and commissioned 1,154 U-boats of varying types from the mid-1930s through the end of the war (Showell 2006). These new submarines included: Type IA submarines, which were sea-going vessels that would later be used for training; Type II (A, B, C, and D) submarines, which were coastal boats mainly used for training; Type III, IV, V, and VI submarines, which were never built; Type VIII, which was merely a design study; Type IX (A, B, and C) submarines, which were ocean-going boats used for both raiding and mine-laying operations; and Type IX (D and E) and X (A and B) submarines, which were ocean-going mine-laying submarines (Lenton 1967:19-115). In contrast to what was presented in WWI (Table 5-1), there is a much heavier concentration during WWII on U-boats capable of extended oceangoing operations.

Table 5-2 Types of U-boats commissioned in WWII and the number of each type produced

Coastal Boats	IA	IIA	IIB	IIC	IID	
Number Built	*2*	*6*	*20*	*8*	*16*	
Long Range Boats	IX	IXB	IXC	IXC/40	IXD	
Number Built	*8*	*14*	*54*	*87*	*30*	
Atlantic Boats	VIIA	VIIB	VIIC	VIIC/41	VIID sp.	VIIF sp.
Number Built	*10*	*24*	*568*	*91*	*6*	*4*
Specialized Boats	XB	XIV	XXI	XXIII		
Number Built	*8*	*10*	*118*	*61*		
Experimental	V80	XVIIA	XVIIB			
Number Built	*1*	*4*	*3*			

Source: Rössler 1981

Though most vessel types underwent minor changes and upgrades throughout the war, the vast majority of boats commissioned during WWII were of three basic types: VII, IX and XXI. Of these, the Type VII was by far the most prolific. These submarines were mass-produced on a scale never seen before and became the primary workhorse of the German U-boat arm, despite being originally intended as a medium range type (Figure 5-1).

Near the time of US entry into the War, Germany introduced into their fleet the "milch cows," which were large U-boats capable of supplying between 250 and 430 tons of fuel to other U-boats (Ruge 1957:255). These supply U-boats were increasingly important as the war progressed and as many of the German surface tankers were destroyed. Designated Type XIV, these U-boats were 1,688 tons, capable of traveling 12,300 miles, and delivering torpedoes, fuel, fresh food, water, and medical equipment, as well as supplying reserve crew members and taking sick or injured crew members off the smaller U-boats (Busch 1955:83).

The Germans were even able to use submarines as troop transports. Such U-boats placed meteorological personnel in Greenland, allowing Germany to receive updated weather information beneficial to many missions including those of the Luftwaffe. These U-boats were then again called upon to extract these same crews from Greenland and return them to Germany (Ruge 1957:286-287). By the end of the war, Germany had multiple Type XXI, and smaller Type XXIII U-boats in testing and production, and several more that actually completed missions. These state-of-the-art subs were faster underwater than surface vessels and had batteries twice as large as other U-boats, allowing them to remain underwater much longer without surfacing to recharge batteries (Bekker 1974:186; Marx and Delgado 2013e).

In addition to mass producing effective U-boats, the German Navy also continued research and development on submarine technology, notably, the Type XVII submarines. Named the Walter U-boat after the Walter turbine that drove the submarine, Type XVIIs used a hydrogen-peroxide fuel source and were capable of underwater speeds of 25 kts (Bekker 1955:221). Developed at the end of the war, these submarines never made it much further than the testing phase, and no Walter U-boat ever saw service. Regardless, the Kreigsmarine allocated extensive resources for development of the U-boat arm. The multi-faceted nature of U-boats as training submarines, mine-layers, tankers, supply ships, troop transports, and attack submarines made them a formidable enemy throughout the World Wars and allowed the German Navy to inflict many serious casualties on American and British merchants and navies.

U-boat captains began WWII at a severe disadvantage, as Hitler had imposed strict regulations as to their use in accordance with international "Prize Rules." U-boats had to warn any boats that were not armed merchant ships or escorted by warships before firing upon them. This removed the U-boat's advantage of stealth and left it vulnerable to surprise attack when it stopped vessels that appeared unarmed. After U-*30* sank the liner *Athenia*, Hitler ordered that no passenger ship could be attacked even if in convoy (Ruge 1957:60-61). Despite these limitations, U-boats operated effectively against English or England-bound ships throughout the Atlantic. As the war continued on, Prize Rules were periodically relaxed, eventually leading to unrestricted and unprovoked U-boat attacks.

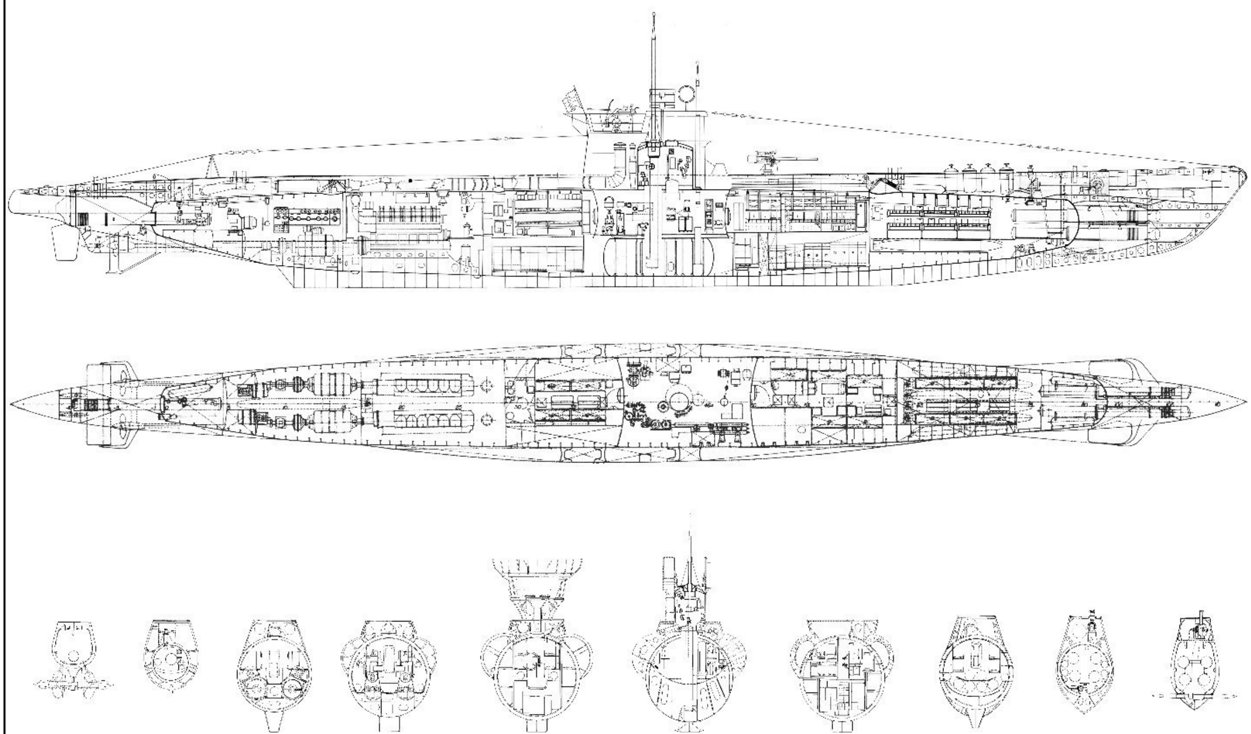


Figure 5-1 Type VIIC General Arrangement.
Source: Rössler 1981

In September 1939, U-boats managed to sink 40 ships amounting to 153,000 tons, and another 31,000 tons were lost as a result of mines laid by U-boats. In October, U-boats again managed to sink 135,000 tons with torpedoes and another 29,000 tons with mines (Ruge 1957). Germany then audaciously flaunted the capabilities of their U-boats when on the night of 13-14 October 1939, Gunther Prien, commanding the Type VIIB U-*47,* slipped into Scapa Flow, the base of the British fleet, and twice torpedoed battleship *Royal Oak*, killing 833 British sailors (Bekker 1974:48-49; Botting 1979:92-97). Prien became a German war hero and returned to great fanfare, becoming known as the "Bull of Scapa Flow." A depiction of a rampaging bull became the conning tower emblem of the U-*47* (Höel 1999).

As a result of merchant ships carrying guns, depth charges, depth charge throwers, surface radar, and being encouraged to ram U-boats, the German government soon realized the impracticality of abiding by prize rules. On 6 January 1940, Germany declared several "operational areas" where any ships encountered would be sunk. This paralleled directly the strategy used in WWI and again brought Germany's unrestricted submarine warfare in these areas. This also allowed the Admiral in charge of the U-boat fleet Rear Admiral, Karl Dönitz, to implement his infamous "wolf-pack" tactics (Busch 1955:4-5).

This tactic called for U-boat commanders to delay attacking convoys until multiple U-boats had been radioed and closed on the convoy's position. With these new tactics, Dönitz boasted, "I will show that the U-boat alone can win this war" (*Navy Times* 1962:104). The effectiveness of these cooperative tactics was demonstrated during the 20 September 1940 attack on Convoy HX-72 by multiple U-boats, resulting in the loss of 11 ships. In October, another two convoys were attacked by U-boats resulting in the loss of 31 ships, and by the end of October, 63 ships had been sunk by U-boats amounting to 352,000 tons. The attacks on Allied shipping were so successful between July and October 1940 that the German submariners called it "the Happy Time (Die Glückliche Zeit)." On 1 and 2 December, Convoy HX-90 was attacked five times resulting in the loss of 10 ships and an escort. This brought the total loss since the beginning of the war to 1,026 Allied and neutral ships weighing over 4 million tons (*Navy Times* 1962:107-108). Operating both independently and massed in wolf packs, U-boats continued to successfully attack merchant shipping in the North Atlantic throughout 1941.

Thanks to foul weather in the Atlantic in January 1941, the onslaught of German U-boat aggression was slowed to 21 merchant ships sunk; February was much the same. In March however, Dönitz sent 12 new U-boats into the Atlantic, along with three of his finest submarine commanders. This intervention helped to raise the Allied shipping losses to an average of 225,000 tons. From March through May 1941, the U-boats destroyed 818,000 tons of Allied shipping. As these shipping losses climbed and America was drawn into the war by Japan's attack on Pearl Harbor, it became evident that America and England had to find ways to counter the threat U-boats posed to Allied shipping. This realization in both World Wars led to new and improved technologies and strategies for combating German U-boats (*Navy Times* 1962:108-109).

Implementation of convoys was needed to combat the uboat threat. However the use of convoys was not universally accepted. The British Admiralty had a resounding fear that if ships were put into convoys that were sparsely guarded by warships, they would be exterminated by the U-boats. They also feared attempting to keep ships of varying speeds and sizes together at night while zigzagging and keeping lights extinguished. According to the Admiralty, those ships that were not destroyed by U-boats would undoubtedly be involved in collisions (Botting 1979:58). Regardless of the British apprehensions, America instituted the convoy system immediately. Convoys were escorted by destroyers, and the "first dramatic fruits of the convoy technique plus the escort by destroyers were made eloquent in late June when the initial unit of the A.E.F.—the First Division—arrived in St. Nazaire aboard 18 transports and supply ships… [t]here had been no losses, not even an attack" (*Navy Times* 1962:65). The convoy system became even more effective as air escorts were added in addition to the destroyer escorts.

No attacks were made on convoys that were guarded by air until December 1917. That U-boat missed its target, however, and was quickly chased from the convoy by seaplane. By 1918, the number of attacks on convoys escorted by both air and surface ships numbered only six, and there were only three ships sunk. The success of air support and surface support are evident in the fact that the enemy merely sank five ships out of the thousands of ships that traveled in convoys (Abatiello 2006:107-108). These convoys had successfully reduced the threat of U-boats to a negligible annoyance and would again play a major role in WWII.

At the onset of WWII, the convoy system led to the sinking of multiple vessels during the same attack. There was nothing fundamentally wrong with the convoy system, but the Allies had counted on U-boat attacks occurring by one submarine at a time and had, therefore, failed to plan for the multiple U-boats utilized in concert in Germany's coordinated wolf pack attacks. Without a convoy system, however, the Allied shipping losses would have been far greater, as evidenced by the destruction of multiple unescorted ships along the American coast by U-boats during the war.

Establishment of well-organized convoys and air cover in conjunction with incredible cryptographic breakthroughs allowed the major threat of U-boats in the North Atlantic to be effectively mitigated by the end of 1942.

5.2.4 The Undeclared War

Despite hiding behind a façade of neutrality, American interests had been closely aligned with Britain prior to formally entering the war. Indeed, a great deal of United States support was provided, particularly as it related to British naval operations. Support fell just short of actual military action in this period and is often referred to as the 'undeclared war.' This began in earnest with the language of the neutrality acts of the 1930s, particularly the Neutrality Act of 1939, passed on 4 November of that year. This modified the previous neutral position that arms and other war materiel would not be sold to belligerents by establishing the so-called 'cash-and-carry' policy (United States Department of State 1942). This policy allowed for the sale of arms and munitions, provided the purchaser could pay cash and could provide their own country's vessels to ship the cargo. While ostensibly this provision was available for German merchant vessels as well, Britain maintained dominance on the surface of the Atlantic and it was clear no German merchant vessel could freely navigate to United States ports, thus conveying a de facto benefit to Britain (United States Department of State 1942; Döenitz 1959:186; O'Connor 2004).

In September of 1940, following repeated requests from Churchill, Congress approved a deal to exchange 50 WWI era US destroyers for a 99-year lease on Bermuda as a strategic military base, an act upon which Winston Churchill remarked that "[t]he transfer to Great Britain of fifty American warships was a decidedly unneutral act by the United States… [i]t would, according to all the standards of history, [have] justified the German Government in declaring war on them" (Churchill 1949).

Shortly after Roosevelt's reelection in November 1940, he held a 'fireside chat' on 29 December 1940 in an attempt to build public support for aiding Britain in the war effort using United States' resources as an 'arsenal of democracy':

> Never before since Jamestown and Plymouth Rock has our American civilization been in as great danger as now…. If Great Britain goes down, the Axis Powers will control the continents of Europe, Asia, Africa, and Australia and they will be in a position to bring enormous military and naval resources against this hemisphere. It is no exaggeration to say that all of us in all the Americas would be living at the point of a gun, a gun loaded with explosive bullets, economic as well as military (Roosevelt 1940).

Shortly thereafter Congress passed 'An Act to Promote the Defense of the Unites Sates,' colloquially known as 'Lend-Lease' (pub. l. 77-11, H.R. 1776, 55 Stat. 31). Enacted on 11 March 1941, this allowed the United States to provide war materiel indiscriminately to Great Britain and other Allied nations without requiring those nations to have cash up front. This amounted to open support for Britain and effectively ended any illusion of neutrality, while still falling short of formally entering the war (Döenitz

1959:192-194; O'Connor 2004). Likewise, the United States was openly radioing the positions of the German fleets to England (Busch 1955:41-42). On 31 October 1941, while on convoy duty, United States destroyer USS *Reuben James* was sunk off Iceland by U-*552*. It was the first US Navy ship sunk by hostile action in WWII. Only 44 sailors out of the 159 crew survived. Most of the provisions of the Neutrality Act were repealed on 17 November 1941, allowing merchant vessels to be armed and carry Lend-Lease cargoes to belligerent nations (Blair 1996:375).

Although the nearly open naval war taking place on the North Atlantic failed to push the US Congress into a declaration of war; the surprise attack by Japanese forces on the United States Pacific Fleet docked in Pearl Harbor, Hawaii on 7 December 1941 forced action. The United States formally declared war on Japan on 8 December 1941. Germany and Italy declared war on the United States on 11 December 1941, and the United States responded with a declaration of war on the same day. As soon as America entered the war after the attack on Pearl Harbor, Germany wasted little time sending U-boats to the American coast.

When the United States entered the war against Germany, there were some key developments in the U-boat war that had a significant impact on events in United States waters. The first was the addition of a fourth rotor to the infamous enigma machine (Blair 1996:693). There was a bit of a cavalier attitude towards U-boats near America's entry into the war due to the fact that Britain had been so effective at breaking the enigma code. Nearly all transmissions, and consequently positions, of U-boats were known and convoys could be safely routed away from them. As a result, by the end of 1941, the U-boat threat was somewhat under control. However, with the addition of a fourth rotor, U-boats were once again able to keep Allied codebreakers in the dark. The fourth rotor enigma was also eventually cracked, but it gave the German U-boat command a temporary advantage.

Similarly, the range of the U-boat was being extended. The establishment of U-boat bases along the coast of occupied France beginning in June of 1940 allowed Germany to amass supplies and deploy U-boats 450 miles closer to American waters than from German ports alone, a geographic advantage which also facilitated Type VII boats for working so far afield (Döenitz 1959:110; Bright 2012:84). In April of 1942, at the height of the campaign in United States waters, U-tankers, 'milch-cows' went operational. This allowed U-boats to operate further afield by refueling mid-ocean, a particular advantage for Type VII U-boats operating in American waters, which were beyond the range for which they were designed (Döenitz 1959:219).

Finally, another advantage was improvements to German torpedoes. There was a defect discovered in the balance chamber, which caused the torpedoes to run much deeper than they were set (Blair 1996:694). With this defect resolved, the accuracy and lethality of torpedoes was improved in the early part of 1942.

5.3 WWII In The American Theatre

Döenitz correctly identified the western Atlantic as the weakest segment in the supply system that kept Great Britain fighting. By sinking ships along America's coast he hoped to cause a significant disruption in shipping that would stop Lend-Lease cargoes from reaching the European theater and lower the morale of the Allied nations. Ideally, he intended his U-boats to sink merchant ships at a rate greater than what was being replaced in Allied shipyards in order to starve Great Britain of war materiel, fuel, and food. Admiral King, Commander in Chief of the Atlantic Fleet, unknowingly echoed Döenitz's plan by stating, "The fabric of shipping is closely interwoven; no single strand can be broken or snarled without destroying the basic pattern of the commerce of the world" (DIO 1987:108). A report from Döenitz, the Befehlshaber der U-Boote (BdU) (commander of the German U-boat force), to Hitler in July 1942, detailed his thoughts about how the U-boat affected the American home front:

> U-boat warfare is a fight against enemy merchant tonnage. American and English tonnage work in conjunction and are therefore to be considered as a single unit... The use of boats in the American area is right according to this standpoint of economic deployment… the use of U-boats in this area is also in line with the opinion that the sinkings are a race with merchant shipping construction. America is the largest enemy ship builder. The shipbuilding industry area lies in the eastern states and it, and the industries connected with it, relies considerably on oil fuel. The main American oil area lies on the Gulf of Mexico, and for this reason the larger part of the American tanker tonnage used in the coastal traffic is from the oil fields to the industrial area… For each tanker which is shot up, the Americans lose not only the oil transport but it [a]ffects their new construction adversely. Therefore the sinking of this American transport tonnage seems to me especially important (Befehlshaber der Unterseeboote [BDU] 1942b:28-29).

When the U-boats arrived off the east coast of America, they were overwhelmed by the sight of the American coast. America did not appear to be at war; ships continued to cruise about unescorted, fully-lighted, and starkly silhouetted by city lights. By staying submerged during the day and coming to the surface at night, the U-boats were able to cruise the sea-lanes of America unhindered, laying mines and torpedoing vessels as they went (Botting 1979:130; DIO 1987:27). In a campaign known to the Germans as "The American Shooting Season," the U-boats "enjoyed for a time a veritable Eldorado, and their successes rose to undreamed-of figures—in six-and-a-half months, over 2,500,000 tons… Targets were so plentiful that it was more often lack of torpedoes than shortage of fuel which compelled the U-boats to turn for home" (Busch 1955:40-45).

It appeared, for the time being, that Döenitz was correct in his summation that, "in the virgin waters of the American theater we expected success on a scale that would repay the long voyages involved" (Beyer 1999:20). The Americans however, quickly learned that "shipping losses should council us to employ convoy systems at all times, and never permit a ship to go unescorted, even though the risk may seem slight" (Stirling 1944:268).

From the US Navy perspective, the arrival of U-boats off the east coast was not at all unexpected; after all, it had happened during WWI. Likewise, the Eastern Sea Frontier (ESF), the US Navy command established off the east coast during WWII, realized that given the effectiveness of anti-sub operations in the North Atlantic, Döenitz would shift his focus quickly towards easier locations using different tactics (DIO 1987:22-23). This was underscored by the 15-16 December attack on Convoy HG-76, which resulted in the sinking of four German U-boats while only suffering the loss of two ships.

As America began utilizing the convoy system at home and abroad as well as employing new methods of anti-submarine warfare, U-boat successes lessened dramatically (Busch 1955:45). The United States began converting ships into the Q-ships, or decoy vessels, that the British had used successfully against U-boats in WWI. Rumors of these decoy ships being built spread rapidly and many of the U-boat commanders became leery of any ship acting strangely; they often would refuse to engage such a ship. This angered the German U-boat headquarters, and a message was quickly sent on 11 March 1942, relating how absurd it would be for the Americans to waste good vessels as decoy ships when their shipping was already drastically reduced and their chances of success were slim. Unknown to the German U-boat headquarters, just 15 days after their admonition of the U-boat commanders, two Q-ships were launched. Unlike the Q-ships of WWI, the Q-ships of WWII proved to be a futile effort. While it cost the lives of 140 crew men, sunk aboard the Q-ship *Atik*, and only resulted in the death of one German soldier, killed by the *Atik's* machine guns, the Q-ships of WWII merely represented one form of warfare intended to alleviate the burden of the U-boat war. Another method that proved valuable in WWI would again prove its usefulness in WWII. This was the use of aircraft as convoy support, submarine hunter, and offensive bomber (Beyer 1999:61).

Aircraft technology had grown immensely since the end of WWI and its successes during that war proved that it had a promising future in WWII. Airplanes in WWII, despite the disbelief of the German Navy, were often provided with surface radar that allowed them to cover 4,000 square miles of sea while flying at 3,048 m (10,000 ft). This allowed the pilots to align their planes with a surfacing U-boat and bomb it before it had a chance to re-submerge. Airplanes were also often armed with "300-pound depth charges, 600-pound bombs, torpedoes with acoustic homers, and new low-level bombsights" (Kaplan 1997:172-178). These airplanes were much more successful in destroying U-boats, while at the same time resurrecting their role as convoy escort and deterrent against attacks. The first successful aerial sinking of a U-boat in United States territorial waters was the destruction of U-*701* off of Cape Hatteras, North Carolina.

Since U-boats could not protect themselves against airplanes, aerial convoy escorts were a most useful weapon against the threat of submarines. The Allies successfully utilized airplanes to flank convoys as well as to search in front of and behind convoys, thereby providing a large area of radar and visual coverage (Syrett 1994:61). Additionally, airplanes would further revive their role as an active U-boat manufacturing hindrance through bombings on the German U-boat pens and submarines returning to those pens. The American naval command believed that the best way to eliminate the U-boat threat at home was to take the war to the German front. They employed air attacks and commando raids on submarine bases as "the best way to exterminate vipers is in their nests" (Stirling 1944:209).

The device that enabled the Allies to listen for the sounds the U-boat made while submerged was called "ASDIC," an acronym for Anti-Submarine Detection Investigation Committee, by the British. The United States referred to this device as "SONAR," for Sound Navigation Ranging. This detection system consisted of audible pings that a transmitter would receive and monitor for any variations in the returning sounds.

This invention was limited, however, in that submerged wrecks, rocks, and fish could alter its reliability. Furthermore, its range was merely 1,500 yards, and the cone of coverage provided by ASDIC could be avoided by a skilled submarine commander (Botting 1979:110-11). In spite of these limitations, 200 British ships had been equipped with ASDIC by 1939 and by 1944 3,000 ships had been outfitted with the device. Allies could use the ASDIC to hunt out submarines or place them on the leading ships of convoys to sweep the area clear of U-boats as the convoy progressed and deterring U-boat attacks from the bow side, which was common practice (Ruge 1957:53, 301). ASDIC proved to be a valuable asset to the Allies as it contributed to their finding and sinking of many hidden U-boats as well as to deterring U-boat attacks since the perceptible pinging of the ASDIC was often enough to chase away a lurking German submarine (Botting 1979:111). These technological advances in conjunction with the newly formed hunter-killer groups made Allied naval forces a formidable force.

The Allied hunter-killer groups consisted of a convoy of warships built around an aircraft carrier. These groups enabled the Allies to actively search the sea with ASDIC and when a contact was discovered, the carrier would deploy its aircraft to hunt out and destroy the U-boat. These groups were also extremely valuable for destroying U-boat tankers, which drastically reduced the operational area of the German submarine forces. With the range of U-boats drastically reduced and the threat of submarine attack diminishing, the hunter-killer groups destroyed the German submarine arm (Ruge 1957:301-302). The WWII-era hunter-killer group concept was so effective that it still forms the basis of modern US Naval anti-submarine warfare tactics, which today also include a Los Angeles-class attack submarine as part of a Carrier Strike Group.

While convoys, Q-ships, air power, radar, ASDIC, and hunter-killer groups all contributed greatly to the Allied victory over the German U-boats, one of the most decisive victories of the war came with the capture of U-*110*. On 9 May 1941, Lieutenant Fritz-Julius Lemp, who had fired the first torpedo of the war, led the brand-new Type IX submarine U-*110* on an attack of an Allied convoy. Lemp torpedoed two merchant ships and, instead of leaving the scene, stayed at periscope depth. Escort corvette *Aubretia* picked up the sound of the torpedoes on its ASDIC, spotted the periscope of the submarine, and instantly fired depth charges. The *Aubretia's* ASDIC soon malfunctioned, but Allied vessels *Bulldog* and *Broadway* took up the chase. These ships' depth charges found their target and U-*110* soon sank past 300 ft deep. At this depth, Lemp blew the ballast tanks, and the submarine rapidly ascended and broke the surface. *Broadway* immediately rammed the U-boat, forcing the crew of the crippled submarine to abandon ship (Botting 1979:147-149; Showell 2000:73-75).

Either the submarine did not sink as fast as its crew thought it would or scuttling charges were not set or failed to fire, for the U-boat continued to stay afloat. The Germans were captured and taken aboard *Aubrietia,* and did not witness the crew from *Bulldog* board their submarine. This crew quickly obtained the code books, charts, and ciphering machine referred to as the Enigma (Botting 1979:148; Showell 2000:75). Once they deciphered these codes, the Allies could easily read radio messages to and from U-boats. These messages provided valuable information about the U-boat fleet for they often included "a U-boat's position, any defects, and fuel status" (Syrett 1994:20-23). Unfortunately for the Allies, the success of the Enigma machine capture was short lived. In 1942, the Germans would modify the Enigma machine and it was not until December of that year that the Allies were able to break the new codes. The addition of a fourth rotor to the enigma devices largely negated the three rotor unit that was recovered from U-*110*. This additional rotor concealed U-boat positions and coincided closely with the commencement of action on the east coast of the United States (Blair 1996:693).

Continuous efforts in code-breaking, in conjunction with a successful convoy system, hunter-killer groups, and newer and better ways of fighting submarines, collectively led to an Allied victory over the U-boats in WWII. On 7 May 1945, Germany surrendered to the Allies (Botting 1979:167). The German surrender may have spared the Allies another lengthy, destructive U-boat war in the Atlantic. Tests of the new German submarine types under development – namely Type XVII, Type XXI and Type XXIII – had shown their ability to defeat many of the new anti-submarine technologies the Allies had developed. Type XVII submarines had an underwater speed of 25 kts and were capable of outrunning most Allied vessels, allowing them to attack convoys and escape unmolested (Bekker 1955:221). Type XXI submarines contained three times the number of batteries and could achieve 17 kts for an extended period of time, allowing them to escape Allied attempts to follow the U-boat until it had expended its batteries and had to surface to recharge them.

Two of these submarines, U-*2511* and U-*3008* had been put to service by the end of the war and had outmaneuvered destroyer and cruiser escorts. Each of these ships had even managed to sneak within firing distance of a convoy of warships, but they were unable to fire since a cease-fire order had been given three days prior. The British warship officers refused to believe that a submarine had succeeded in evading detection and been within firing range of a fleet of warships until the German submarine and British destroyer logbooks were compared, revealing that the ships were indeed in the same locations at the same times. The Type XXIII U-boats were smaller electric submarines used in coastal operations. Seven of the submarines had been involved in engagements before the end of the war, and all returned to Germany without having been detected (Bekker 1955:211-221; Brennecke 1957:302).

Each of these submarines was equipped with a snorkel, "called a snort," that allowed the submarine to recharge its batteries without having to surface. These snorkels were also coated with a rubber coating that would render them nearly invisible to the Allied radars. In addition, the Germans had equipped them with a sensor that could tell when the snorkel had been detected by Allied radar, allowing the U-boat to submerge well before an attack (Busch 1955:158-159; Marx and Delgado 2013e)).

Late war German submarine technology also employed a synthetic rubber skin to counter Allied sonar devices. A key example is the U-*1105,* a Type VII-C/41 and one of only 10 U-boats outfitted with this synthetic rubber tiling, known as the "Alberich" process. U-*1105* also had advanced passive sonar called Balkongerät, which featured 48 hydrophones and improved positioning electronics. U-*1105* successfully attacked and evaded capture by the 21st escort group in spring 1945; it later surrendered to the same group at the end of the war and was turned over to the United States as a war prize for study of the "Alberich" rubber skin (Naval History and Heritage Command 2017).

The Germans additionally furnished late war submarines with a version of sonar called "S gear." This S gear sent out a tick at regular intervals that picked out the location of ships on the surface and plotted them on a grid in relation to the U-boat, allowing a torpedo to be fired from depths of 160 ft (Bekker 1955:216). They even extensively modified the torpedoes in use on these submarines to make them an even greater threat. Consequently, the Germans could fire them in any direction, and the torpedoes would find their own route to the target over the course of a series of sweeping turns. The men could fire six of these torpedoes at once, followed 10 minutes later by another six, and again followed by another six after an additional half an hour (Busch 1955:159). Ironically, German submariners disliked using the S gear because it effectively announced the precise location of the U-boats to Allied sonar technologies. However, these U-boats, if fully operational at the end of the war, would have reopened the Atlantic theater and potentially prolonged the war. As a British officer would state,

> It was a bit of luck that these U-boats never came into action. There was nothing we could have done about them. If they'd been operational two years ago, the invasion would have been impossible, and the Germans would once again, and this time decisively, have taken the offensive in the Atlantic. We should have been overtaken by a catastrophe just as surely as the U-boats were in 1943 (Brennecke 1957:320).

Fortunately for the Allies, the war ended before these new U-boats were fully operational. Nevertheless, German U-boats had exacted a great toll on merchant shipping, as well as taking the lives of German U-boat crews, Allied sailors, and even the seamen and citizen-passengers of neutral nations. These losses attest to the dangers the U-boats levied over the course of two wars, as well as the ever-improving methods used to check Germany's submarines. Over the course of the wars, the Allies' successful utilization of new technologies twice overcame a threat that had the advantage of near invisibility and the freedom of unrestricted warfare. Through the use of Q-ships, airplanes, and convoys in WWI, and the use of Q-ships, radar, ASDIC, airpower, hunter-killer groups, and coordinated convoy routes among Allied forces in WWII, the German attacks on shipping became negligible, and the course of the wars in the Atlantic were altered in favor of the Allies. These rapid changes in Allied technology served to challenge and eventually dominate the various types of U-boats (Syrett 1994:24). Such advances helped the Allied powers bring WWI to a close with minimal losses from U-boats in the closing year of the war and aided in bringing WWII to a close in time to avoid the dangers the new U-boat designs would carry with them. While the lives and ships lost to the ocean floor are a vivid representation of the destruction of war, they also attest to the awesome power possessed by the German U-boat fleet and the necessity of defeating these submarines. The wars against the U-boats are best summed by Rear Admiral Yates Stirling Jr.:

> All would be clear sailing for the United Nations if the U-boat menace could be swept from the seas… The destruction of these vipers, not only at sea but in their nests, is the paramount aim of the Allies, and nothing should impede those objectives" (Stirling 1944:266).

5.4 Operation Paukenschlag (Drumbeat)

Anti-submarine warfare during WWII required the skilled use of sophisticated equipment by specially trained crews aboard quick and sturdy vessels. In the years between WWI and WWII, the US Navy neglected the development of anti-submarine weapons, training and craft, no doubt placing trust in the multitude of international agreements and naval treaties aimed at reducing submarine forces worldwide and forbidding them entirely among nations potentially threatening to the Anglo-American balance of power.

In 1939, the US Navy had 10 Eagle Class patrol boats, 14 wooden-hulled submarine chasers, 28 minesweepers, 5 gunboats, 6 river gunboats, and a single converted yacht (DOC 1939:521-531). Between 1939 and 1941, the Navy initiated a building program, constructing 32 motor torpedo boats, and the first 26 of an eventual 600 purpose built submarine chasers (DOC 1941:525-535). By July 1942, the Navy would have 190 subchasers: 14 large (Treasury, Haida, and Algonquin class) US Coast Guard Cutters, 49 medium US Coast Guard Cutters (the Argo and Active class), 54 wooden-hulled subchasers, and 67 steel-hulled subchasers of various size and class. By July 1943, the number of wooden and steel-hulled subchasers would increase four-fold. This excludes the US Coast Guard Cutters brought into use by the Navy in 1942; their numbers remained constant (Morison 1947:235).

Unlike smaller anti-submarine craft, the Navy had built destroyers. In 1939, the Navy possessed approximately 240 destroyers (DOC 1939:521-531). When war broke out in Europe, several were sent to Great Britain for use in the Royal Navy. By 1941, the US Navy possessed only about 175 destroyers (DOC 1941:525-535). By July of 1942 this number had grown to 190, and a year later there were over 280 (Morison 1947:235). Although originally intended only to support fleet actions, destroyers would prove to be highly effective anti-submarine craft.

The lack of purpose-built craft left the US Navy unprepared for anti-submarine warfare when America entered the war German U-boat attacks along the coast increased. Yachts and fishing vessels were hastily converted for coastal patrol duty while the Navy's few destroyers and subchasers were thinly spread on convoy duty. By 1942, the Navy enlisted the help of approximately 45 converted yachts (designated PY), adding 15 more in 1943 (McMurtrie 1943:431-548 and USONI 1943:index). By 1943, over 600 fishing trawlers and other utility craft had been compelled for defense (USONI 1943:index). In 1941, the US Coast Guard was brought under the control of the Navy, as is custom in time of war. Regular US Coast Guard craft were converted for use and sent across the ESF for duty.

The British, unlike the United States, had devoted time and resources to the development of anti-submarine weapons after WWI. The Admiralty established a unit for the study of, and training for, anti-submarine warfare in 1921. Its American counterpart was not established until 1934, and the first standardized training and research unit dedicated to anti-submarine warfare, the Atlantic Fleet ASW (Anti-Submarine Warfare) Unit, was not established until 7 February 1942 (Morison 1947:209-215). As a result, the United States relied heavily upon sophisticated anti-submarine technology from Great Britain, as well as the acquisition of some vessels to aid in ASW.

The array of tools needed to combat submarines during WWII was complex. A basic arsenal consisted of two types of ordnance: depth charges and guns. The simplest form of depth charge was launched off the stern of a vessel as it passed over the submarine. Inherent in the design, however, was the interruption of underwater sound, indicating the submarine's position, as the vessel passed over. In 1942, side and forward-launching depth charges were introduced by the British to solve the issue (Morison 1947:211-212). Guns available for armament included .30 and .50 caliber machine guns, 3-inch .23 caliber artillery, and 5-inch artillery. This basic arsenal also included radio equipment to report the position of a submarine, if spotted.

The basic ordnance was useless, however, if submarines could not be found. Scientific research and development before and during the war churned out a myriad of radar, radio direction finding, sonobuoys, long-range navigation (LORAN), magnetic anomaly detectors, magnetic airborne detectors, and sonar equipment (Blair 1996:476-479). These devices, however, were undeveloped as the United States entered the war. Furthermore, to use radar, radio direction finding, and sonar equipment required extensive training. To the untrained operator, a school of shrimp or a thermocline might be mistaken as a submarine. Although sonar technology had been developed in WWI, the training curricula and programs needed to implement the technology within the fleet remained in their infancy in 1941. By the time America was brought into the war, the infrastructure to train competent operators did not exist. Neither was it practical: there simply was not time to delay the outfitting of vessels and crews to begin patrols.

Thus, the converted craft were equipped with a basic array of guns, artillery, depth charges, and communication radios. For example, USS *Cythera* (PY-26), YP-389, and HMT *Bedfordshire*, were civilian craft, built prior to WWII, and modified for use as patrol vessels by the US Navy. All three vessels were lost in combat operations off the North Carolina coast; sunk by German U-boats. The modifications performed on these vessels represented what, at the time, were the best practical measures for anti-submarine warfare. Given the number of these vessel types produced – over 600 PYs and YPs – the prevailing strategy of early 1942 was, by necessity, one of quantity over quality. Vessels such as HMT *Bedfordshire* and YP-389 are representative of the types of craft that were initially participating in the Battle of the Atlantic in the Eastern Sea Frontier.

Admiral Karl Döenitz was acutely aware of the strategic conditions along the eastern seaboard of the United States. It would take American forces time to organize convoys, build ships, and effectively combat U-boats in their waters, so the decision was made to exploit these weaknesses. Döenitz was also aware that time was limited, stating it was essential to "take full advantage of the favourable situation as quickly as possible and with all available forces, before the anticipated changes occurred" (Döenitz 1959:196).

The initial wave of U-boats deployed in Operation Paukenschlag (Drumbeat) consisted of just six vessels deployed between 16 and 25 December 1941, arriving off the east coast in mid-January 1942. This is far fewer than Döenitz had hoped. It was not politically possible to get all U-boats available for the operation, despite his argument that an assault on America's east coast would be the best use of these resources. Ongoing operations off Gibraltar in the Mediterranean required U-boat support, and nervousness over a possible Allied invasion of Norway resulted in several U-boats being stationed there defensively (Döenitz 1959:206, Blair 1996:442-444). Regardless, with just six boats on this first foray, enormous successes were achieved. Because of the low number of U-boats available and the vast expanse of operations, it was not practical to use 'wolf-pack' tactics in this theatre and German commanders were operating alone. In fact, at any given point during the first part of 1942, there were never more than 12 U-boats operating at one time along the United States east coast (Roskill 1956:96; Döenitz 1959:197).

Operation Drumbeat is widely considered to have been a major success for the German U-boat command and a failure of American readiness; it is likely that had Döenitz been successful in allocating more resources to the effort it could have been far more devastating to Allied shipping. This sentiment was reflected on in Döenitz's War Diary upon hearing about the great successes in the initial wave:

> From the commanding officer's report it is perfectly clear that 'Drumbeat' could have achieved far greater success, had it been possible to make available the 12 boats for which U-boat Command had asked, instead of the 6 by which the operation was carried out. Good use, it is true, was made of this unique opportunity, and the successes achieved have been very gratifying; we were, however, not able to develop to the full the chances offered us (Döenitz 1959:221).

There is no way to be certain how much more damage could have been achieved had more U-boats been available. By the end of April 1942, following the loss of U-*85* and U-*352*, convoys were better organized and U-boat success declined. Efforts persisted into the summer of 1942 with appreciable results, but by mid-July it was clear with the loss of U-*576* and U-*701*, that the east coast was no longer an effective use of resources; U-boats we recalled or rerouted to the Gulf of Mexico or Canadian waters (Döenitz 1959:220-223, Blair 1996:678-680). According to some historical assessments, the U-boat war in American waters accounted for approximately 25 percent of all Allied shipping sunk during WWII (Blair 1996:696). This figure is more impressive considering the comparatively brief window from January to July of 1942 during which the vast majority of these vessels were lost.

5.4.1 Cape Hatteras and the Battle of the Atlantic

Although the Battle of the Atlantic took place along the entirety of the United States east coast and Gulf of Mexico, it was quickly evident that North Carolina was of strategic importance. According to Döenitz, the "area off Cape Hatteras proved particularly fruitful" (Döenitz 1959:215). The environmental setting and oceanographic landscape contributed greatly to this area being singled out as particularly unique and effective for U-boat tactics. It was also recognized by United States Forces that for U-boats, "the favorite hunting ground was in the waters off Cape Hatteras" (DIO 1987:27, 94, 166).

The general environmental conditions offshore North Carolina in 1942 were highly advantageous for U-boat operations. In the winter of 1942, during the main invasion push into American waters, U-boat commanders reported terribly frigid temperatures and high sea state conditions north off New England, which decreased productivity (Döenitz 1959:204). By contrast, Cape Hatteras sits at the epicenter of the confluence of the Labrador and Gulf Stream currents. Even during the winter months, the water and sea conditions offshore can be quite moderate, owing to the warm waters of the Gulf Stream (Figure 5-2). In addition to lending milder conditions to the theatre, this fact also ensured a certain density of shipping, as it naturally created a bottleneck concentrating the density of shipping traffic. Hatteras and these currents has long been a recognizable feature in the landscape that has influenced shipping lanes since the Colonial Period (Hoyt et al 2014). Likewise, the confluence of the Labrador and Gulf Stream currents offshore North Carolina provided a thermally stratified water column useful for submarines evading acoustic detection devices, while also directing coastal shipping to a natural bottleneck along the Gulf Stream. These unique features made North Carolina a desireable theatre for U-boat attacks.

Also significant is North Carolina's coastal geography and formation of the continental shelf. Diamond Shoals and Cape Hatteras protrude seaward towards the edge of the continental shelf (Figure 5-3).The more northerly one goes, the distance increases between the shore and the shelf break. This offered some operational implications for the U-boats, as they preferred to hunt in deep waters where they could safely dive for protection. Off the northern ports of the United States, the most heavily concentrated shipping lanes could be hundreds of miles from deep water (Döenitz 1959:215; DIO 1987:94, 166), which made attacks riskier. While in North Carolina, the shipping lanes would come very close to Hatteras and U-boats could more readily retreat to the safety of deep water, as noted by the ESF:

> the most dangerous area during this month [April] as in the past, remains in the waters around Hatteras. Here the narrowness of the continental shelf enables the U-boats to operate in deep water close inshore with great success and comparative impunity (DIO 1987:174).

While the continental shelf is similarly close off the coast of Florida, there are other natural environmental factors that made this area less desirable. The shipping tended to be more spread out, and the water was so much warmer, there was a higher possibility of bioluminescent algae in the water (Blair 1996:439). This phosphorescent phenomenon caused tiny organisms in the water to illuminate when disturbed by the propeller of a vessel, creating a glowing wake, which could easily be spotted from the air. For U-boats, operation at night and near shore, where air cover was possible, became a dangerous prospect.

Initially, these shipping lanes, currents, and natural features of the landscape combined to make the waters off Cape Hatteras particularly deadly for merchant vessels, and optimal hunting grounds for U-boats. The first six months of 1942 saw a great number of Allied vessels sunk off the east coast, particularly in the waters near Cape Hatteras, North Carolina. The actual numbers of vessels lost and at what location is a difficult figure to establish. This is due in part to the different methods applied by various researchers, and in part because the location of some of the vessels was pieced together post-war with best guesses assigned to vessels that were lost without reports or survivors and were unnamed by the U-boat commanders (for example, see *Olympic* in the Results Chapter).

On the broad scale, one comprehensive estimate holds that between January and August of 1942, there were 184 war patrols of U-boats that sailed for American waters resulting in 609 ships being lost, including vessels attacked en route (Hickam, Jr. 1989:295-305; Blair 1996:694). While this estimate includes all vessels known to have been sunk, it does not distinguish between small coastal fishing vessels and large tonnage tankers and freighters. Nevertheless, this figure constitutes nearly a quarter of the vessels sunk by U-boats during the entirety of WWII in any theatre. As such, historians have referred to the American campaign as, "the single most important of the [U-boat] war in terms of sinkings achieved in a relatively brief period of time for effort expended – the high water mark of the U-boat war" (Blair 1996:694).

The above figures take into account losses in Caribbean and Canadian waters as well as South America. Paring this figure down further, and focusing an estimate just on North American waters, including the Florida Straits and Gulf of Mexico, there were 285 attacks logged, resulting in 253 sinkings and the loss of 7 U-boats (Hickam, Jr. 1989:295-305; Marx and Delgado 2013e).

For the purposes of this study, the area of interest is off North Carolina, but even that descriptor can be problematic. Many ships sunk are described in primary sources with vague locations such as 'lost 200 miles east of Cape Hatteras' or 'sunk 450 miles off North Carolina.' Drawing an arbitrary line to limit the scope of a study is difficult, but necessary to understand where a particular geographic area fits within a larger dataset.

Zeroing in on the area 'off North Carolina,' a good estimate of vessels lost during Battle of the Atlantic between January and August 1942 is approximately 80 vessels sunk by U-boats (with an additional 7 vessels lost indirectly) and 4 U-boats sunk by Allied defense, for a total of 91 vessels lost (compiled from Stick 1952; Döenitz 1959; Hickam, Jr. 1989; Blair 1996; Wynn 1997, 1998). These events resulted in an estimated loss of 1,210 merchant mariners, 302 Allied military personnel and 145 German submariners for a total loss of approximately 1,657 lives.

Out of the figure of 253 vessels lost in North American waters, including the Florida Straits and Gulf of Mexico, those 91 vessels lost off North Carolina alone constitute approximately 35 percent of all vessels lost in the American theatre, by far the heaviest concentration in United States waters. Approximately 37 out of these 91 vessels are believed to be from 50-600 miles offshore. This leaves 54 vessels and 4 U-boats lost directly to enemy action in waters believed to be reasonably accessible on the continental shelf. There are also additional vessels that were lost as an indirect result of the Battle of the Atlantic, including collisions, destruction from friendly sea mines, and storms. Including those 7 additional vessels in the study area brings this figure to 54 merchant and Allied and Axis vessels sunk during the Battle of the Atlantic on the continental shelf of North Carolina.

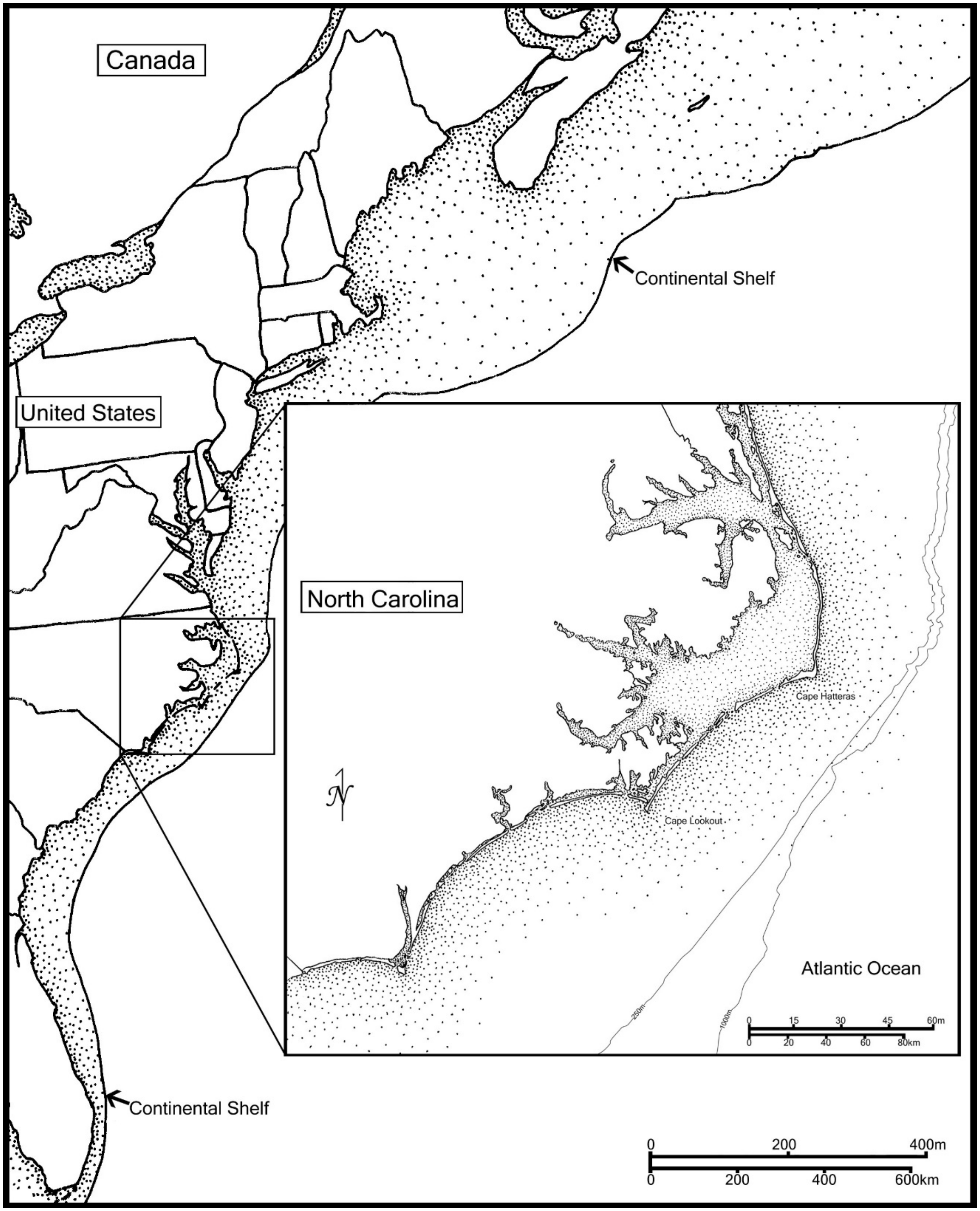


Figure 5-2 Map depicting the east coast of the United States and its relationship to the Continental Shelf (Base) and detail of the coast of North Carolina (inset).

Note: The contour lines on the inset map depict the 250-m curve line and the 100-m curve.
Source: NOAA

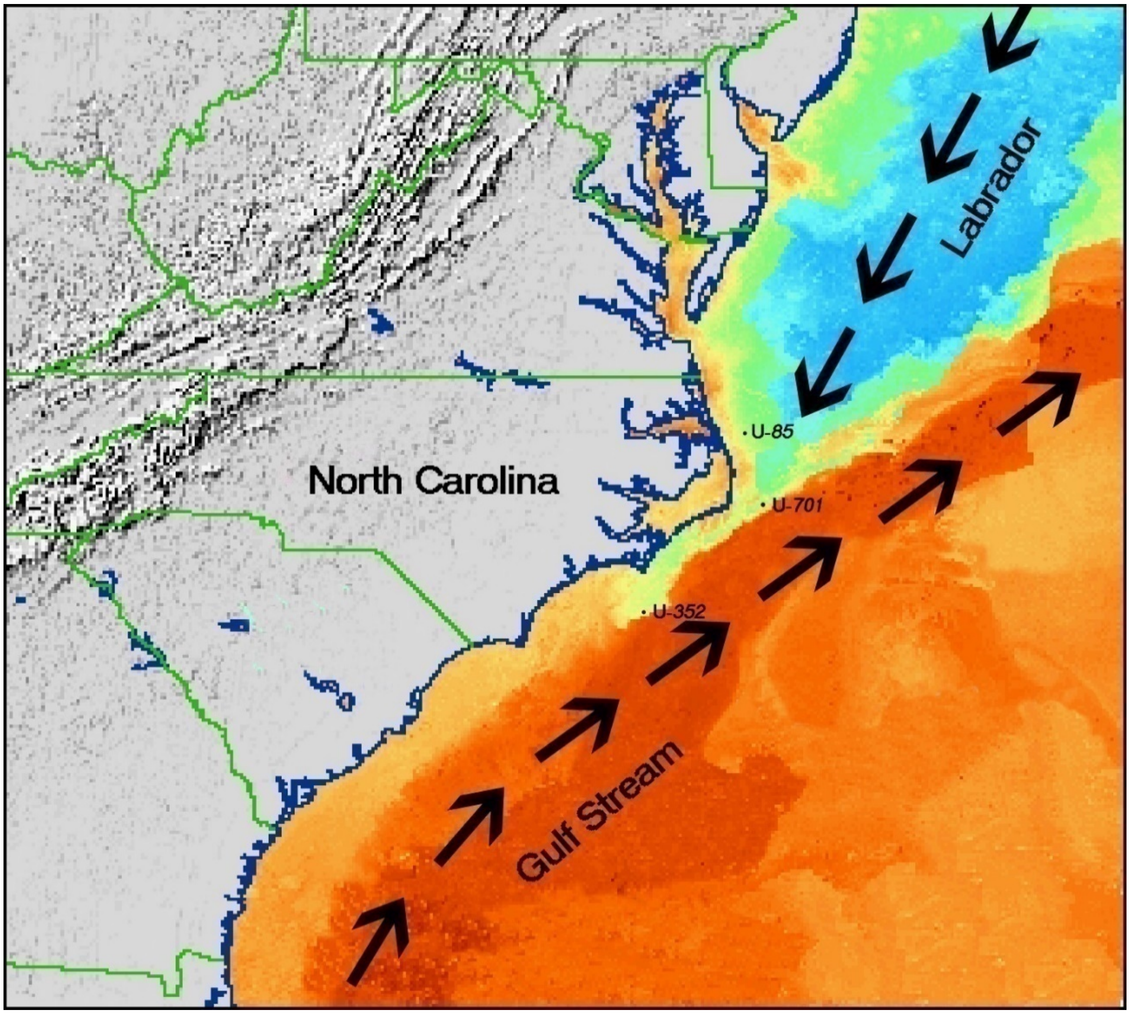


Figure 5-3 Graphic depicting the confluence of oceanic currents as imaged by water temperature acquired from satellite data. The relative positions of the U-*85*, U-*701* and U-*352* wreck sites are also depicted.

Source: NOAA

Likewise, many of the secondary resources available focus predominantly on vessels that were sunk, often glossing over vessels that were attacked and damaged and subsequently returned to service. By some estimates there were as many as 59 additional attacks in North Carolina waters that did not result in the loss of a vessel (Wagner 2010:157). When taken in total, density of U-boat attacks off the coast of North Carolina can be seen to have heavier concentration around Cape Hatteras, thus demonstrating its strategic importance (Figure 5-4).

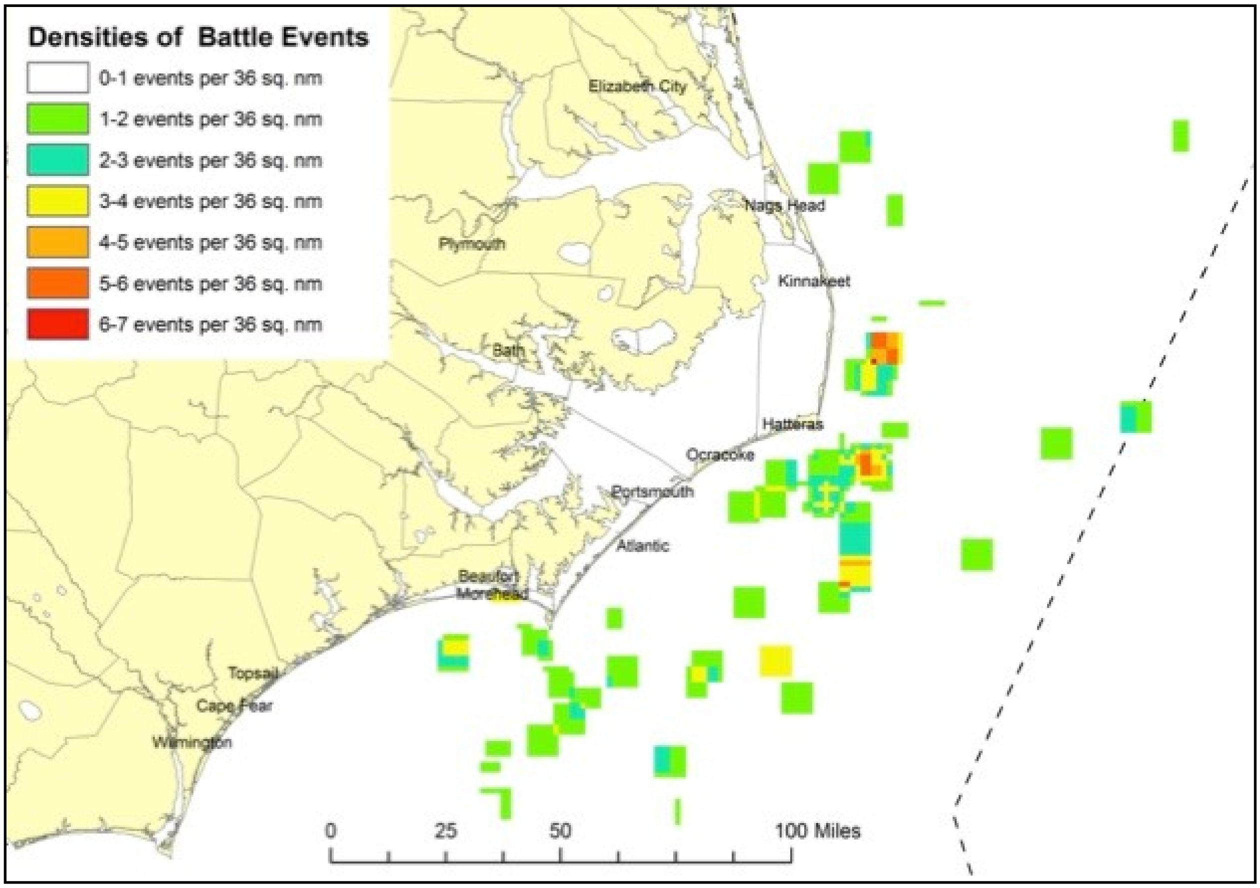


Figure 5-4 GIS Map depicting the density of battle related events off the Coast of North Carolina.
Source: Wagner 2010:165

5.4.2 End of Operations on East Coast (KS-520)

Döenitz was correctly aware that the ease of operations would be short lived. By about mid-April of 1942 escort vessels and air cover improved, and the first U-boat, U-*85*, was lost to American forces (Blair 1996:541). While activity continued through July, by May it was clear that conditions favorable to German U-Boat operations were ending and Döenitz "found it difficult to accept as an irrevocable fact that a turning point had come and that the Americans had now introduced a convoy system in their coastal waters" (Döenitz 1959:220). The finality of this fact is best encapsulated in the Battle of KS-520 off Cape Hatteras, an engagement which in itself did not alter the course of the east coast campaign, but rather, in concert with increasing U-boat losses, presents an example of its demise.

Twenty-one merchant ships and five US Navy and US Coast Guard escorts prepared for a mid-July 1942 departure from Lynnhaven [Hampton] Roads, Virginia. They would unite under convoy KS-520 and steam together south to Key West, Florida. The convoy code KS designated convoys sailing between Hampton Roads, Virginia and Key West, Florida. This was the second in the KS series, the first of which denoted a route between Casablanca, Morocco and several French ports operating until June 1940. The second KS series began with KS-500 and operated along the eastern seaboard between May and September 1942. In total, there were 73 KS convoys encompassing 1,139 individual ships during WWII (Hague 2000:12; Hague 2014).

Of the 21 merchant vessels schedules for convoy KS-520, only 19 sailed from Virginia on 14 July. They included: United States freighters *Unicoi* and *Chilore*, and United States tankers *Rhode Island*, *Toteco*, *American Fisher*, *Tustem*, *Gulf Prince,* and *Robert H. Colley*; British freighters *Egton* and *Zouave* and British tankers *Clam* and *Nicania*; Norwegian registered freighters *Para* and *Hardanger*; Panamanian registered tanker *J.A. Mowinckel*; Dutch registered freighter *Jupiter*; Greek registered freighters *Mount Helmos* and *Mount Pera*; and Nicaraguan registered freighter *Bluefields* (USN 1942b). The 5 support vessels that made up Escort Group Easy were Navy destroyers USS *Ellis* (DD-154) and USS *McCormick* (DD-223), Navy corvette USS *Spry* (PG-64), and US Coast Guard Cutters (USCGC) *Triton* (WPC-116) and USCGC *Icarus* (WPC-110). Many vessels including the American ships in the convoy were outfitted with light armament to help defend the convoy. These also carried armed guard crews in charge of manning the artillery, such as deck guns mounted on the stern. Out of the 19 vessels, nine sailed in ballast and the others carried a large variety of cargo (Bright et al. 2012:136).

KS-520's Convoy Commander was Captain N.L. Nichols (US Navy retired), stationed onboard J.A. *Mowinckel* and the Escort Commander was US Navy Lieutenant Commander Leland R. Lampman, stationed onboard the USS *Ellis* (Commandant Fifth Naval District [COM5] 1942a, 1942b; USN 1942b). Once past the minefield at the Chesapeake Bay approaches, the convoy would convene and sail at 8 kts to Key West, a 7-day transit with estimated arrival of 21 July. The merchant vessels were positioned in three rows with seven columns. The escort group maintained anti-submarine patrol stations around the convoy and for some of the route there was additional cover provided by blimps or airplanes. Intelligence indicated that convoy KS-520 would be in direct threat from U-boats, given that during the two previous days, four aircraft had reported U-boat attacks east of Cape Hatteras (Blair 1996:626-627).

At 0430 hours Eastern War Time (EWT) the morning of 14 July 1942, 19 ships in convoy KS-520 left port near Hampton Roads, Virginia, for a voyage south through the waters of the ESF. By 0700 hours EWT the next morning, the ships had rounded Cape Hatteras and continued south. Maintaining a course just inside the 100-fathom curve, the convoy passed 20 miles outside Ocracoke inlet at 1600 hours EWT without incident. Five minutes later, a contact was picked up and bombed by the convoy escort USCGC *Triton* without result (US Coast Guard 1942). This contact aroused the suspicion of the other four escorts and extra vigilance was put into scanning the horizon for submarines. Despite this extra vigilance, a torpedo struck *Chilore*, the lead vessel in the second column of ships at 1620 hours EWT, sending a geyser of water over the vessel, which momentarily obscured it from the air escorts. Unable to react quickly enough and alter course, *Chilore* was struck by a second torpedo one minute later. Moments after the second torpedo rocked *Chilore*, *J.A. Mowinckel*, lead vessel of the convoy, was shaken by a violent explosion (DIO 1987:411-412). The blast of the torpedo was devastating:

> The shock of the blow ran down through the entire ship, breaking china in the galley, overturning chairs and tables, knocking men off their feet. Black water shot in a great plume over the poop deck. Dense, pungent smoke poured into the after compartments bringing with it the smell of gas and powder. The steering machinery was carried away as the explosion blasted a hole 20 by 20 [ft] in the stern of the *Mowinckel*. One man was killed outright, while 20 were injured, some severely (DIO 1987:412).

As the convoy began to break apart to avoid additional attack, a torpedo struck *Bluefields*. The single U-boat – U-*576* – carried out its entire attack in less than six minutes before surfacing in the middle of the convoy. Why U-*576* suddenly surfaced is somewhat a matter of speculation. The U-boat had reported to BDU on 13 July that, following an aircraft attack, it had sustained irreparable damage to its main ballast tank and was operating with ballast tank #5 flooded and a ruptured saddle fuel tank (Döenitz 1959:250; Hickam, Jr. 1989:285; Blair 1996:627). Following this damage, U-*576* likely moved a safe distance offshore, away from the threat of air attack, and attempted repairs. It is possible that the damaged ballast system could not appropriately compensate for the loss of weight due to the discharge of torpedoes. This could have caused the submarine to surface unexpectedly.

Irrespective of the cause, U-*576* found itself in an extremely vulnerable position. The Naval Armed Guard crew aboard the merchant vessel SS *Unicoi* opened fire, claiming a direct hit. Almost simultaneously, two Navy Kingfisher aircraft from squadron VS-9 out of Marine Corps Air Station (MCAS) Cherry Point, North Carolina straddled the submarine with aerial depth charges. It is now known that the combination of these attacks was successful in sinking U-*576*, but at the time it was less certain. The convoy escort vessels continued searching for over 40 minutes following the attacks, and the ESF believed that the U-boat may well have dived to safety (ComScorn Nine 1942; DIO 1987:412; Hickam, Jr. 1989:286-287; Gannon 1990:384; Blair 1996:627).

Coupled with the suspected recent losses of U-*701* and U-*215*, and the continued harassment of U-boats across the region by American aircraft, the destruction of U-*576* was enough to demonstrate that the German "happy time" had ended, with Döenitz concluding that:

> As a result of the strong air and sea patrols and the introduction of the convoy system, the situation which we had long anticipated would arise in these coastal waters had now materialized. There seemed to be no justification for keeping boats there any longer, and so I withdrew them. Thus the operations off the North American coast, which had been started in January 1942, now appeared to have come to an end (Döenitz 1956:250).

Having finally assembled all the myriad pieces of an effective ASW program along the eastern seaboard, the American Navy effectively defeated U-boat operations in the area through deterrence. Isolated incidents through 1944 saw the occasional U-boat return, but none achieved sufficient success for BDU to dedicate more U-boats. Though the German U-boat campaign extended into the Gulf of Mexico and Caribbean in the fall of 1942, the formula to effectively combat U-boats had been derived by the American navy. Convoys and air cover were extended into these areas, and in due course, U-boats were again driven away. Thus, the KS-520 convoy battle off Cape Hatteras occurred just at the tipping point of strategic initiative of the Battle of the Atlantic in American waters.

6 Summary of Results

6.1 WWII Related Sites Offshore North Carolina

As discussed in Chapter 5 (Historical Context), the bulk of the naval conflict which took place off Hatteras occurred during the first eight months of 1942. Less than a week after Germany declared war on the United States (11 December 1941), preparations were well underway for the first sortie of U-boats into American waters (see Blair 1996:435-442). At the outset, a prominent feature of the American coast was well-known to U-boat commanders and merchant mariners alike:

> There was one very promising spot [for U-boat operations] in this otherwise hostile subsurface geography: the Outer Banks of North Carolina, whose chief feature was Cape Hatteras. At that protrusion, the continental shelf is less than thirty miles wide, merely a two-hour run to deep water at full speed on the surface. Hence, if shipping hugged the coast, as might be expected, to take advantage of air cover, Cape Hatteras offered the possibility of dense traffic with easy access to deep-water sanctuary and probably lightships and lighthouses to provide precise navigation (Blair 1996:439).

As months wore on, Cape Hatteras emerged as a focal point for U-boat activities. Since their primary targets were vessels carrying war materiel into the European theater, the U-boat's main victims were the merchant vessels themselves. Military vessels, however, were not safe from attack either, as evidenced by the losses of HMT *Bedfordshire*, USS *YP-389*, USS *Atik*, and USS *Cythera*.

Following a steep learning curve, defenses along the American coast improved and momentum drained from Germany's naval offensive. By July initiative shifted to the Allied forces, which quickly drove U-boats from the Hatteras waters. By the end of this 8-month stretch, 75 merchant vessels, 4 Allied military craft, and 4 German U-boats were lost off Hatteras.

Though the Germans withdrew from Hatteras in earnest in August 1942, they did periodically return. As a result of the continued threat of U-boats in early 1943, the blacked-out freighter *Suloide* struck the remains of tanker *Ario* and sank south of Cape Lookout (Barnette 2006:80). That same year, three merchant vessels—*Libertad*, *Panam*, and *Santa Catalina*—fell victim to U-*129* (Blair 1998:220, 463). This U-boat, however, only briefly entered American waters. Similarly, U-*518* entered American waters in July 1944, after an ad hoc cancellation of its planned war patrol to Panama. On the night of 12 September, U-*518* attacked but failed to sink merchant ship *George Ade*. During the ensuing salvage operation, the aged US Coast Guard cutters dispatched to run escort and ASW patrol—USCGCs *Bedloe* and *Jackson*—were lost when the rescue convoy was overtaken by a large hurricane (Galecki 2005:128-160). In the final days of the war, U-*879* managed to sink freighter *Belgian Airman* (Blair 1998:684), the last wartime loss off the North Carolina coast.

The main shipping lane off Hatteras, straddling the edge of the continental shelf, was the definitive nucleus of naval activity within the North Carolina area and represented a significant strategic location for U-boat activity in the entirety of American waters. This chapter summarizes the vessels lost – both directly and indirectly – within this core area of the American portion of the Battle of the Atlantic.

6.2 Introduction to Chapters 7 through 11

The next several chapters of this report (Chapters 7 through 11) collectively inventory all 91 vessel losses ascribed to the Hatteras region during WWII. Here, both historical and archaeological data collected during the course of this multi-year study are integrated into a single narrative for each vessel.

Ninety-one individual vessel losses constitute all of the known (both located and historically reported) casualties off the North Carolina coast during WWII. Here, the North Carolina coast is broadly defined as the geographical area encompassing the state's coastal features as well as the prevailing shipping lanes and resulting areas of naval activity which, in historical sources, is often referenced as the "Hatteras area," or "off Cape Hatteras" (see Gannon 1990:242-247). Included in this inventory are vessels lost relatively near to shore; those lost within the main shipping lane paralleling the Eastern seaboard; and those lost hundreds of miles offshore while traveling the shipping lanes connecting East Coast ports to Bermuda, the Caribbean, and Central and South America. Regardless of coastal proximity, however, the same U-boat force that patrolled and attacked along these latitudes considered this patrol station simply as "Hatteras". Comprising these 91 vessel losses are 79 merchant vessels, 8 Allied military vessels, and 4 German U-boats, as shown in Figure 6-1 (compiled from Stick 1952; Döenitz 1959; Hickam, Jr. 1989; Blair 1996; and Wynn 1997, 1998).

Chapters 7 through 9 include 54 sites situated in nearshore coastal areas that were the primary geographic focus of the investigation. These include 47 vessels lost as a direct result of combat action and 7 vessels lost incidental to battles (collisions, friendly mines, weather, etc.) as shown in Table 6-1. The sites are presented alphabetically within the categories of merchant vessels (Chapter 7), allied military assets (Chapter 8), and German military assets (Chapter 9).

Among this group of 54 sites, this survey collected archaeological data at 40 vessel locations—meaning some form of physical data collection took place through either remote sensing methods, diver-based methods, or both. Though many of these sites were known and identified in the decades since the end of the war, this survey also located, identified, and documented 3 new WWII sites (USS YP-*389*, *Bluefields*, and U-*576*). Only 5 known sites were not examined during this survey—USCGCs *Bedloe* and *Jackson*, *Equipoise*, *Buarque*, and *Chenango*—the latter 3 of which have unsupported identities. The remaining sites listed are regularly visited by divers and fishermen and have fairly well-established locations and identities. Lastly, historical records indicated that 9 sites—*Allan Jackson*, *Ciltvaira*, *City of New York*, *Ljubica Matkovic*, *Nordal*, *Olympic*, *Rio Blanco*, *Venore*, and *William Rockefeller*—were lost on or around the continental shelf, but they have not been located at present (first division of Table 6-2).

The individual vessel descriptions provided in the inventory follow the format of a detailed vignette. These include a data table that presents general details for each vessel (size, builder, owner, port of registry, former names, etc.), followed by a narrative description related to the vessel's service life and loss. For broader historical context, see Chapter 4 (Historical Context). Next, an archaeological site description is reported for located sites where physical data were collected. These data are included with the description as final remote sensing data products, feature photos, photomosaics, 3D models, or archaeological site plans. At the conclusion of each vessel description is a short section on management recommendations. For sites with an abundant photographic dataset, additional photos not referenced in the main body of text are included after the recommendations section for additional reference.

One noteworthy inclusion among the merchant vessel losses on the continental shelf is *Chilore*, the remains of which are not in North Carolina waters. Instead, the vessel's final resting place is just off Cape Henry, Virginia. It is included here because the combat action that compromised *Chilore* happened in the vicinity of Cape Hatteras when several merchant vessels, including *Chilore*, were damaged during a U-boat attack. Following the attack, an extensive rescue and salvage operation ensued; during these operations *Chilore* was lost while undertow to Norfolk. Thus, while it ultimately sank in Virginia waters, the vessel's demise was decided in a convoy attack along Diamond Shoals offshore North Carolina.

Chapter 10 presents the 37 sites (35 merchant vessels and 2 US warships) that are located between 50 and 600 miles offshore, beyond the continental shelf break and in thousands of feet of water. While just as important as vessels lost closer to the coast, they were too far offshore and too deep to be accessed within the scope of field operations under this study. To date, none of these 37 sites lost off the continental shelf have been located. Nevertheless, a brief discussion of these sites, including a select individual narrative description of the vessel *Lady Hawkins*, is included in the interest of presenting a a complete inventory of all naval engagements during WWII along the North Carolina coast.

Chapter 11 presents the results of the potential archaeological sites identified through the wide-area remote sensing surveys discussed in Chapter 3 (Methodological Approaches). These surveys resulted in the discovery of several WWII sites and, in the process, also generated numerous additional targets representing potential cultural resources that have not been investigated further. Only selected targets—those interpreted as most likely to be the remains of period vessels—were investigated in detail during the present study. The remaining sites, several of which are most certainly cultural, remain uninvestigated.

Table 6-1 WWII Merchant Vesel, Allied Military, and German Military Losses off the Coast of North Carolina

Name	Lives Lost	Date Lost	Sunk By
Merchant Vessels			
Agra*	6	20-Apr-42	U-*654*
Alcoa Guide*	6	17-Apr-42	U-*123*
Allan Jackson	22	18-Jan-42	U-*66*
Amerikaland*	5	03-Feb-42	U-*106*
Anna*	0	03-Jun-42	U-*404*
Arabutan *	1	07-Mar-42	U-*155*
Ario	8	15-Mar-42	U-*158*
Ashkhabad	0	30-Apr-42	U-*402*
Atlas	2	09-Apr-42	U-*552*
Australia	4	16-Mar-42	U-*332*
Belgian Airman*	1	14-Apr-45	U-*857*
Blink*	24	12-Feb-42	U-*108*
Bluefields	0	15-Jul-42	U-*576*
Bris*	5	21-Apr-42	U-*201*
British Splendour	12	07-Apr-42	U-*552*
Buarque (unconfirmed)	1	15-Feb-42	U-*432*
Byron Benson	10	05-Apr-42	U-*552*
Caribsea	21	11-Mar-42	U-*158*
Cassimir	5	26-Feb-42	collision
Ceiba *	44	17-Mar-42	U-*124*
Chenango (unconfirmed)	31	21-Apr-42	U-*84*
Chiloret	0	15-Jul-42	U-*576*
Ciltvaira (unconfirmed)	2	19-Jan-42	U-*123*
City of Atlanta		19-Jan-42	U-*123*
City of Birmingham*	9	01-Jul-42	U-*202*
City of New York*	24	29-Mar-42	U-*160*
Clan Skene*	9	10-May-42	U-*333*
Derryheen*	0	22-Apr-42	U-*201*
Desert Light*	1	16-Apr-42	U-*572*
Dixie Arrow	11	26-Mar-42	U-*71*
E.M. Clark	1	18-Mar-42	U-*124*
Empire Dryden*	26	20-Apr-42	U-*572*
Empire Gem	49	24-Jan-42	U-*66*

Table 6-1 WWII Merchant Vesel, Allied Military, and German Military Losses off the Coast of North Carolina (continued)

Empire Thrush	0	14-Apr-42	U-*203*
Equipoise (unconfirmed)	41	27-Mar-42	U-*160*
Esso Nashville	0	21-Mar-42	U-*124*
F.W. Abrams	0	11-Jun-42	friendly mine
Harpagon*	41	20-Apr-42	U-*109*
John D. Gill	23	13-Mar-42	U-*158*
Kassandra Louloudis	0	18-Mar-42	U-*124*
Koll*	3	06-Apr-42	U-*571*
Kollskegg*	4	19-Jun-42	U-*754*
Lady Hawkins*	251	19-Jan-42	U-*66*
Lancing	1	07-Apr-42	U-*552*
Leif*	15	28-Feb-42	U-*653*
Liberator	5	19-Mar-42	U-*332*
Libertad*	25	04-Dec-43	U-*129*
Ljubica Matkovic	0	24-Jun-42	U-*404*
Major Wheeler*	35	06-Feb-42	U-*107*
Malchace	1	09-Apr-42	U-*160*
Manuela	2	25-Jun-42	U-*404*
Margaret*	29	14-Apr-42	U-*571*
Marore	0	27-Feb-42	U-*432*
Naeco (bow)	24	23-Mar-42	U-*124*
Naeco (stern)	-	-	-
Narraganset*	49	25-Mar-42	U-105
Nordal (unconfirmed)	0	25-Jun-42	U-404
Norvana	29	19-Jan-42	U-123
Oakmar*	6	20-Mar-42	U-71
Olympic (unconfirmed)	35	22-Jan-42	U-66
Otho*	32	03-Apr-42	U-754
Panam	2	04-May-43	U-129
Papoose		19-Mar-42	U-124
Pleasantville*	2	08-Jun-42	U-135
Rio Blanco*	19	01-Apr-42	U-160
San Delfino	28	10-Apr-42	U-203
San Jacinto*	14	22-Apr-42	U-201
Santa Catalina*	0	24-Apr-43	U-129
Steelmaker*	1	20-Apr-42	U-654
Suloide	0	26-Mar-43	collision (Ario)
Svenør*	8	27-Mar-42	U-105
Tamaulipas (bow)	2	10-Apr-42	U-552
Tamaulipas (stern)	-	-	-
Tolosa*	22	09-Feb-42	U-108
Ulysses*	0	11-Apr-42	U-160
Venore (unconfirmed)	17	24-Jan-42	U-66
Victolite*	47	11-Feb-42	U-564
W.E. Hutton	13	19-Mar-42	U-*124*
West Ivis*	45	26-Jan-42	U-*125*
West Notus*	4	01-Jun-42	U-*404*

Table 6-1 WWII Merchant Vesel, Allied Military, and German Military Losses off the Coast of North Carolina (continued)

William Rockefeller*	0	29-Jun-42	U-*701*
Allied Military Assests			
USCGC Bedloe	26	14-Sep-44	storm
USCGC Jackson	21	14-Sep-44	storm
USS Atik (Carolyn)*	141	27-Mar-42	U-*123*
USS PY-26 (Cythera)*	69	02-May-42	U-*402*
USS YP-389	6	19-Jun-42	U-*701*
HMT Senateur Duhamel	0	06-May-42	collision
HMT Bedfordshire	37	12-May-42	U-*558*
Tug Keshena	2	19-Jul-42	friendly mine
German Military Assests			
U-85	46	14-Apr-42	USS Roper
U-352	15	09-May-42	USCGC Icarus
U-576	45	15-Jul-42	aircraft/SS. *Unicoi*
U-701	39	07-Jul-42	aircraft

Note: List of all known shipwreck sites associated with Battle of the Atlantic around North Carolina.
* Vessels reported lost off the continental shelf.

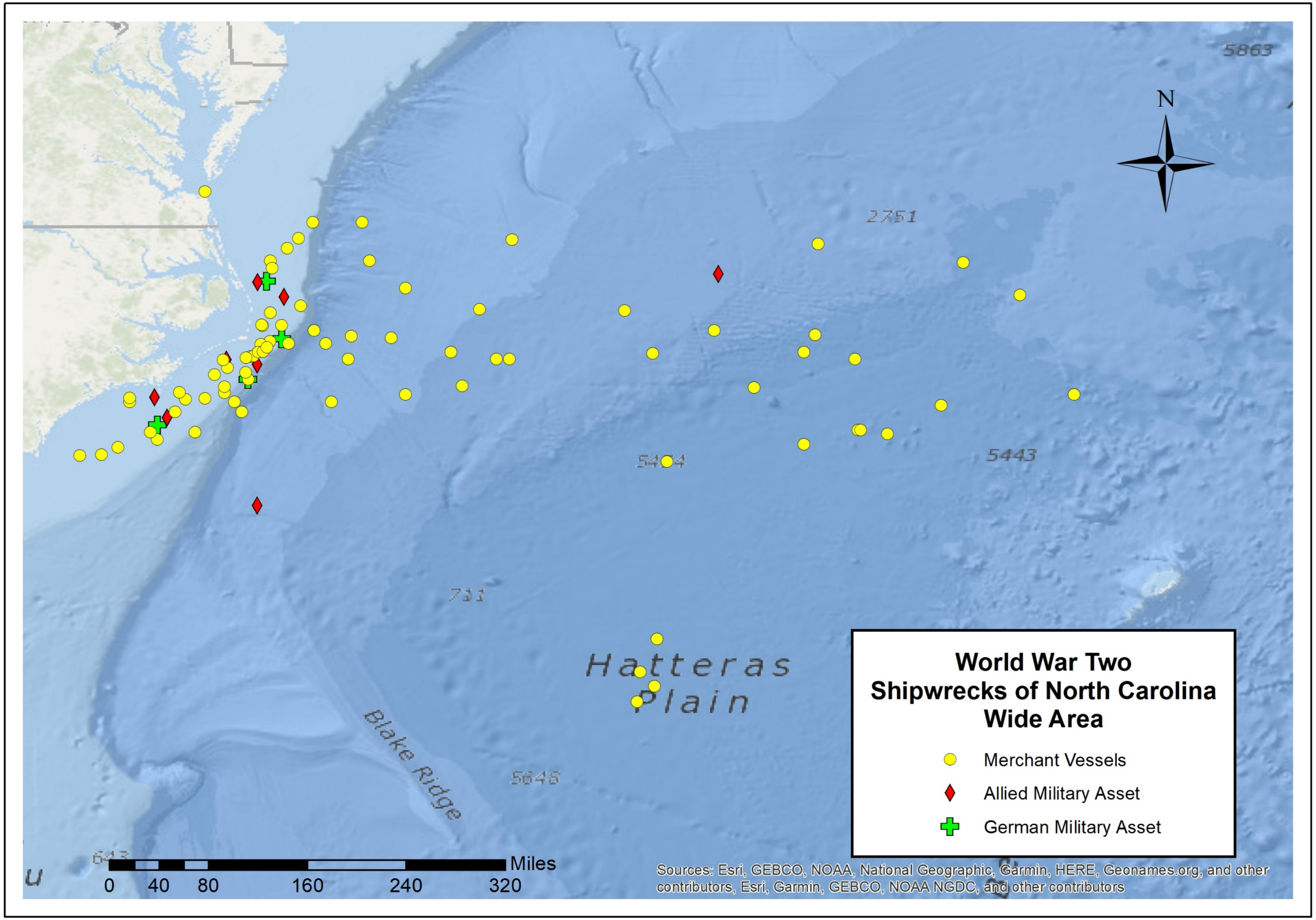


Figure 6-1 **Map showing the positions of all historically known wrecks off the coast of North Carolina. While these sites comprise the totality of the battlefield area, the primary focus of site assessments took place much closer to the continental shelf.**
Source: NOAA

Table 6-2 WWII related shipwreck sites along the continental shelf adjacent to the North Carolina Coast

Merchant Vessels Lost in Combat					
Unknown Location					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
Allan Jackson	unlocated	N	-	-	Tanker
Ciltvaira	unlocated	N	-	-	Freighter
City of New York	unlocated	N	-	-	Passenger
Equipoise	unlocated	N	-	-	Freighter
Nordal	unlocated	N	-	-	Freighter
Olympic	unlocated	N	-	-	Tanker
Rio Blanco	unlocated	N	-	-	Freighter
Venore	unlocated	N	-	-	Freighter
William Rockefeller	unlocated	N	-	-	Tanker
Known Location					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
Ario	located	Y	70	Confirmed	Tanker
Ashkhabad	located	Y	55	Confirmed	Tanker
Atlas	located	Y	125	Confirmed	Tanker
Australia	located	Y	110	Confirmed	Tanker
Bluefields	located	Y	750	Confirmed	Freighter
British Splendour	located	Y	100	Confirmed	Tanker
Buarque	located	N	250	Unconfirmed	Freighter
Byron Benson	located	Y	105	Confirmed	Tanker
Caribsea	located	Y	80	Confirmed	Freighter
Chenango	located	N	140	Unconfirmed	Freighter
Chilore[t]	located	Y	60	Confirmed	Freighter
City of Atlanta	located	Y	90	Confirmed	Freighter
Dixie Arrow	located	Y	90	Confirmed	Tanker
E.M. Clark	located	Y	260	Confirmed	Tanker
Empire Gem	located	Y	150	Confirmed	Tanker
Empire Thrush	located	Y	65	Confirmed	Freighter
Esso Nashville	located	Y	120	Confirmed	Tanker
John D. Gill	located	Y	90	Confirmed	Tanker
Kassandra Louloudis	located	Y	70	Confirmed	Freighter
Lancing	located	Y	160	Confirmed	Tanker
Liberator	located	Y	120	Confirmed	Freighter
Ljubica Matkovic	locater	Y	400	Confirmed	Freighter
Malchace	located	Y	205	Confirmed	Freighter
Manuela	located	Y	160	Confirmed	Freighter
Marore	located	Y	130	Confirmed	Freighter
Naeco	located	Y	140	Confirmed	Tanker
Norvana	located	Y	110	Confirmed	Freighter
Panam	located	Y	480	Confirmed	Tanker
Papoose	located	Y	200	Confirmed	Tanker
San Delfino	located	Y	110	Confirmed	Tanker
Tamaulipas	located	Y	155	Confirmed	Tanker
W.E. Hutton	located	Y	125	Confirmed	Tanker

Table 6-2 WWII related shipwreck sites along the continental shelf adjacent to the North Carolina Coast

Non-Combat Merchant Vessel Losses					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
F.W. Abrams	located	Y	90	Confirmed	Tanker
Non-Combat Merchant Vessel Losses					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
Suloide	located	Y	65	Confirmed	Freighter
Cassimir	Located	Y	150	Confirmed	Freighter
Allied Military Vessel Losses[2]					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
HMT Bedfordshire	located	Y	85	Confirmed	ASW Trawler
HMT Senateur Duhamel*	located	Y	60	Confirmed	ASW Trawler
USS YP-389	located	Y	320	Confirmed	Patrol Craft
Keshena*	located	Y	85	Confirmed	Tugboat
USCGC Bedloe*	located	N	150	Confirmed	125' Cutter
USCGC Jackson*	located	N	75	Confirmed	125' Cutter
German Military Losses (All lost in combat)					
Vessel Name	**Status**	**Data**	**Depth**	**Identity**	**Type**
U-*85*	located	Y	90	Confirmed	Type VIIB
U-*352*	located	Y	115	Confirmed	Type VIIC
U-*576*	located	Y	780	Confirmed	Type VIIC
U-*701*	located	Y	120	Confirmed	Type VIIC

Note: All WWII related shipwreck sites along the continental shelf adjacent to the North Carolina Coast.

[2] Two American military vessels—USS *Cythera* (PY-26) and USS *Atik*—were lost during combat activity during 1942 but did not sink within the continental shelf.

[t] Remains of *Chilore* located in Virginia waters as a result of actions which took place in North Carolina water.

*Indicates military vessels not lost during combat operations (friendly mines and weather).

7 Merchant Vessels

Forty-five merchant vessel losses associated with Second World War conflict off the North Carolina coast are herein described as individual archaeological sites. They are presented in alphabetical order, and each site is presented with a historical overview followed by an archaeological site description. Each site description, moreover, is intended to inform site analysis and interpretation throughout the report, as well as individual publications and studies produced by NOAA and partner agencies (see Section 1.2) emanating from this overarching body of research.

7.1 Allan Jackson

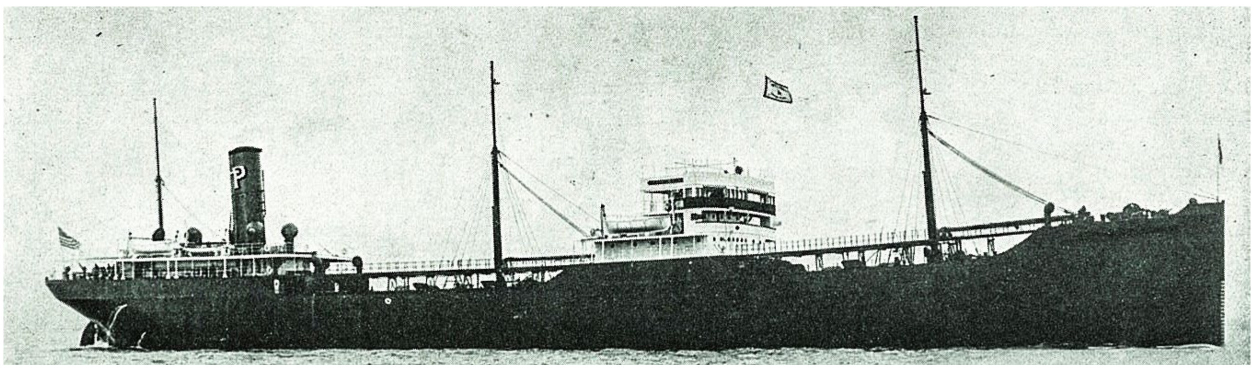


Figure 7-1 Image of *Allan Jackson*, Pre-War as a "Panama transport ship."
Source: Standard Oil Company 1946:79

Table 7-1 Characteristics of *Allan Jackson*

Characteristics	*Allan Jackson*
Year of Build/Type/Hull #	1921/Tanker/5303 A
Date Lost	18 January 1942
Position & Depth	Reported70 miles ESE of Cape Hatteras, NC Site not identified during present study
Ship Characteristics	Length: 435' Breadth: 56' Depth: 33.5' Gross Tonnage: 6,635
Cargo	72,870 barrels of crude oil
Survivors	13 (35 Total on board [22 lost])
Owner	Standard Oil Company, NJ
Builder	Bethlehem Shipbuilding Corp., Alameda, CA
Former Names	*Crampton Anderson* (Standard Oil Company, NJ, 1921-1931)
Lloyd's Register Details	Steel (Stl) hull, fitted for oil fuel, two decks, web framing, carrying petroleum in bulk, triple expansion three cylinder engine
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*66* (Richard Zapp)
Data Collected on Site	n/a

7.1.1 History

Built in 1921 by the Bethlehem Shipbuilding Corporation at its Union Plant in Alameda, California, *Allan Jackson* was originally named *Crampton Anderson*. As built, the tanker could carry a maximum cargo of

75,289 barrels of oil, with the ability to pump 3,500 barrels per hour (Figure 7-1, above). The ship's triple expansion steam engine was supplied by three Scotch boilers and was capable of producing 2,800 indicated horsepower that moved the 435-ft long tanker at a maximum speed of 10.2 kts. For the first 10 years of its service life, the tanker worked Pacific routes in service of the Panama Transport Company (a subsidiary of US-based Standard Oil Company). By 1931, however, the vessel was transferred to the East Coast and renamed *Allan Jackson* (Figure 7-2). For a brief period the tanker was laid up in the Patuxent River for repairs, but was readily put back into service at the outset of European hostilities in September 1939. In fact, *Allan Jackson* delivered eight wartime fuel cargos by the end of the year (Standard Oil Company 1946:76).

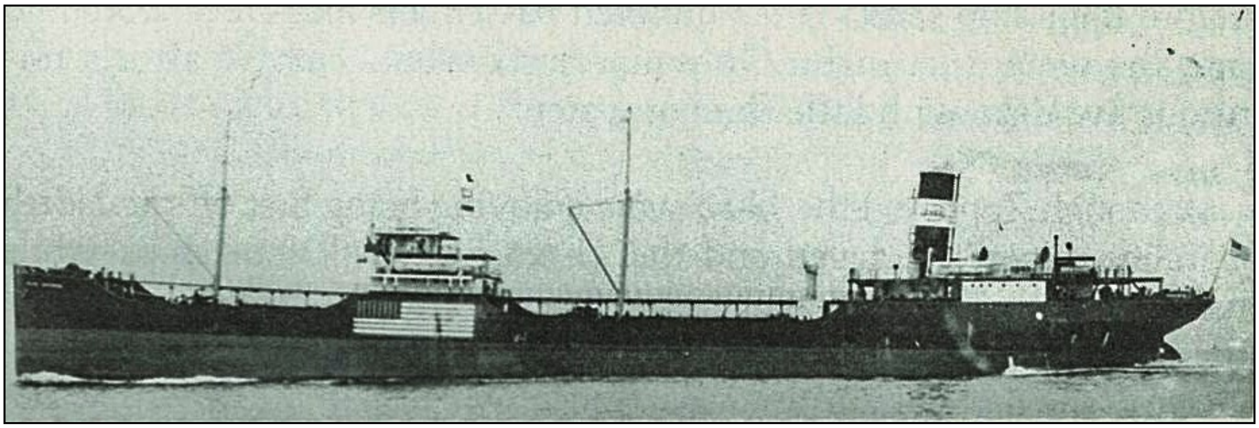


Figure 7-2 Port side view of *Allan Jackson* during service for Standard Oil Company.
Source: Hickam, Jr. 1989:13

The tanker continued to carry European-bound oil cargos throughout 1940 and 1941, making a total of 62 voyages that amounted to more than 4.2 million barrels of oil delivered for the Allied war effort. At the beginning of 1942, *Allan Jackson* continued what had become a regular delivery service between the Caribbean, Gulf of Mexico, and East Coast ports. The tanker's first voyage of the year, a departure from Cartagena, Columbia to New York, New York, on 11 January would ultimately be its last.

With a cargo of 72,870 barrels of crude oil, Captain Felix W. Kretchmer was anticipating trouble from German U-boats. He had no doubt heard the tales of North Atlantic U-boat attacks while disembarking cargoes in American and Canadian ports in the previous 24 months, and one of the crew, Steward Benjamin M. Olsen, had survived a U-boat attack while serving on another ship in September 1941. Now, the attack at Pearl Harbor and German declaration of war would almost certainly invite hostilities into American waters. As a result, Kretchmer decided (without any official instruction) to blackout his ship, provision its lifeboats, and even went so far as instructing the officers and crew to sleep fully clothed (Standard Oil Company 1946:76-80; Gannon 1990:244-245).

A week into their voyage, just past midnight on the morning of 18 January, the tanker was traveling ENE of Cape Hatteras, making 10 kts. On that night, with a new moon providing near-total darkness, Captain Kretchmer decided not to zigzag but instead to travel as fast as possible through the Hatteras area (Gannon 1990:245). He later recalled what transpired in the inky darkness of that winter night:

> The vessel was following a course of about 354° true, so as to raise Winter Quarter Lightship [LV 107], and was about 60 miles E.N.E. from Diamond Shoals. The weather was fine. I was in my bed resting when at 1:35 a.m. the ship was suddenly struck without warning by two torpedoes, amidships on the starboard side, resulting in two consecutive explosions. The first explosion was comparatively mild, but the second, which occurred almost immediately afterward, was very

> severe and threw me against the walls of my cabin. It broke the vessel apart and set her afire (Standard Oil Company 1946:77).

On patrol in that area was one of the first German Operation Paukenschlag (Drumbeat) boats: U-*66*. An unarmed, lone tanker moving along a straight path at night was an ideal target. Two torpedoes hit their mark and almost instantly set the ship afire.

The first torpedo hit the forward tank on the vessel´s starboard side and exploded beneath an empty cargo hold. The damage was comparatively minor. The second torpedo, however, hit between the #2 and #3 tanks, in line with the foremast and caused a massive explosion which separated the bow section starting 25-30 ft forward of the midship house. The cargo of oil spilled out into the water, igniting and spreading over an area of about a half mile around the vessel (Standard Oil Company 1946:77-80; Hickam, Jr. 1989:11-13; Gannon 1990:244-247).

Following the second torpedo strike, only a single lifeboat remained useable; the remaining three were smashed, fouled, or engulfed in flames. As the boat was lowered, 8 members of the crew jumped inside. A few hectic minutes ensued as they fought off flames, the listing hulk of a sinking ship above them, and the suction of the propeller. Fortunately, the crew of the life boat was able to push against the stern of the ship with their oars and cleared the wreckage. Several of the other crew, including Captain Kretchmer, escaped the ship and floated alone or in small groups along chunks of debris. Within 10 minutes, both sections of the tanker sank and 22 of the 35-person crew were lost. Several hours later the surviving crew were rescued by destroyer USS *Roe* and taken ashore at Norfolk, VA (Standard Oil Company 1946:77-80; Hickam, Jr. 1989:11-13; Gannon 1990:244-247). The *Allan Jackson* was the first ship lost in North Carolina waters during WWII, the first Standard Oil Company tanker lost during the war, and the first vessel sunk by U-*66* during its Operation Drumbeat patrol in American waters. This patrol earned its commanding officer, Korvkpt. Richard Zapp, a Knight's Cross.

7.1.2 Archaeological Site Description

The site of *Allan Jackson* was not identified as part of this effort. The reported location suggests the vessel sinking within an area between 60 and 75 miles offshore and north of Diamond Shoals as the vessel was traveling en route to New York. This general vicinity would place the attack position off the continental shelf break and in several thousand feet of water. Nevertheless, the historical accounts detail a series of events that would produce a fairly distinct archaeological site and a number of potential diagnostic features that would assist in determining the identity of the site, if potential candidates for *Allan Jackson* are located in the future. First, the ship was completely unarmed. Second, the vessel was broken under the foremast and separated into two sections that were reported listing and sinking to opposite sites (the bow to port and the remainder of the ship to starboard). Yet, both sections sank quickly and could conceivably be near each other. Third, three of the four lifeboats were fouled or damaged in the explosions following torpedo strikes; they should still be present on the ship, minus the No. 3 boat at the vessel's starboard stern.

A forth distinguishing feature would be along the bow section. After abandoning ship in the No. 3 lifeboat, Boatswain Rolf Clausen reported:

> The first torpedo hit the forward tank on the starboard side. There was an empty cargo hold above this tank and the effect of the explosion was not serious, judging from the hole I saw later when I was in the lifeboat (Standard Oil Company 1946:77).

Based on this description and the knowledge that the bow section broke abaft the first torpedo strke, it would also be reasonable to expect a large hole on the starboard side of the bow section, in addition to the breaking damage where it severed from the remained of the ship.

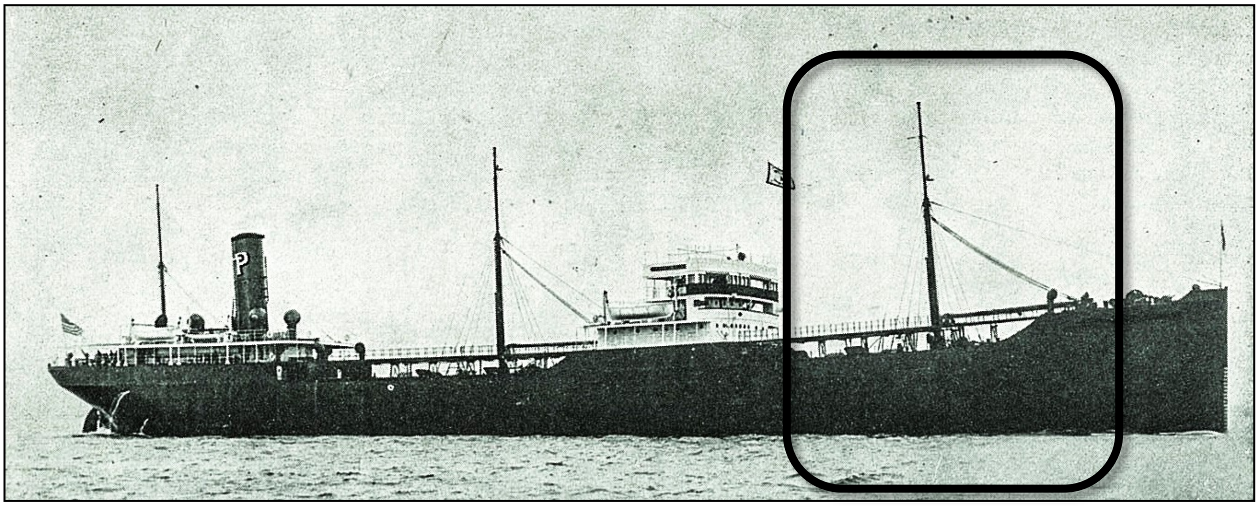


Figure 7-3 Diagram illustrating the area of potential damage reported to the hull of *Allan Jackson* during the sinking event including broken bow section separated beneath the foremast.
Source: Standard Oil Company 1946:79

7.2 Ario

Figure 7-4 *Ario* in port, date unknown.
Source: Mariners' Museum and Park

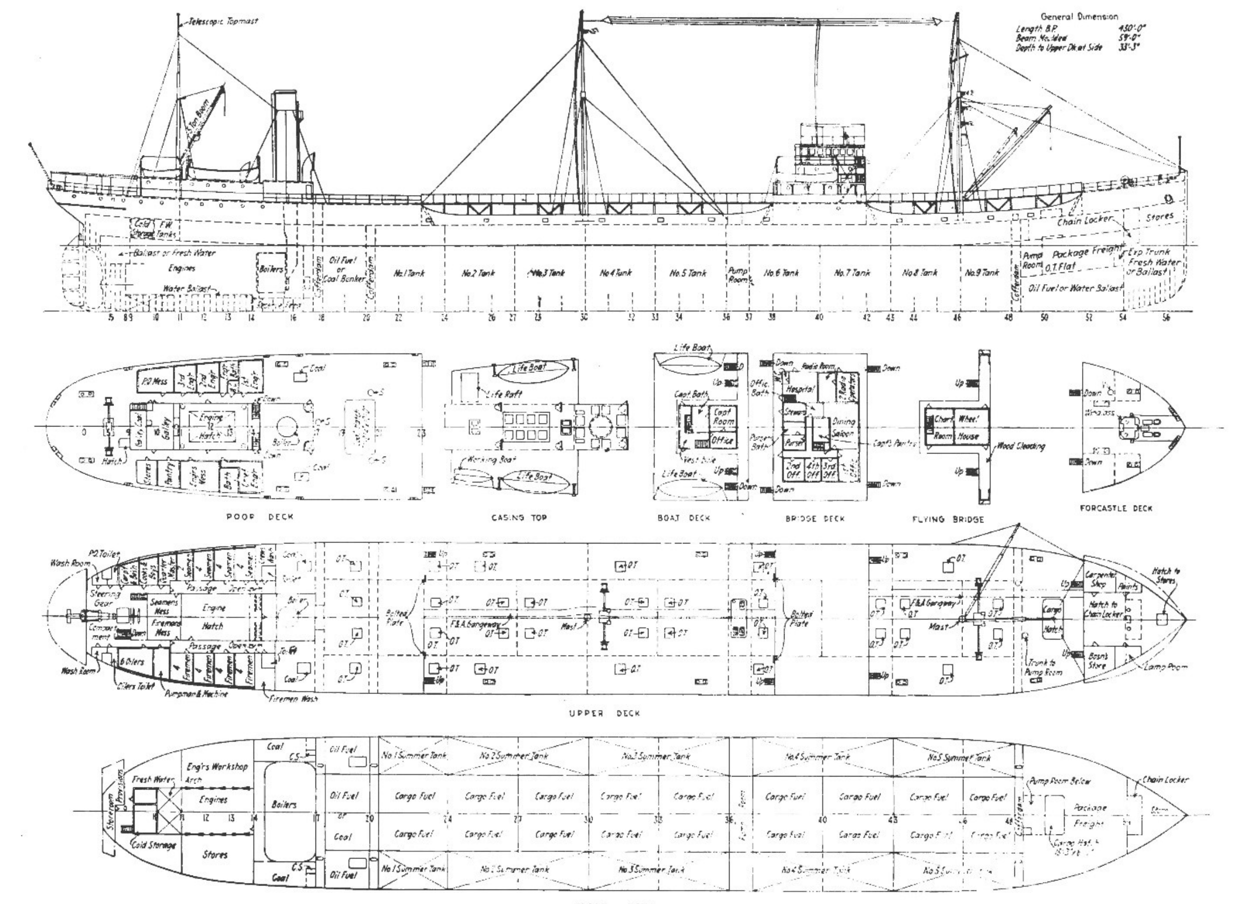
Table 7-2 Characteristics of *Ario*

Characteristics	*Ario*
Year of Build/Type/Hull #	1920/Tanker/4202
Date Lost	15 March 1942
Position & Depth	11 Miles SW of Cape Lookout 70 ft
Ship Characteristics	Length: 436' Breadth: 56.1' Depth: 31.7' Gross Tonnage: 6,952
Cargo	n/a (ballast)
Survivors	30 (38 Total on board [8 dead])
Owner	Socony-Vacuum Oil Co. Inc., NY
Builder	Bethlehem Shipbuilding Corp. Ltd. Sparrow's Point, USA
Former Names	N/A
Lloyd's Register Details	Two decks (Stl), Web frames, longitudinal framing, triple expansion engine
Port of Registry/Flag	New York/USA
Sunk by	U-*158* (Erwin Rostin)
Data Collected	Simrad multibeam Survey 2010; photo and video documentation 2012.

7.2.1 History

A tanker built in 1920 by Bethlehem Fairfield Shipbuilding Corporation, *Ario* was originally owned and operated by the Standard Transportation Company, later the Socony-Vacuum Oil Company after the merger of Standard and Vacuum Oil companies in 1931 (Figure 7-4, above). *Ario* remained in service of the company, operating out of New York from 1930 until 1942 (see Figure 7-4). During the war, the tanker maintained regular service throughout the Gulf and up the East Coast. It was along this route in March 1942, as *Ario* was traveling south, alone 11 miles southwest of Cape Lookout, that the ship was hit. A single torpedo from U-*158* found its mark on the starboard side, in tank #9 (Lloyd's Register of Shipping 1920-1942; DIO 1987:141; Blair 1996:516; Wynn 1997:122).

Despite the damage, *Ario* remained afloat. The U-boat, which had earlier that day attacked another Socony-Vacuum owned tanker *Olean* (which also failed to sink), was running low on torpedoes and decided to finish its attack with surface fire from its 88-mm deck gun. The U-boat's commanding officer, Kplt. Rostin, had experienced some difficulty in making the attack upon *Ario*. Upon first sighting the ship, he used a blinking red light to simulate a navigation buoy in an attempt to draw the tanker in closer. When this failed, the U-boat gave chase and maneuvered into the ship's path to slow its speed, which also failed. Next, Kplt. Rostin fired two illumination flares that finally allowed him to achieve the position needed for an attack run. After all this effort, the unladen tanker still remained afloat (Hickam, Jr. 1989:71-72).



GENERAL ARRANGEMENT PLANS OF A 10,000-TON D. W. STANDARD TANKER
Sun Shipbuilding Co., Chester, Pa.

Figure 7-5 General plans for 10,000-ton (deadweight) tanker circa 1920.

Note: Though not the same builder that produced *Ario,* this design is very similar to the tankers made in the Bethlehem yards.

Source: Webster et al. 1920:424

Meanwhile, the crew of *Ario* was ordered to abandon ship. As they made their way off, Kptl. Rostin's U-boat surfaced and opened fire on the vessel. For 30 minutes the ship was shelled with 40 rounds. One round made a direct hit upon the No. 3 lifeboat, instantly killing 5 of the 12 crew inside. Three others later died of injuries sustained during the attack. As U-*158* closed in to view the vessel, it almost collided with a fleeing lifeboat. Dawn was approaching and with *Ario* still afloat, Kplt. Rostin assessed the situation. In his reckoning it was best not to be caught surfaced in shallow water, close to shore, and in daylight. He ordered U-*158* to submerge and left the damaged tanker to its fate (Hickam, Jr. 1989:71-72).

About an hour later, the master, the chief mate, the second mate, the chief engineer, and an able seaman re-boarded *Ario* to check for possible salvage, but the vessel was too far gone and slowly began sinking. After 7 hours the survivors were picked up by USS *Du Pont* (DD 152) and landed at Charleston, South Carolina (DIO 1987:141; Wynn 1997:99).

7.2.2 Archaeological Site Description

Interestingly, the location of *Ario's* remains were not well documented at the time of sinking. The volume of U-boat activity at the time, as well as the preponderance of other vessel losses in the area, combined with post-war efforts to clear navigable areas by dynamiting and wire-dragging sunken vessel remains, caused much ambiguity as to *Ario*'s (and several other vessels') final resting place. In the days before and after the tanker's loss, several other vessels were also being attacked within the Cape Lookout vicinity. In particular, *Ario's* sister ship, tanker *Olean*, was torpedoed just hours before U-*158* moved on to attack *Ario*; both tankers were abandoned and left adrift. In fact, *Olean* was left adrift for several days before a crew returned and began salvage efforts; *Olean* was saved while *Ario* was ultimately lost (Hickam, Jr. 1989:70-72; Barnette 2006:79).

After the main thrust of U-boat activities concluded, the US Navy and US Coast Guard refocused their efforts from ASW, rescue, and salvage, to documenting the substantial amount of vessel losses within the Fifth Naval District, including the Hatteras area. A comprehensive survey, the result of a partnership between the US Navy's Fifth Naval District Intelligence Office, Woods Hole Oceanographic Institution, and the US Coast Guard, was conducted onboard USCGC *Gentian* from 24 June to 19 September 1943. Here, two potential targets around the location of *Ario's* reported attack were documented. One was determined to be a non-period wooden vessel (DIO 1944:11-12) due to its low relief and lack of measureable magnetic field.

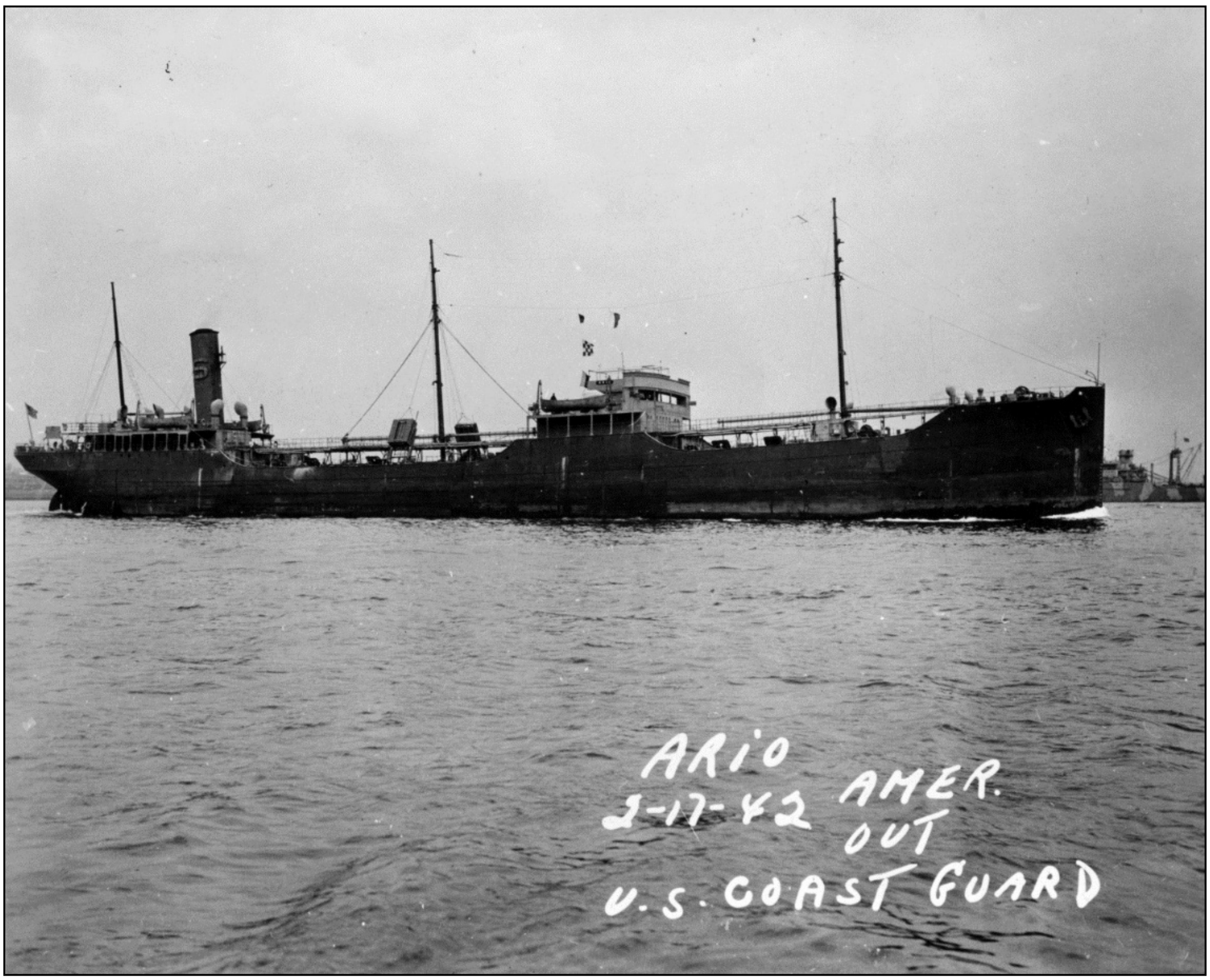


Figure 7-6 ***Ario*** **as she would have appeared at the time of her loss; taken on 17 February 1942, location unknown.**

Source: Mariners' Museum and Park

The second target believed to be *Ario*, reportedly spotted by Coast Guard patrol planes on 30 March and 4 April, was listed at a location nearly 50 miles from the position of U-*158*'s attack, just offshore of Ocracoke Island. A partially submerged vessel at this position was observed by aircraft (as mentioned above), and was even visited by a boat for the purposes of affixing a buoy to the site. Divers and drop cameras, however, were not deployed and the wreck's identity was inferred based upon three masts observed protruding from the water. Since very few ships lost in the area had three masts (most had two), the surveyors deduced the remains to be those of *Ario*, despite the substantial geographical distance separating this site from the tanker's reported attack and sinking location (DIO 1944:11-25).

Review of these documents, however, revealed that the surveyors had, in fact, located one of the other vessels lost in the area which also had three masts: *Dixie Arrow*. Incidentally, this tanker was lost in the vicinity of the position listed for *Ario* in the *Gentian* survey report, and it was lost on 26 March, meaning its remains would have been visible to patrol aircraft in the area and is likely the three-masted ship they observed. Given that *Dixie Arrow's* location is now well established, it is reasonably conclusive that the 1944 *Gentian* survey report was incorrect in ascribing these remains to tanker *Ario*; they were in fact seeing *Dixie Arrow's* remains (DIO 1944:11-26; Hickam, Jr. 1989:298).

Thus, the tanker's final resting place remained somewhat of a mystery until a 2006 review of shipwreck identities along the North Carolina coast determined that several sites which had been 'identified' following the war were, in fact, erroneous. In particular, Barnette re-examined four sites believed to be *Papoose* (WWII loss), *W.E. Hutton* (WWII loss), *San Delfino* (WWII loss) and *Mirlo* (WWI loss). Based upon several historical records, photographs, and firsthand diver observations, Barnette argued that the site commonly visited and believed to be *W.E. Hutton* was actually the remains of tanker *Ario* (Barnette 2006:79).

The proliferation of such ambiguity in the vessel's final resting place despite multiple visits from several surface ships, as well as being sunk nearshore in relatively shallow water (where, presumably it would be visible from aircraft), was also explained by Barnette (2006:79):

> The position of *Ario* was never accurately reported, which is not totally surprising given the wartime activities transpiring off Cape Lookout during the period. Numerous U-boat attacks occurred just days after the *Ario's* loss… which kept the Coast Guard and Navy busy off Cape Lookout. Furthermore, the ongoing salvage of the *Olean* also demanded significant Coast Guard and Navy resources. In that interim, the drifting wreck of the *Ario* simply slipped through the cracks.

Nevertheless, though its identitiy was unknown, the vessel's location in shallow, nearshore waters meant it was quickly discovered and regularly visited by fisherman and divers alike during the decades after the war. The site surveyed during the present study and believed to be the remains of *Ario* is the same site identified by Barnette as such, though this location is still commonly referred to as *W.E. Hutton* by many sources.

In September 2010, the team conducted a series of targeted multibeam surveys off the Cape Lookout area near Beaufort, North Carolina onboard the NOAA R/V *Nancy Foster* (Cruise Number NF-10-10-LF). The surveys focused on known wreck sites using a mid-depth Simrad EM1002 System operating at a frequency of 95 kHz, with a swath between 20 m – 1,000 m. This data were processed and exported at 1 meter resolution, providing and excellent overall site layout and feature distribution, as shown in Figure 7-7. The reduction of extant vessel structure in the years following the war, necessary to clear safe, navigable shipping lanes, substantially altered the vessel's integrity. As a result, *Ario's* remains, like many vessels lost in shallow water, are discontinuous and often difficult to navigate and interpret underwater. Complete imaging of features via sonar or other remote sensing tools was invaluable to capture the site in totality (Figure 7-8).

The vessel's remains are located in approximately 60 ft of water, in the 'inshore' section of Onslow Bay; the stretch of water between Cape Lookout (north) and Cape Fear (south). Due to its location, the site experiences a high degree of variability in ambient water conditions as clear, Gulf Stream waters periodically move inshore and mix with or offset the murkier inshore waters introduced to the area via the Pamlico Sound. The resulting mixture produces a wide range of temperature, current, and visibility conditions. Combined, these factors make traditional recording very challenging. In 2012, the team visited the site and experienced favorable conditions, 15-20 ft of visibility, sufficient for underwater photography to document large features (Figure 7-9).

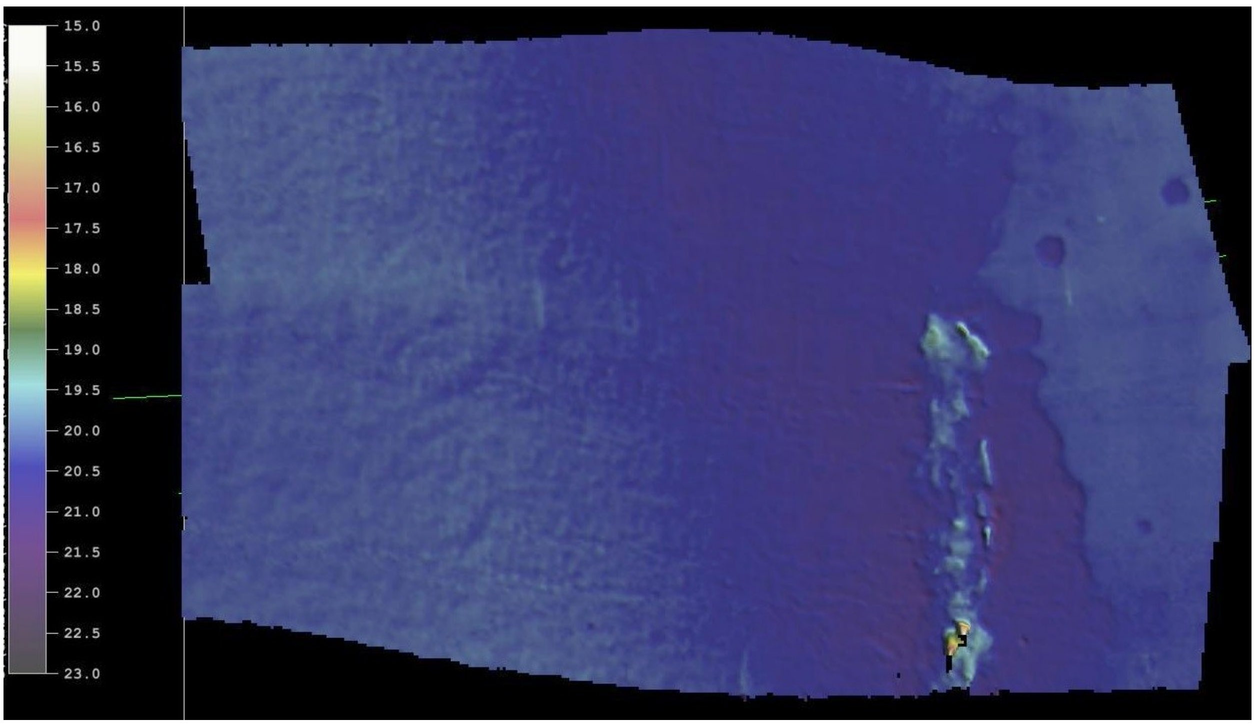


Figure 7-7 Multibeam survey of the wreck of *Ario*; data collected at 95 kHz and visualized at 1 m resolution.
Source: NOAA

The site is large and heavily disarticulated due to post-sinking clearance. Historically, the vessel was first fired upon and struck by a torpedo on the starboard side. This was followed by over 40 rounds of shellfire. At the time of investigation, it was impossible to determine the location of either the torpedo strike or the shellfire. Also of note, the engine machinery, including the boilers, is located at the stern.

The wreck site mainly consisted of remains located at the bow and stern, with disarticulated features throughout the amidships area. At the bow, there were some features remaining, extending approximately 35 ft. Moving aft, a large disarticulated section comprised the majority of the shipwreck remains. This section was roughly 290 ft in length, and at its widest point measured 87 ft. Following this disarticulated section, the boilers and machinery were observable, located approximately 350 ft from the tip of the bow section (Figure 7-10 and Figure 7-11). This section was roughly 75 ft in length and at its widest beam, approximately 50 ft. Overall, the most observable assemblage was located in the stern section. The depth and location of this site are favorable for extended diving that could allow archaeologists to complete a detailed recording of the site. The site is recommended for additional investigation including the creation of a detailed site plan.

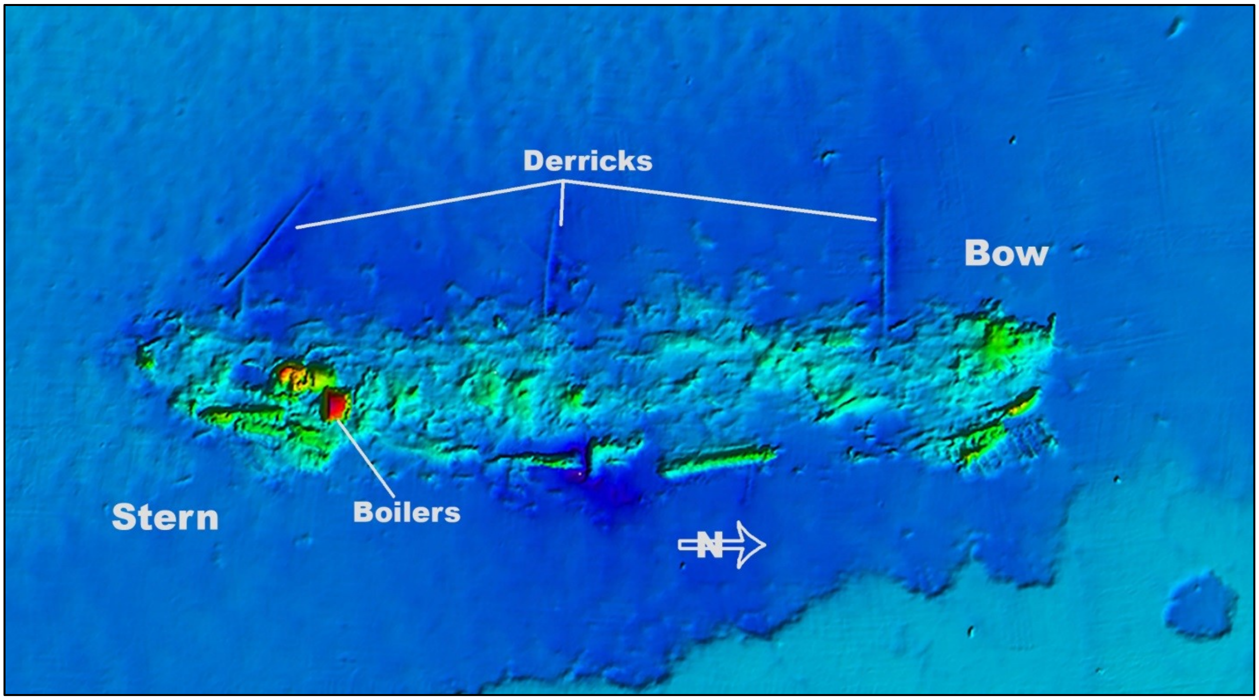


Figure 7-8 Reson 7125 400 kHz multibeam image gridded at 0.25 m of *Ario* wreck site.
Source: NOAA R/V *Nancy Foster*

Figure 7-9 Archaeologists exploring the scattered wreckage of *Ario*.
Source: NOAA

Figure 7-10 Crankshaft on the wreck of *Ario*.
Source: NOAA

Figure 7-11 Remains of one of *Ario*'s three Scotch boilers.
Source: NOAA

7.3 Ashkhabad

Figure 7-12 *Ashkhabad*, dated 8 January 1942, location unknown.
Source: Mariners' Museum and Park

Table 7-3 Characteristics of Ashkhabad

Characteristics	*Ashkhabad*
Year of Build/Type/Hull #	1917/Tanker/unknown
Date Lost	30 April 1942
Position & Depth	18 miles SE of Cape Lookout, NC 55 ft
Ship Characteristics	Length: 401'; Breadth: 52.3'; Depth: 28.5' Gross Tonnage: 5,284
Cargo	n/a (ballast)
Survivors	47 (entire crew)
Owner	Sovtorgflot – Soviet State Shipping Line, Moscow Russia (1938 – 1942)
Builder	Harland & Wolff Ltd, Glasgow, Scotland
Former Names	Dneprostroy (Soviet Shipping Line, 1935-1938) Kutais (Soviet Shipping Line, 1934-1935) Mistley Hall (Dunn C.G. & Co., 1927-1934) Aldersgate (Dillon H.W. & Sons, 1925-1927) Milazzo (Italian merchant fleet, 1919-1924) War Hostage (Shipping Controller, 1917-1919)
Lloyd's Register Details	One deck (Stl), expanded from 5,181 original gross tonnage to 5,284. Triple expansion engine.
Port of Registry/Flag	Odessa, Russia
Sunk by	U-*402* (Siegfried Freiherr von Forstner)
Data Collected	SRI MB Survey 2011; photo and video 2012; full site survey 2013.

7.3.1 History

Ashkhabad was originally named *War Hostage* and was built during WWI as an 'A-class' standard cargo ship, operated by The Shipping Controller (TSC) of London, England (Figure 7-12, above). Following the war it was transferred to an Italian merchant fleet under the name *Milazzo*. During these years, the original dimensions remained the same, with an operating weight of 5,181 gross tons. It operated in this manner from 1919 to 1924, and in 1925 was purchased by Dillon H.W. & Sons of Liverpool, England, and renamed *Aldersgate*. Shortly thereafter, the vessel was sold to Dunn C.G. & Company and renamed *Mistley Hall*. In 1927, *Mistley Hall* would undergo conversions to become an oil tanker. The requisite modifications to internal arrangements resulted in increasing gross tonnage to 5,284 by 1931. In 1934 *Mistley Hall* was sold once more, now to the Soviet State Shipping Line, where from 1934 to 1938 it underwent three name changes, *Kutais*, *Dneprostroy*, and finally to *Ashkhabad* (see Lloyd's Register of Shipping 1918-1942). During the war the freighter was fitted with a defensive bow gun and registered in the port of Odessa, Russia.

In April of 1942, *Ashkhabad* was traveling southbound in ballast from New York to Cuba, escorted by converted British trawler HMT *Lady Elsa.* As per standard procedure at this time, the ship utilized a zig-zag course in an effort to confound potential U-boat attacks. This, however, proved ineffective. On 30 April 1942 as *Ashkhabad* passed SE of Cape Lookout under the cover of darkness, the ship was hit on the starboard side by a single torpedo and sunk by its stern end in the shallow water (Figure 7-13 and Figure 7-14). The ship was abandoned for a later salvage attempt and the crew was taken to Morehead City by HMT *Lady Elsa.* Several days later, destroyer USS *Semmes* (DD-*189*) came upon the vessel's floating wreckage and, unaware of the intent to salvage, followed its standing orders to sink wrecks that posed a hazard to navigation by firing three shells into *Ashkhabad.* Another armed trawler, HMS *St. Zeno*, soon joined in the shelling and completed the destruction of the vessel (Figure 7-15; DIO 1987:242; Hickam, Jr. 1989:178-179; Blair 1996:544; Wynn 1997:264).

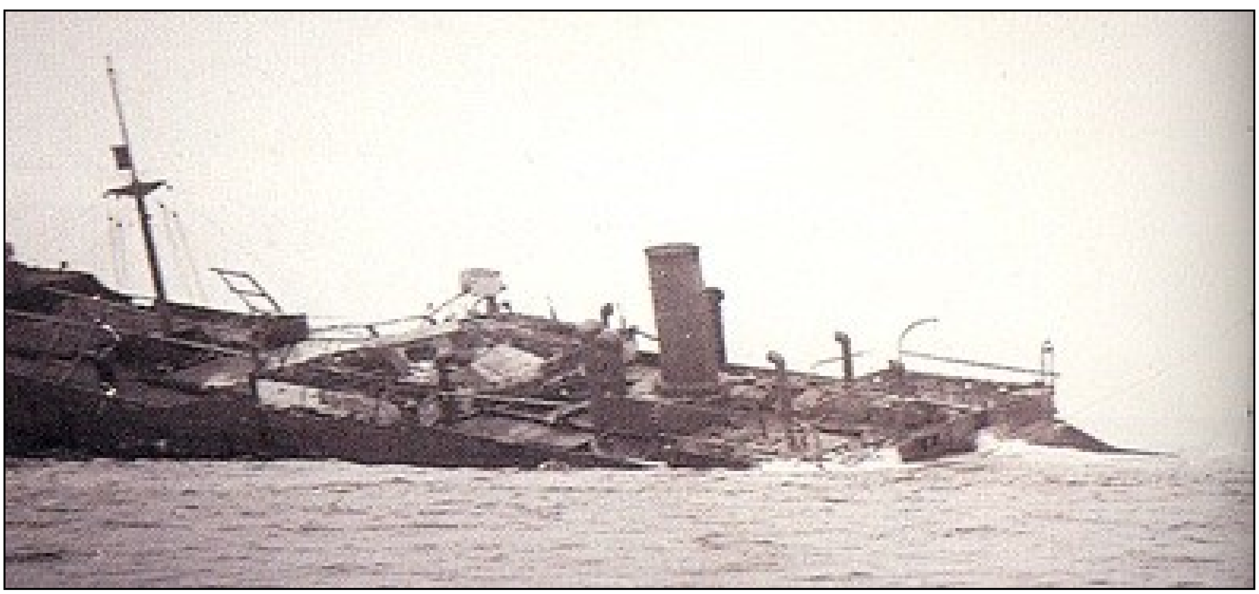


Figure 7-13 *Ashkhabad* following the attack.
Source: NARA/Aaron Hamilton Collection

Figure 7-14 ***Ashkhabad* following the attack.**
Source: NARA/Aaron Hamilton Collection

Figure 7-15 ***Ashkhabad* one month after being sunk, with masts protruding.**
Source: NARA/Aaron Hamilton Collection

7.3.2 Archaeological Site Description

Following the cessation of hostilities in the area, the US Navy and Coast Guard embarked upon a systematic program to clear large vessel remains in shallow water posing a hazard to navigation. Generally this meant establishing a clearance of greater than 60 ft of water, and was executed via demolition and wire-dragging. Lost in sufficiently shallow water for parts of the superstructure to remain exposed, *Ashkhabad* was most certainly a hazard to navigation. As a result, the vessel's remaining structure was substantially reduced. Consequently, the location of the vessel's remains was well known, and the site became a popular attraction for diving and fishing in the intervening decades.

Researchers began surveying *Ashkhabad* in 2011 via an AUV-mounted blueview multibeam sonar operated by SRI International (Figure 7-16). The site consisted of a large, widely dispersed scatter due to the demolition and wire-dragging. As a result, the vessel's remains were characterized by low relief (the highest point of relief being the tops of the boilers) distributed along a flat, sandy bottom between 55 and 60 ft deep.

Optimizing the color range of the multibeam results significantly increased the detail needed for feature identification (Figure 7-17). In the multibeam image, the three boilers are visible, as well as the framing elements of the hull and deck plating. Phase two diving operations focused on detailed photographic and video documentation of the site. Combining these two datasets resulted in a preliminary site map, which was later developed into a comprehensive hand-drawn archaeological site plan by divers in 2013.

The level of detail collected in 2012 by both divers and multibeam constituted a comprehensive site assessment. The highest point of relief on this site is the remains of three Scotch boilers. Though the conditions of the site fluctuate considerably, the researchers during this survey experienced excellent visibility, consistently in excess of 100 ft. To take advantage of these conditions, research collected a photo and video dataset consisting of over 500 still images and 2 hours of video footage (Figure 7-18).

Following the detailed research diver investigations of 2012, avocational archaeological researchers from BAREG returned to the site in 2013 to create a detailed site plan of the wreck, building off the preliminary plan and sonar images of the site (Figure 7-19). During the month of May 2013, BAREG divers worked with team archaeologists to record these features resulting in data, used to consider the wreck site for a NRHP nomination (Figure 7-20 through Figure 7-22).

Though the site was disarticulated, the general outline and shape of the vessel was discernable. Piles of anchor chain as well as an anchor were visible in the bow section, which extended approximately 35 ft aft, before a major section of hull plating was observed. This section of port side hull plating extended approximately 150 ft to the SE, whereas the vessel remains were generally oriented bow to stern, in a horizontal west to east direction. A spare propeller was located underneath this hull plating. From the end of the visible bow section to the boilers was approximately 180 ft of disarticulated hull plating. At its widest extent, beginning approximately at 150 ft amidships, a second section of hull plating extended off the starboard side for a total combined distance of approximately 145 ft of wreck remains athwartships. This starboard hull section extended 43 ft in length. Directly aft of this section were the three boilers, which provide the highest relief on the site. Two were located approximately in their original positions, with the third removed and located 25 ft off to the port side. Aft of the boilers were more disarticulated features that extended out another 170 ft.

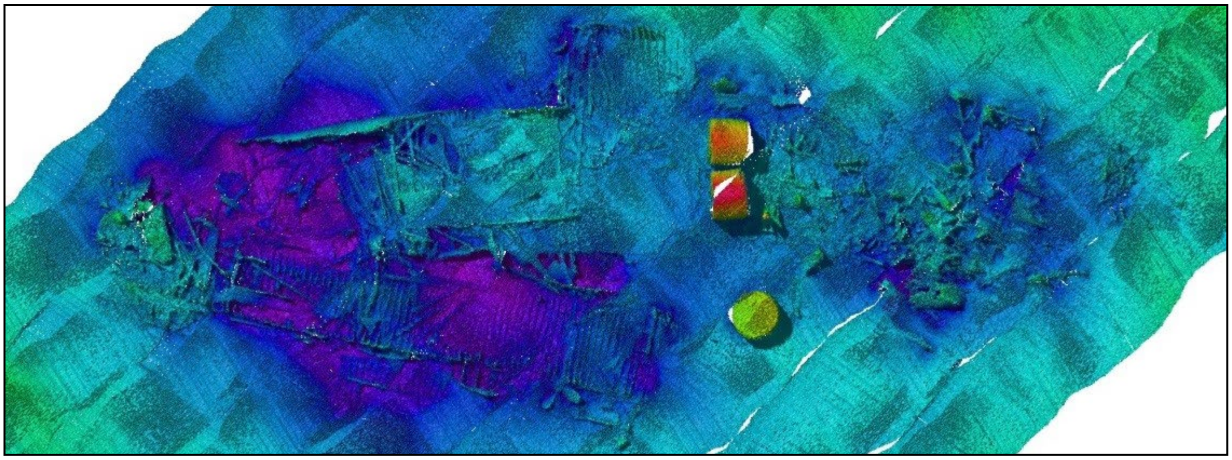


Figure 7-16 High-resolution Blueview multibeam survey of Russian merchant ship *Ashkhabad* BlueView MB1350 1.35 MHz.
Source: SRI/NOAA

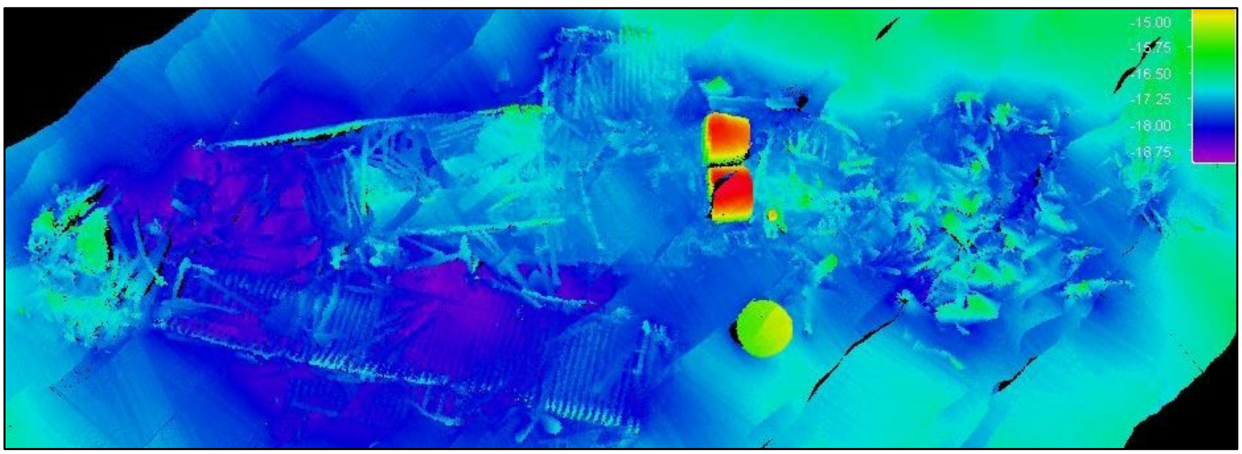


Figure 7-17 *Ashkhabad* survey optimized for feature identification BlueView MB1350 1.35 MHz.
Source: SRI/NOAA

Figure 7-18 Diver exploring the remains of *Ashkhabad*.
Source: John McCord, UNC-CSI

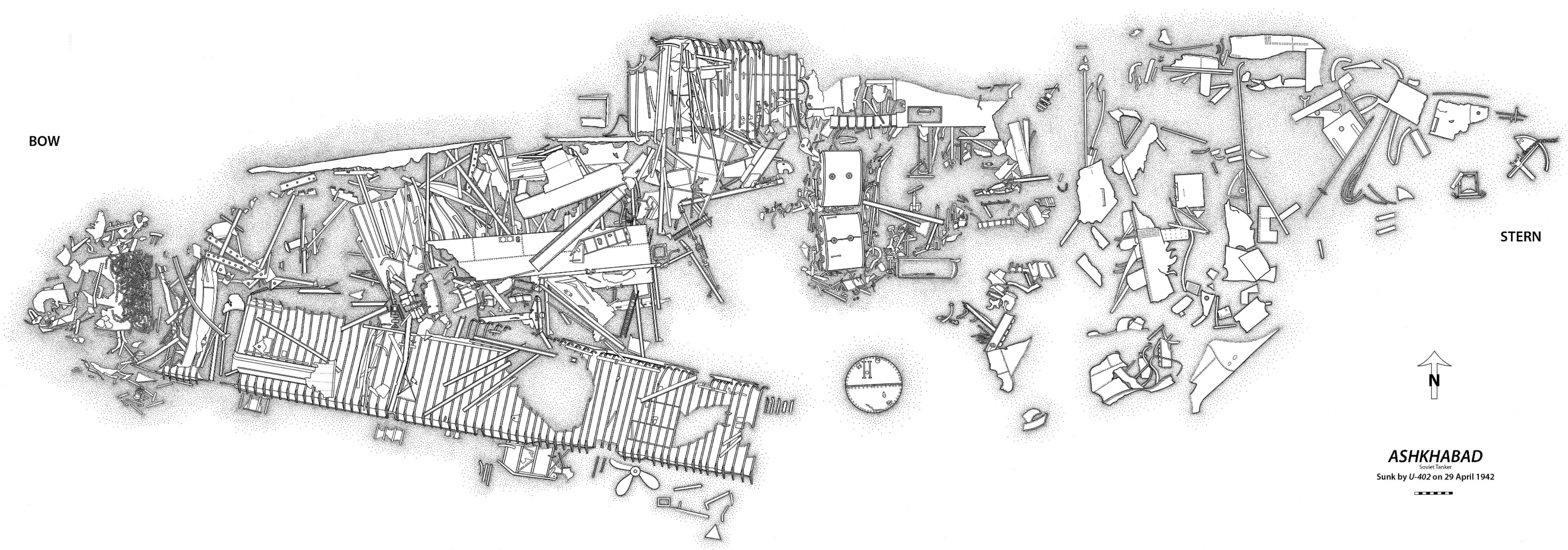


Figure 7-19 Final site plan of *Ashkhabad*.
Source: BAREG/NOAA

Figure 7-20 Towing bits on a section of *Ashkhabad*'s collapsed decking.
Source: NOAA

Figure 7-21 Boilers on the *Ashkhabad* site.
Source: CSI

Figure 7-22 Spare propeller resting in the sand on the *Ashkhabad* site.
Source: NOAA

7.4 Atlas

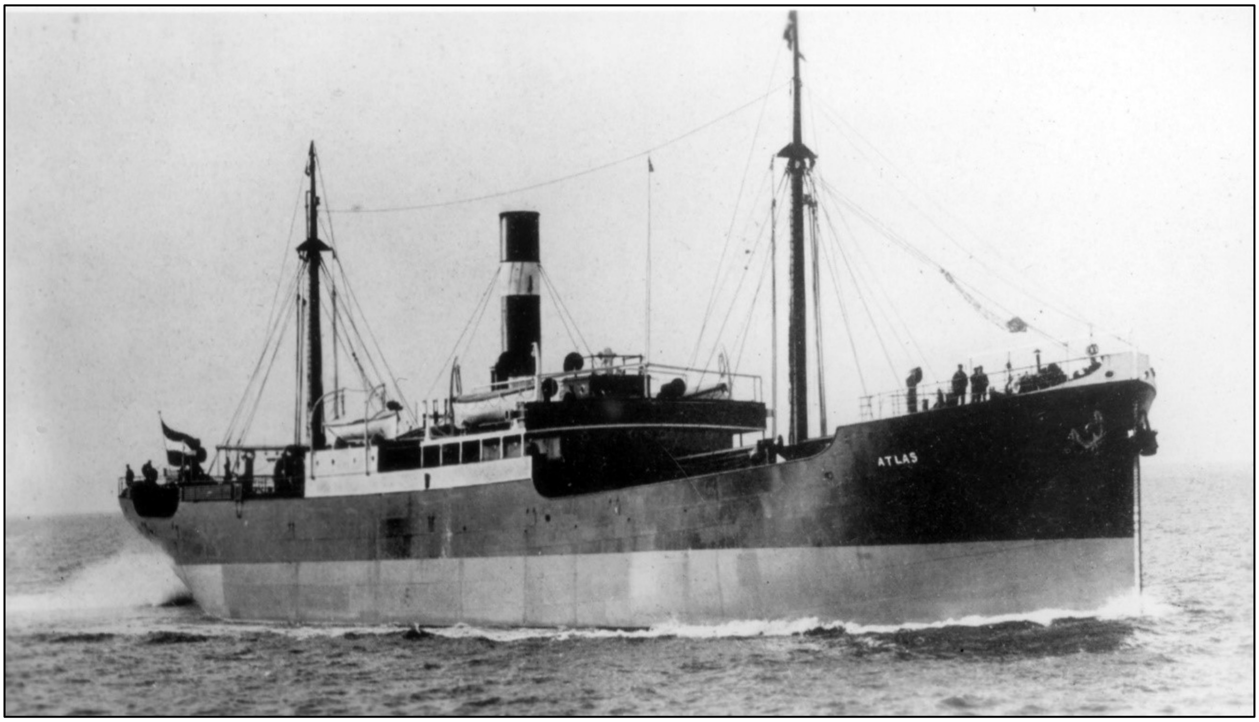


Figure 7-23 *Atlas* underway, date and location unknown.
Source: Steamship Historical Society of America

Table 7-4 Characteristics of *Atlas*

Characteristics	*Atlas*
Year of Build/Type/Hull #	1916/Tanker/107
Date Lost	9 April 1942
Position & Depth	17 miles E of Cape Lookout, NC 125 ft
Ship Characteristics	Length: 430.0'; Breadth: 58.2'; Depth: 33.3' Gross Tonnage: 7,137
Cargo	84,239 barrels gasoline
Survivors	32 (34 Total on board [2 dead])
Owner	Socony-Vacuum Oil Co. Inc., NY
Builder	William Cramp & Sons Ship and Engine Building Company, Philadelphia, USA
Former Name	Sunoil (Sun Company, 1916-1927)
Lloyd's Register Details	Steel (Stl) hull, Steam Screw (St.s), Single Screw, 2 decks, Machinery Aft, Triple-expansion steam engine, 3 190psi Scotch Boilers.
Port of Registry/Flag	New York/USA
Sunk by	U-*552* (Erich Topp)
Data Collected	Mulibeam (ADUS Survey) 2011; photo and video 2012.

7.4.1 History

Atlas was built in 1916 under the original name *Sunoil* by William Cramp and Sons Ship and Engine Building Company of Philadelphia, Pennsylvania (Figure 7-23, above). Purchased by the Sun Company, the vessel operated as a tanker, making trips from the Gulf of Mexico to New York. Sold to Socony-Vacuum Oil Company of New York in 1927, the vessel was then renamed *Atlas*. *Atlas* would continue to operate the same route through the beginning of WWII, as shown in Figure 7-24 through Figure 7-26 (Lloyd's Register of Shipping 1916-1942).

On 9 April 1942, the unescorted and unarmed *Atlas* was sailing from Houston, Texas to Seawarren, New Jersey, loaded with over 84,000 barrels of gasoline. Traveling off the coast of North Carolina, Master Hamilton Gray steered a non-evasive course, passing Cape Lookout. Early that morning, at approximately 0500 hours, the vessel was unexpectedly struck by a torpedo on the starboard side, near its #6 fuel cargo tank. U-*552*, operated by Erich Topp, had spotted *Atlas* and fired two torpedoes at 300 yards range. The explosion threw up a cloud of smoke and water but did not ignite the cargo. The engines were stopped and the crew of 8 officers and 26 men abandoned ship in 3 lifeboats (Moore 1983:25; DIO 1987:215; Hickam, Jr. 1989:127; Wynn 1998:28).

Topp brought U-*552* in closer and fired a second torpedo, striking *Atlas* in the same vicinity as the first, creating a fireball that set the ship afire from stem to stern. Following the first torpedo blast, the crew was ordered to abandon ship. Two life boats got away without any harm; however, one lifeboat containing 11 crewmembers drifted into the burning gasoline on the water. These men were ordered to jump overboard before the fire swept over them. The third mate and an ordinary seaman drowned trying to escape the flames. The master was severely burned and the others from that boat all suffered various degrees of burns (Figure 7-27). An aircraft sighted the lifeboats at daylight and directed a US Coast Guard cutter to pick up survivors and take them to Morehead City, North Carolina, (Figure 7-28) as *Atlas's* remains continued to burn adrift well into the night (Moore 1983:25; Hickam, Jr. 1989:127; Wynn 1998:28).

Kplt. Topp would go on to sink 5 more ships, in addition to *Atlas*, during the week of 3 April. The net result was a staggering 40,000 tons of total shipping lost, including vessels *Byron D. Benson*, *Tamaulipas*, *British Splendor*, and *Lancing* in the Hatteras area. A review of records post-war revealed that this 6-day period marked the most effective week-long period of any U-boat commander operating in American waters in terms of number and size of merchant vessels sank (Blair 1996:539). As a result of his success in American waters, as well as the North Atlantic, Erich Topp would become one of Germany's most decorated U-boat commanders; one of only five to receive the Knight's Cross with Swords and Oak Leaves (Blair 1998:523).

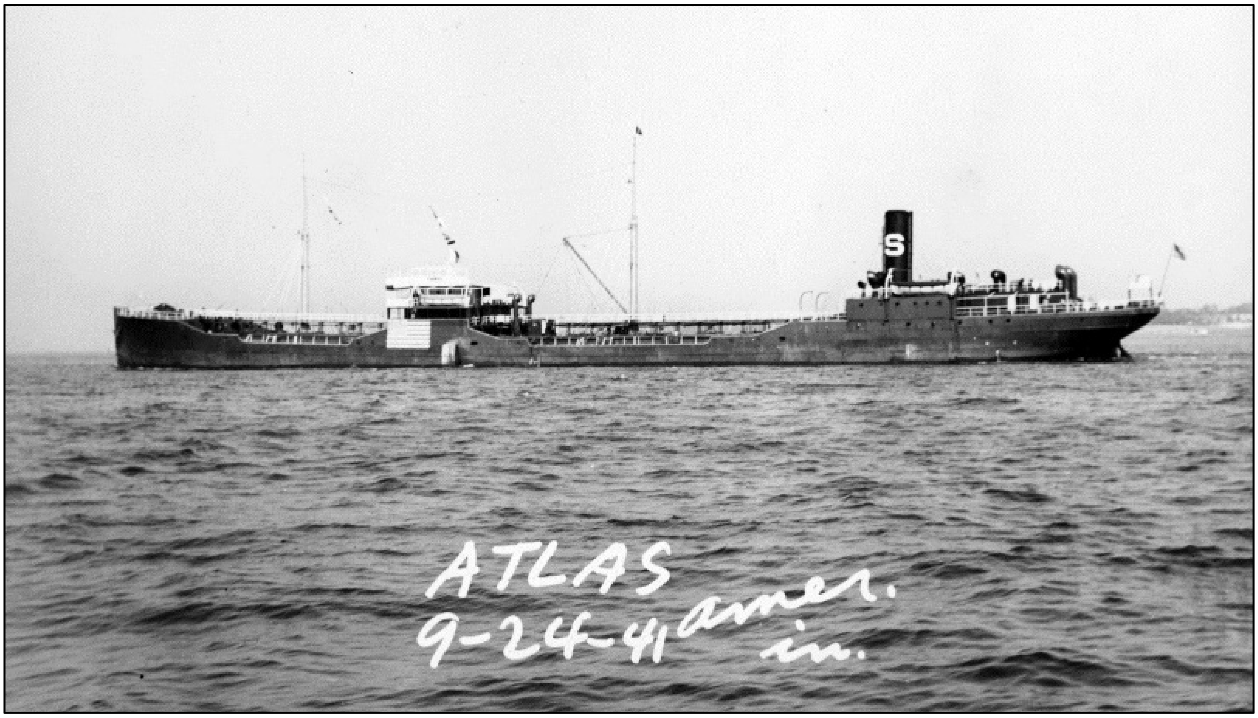


Figure 7-24 ***Atlas* on 24 September 1941, location unknown.**
Source: Mariners' Museum and Park

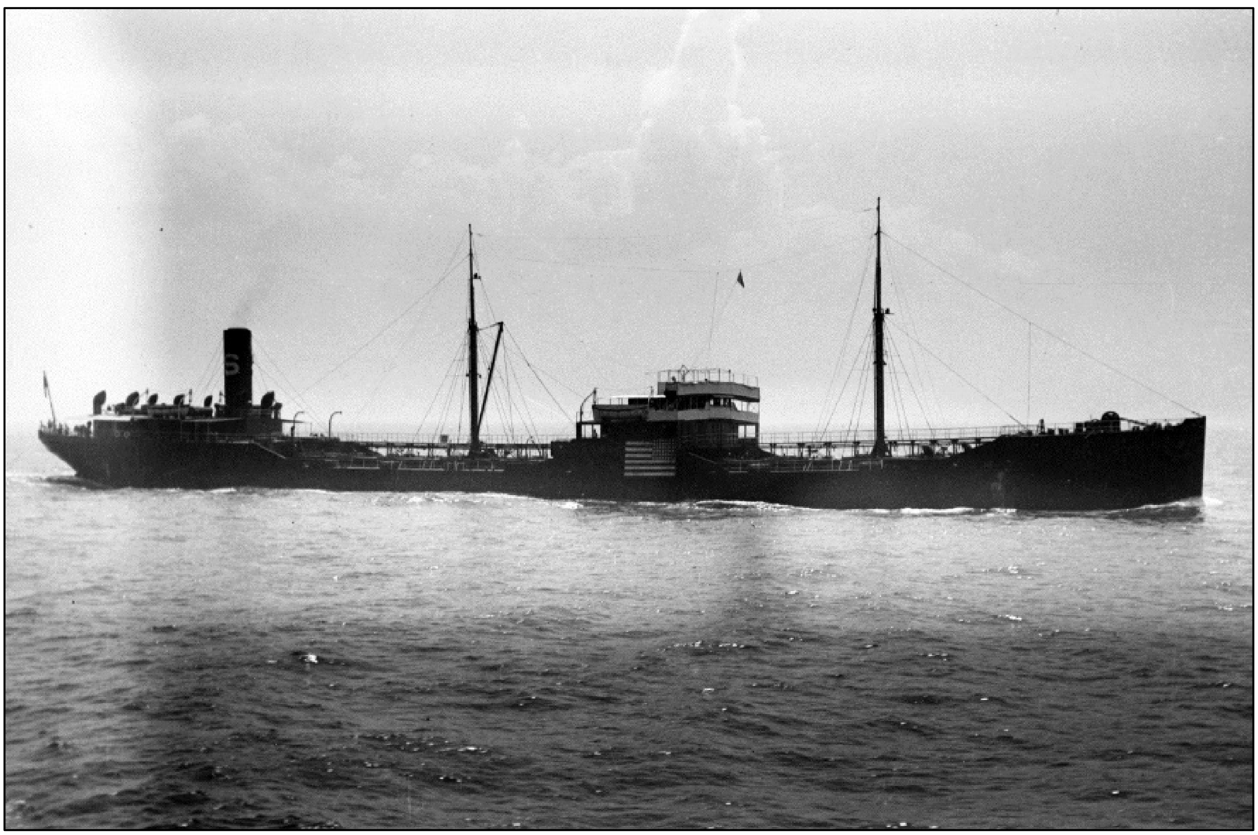


Figure 7-25 ***Atlas*, date and location unknown.**
Source: Mariners' Museum and Park

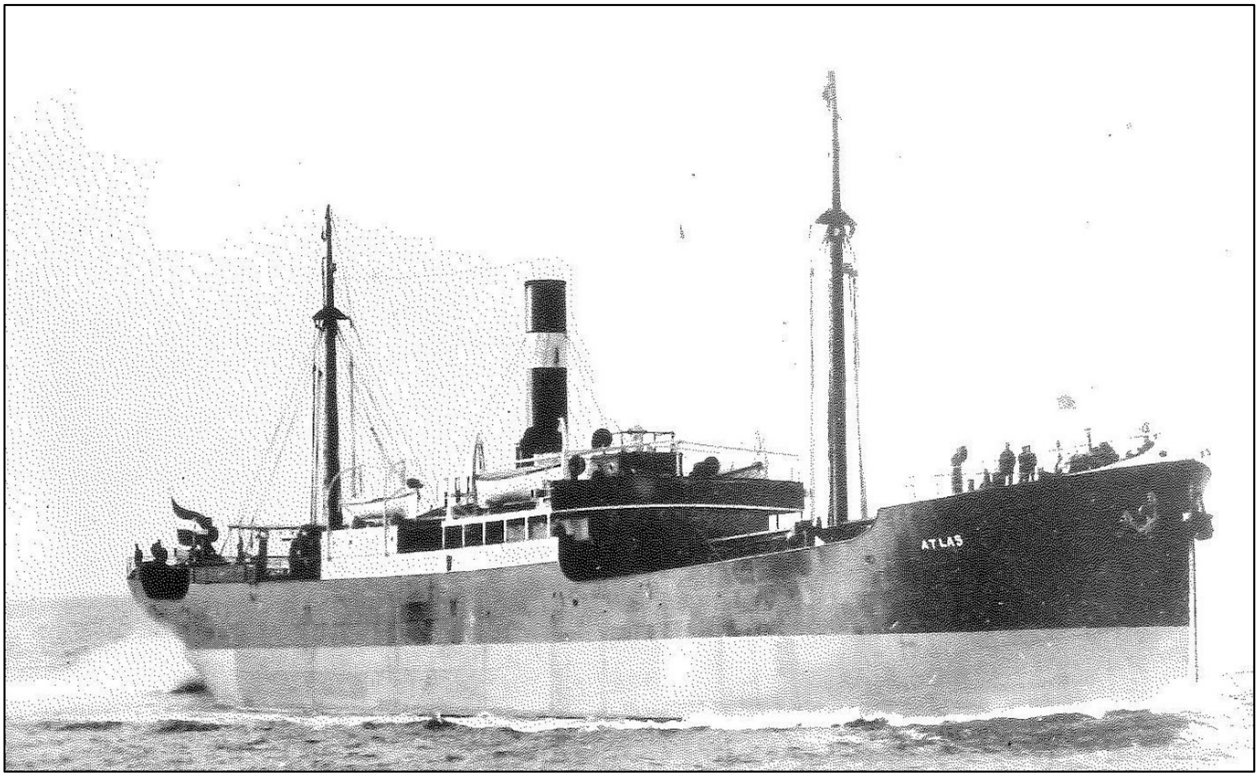


Figure 7-26 Tanker *Atlas* traveling in ballast.
Source: Steamship Historical Society of America

Figure 7-27 Burning oil from a tanker torpedoed 15 miles off Cape Lookout, believed to be *Atlas*.
Source: NARA

Figure 7-28 Crew of *Atlas* after being delivered to Morehead City, North Carolina.
Source: NARA

7.4.2 Archaeological Site Description

In 2011, the team completed a high-resolution multibeam sonar survey of the *Atlas* wreck site. Processed, the data generated extremely detailed 3D point cloud models of the site which, rendered in a visualization program, allowed for three-dimensional viewing and manipulation utilizing pole-mounted Reson SeaBat 8125 (6-mm resolution; Figure 7-29).

The multibeam data that were acquired during the 2011 ADUS survey provided detailed baseline imagery on the site (Figure 7-30 and Figure 7-31), and allowed for further documentation utilizing dive teams to assess the conditions of the site (Figure 7-32). During 2012, researchers collected video and photographic documentation of the site. Over the course of two dive rotations, approximately one hour of video footage was collected along with over 200 still images. Situated in approximately 120 ft of water, near no decompression diving limits, dives on the site were restricted to less than 20 minutes.

The remains of *Atlas* had high relief. The highest point was found on the forward edge of the intact amidships section where the remains rose 33 ft of the bottom. Forward of this point the bow was heavily degraded and separated from the section. The intact amidships section was 103 ft long. At this point, it was clear the vessel was broken in half through the keel and was offset approximately 19 ft from the stern section. In this area, the hull structure was broken into a large debris field approximately 92 ft in length before the vessel regained vertical structure up to the deck level back to the stern, particularly on the starboard side. The engineering space was exposed, revealing the intact triple expansion steam engine.

The wreck site consisted of three major parts, with gaps in between with little or no observable remains, and was mostly contiguous. These three sections were located at the bow, amidships, and stern. The length and beam of the bow section scatter extent was approximately 200 ft by 100 ft. Moving aft, a gap of approximately 25 ft was between the bow section and the beginning of the amidships section. The extent of the amidships remains was approximately 140 ft by 103 ft. The third section located at the stern was approximately 30 ft by 50 ft, following a gap from the amidships area of over 40 ft.

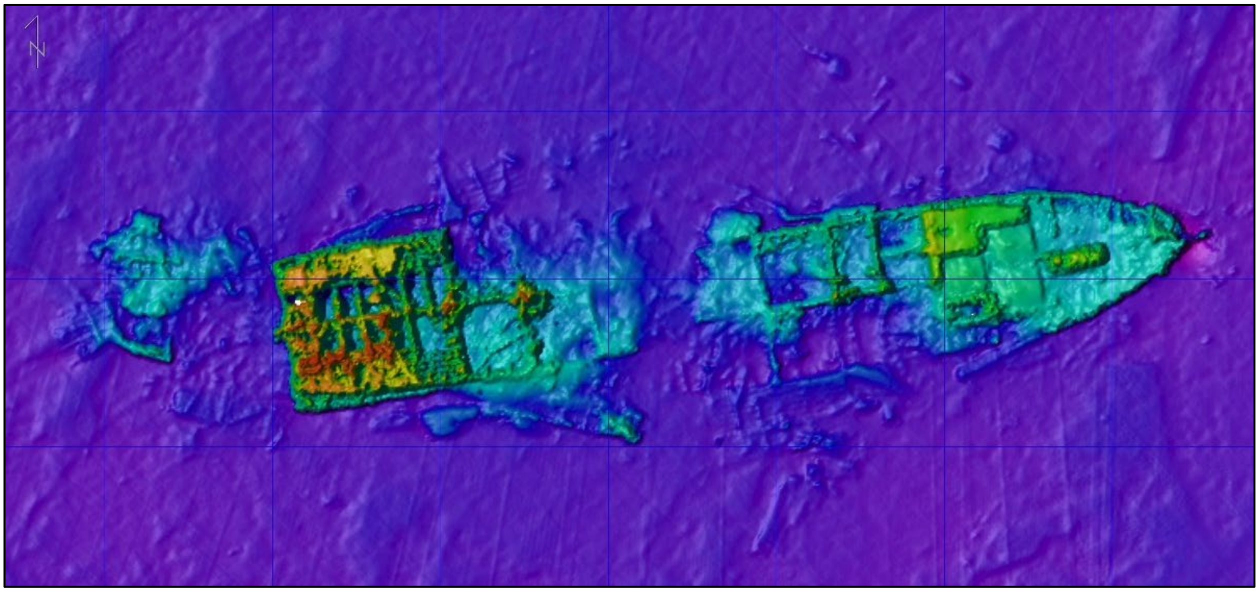


Figure 7-29 Reson 8125 scaled multibeam survey of *Atlas* wreck site 455 kHz 6-mm resolution.
Source: ADUS/NOAA

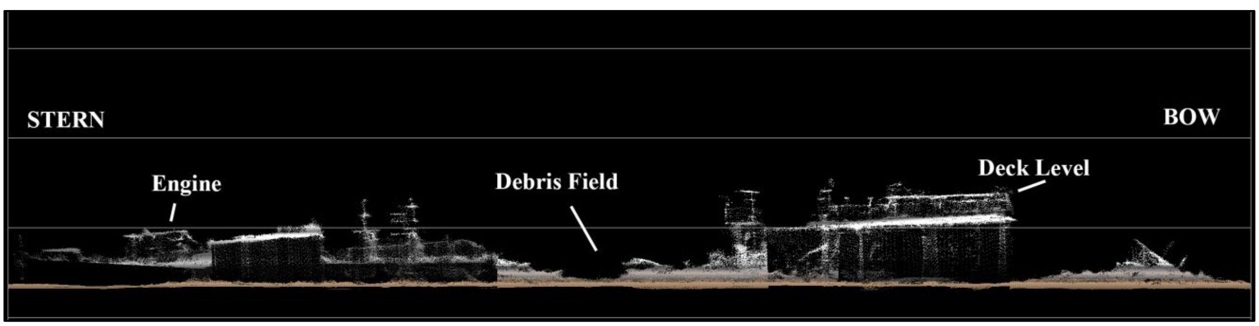


Figure 7-30 Multibeam SONAR WreckSight visualization of *Atlas* wreck site scaled in 10-m grid profile view.
Source: ADUS/NOAA

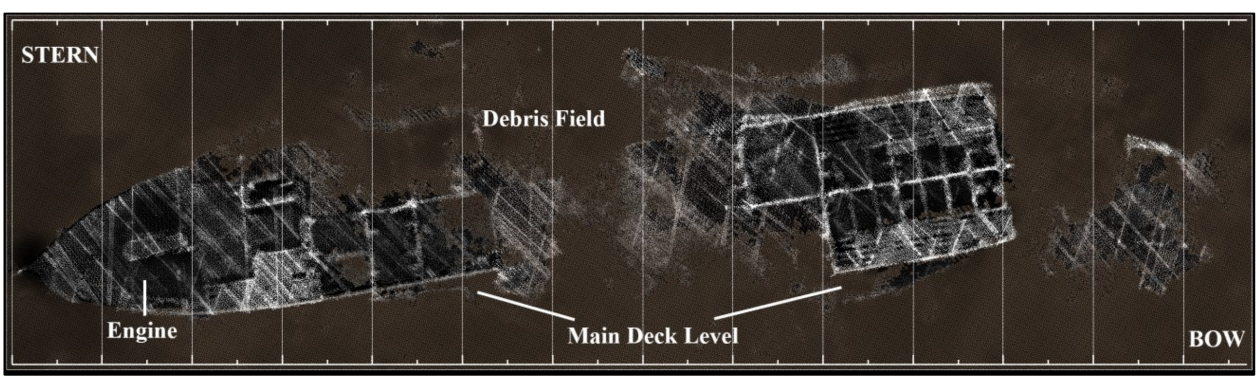


Figure 7-31 Multibeam SONAR WreckSight visualization of *Atlas* wreck site scaled in 10-m grid plan view.
Source: ADUS/NOAA

Figure 7-32 A diver documents the remains of the quadruple expansion steam engine on *Atlas*.
Source: NOAA

7.5 Australia

Figure 7-33 ***Australia* underway 13 February 1942, location unknown.**
Source: Mariners’ Museum and Park

Table 7-5 Characteristics of *Australia*

Characteristics	*Australia*
Year of Build/Type/Hull #	1928/Tanker/107
Date Lost	16 March 1942
Position & Depth	25 Miles E of Cape Hatteras, NC 110 ft
Ship Characteristics	Length: 509’ Breadth: 70.3’ Depth: 39.9’ Gross Tonnage: 11,628
Cargo	110,000 barrels fuel oil
Survivors	36 (40 Total on board [4 dead])
Owner	Texaco – The Texas Co.
Builder	Sun Shipbuilding & Drydocks Co., Chester, PA USA
Former Name	Mary Ellen O’Neil (California Petroleum Co. 1928-1929)
Lloyd’s Register Details	Two decks, Machinery aft, Cruiser Stern, Two 8 cyl. diesel engines, dual shaft, two screws
Port of Registry/Flag	Wilmington, DE/ USA
Sunk by	U-*332* (Johannes Liebe)
Data Collected	ADUS Survey 2011; photo and video 2013.

7.5.1 History

Australia was an American tanker of 11,628 gross registered tons built in 1928 by Sun Shipbuilding & Drydock Co., Chester, PA (Table 7-5 and Figure 7-33, above, and Figure 7-34). Originally named *Mary Ellen O'Neil*, for the California Petroleum Co., in 1929 it was renamed *Australia* after being sold to Texas Co (Texaco) and registered in the port of Wilmington, Delaware. On 16 March 1942 *Australia* was sailing from Port Arthur, Texas to New Haven, Connecticut loaded with 110,000 barrels of fuel oil. The tanker was sailing alone and unarmed, zig-zagging at approximately 10 kts. In the days prior, numerous ships had been attacked by U-boats patrolling around the Cape Hatteras and Cape Lookout areas; nevertheless, ships continued to travel independently and without convoy protection. The US Navy and US Coast Guard, however, had dispatched several patrol vessels to maintain a constant vigilance in anticipation of continued U-boat activity. At approximately 1405 hours, a single torpedo from U-*332* struck on the starboard side in the area of the tanker's propulsion machinery (Moore 1983:26; DIO 1987:143; Wynn 1997:221).

When the torpedo struck the machinery room, it ruptured fuel lines and shattered auxiliary pipes, killing the four engine room crew immediately. The remainder of the crew (36 total) was then ordered to abandon ship. Approximately 90 minutes after the attack the crew, distributed in three lifeboats, were picked up and brought ashore. Survivors reported seeing the vessel with the stern resting on the bottom and the bow afloat (Figure 7-35 and Figure 7-36). (Moore 1983:26; DIO 1987:143; Hickam, Jr. 1989:72-73).

Merchant vessel *William J. Salman* and patrol vessel USS *Ruby* (PY-21) quickly arrived on the scene to gather the 36 survivors, who were taken ashore at Southport, North Carolina. One of the dead crewmen, William F. Johnson, Second Assistant, age 39, had a liberty ship christened in his name, a common practice used by the families of lost sailors to commemorate their service. *Australia* settled by its stern, with its bow afloat and, in spite of the torpedo damage, none of its cargo holds were ruptured and no fires broke out (Moore 1983:26).

Meanwhile The USCGC *Dione* had been actively monitoring the situation via radio. Throughout the days prior, USCGC *Dione* listened helplessly as ships all throughout the Hatteras area were coming to grief following U-boat attacks. The cutter, in each instance, seemed to be in the wrong place at the wrong time; too far away to respond. Its crew badly wanted to catch, and sink, a U-boat in the act. Now, a mere 20 miles away, *Australia* radioed in distress. The cutter made full speed and arrived on station less than 2 hours after the attack. Seeing no signs of the crew the cutter began a search of the area; almost immediately the sonar operator announced a contact. A course was set, depth charges dropped, and, after the chaos settled, the contact was lost. The cutter, however, had not succeeded. Despite getting caught by the US Coast Guard crew in shallow water, U-*332* managed to slip away unharmed and began its journey back to France (Hickam, Jr. 1989:72-73; Blair 1996:517).

Afterwards, the salvage tug *Relief* (SP-*2170*) was dispatched to inspect the damage. It reported the wrecked tanker was burned out and probably a total loss. It is unclear, however, as to the source of the fire as the crew did not report the ship burning when they abandoned the vessel; it is possible *Relief* had spotted the remains of several other tankers torpedoed and left adrift in mid-March, including *Olean* and *Ario*. The ship later broke apart and sunk, with further evidence of being broken apart in 1954 (Moore 1983:26; DIO 1987:143; Hickam, Jr. 1989:72-73; Wynn 1997:221).

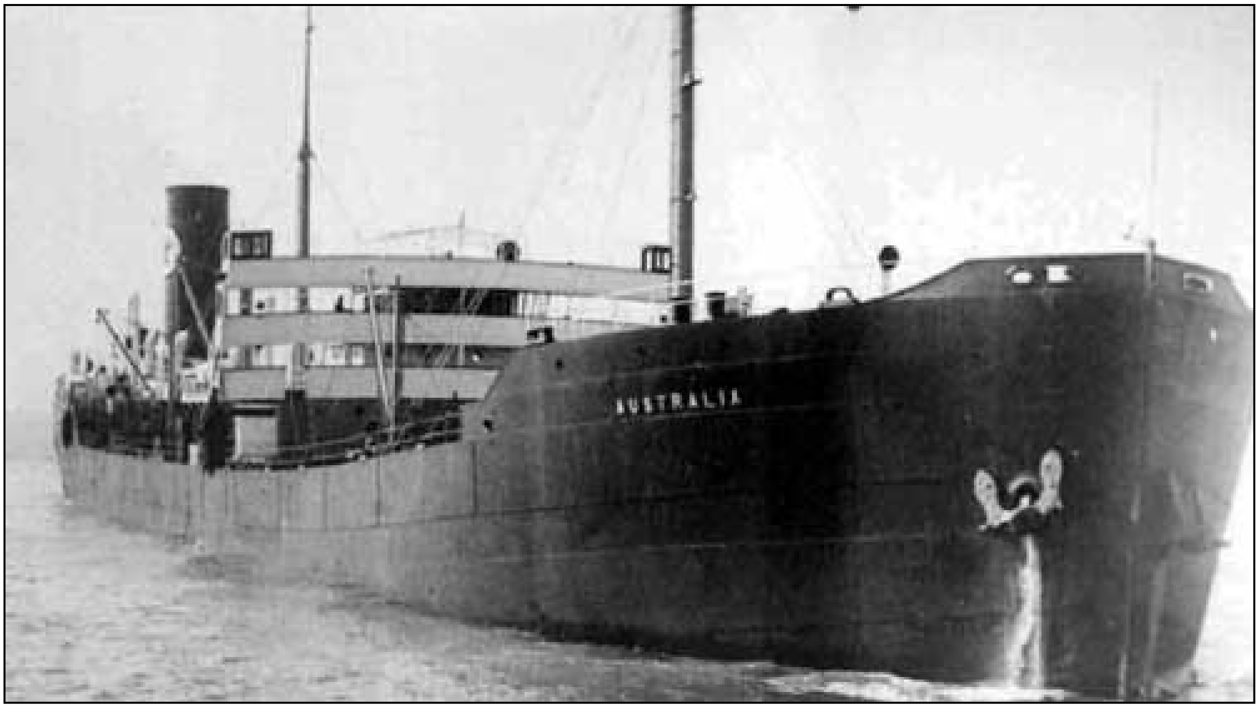


Figure 7-34 ***Australia*, date and location unknown.**
Source: Mariners' Museum and Park

7.5.2 Archaeological Site Description

The same day the tanker was abandoned by the crew and left aground on Diamond Shoal, USCGC *Dione* placed lights aboard the ship to warn off other mariners of the potential hazard to navigation (DIO 1987:143). Since the vessel foundered on the shoals for so long, it was likewise easily spotted by USCGC *Gentian* in the fall of 1943, where an additional navigation buoy was placed on the wreck, and the tanker's two masts were still reported as visible above the water (DIO 1944:Appendix B,23). In short, the tanker's location was fairly well known following the war. Structural degradation and the shifting of Diamond Shoals, however, resulted in the vessel settling into 110 ft of water, with much of the ship's structure disarticulated.

Figure 7-35 ***Australia* still with bow floating, dated 20 March 1942.**
Source: NARA

Figure 7-36 View of tanker *Australia* down by its stern.
Source: NARA

During 2011, the team conducted a high-resolution multibeam sonar survey of the *Australia* wreck site, resulting in an extremely detailed 3D point cloud model of extant structural remains (Figure 7-37). The resulting data revealed a preponderance of buried sections along an otherwise linear arrangement of material.

Distinct bow, midships, and stern sections were clearly discernable in the sonar data, with small debris fields extending to the starboard side of both the bow and midships sections. A small section of high relief was located at the stern of the vessel, consisting of the various elements of the vessel's machinery and propulsion system. The surrounding geology—the shifting outer sands of Diamond Shoals—can variably cover and uncover portions of the vessel. Despite being situated in a depth of 110 ft, the proximity to the outer shoals resulted in a dynamic environment with highly variable site conditions. Temperature, visibility, and current can be highly variable throughout a single season. During a visit to the site in 2013, a dive team captured the images of the stern structure and diesel engine machinery shown in Figure 7-38 and Figure 7-39.

The wreck site consisted of two significant feature areas, with a small contingent of remains located amidships. The bow area measured approximately 30 ft in length and 35 ft at its widest beam. Moving aft, there was a large featureless field of approximately 150 ft, followed by disarticulated features that extended outward to approximately 110 ft in width. This area, amidships, contained the widest area of site scatter. Continuing aft, the stern section extended approximately 156 ft in length, with a beam of approximately 53 ft. Most of the observable wreck remains were located at this stern section. This site was located in an area known for extreme shifts in sediment deposition and at times may have far more, or less, exposed.

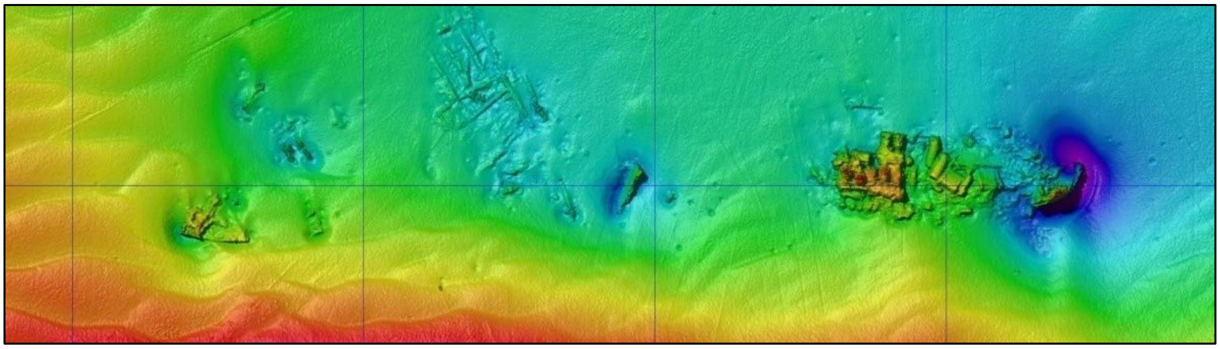


Figure 7-37 Exported Reson 8125 scaled multibeam survey of *Australia* wreck site 455 kHz 6-mm resolution.
Source: ADUS/NOAA

Figure 7-38 Diver view from inside relief of stern section of *Australia*.
Source: NOAA

Figure 7-39 Cylinder Diesel Engine piston and connecting rods located at the stern of *Australia*.
Source: NOAA

7.6 Bluefields

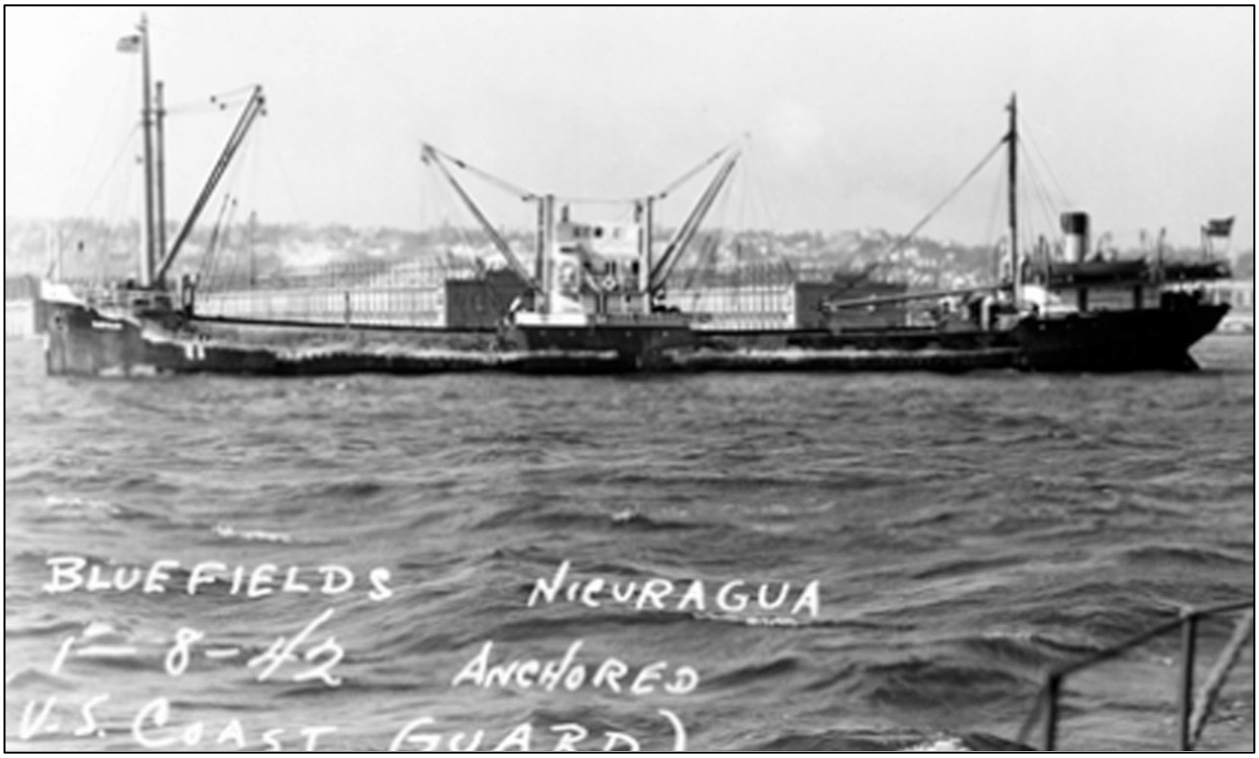


Figure 7-40 Port side view of *Bluefields;* 8 January 1942, location unknown.
Source: Mariners' Museum and Park

Table 7-6 Characteristics of *Bluefields*

Characteristics	*Bluefields*
Year of Build/Type/Hull #	1917/Freighter/81
Date Lost	15 July 1942
Position & Depth	25 Miles S of Cape Hatteras, NC Approximately 690 ft
Ship Characteristics	Length: 250.5'; Breadth: 43.5'; Depth: 20.4' Gross Tonnage: 2,063
Cargo	Two cars, radio, empty burlap bags, and drums of carbide and oil
Survivors	24 (24 Total on board)
Owner	Garcia A. & Cia. Ltda (Nicaragua)
Builder	Manitowoc Shipbuilding Co., WI (Shipbuilding History 2014)
Former Names	*Jupiter* (Garcia Lizardo, 1938-1941) *Ormidale* (Gravel Products Co., 1923-1938) *Astmacho III* (Astmacho Navigation Co., 1920-1923) *Lake Mohonk/Motor I* (US Shipping Board, 1917-1920)
Lloyd's Register Details	One deck, two 12 cyl. Diesel engines, twin screws
Port of Registry/Flag	Nicaragua
Sunk by	U-*576* (Hans-Dieter Heinicke)
Data Collected	Side Scan 2013; Multibeam 2014; Laser scaning 2016.

7.6.1 History

Merchant vessel *Bluefields* served in a critical capacity during both the First and Second World Wars (Figure 7-40, above). While under construction in 1917, the vessel was requisitioned by the United States Shipping Board (USSB) in response to the shipping needs of the ongoing war in Europe. The vessel was launched in 1917 as *Lake Mohonk*, and left the Great Lakes to provide its services to the USSB until 1919. Following its wartime service, *Lake Mohonk* returned to private interests and went through several owners. First owned by Astmacho Navigation Co, of New York, the vessel was repowered and named *Astmacho III*. In 1921, it was sold to Ormidale Steamship Co. of Wilmington, Delaware, and renamed *Ormidale* (Figure 7-41 and Figure 7-42). In 1927, the vessel finally returned to the Great Lakes after it was purchased by Gravel Motorship Company of Buffalo, New York. During this time it kept the name *Ormidale* and transported bulk cargoes of stone and coal (Lloyd's Register of Shipping 1918-1942).

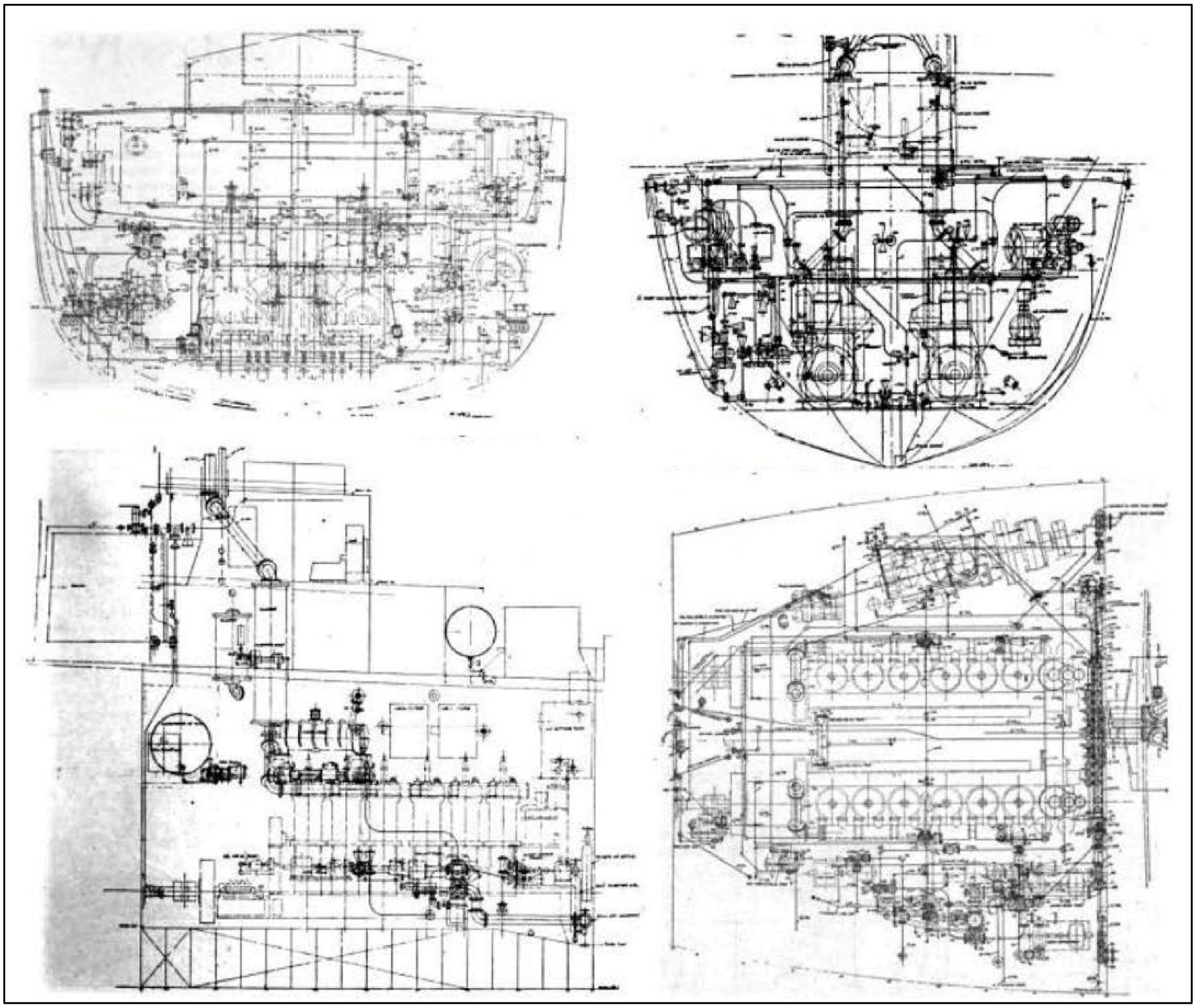


Figure 7-41 Arrangement of *Bluefields* sister ship *Astmacho IV* during conversion.
Source: *Motorship* 1921:397

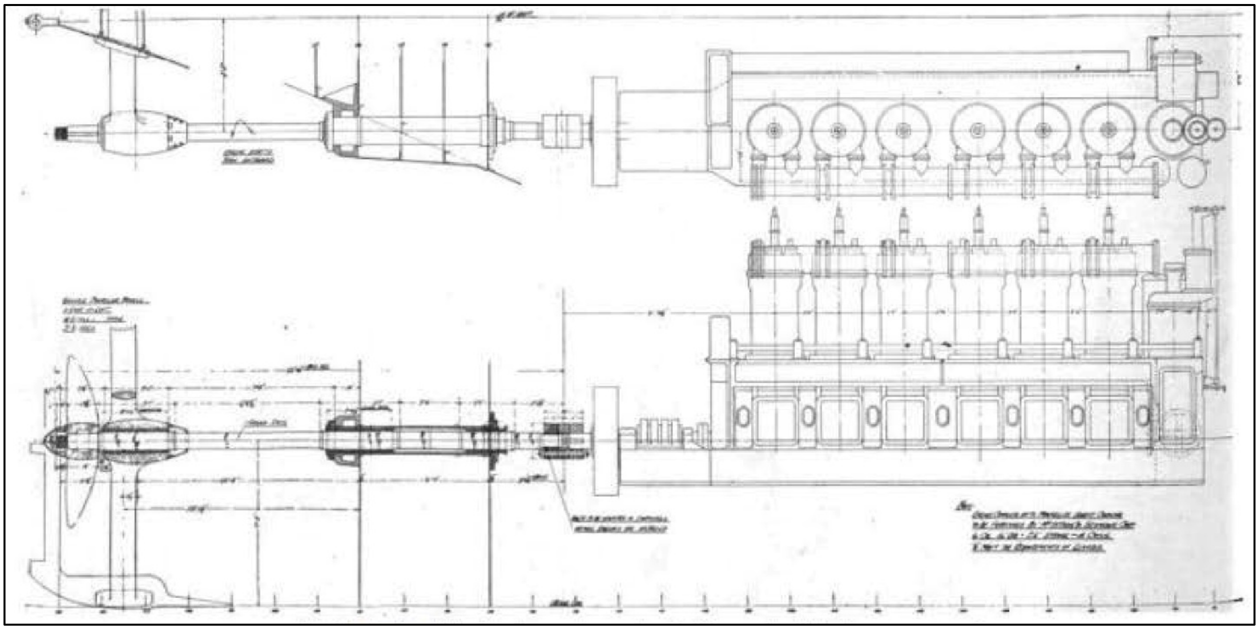


Figure 7-42 Details of *Astmacho IV* showing new propeller-shafting and stuffing-box arrangement.
Source: *Motorship* 1921: 398

The vessel's years of peacetime service on the Great Lakes did not go without incident. On a foggy October night in 1935, *Ormidale* accidentally rammed and sunk the Norwegian freighter *Viator* in Lake Huron, just off Thunder Bay Island. Unlike *Viator*, *Ormidale* stayed afloat and, despite damage sustained, was able to return to service (*Ironwood Daily Globe* 1935). In 1938, *Ormidale* was sold and renamed *Jupiter* and began running cargoes between Central America and US ports. The vessel changed hands for a final time in 1941, being sold to Nicaraguan interest A. Garcia & Cia ltd and renamed *Bluefields*, the namesake of one of the country's Caribbean ports (Lloyds Register of Shipping 1937-1942). Thereafter, the freighter continued coastwise trading runs which inevitably involved war-related cargoes moving through United States waters. In May, 1942, *Bluefields* was traveling southbound with coastal convoy KS-502. At noon on 20 May, while rounding the North Carolina coast, convoy escort USS *Ellis* (DD-154) noticed smoke rising from the Nicaraguan freighter. Somehow the ship's cargo of Kapok, burlap, and paper had caught fire. Onboard, the crew had only a single firehose to fight the spreading flames. The USS *Ellis* came alongside, instructing the vessel to maneuver it's beam to the wind, and six fire hoses from the destroyer had the fires doused by 1430 hours. The ship, however, suffered sufficient damage to require it to put in at Beaufort, South Carolina, for repairs (Hoyt 1978:114-116; DIO 1987:272-274).

Having survived one close call (two, if the 1935 collision with *Viator* is factored) on 14 July 1942, 19 merchant ships, 3 Navy, and 2 Coast Guard escort vessels of convoy KS-520 assembled and then departed Norfolk, Virginia on a planned 7-day transit to Key West, Florida. During this route, the 19 ships in the convoy – *Mount Pera*, *Bluefields*, *Zouave*, *Tustem*, *Gulf Prince*, *Robert H. Colley*, *American Fisher*, *Para*, *Mount Helmos*, *Jupiter*, *Hardanger*, *Nicania*, *Toteco*, *Clam*, *Egton*, *J.A. Mowinckel*, *Unicoi*, *Rhode Island*, and *Chilore*—were under the protection of 5 support vessels, designated Escort Group Easy. These ships included USS *Ellis* (DD-154), USS *McCormick* (DD-223), USS *Spry*, USCGC *Triton* and USCGC *Icarus*. Several merchant vessels in the convoy also had Armed Guard crews aboard manning deck guns (Hoyt 1978:168; DIO 1987:411; Bright 2012; Bright et al. 2012).

Meanwhile, U-*576* was patrolling on station near Cape Hatteras. In the days prior to KS-520's departure, U-*576* was attacked and severely damaged by two patrol aircraft. Though not catastrophic, the attack ruptured one of the boat's saddle fuel tanks and ballast tanks; U-*576* was crippled, but not disabled. The boat's commander, Kplt. Heinicke, elected to remain in the area and returned to patrol the shipping lanes off Hatteras. It was no less than a day later that he spotted a large southbound convoy on the afternoon of 15 July and took the damaged U-boat into battle (Bright 2012; Bright et al. 2012).

At first, Heinicke ran a textbook submerged attack. Using the direction of the prevailing winds to mask the wake of the boat's periscope, Heinicke set up a submerged daylight approach angle which allowed him to target the largest ship in the convoy while remaining close to a deep-water escape route. U-*576* fired a full bow salvo, four torpedoes, aimed at two ships: *Chilore* and *J.A. Mowinckel*. Two torpedoes hit the lead ship, *Chilore*, while another hit *J.A. Mowinckel*. The fourth torpedo sailed past both its intended targets and hit a small ship in the rear column of the convoy: the freighter *Bluefields*. Chaos ensued as the remaining ships in the convoy scattered, crew members of *J.A. Mowinckel* and *Bluefields* were thrown into the sea, and the escort vessels sprang into action to find and retaliate against the attacking U-boat (DIO 1987:412-413; Hickam, Jr. 1989:285-287; Bright 2012).

What happened next proved the definitive event of the engagement: U-*576* surfaced amidst the scattering array of merchant vessels. An Armed Guard crew aboard American freighter *Unicoi* sprang into action and scored a series of hits on the U-boat. Simultaneously, the patrol aircraft attached to the convoy spotted and commenced their own attack run. The result was a combination of surface fire and aerial depth charges that quickly dispatched U-*576* with all hands lost. Heinicke's damaged boat appeared to be a critical factor where, after releasing four torpedoes, it was unable to remain submerged and surfaced indefensible among an armed convoy in the critical moments after its attack.

The first ships hit by torpedoes, *Chilore* and *J.A. Mowinckel*, remained afloat. *Bluefields*, on the other hand, quickly sank; all 24 members of the crew managed to escape safely. Within minutes both the U-*576* and its victim, *Bluefields,* were lost in close proximity to one another. For *Chilore* and *J.A. Mowinckel*, however, the ordeal was not over. As several of the escort vessels continued to sweep the area for U-boats, the convoy commander dispatched USS *Spry* to escort the two damaged vessels, still under their own power, to the nearest inlet for repairs. Waiting for them was yet another tragedy. Standing between this small rescue contingent and the safety of Hatteras Inlet was the large Hatteras Minefield: a network of overlapping mine paths established to create a safe, nearshore anchorage. Navigational errors, however, resulted in both *Chilore* and *J.A. Mowinckel* straying into the friendly minefield. Both ships, and a tug dispatched to assist them, hit mines. Thus, by the end of salvage operations the skirmish with U-*576* resulted in 3 lost ships (*Bluefields*, *Keshena*, and *Chilore*), 2 casualties from *J.A. Mowinckel*, 2 casualties from *Keshena*, and all hands lost (45) onboard U-*576* (see Standard Oil Company 1946:363-372; Bright 2012). See the narratives on *Chilore* and *Keshena* for more details regarding their losses and the events which unfolded as the vessels entered the Hatteras Minefield following the attack offshore. More information on the Battle of Convoy KS-520 is presented in Section 5.4.2.

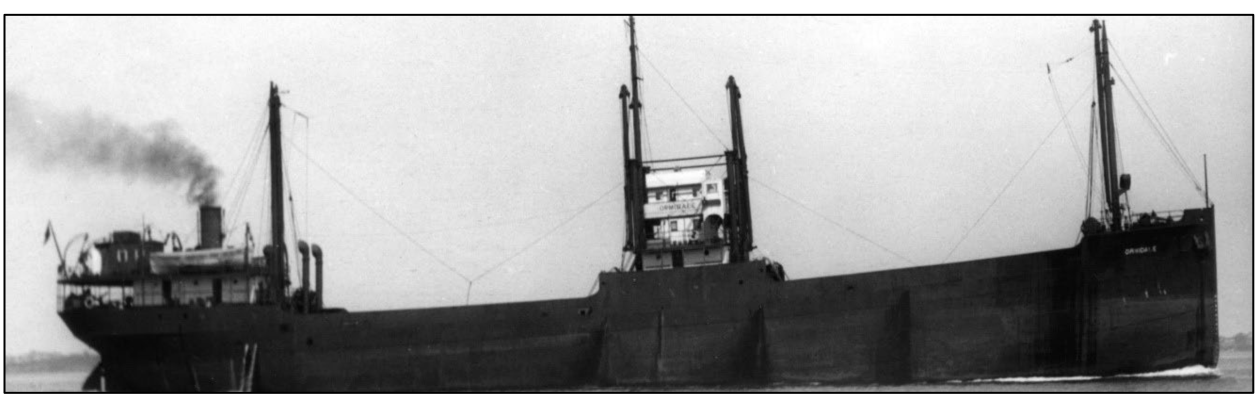


Figure 7-43 *Bluefields* shown as *Ormidale*.
Source: Steamship Historical Society of America

Figure 7-44 ***Ormidale*** **passing through a drawbridge.**
Source: Manitowoc Maritime Museum

Figure 7-45 ***Bluefields*** **under the previous name** ***Ormidale*****, predating 1938, location unknown.**
Source: Historical Collections of Bowling Green State University

7.6.2 Archaeological Site Description

As a unique circumstance of their loss, *Bluefields* and U-*576* constitute the only known remains of Allied and Axis vessels lost proximate to one another during the same combat event off the coast of the United States; the vessels lie less than 300 meters apart on the seafloor. In this way, the sites symbolize an uncommon archaeological record of a period naval battlefield. Unlike terrestrial battlefields, where combatants engage one another through a fixed landscape, the naval battles constituting the bulk of the Battle of the Atlantic preceded through ephemeral features of the sea-surface, subsurface, and airborne spaces. These features included things like atmospheric conditions (visibility, weather, sun position, ambient light, etc.), coastal shipping routes, and oceanic conditions (ocean currents, water depths, bathymetric features, etc.) which were highly variable and dependent upon the exact time and place of an engagement.

During expeditions in 2009 through 2014, attempts were made to locate the sites during which time a number of candidate vessels were located. A systematic survey using the Simrad EM-1002 multibeam sonar system aboard NOAA RV *Nancy Foster* was conducted in 2009, which helped to provide information for future study of the sites, conducted in subsequent years. As the exact location for each site was unknown, survey attempts were made in areas most likely, due to geospatial and historical references, to locate the wreck sites. The location of *Bluefields* and U-*576* were believed to be located closely together.

Perhaps the most significant observations of the 2013 expedition were made at the suspected site of the freighter *Bluefields*. This target was originally surveyed by NOAA, creating a dataset that was later reprocessed, revealing a potential cultural anomaly (Figure 7-46). The location of the anomaly placed the target in the center of the highest probability area based on an amalgam of historic information (Figure 7-47). This fact made the target very appealing for further data acquisition. Unfortunately, the survey package assembled for this project consisted of dual frequency side scan sonar with 1,000 ft of cable. The target of interest is located in 750 ft of water. The rule of thumb for survey is to have three times the cable length for the depth of water in which the survey takes place. In this instance the team had just barely one length. However, since the objective was not to collect a series of parallel lanes, but to simply acquire a decent image of the target, several survey passes were attempted; two of which returned useful sonar imagery (Figure 7-48).

The first successful pass collected an image of the target in question. The observed dimensions were recorded as 244 ft long and 43.2 ft abeam. Historical dimensions of *Bluefields* were reported as 250.5 ft long and 43.5 ft abeam. The wreck was upright and intact and appeared to be on an even keel. The acoustic shadow suggested high relief; however, on the first pass the outside edge of the shadow was outside the channel, and clipped off any details that might be observable. Some deck features were clearly evident, most notably an amidships bridge and superstructure and two longitudinal features extending fore and aft on either side of the bridge (Figure 7-49). The survey tile was further processed to reduce pitch error distortion.

During the second low-frequency pass, the sonar towfish passed directly over the site, splitting the image into two channels. However, the results provided additional definition on deck features as well as provided a valuable acoustic shadow with observable vertical features (Figure 7-50). In this image two vertical posts are clearly seen amidships with high reflectivity. These correspond to vertical shadows. In the shadow area, it can be seen that there are in fact four vertical posts oriented around a shorter bulkier structure. These posts are consistent with king posts surrounding the amidships superstructure observed on *Bluefields* in historic images. Additional comparison to historic imagery reveal consistency in the location of fore and aft cargo cranes as well as derrick masts located at the bow and stern.

Given the wreck's dimensions, observable deck features, and its location on the seabed, it was very likely this was the wreck of the *Bluefields*. No other comparably sized or outfitted vessels were known to have been lost in this area. In 2014, the team returned with an AUV to survey the area of the suspected *Bluefields* and U-*576* wreck sites. This survey confirmed the identity of U-*576*, strongly suggesting the adjacent remains, some 300 m distant, were indeed the remains of *Bluefields*. Submersible dives in 2016 confirmed the wreck to be *Bluefields* by affirming dimensions and observable damage consistent with the narrative of the sinking event. These dives allowed researchers to see that the vessel is remarkably intact, with obvious torpedo damage on the portside forward of amidships. The rest of the vessel is entirely intact including deck cabins (Figure 7-51 and Figure 7-52).

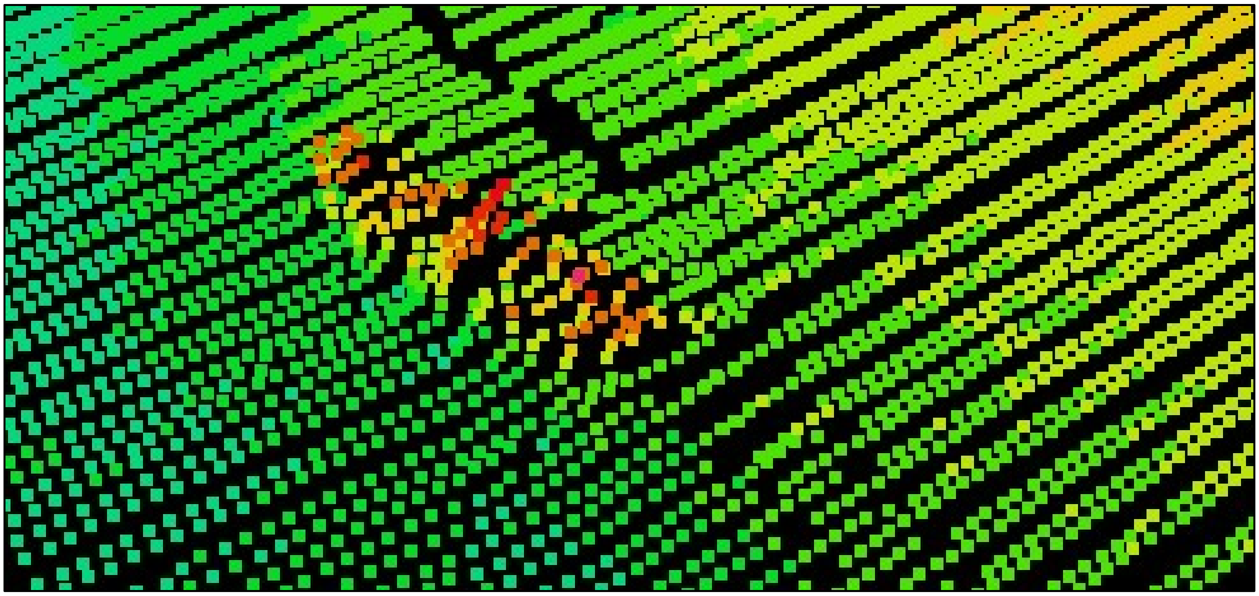


Figure 7-46 Alternative visualization of reprocessed multibeam of Target A site.
Source: SRI/NOAA

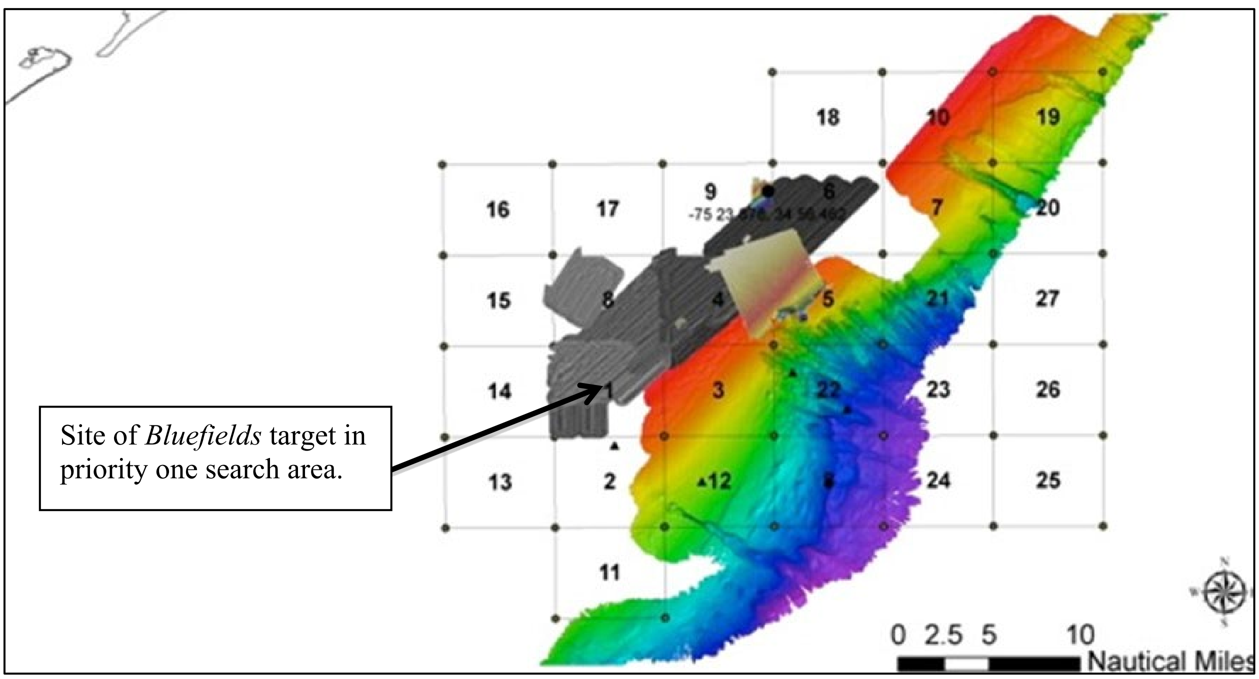


Figure 7-47 The location of the unknown target within the search area.
Source: NOAA

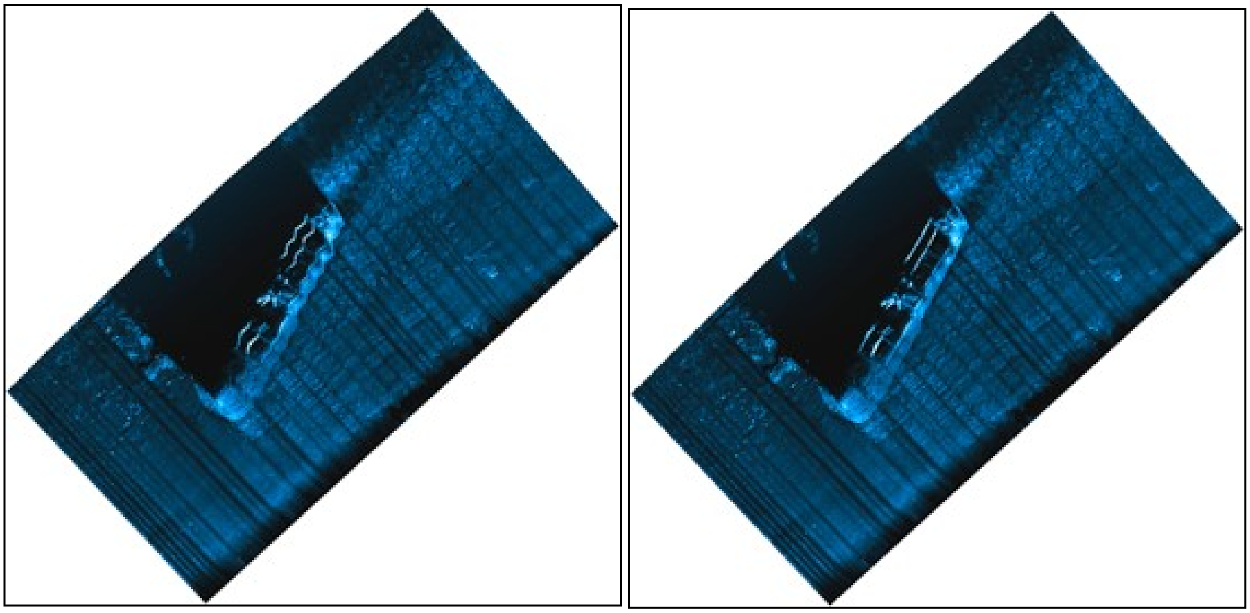


Figure 7-48 Low frequency sonar image of the *Bluefields* wreck site. Left: unaltered sonar image. Right: Same image altered to reduce pitch error distortion.
Source: NOAA

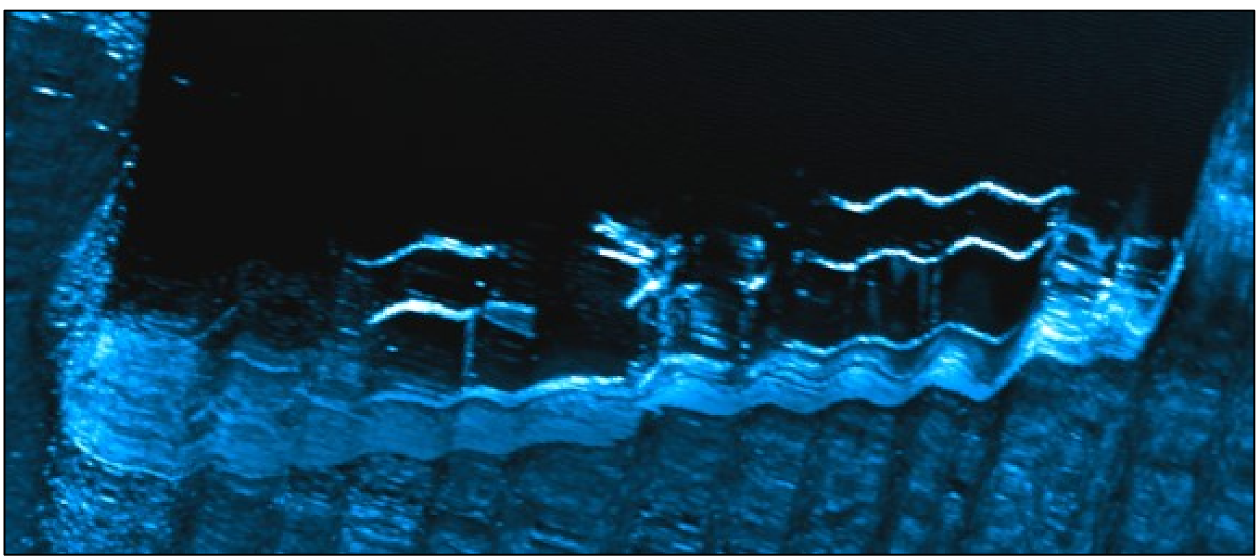


Figure 7-49 Low frequency sonar image of the *Bluefields* wreck site.
Source: NOAA

The site was observed visually via manned submersible and a high-resolution laser scan of the vessel was collected (Figure 7-53). Range limitations for effective acquisition of laser data were problematic on some areas of the wreck due to obstacle and entanglement concerns. The highest area of relief is actually located amidships where the intact remains of the bridge and pilothouse are located. This area has a lot of vertical relief and debris that made safe navigation of this area difficult in manned submersibles. As a result, the vehicle could not approach close enough to collect data and the resultant image shows a dark data holiday in the amidships area (Figure 7-54 and Figure 7-55). This makes it appear that the center portion of the vessel is more degraded than it actually is.

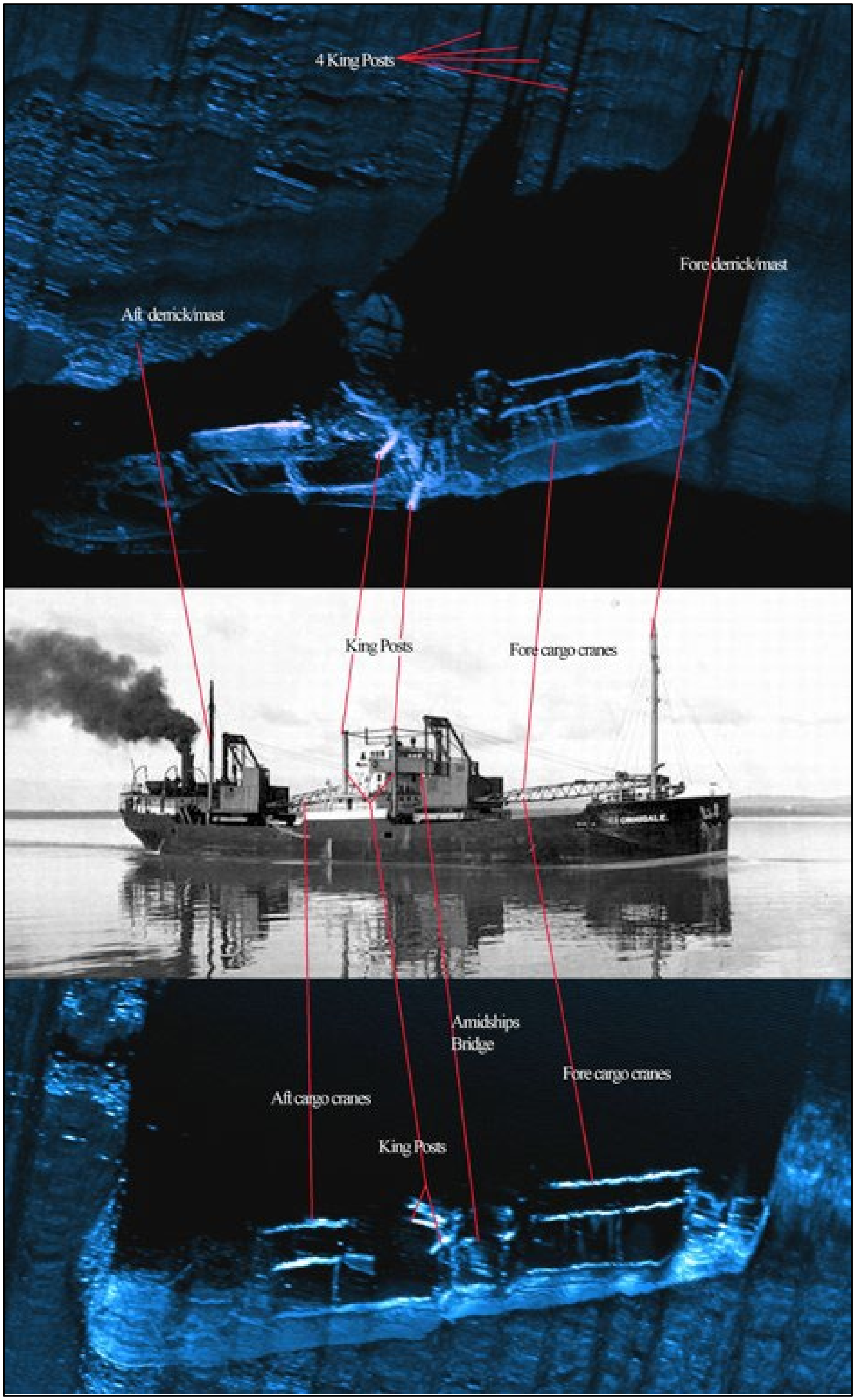


Figure 7-50 Comparison of common features between historic photos and sonar imagery of *Bluefields*.
Source: Composite NOAA and Historical Collections of Bowling Green State University

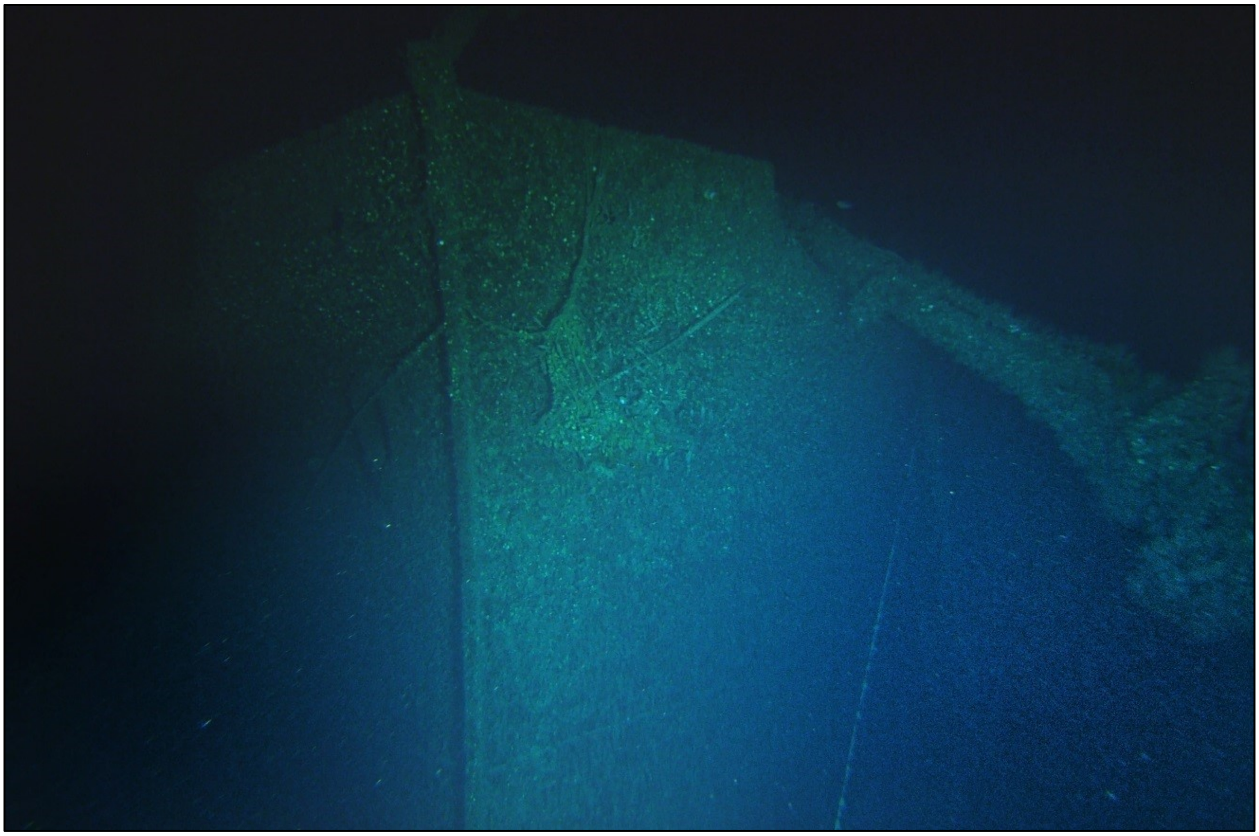


Figure 7-51 Intact bow of *Bluefields* with port anchor still in place.
Source: John McCord, UNC-CSI

Figure 7-52 Intact stern deck cabin of *Bluefields*.
Source: John McCord, UNC-CSI

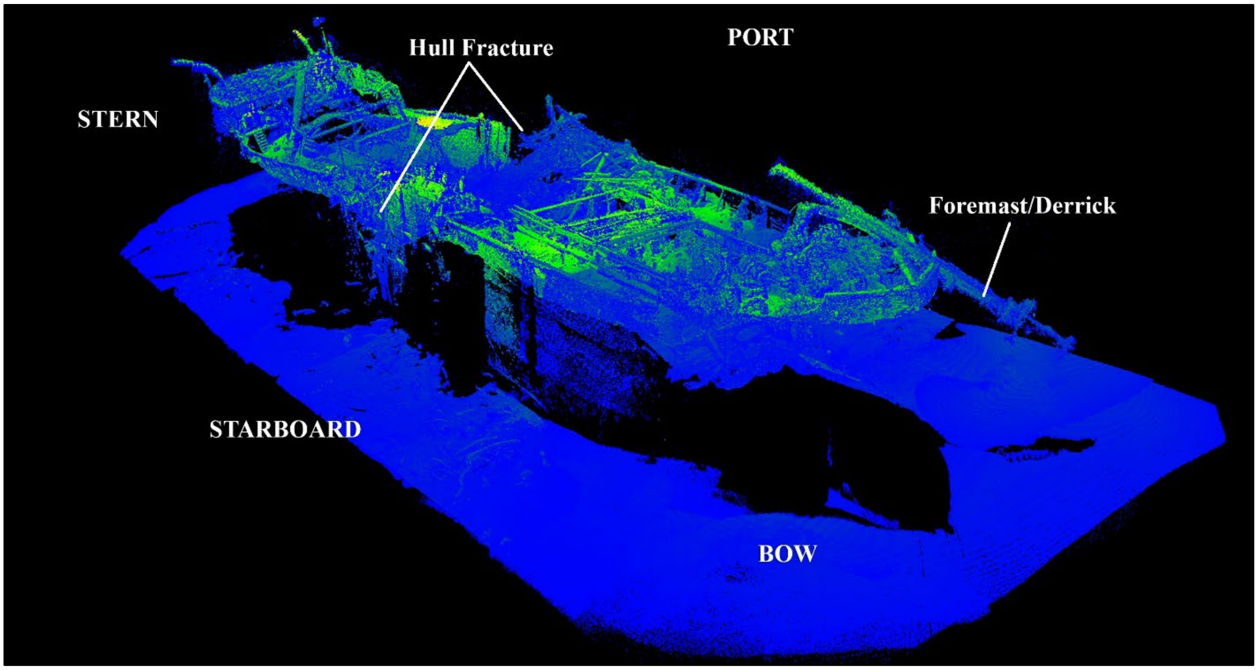


Figure 7-53 Perspective view of *Bluefields* wreck site.
Source: NOAA/2GRobitcs/Sonardyne

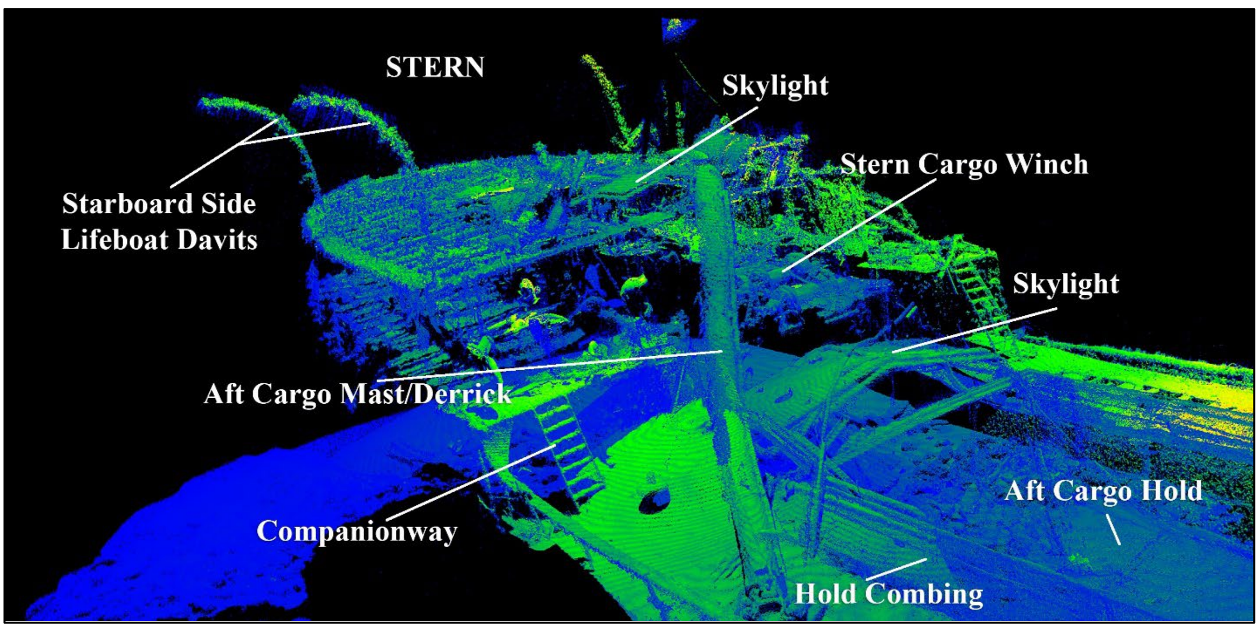


Figure 7-54 Detail view of stern section of *Bluefields*.
Source: NOAA/2GRobotics/Sonardyne

Remains of cargo are strewn throughout the wreckage. Both holds retain a horde of jumbled mixed cargo, which is also littered upon the deck and spilling out onto the surrounding seabed adjacent to the amidships hull breach (Figure 7-55). Observable cargo consists primarily of ceramic toilets, both bowls and tank reservoirs, as well as countless glass bottles, predominantly wine-bottle sized or several gallon glass carboys (Figure 7-56). Conspicuously, the remnants of a motor vehicle can be seen on deck just forward of amidships on the port side (Figure 7-56). It is believed two vehicles were strapped to the deck at the time of loss.

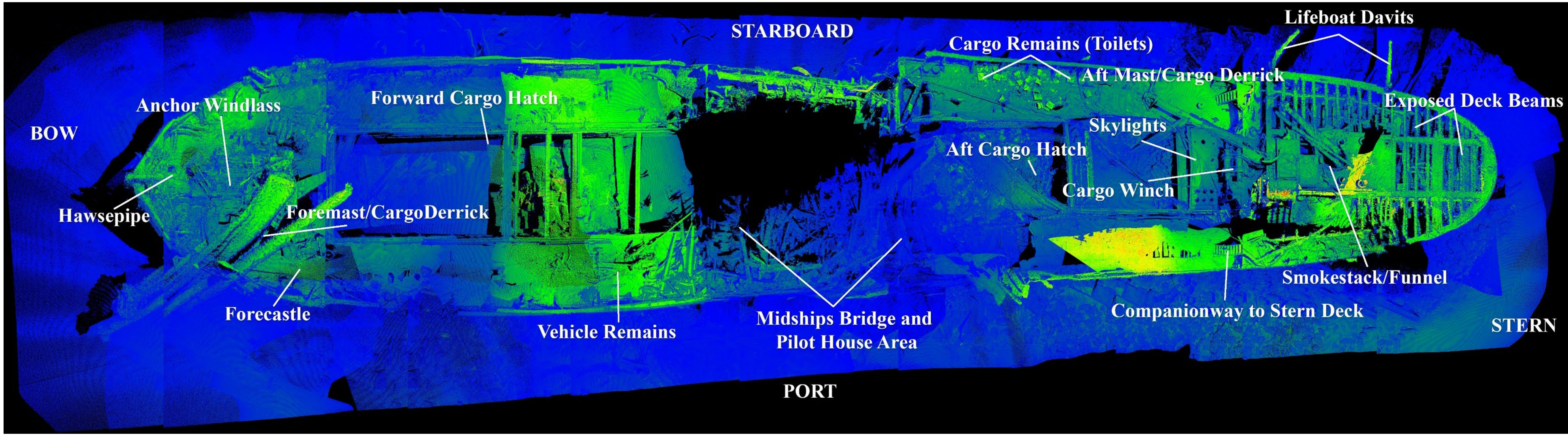
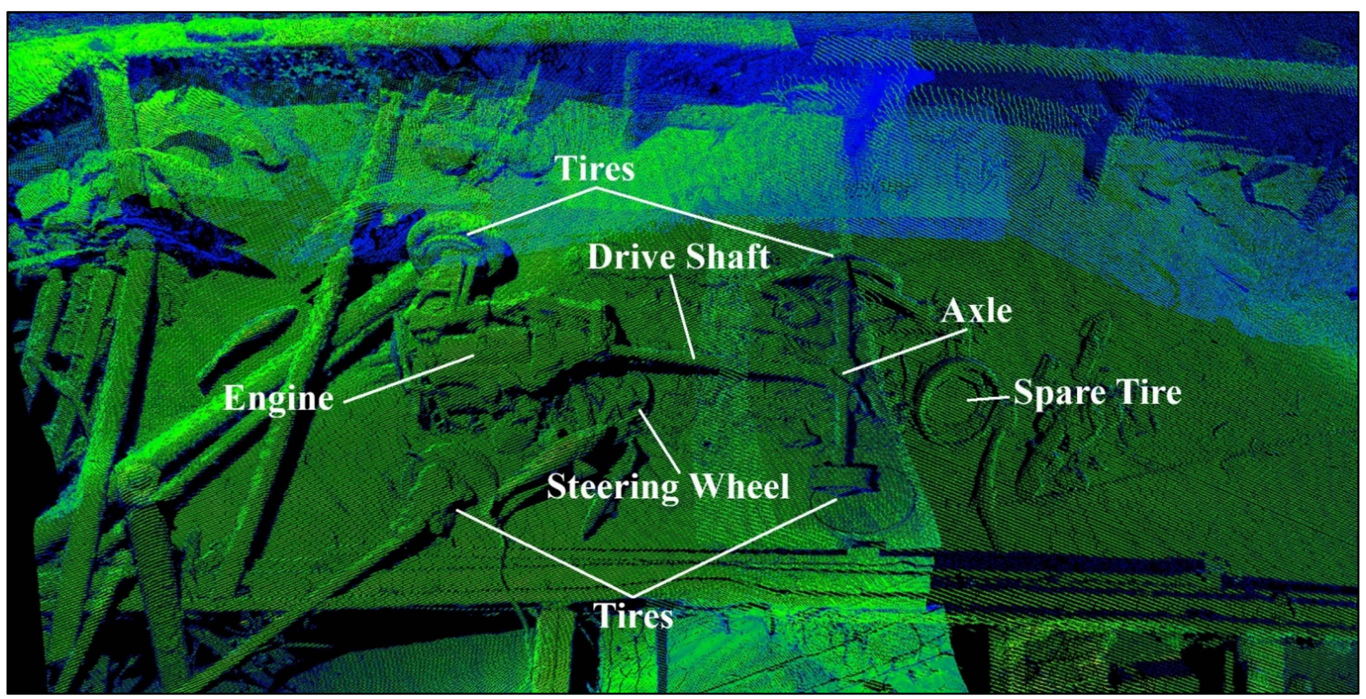


Figure 7-55 Plan view ULS500 laser data of *Bluefields* wreckage.
Source: NOAA/2GRobotics/Sonardyne



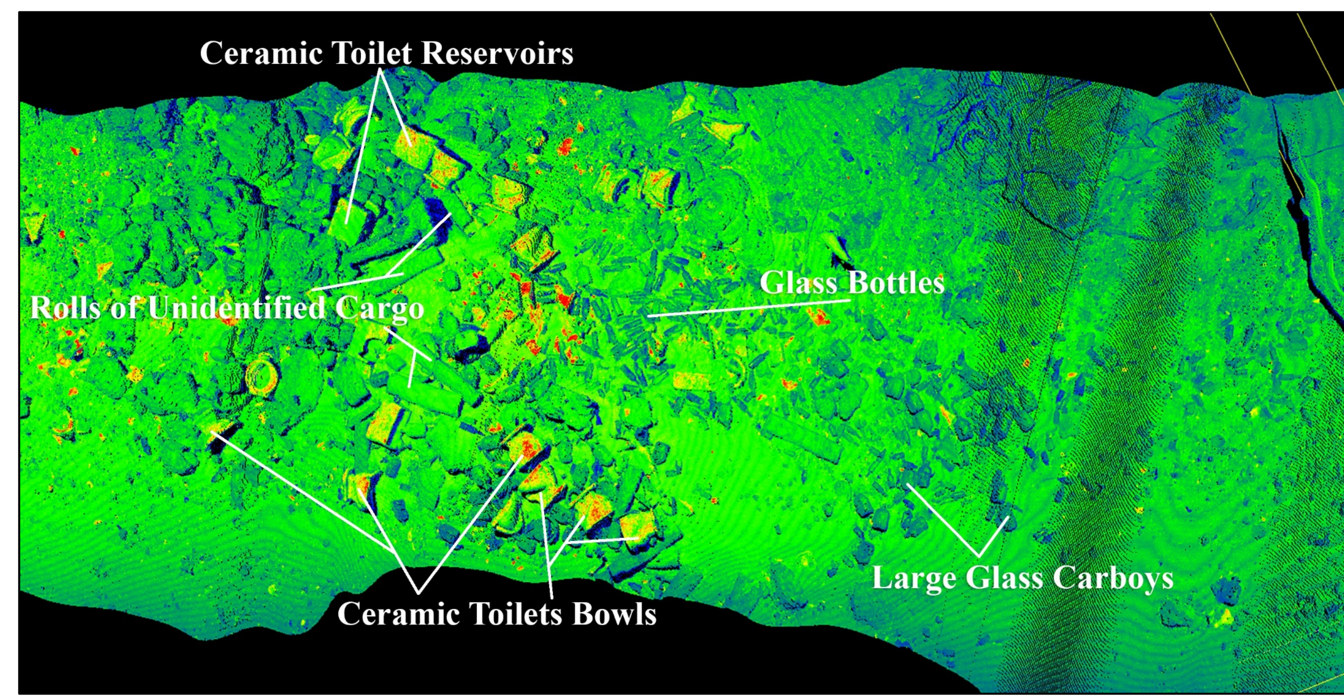


Figure 7-56 Remnants of a motor vehicle on the deck of *Bluefields* (NOAA/2GRobitcs/Sonardyne) [Left] and detail of debris field near starboard amidships [Right].
Source: NOAA/2GRobotics/Sonardyne

7.7 British Splendour

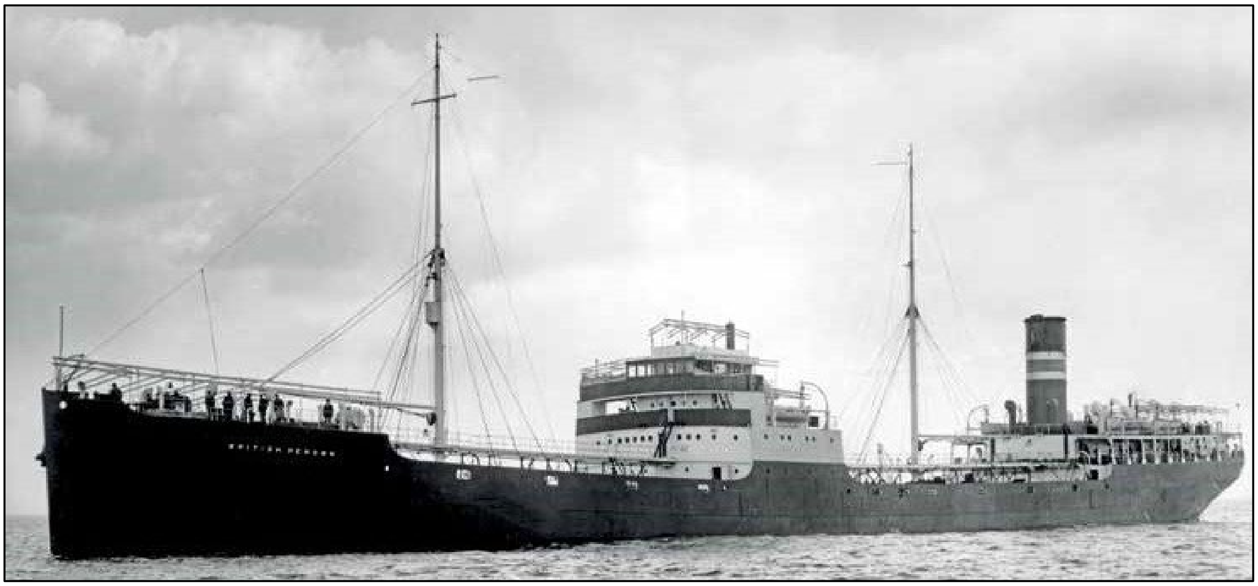


Figure 7-57 British Tanker Company's *British Renown*, a 1928-bulit tanker of similar size and configuration as *British Splendour*.
Source: BP Shipping 2015:34

Table 7-7 Characteristics of *British Splendour*

Characteristics	*British Splendour*
Year of Build/Type/Hull #	1931/ Tanker/162546
Date Lost	7 April 1942
Position & Depth	35 miles SW of Cape Lookout, NC 100 ft
Ship Characteristics	Length: 441.2' Breadth: 59.7' Depth: 33.0' Gross Tonnage: 7,138
Cargo	10,000 tons of benzene (gas/fuel)
Survivors	41 (53 Total on board [12 dead])
Owner	British Tanker Co. Ltd., London, England
Builder	Palmer's Shipbuilding & Iron Co., Newcastle, England
Former Names	N/A
Lloyd's Register Details	Steel hull, two decks, flat keel, single screw, 4 cyl. diesel motor, two stroke cycle single acting engine, 2 donkey boilers
Port of Registry/Flag	London, England/ UK
Sunk by	U-*552* (Erich Topp)
Data Collected	ADUS Survey 2011; photo and video 2013.

7.7.1 History

Built in 1931 by Palmer's Shipbuilding and Iron Company, *British Splendour* carried fuel for the British Tanker Company of London (Table 7-7 and Figure 7-57, above). During the war, *British Splendour* continued to freight fuel and in early April 1942, the tanker left Houston, Texas to meet with a British convoy in Nova Scotia. Under the command of Master John Hall, *British Splendour* cruised off the coast of North Carolina, with escort vessels HMS *St. Zeno* (FY-*280*) and HMS *Hertfordshire* (FY-*176*) nearby (Figure 7-58; Lloyd's Register of Shipping 1931-1942; Hickam, Jr. 1989:124).

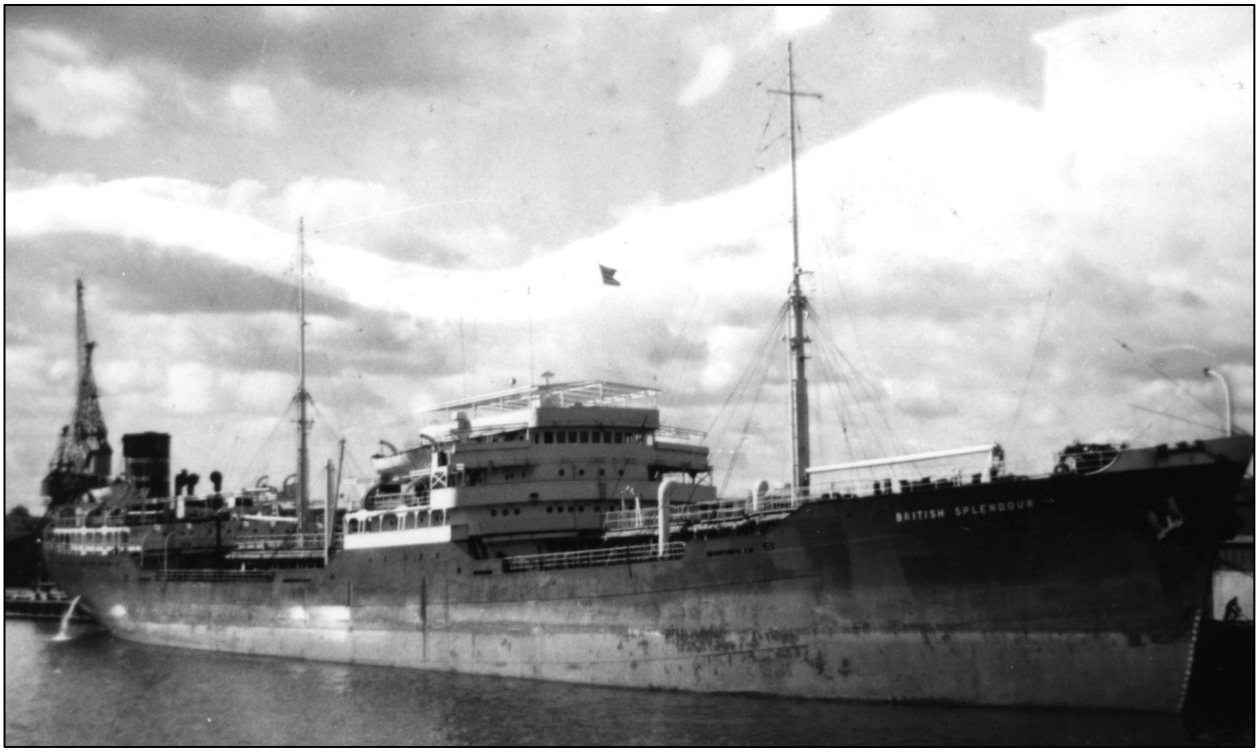


Figure 7-58 ***British Splendour*, date and location unknown.**
Source: Steamship Historical Society of America

Meanwhile, on 7 April 1942, Kptl. Erich Topp in command of U-*552* patiently prowled under the cover of darkness, following an unsuspecting *British Splendour*. Hoping to draw the tanker nearer to the U-boat, Topp illuminated a blinking red alight atop the conning tower, simulating an area shoal buoy; it worked. *British Splendour*, believing they were rounding Cape Hatteras, sped up and passed near the 'buoy' at almost a perfect right angle, giving Topp an ideal firing position. At approximately 2200 hours, U-*552* fired a single torpedo at the passing tanker. It was a devastating hit, striking the port side near the engine room. Immediately the ship was disabled and 12 crew members were killed. Fire spread and when it reached the storage areas, the provisions of gas engulfed the ship in a furious blaze. Master Hall gave the order to abandon ship and within 2 hours, the vessel sank beneath the waves. The surviving 41 crew safely made it into lifeboats and were rescued and later taken to Norfolk, Virginia (Hickam, Jr. 1989:124-125; Wynn 1998:28). After landing in Virginia, US Naval personnel attended to their injuries and distributed supplies among the crew, as shown in Figure 7-59 through Figure 7-62.

Kplt. Erich Topp, in command of U-*552*, would continue this war patrol in American waters and go on to become one of the most decorated German U-boat commanders of the entire war. This war patrol would be among the most successful of any U-boat operating along the US coast (see *Atlas*) throughout the Battle of the Atlantic.

Figure 7-59 Crew members share cigarettes.
Source: NARA

Figure 7-60 A US Naval officer inspects the injured hand of a rescued *British Splendour* crew member.
Source: NARA

Figure 7-61 An American Red Cross worker distributes toiletries to the crew.
Source: NARA

Figure 7-62 Capt. J. Hall passes a cigarette to first officer J. Lumley of *British Splendour*.
Source: NARA

7.7.2 Archaeological Site Description

Following the attack, the vessel settled upside down, as evidenced by the hull plating facing toward the surface. The remains of *British Splendour* featured a small section of high relief, located at the stern of the vessel, where most the distinct engineering features were visible. At a depth of 100 ft, but located in a dynamic zone, site conditions typically vary over the course of a year with shifting sands and variable currents creating an ever changing environment. During 2013, one dive rotation was made on the wreck site of *British Splendour.*

A multibeam sonar survey was conducted in 2011 in collaboration with ADUS using a Reson 8125 (Figure 7-63). The site measured 421.5 ft long by 60.6 ft wide and consisted of two main debris field areas, located at the bow and stern (Figure 7-64 and Figure 7-65). The bow section extended amidships for approximately 125 ft, where there was a distinct break in the hull. Only a few features were visible in an area extending from this break toward the stern area, accounting for approximately 170 ft of open sandy area with scattered debris. The stern section contained the highest relief on the site and encompassed a length of approximately 120 ft by 58 ft at beam.

There is a separation of the hull surrounding the boiler space allowing for access into the hull where the boilers can be seen. At the bow, the hull plating has been lost, however the stem and keelson remain intact forming a large arch (Figure 7-66). The crankshaft for the propeller is dislodged and protruding from the port side (Figure 7-67).

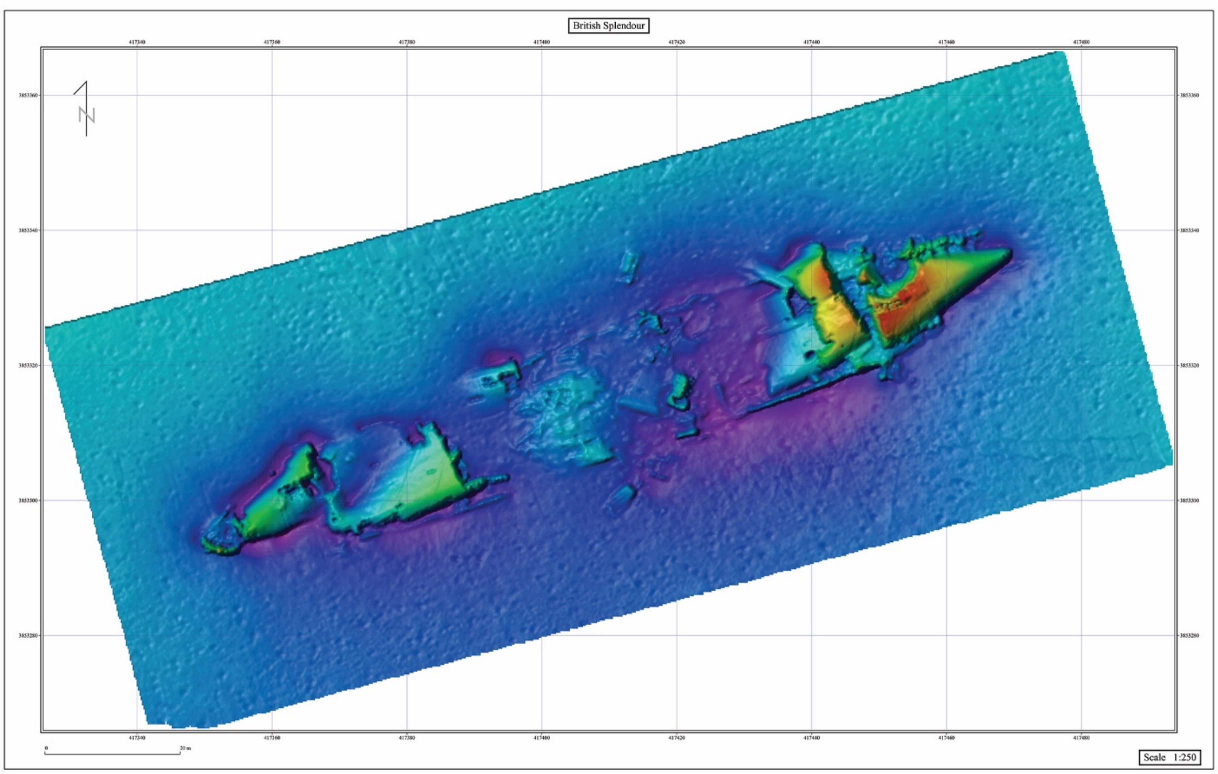


Figure 7-63 Reson 8125 multibeam of *British Splendour* 455 kHz 6-mm.
Source: ADUS/NOAA

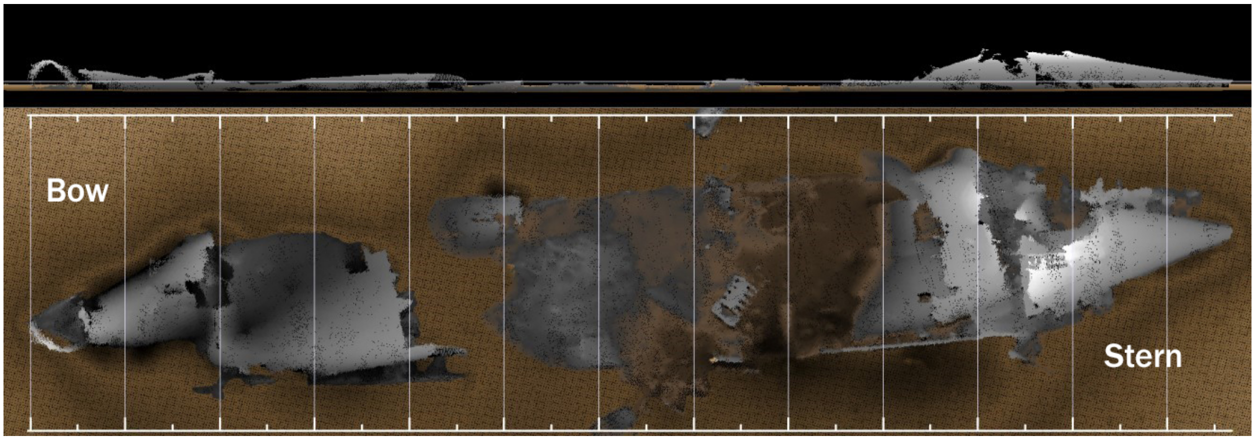


Figure 7-64 Multibeam SONAR visualization of the *British Splendour* wreck site scaled in 10-m grid.
Source: ADUS/NOAA

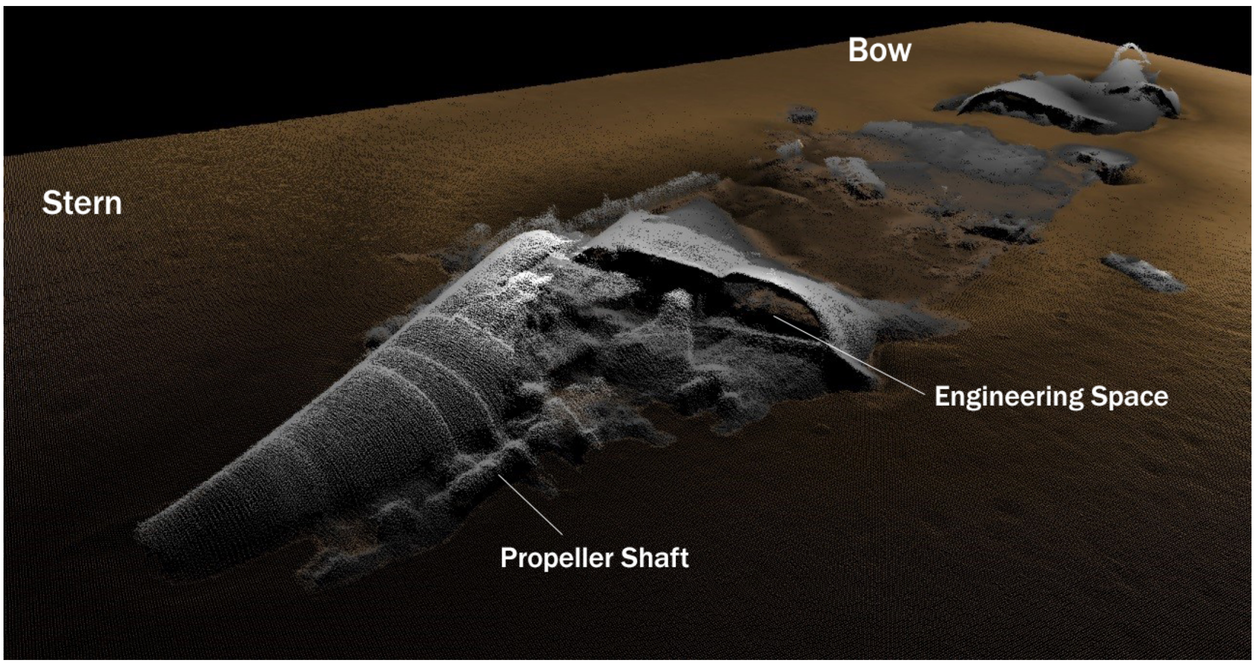


Figure 7-65 Isometric SONAR visualization of the *British Splendour* wreck site; stern in the foreground.
Source: ADUS/NOAA

Figure 7-66 Inverted stem and keel at the bow of *British Splendour* in 2011.
Source: J. Hoyt – NOAA

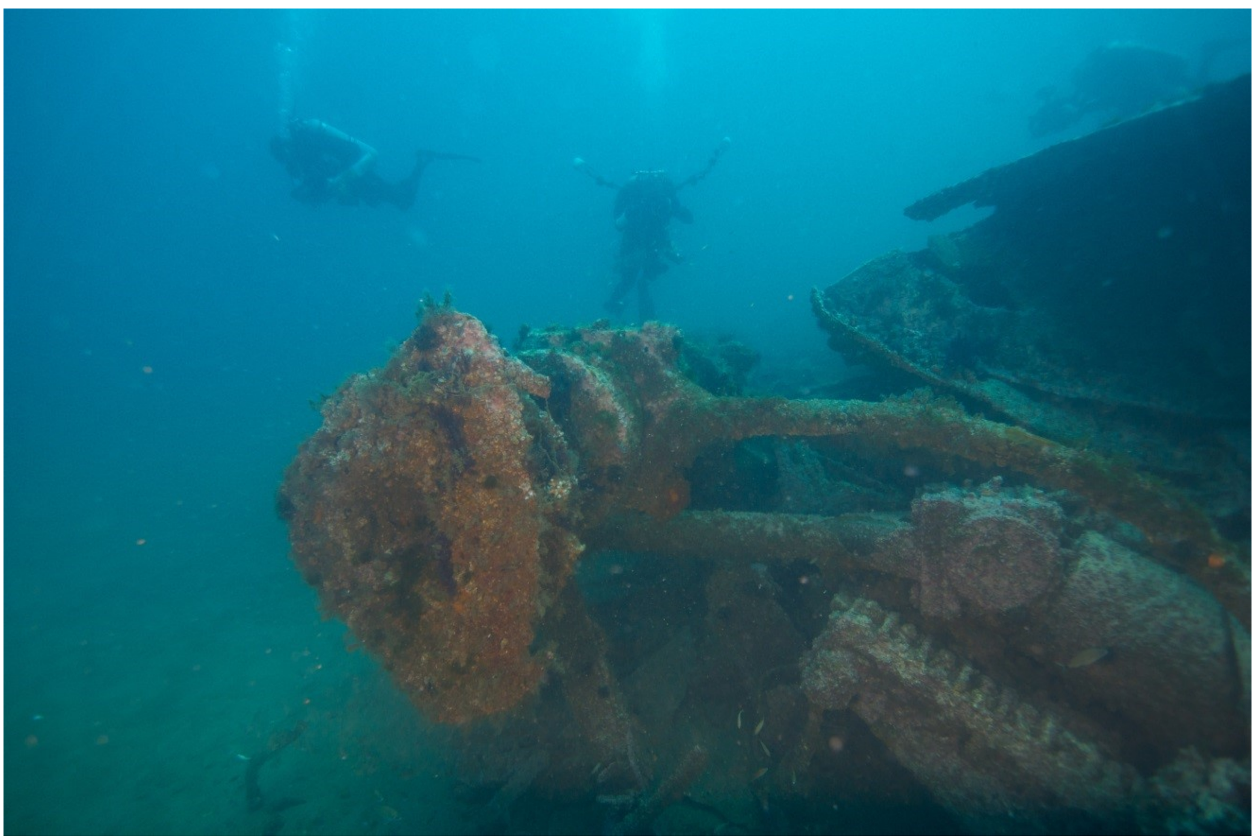


Figure 7-67 Connecting rods and propeller shaft located toward the stern of *British Splendour*.
Source: J. Hoyt – NOAA

The site of *British Splendour* was visited again in 2018 for a more detailed site investigation in collaboration with the Battle of the Atlantic Research and Expedition Group. This survey was successful in conducting a comprehensive photogrammetric survey of the entire site. While the majority of the site appears relatively unchanged from 2011 to 2018, there is one prominent feature missing. The keelson and stempost assemblage that formed a distinctive arch shape in 2011 was now completely gone. A definitive reason for its disappearance is difficult to ascertain. It is possible that this is representative of damage from inadequate anchoring practices from fishing vessels or dive boats. Had the material degraded naturally some remnants of its collapse would be expected, however it appears the remains have been completely removed from the area (Figure 7-68).

Figure 7-68 Bow section of *British Splendour* in 2018 showing missing stem and keelson.
Source: J. Hoyt – NOAA

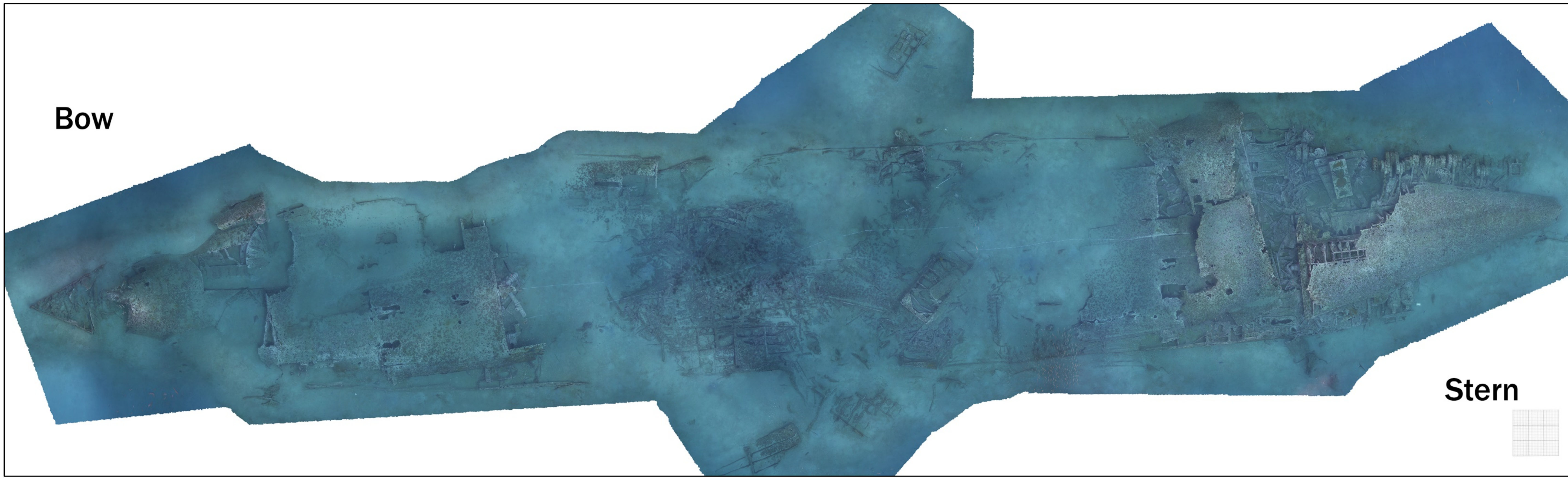


Figure 7-69 Orthographic photomosaic of the remains of *British Splendour* in 2018.
Source: J. Hoyt – NOAA

7.8 Buarque

Figure 7-70 *Buarque* image taken by US Coast Guard, date unknown.
Source: Steamship Historical Society of America

Table 7-8 Characteristics of *Buarque*

Characteristics	*Buarque*
Year of Build/Type/Hull #	1919/Freighter/534
Date Lost	15 February 1942
Position & Depth	Reported 25 miles E of Kill Devil Hills, NC Approximately 250 ft. Site not identified during present study.
Ship Characteristics	Length: 390.0' Breadth: 54.2' Depth: 28.0' Gross Tonnage: 5,152
Cargo	4,639 tons of general cargo including castor beans, rubber, beryllium, and aluminum ores
Survivors	84 (85 Total on board [1 dead])
Owner	Lloyd Brasileiro, Rio de Janeiro, Brazil
Builder	American International Ship Building Corp., Hog Island, PA
Former Names	Scanpenn (Moore & McCormack, 1932-1940) Bird City (Moore & McCormack, 1928-1932) Bird City (US Shipping Board, 1919-1928)
Lloyd's Register Details	Two decks, web frames, DR geared steam turbine, fitted for oil fuel.
Port of Registry/Flag	Rio de Janeiro/Brazil
Sunk by	U-*432* (Heinz-Otto Schultze)
Data Collected	No field data (Screening Level Risk Assessment [NOAA 2013a])

7.8.1 History

Though freighter *Buarque's* service life ended as a Brazilian-flagged cargo ship, it began as part of a massive American ship-building program during the First World War (Table 7-8 and Figure 7-70, above). The American International Shipbuilding Corporation established the Hog Island, Pennsylvania shipyard in the fall of 1917 for the sole purpose to "…produce steel ships faster—and cheaper—than ships have ever been built before" (Stanley 1918:174). The yard, established under contract of the USSB, was needed to fulfill the gargantuan merchant shipping needs of the war. Here, standard sized vessels were assembled from pre-fabricated sections, fitted with oil-burning boilers and turbine engines; during the course of the war hundreds of these vessels were built and delivered to the Shipping Board, employing a workforce of over 30,000 shipbuilders (Figure 7-71). After the war, as the demand for merchant ships steeply declined, the yard closed. The island in the middle of the Delaware River is now occupied by Philadelphia International Airport (see Stanley 1918:173-184).

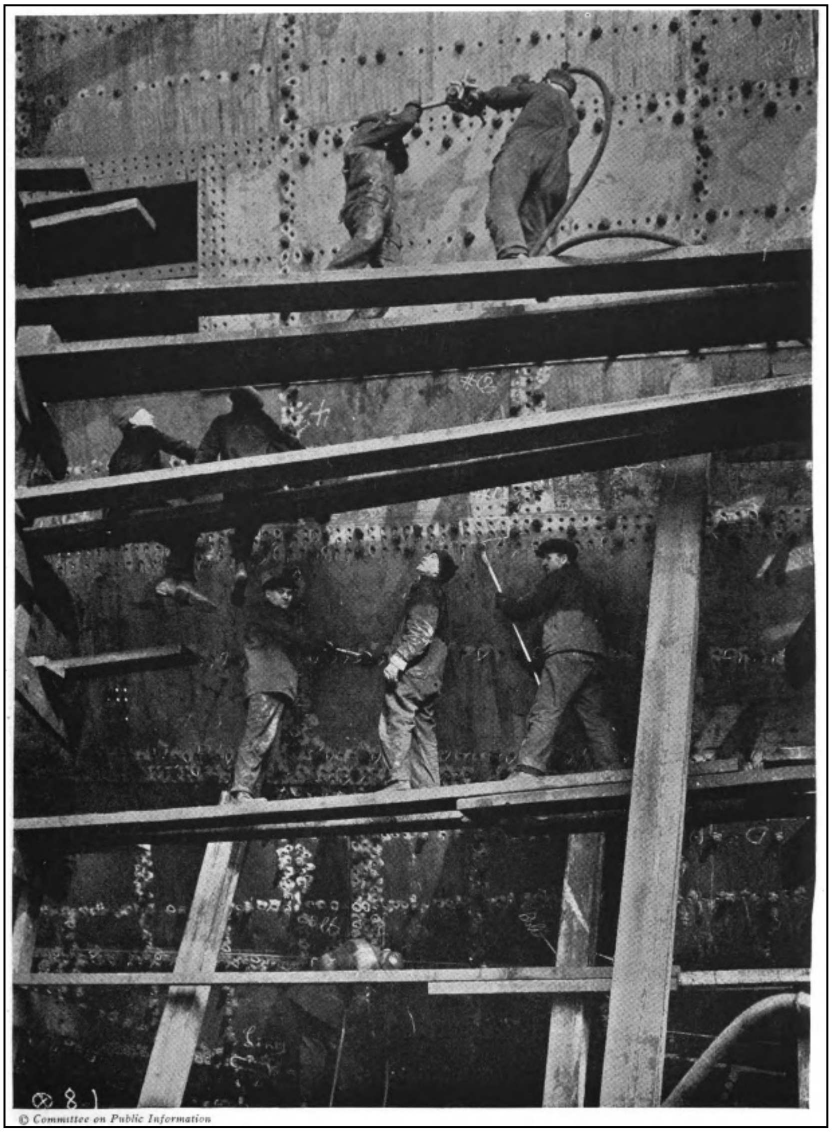


Figure 7-71 Workers at the American International Shipbuilding Corporation's Hog Island Yard assemble standardized, pre-fabricated merchant vessels.

Source: Stanley 1918:177

Among the ships delivered within the yard's first year of operation was *Bird City*. Like nearly all of the Hog Island ships, this freighter was 390 ft long, 54 ft in beam, with a registered 5,152 gross tons. After the war, the vessel was sold to Moore & McCormick and renamed *Scanpenn* in 1932 (Figure 7-72). Next, it changed to *Buarque* in 1940 when sold again, this time to Lloyd Brasileiro of Brazil. By 1942, despite being a 'neutral' vessel under the flag of Brazil, the ship opportunistically carried cargoes, most of which were war-related materials sought by American-based companies and delivered into American ports (Lloyd's Register of Shipping 1920-1941; Gentile 1993:32).

Figure 7-72 Image of vessel under former name of *Scanpenn*.
Source: Basta et al. 2013

It was on such a run in February 1942, while *Buarque* was en route from Rio de Janeiro to New York with a cargo of castor beans, rubber, beryllium, and aluminum ores, that the ship crossed through the Hatteras area. German attacks were happening in earnest by this time, yet *Buarque's* captain wholeheartedly believed that his vessel's neutrality afforded it complete protection from potential attack. Captain Juan J. Moura left the ship completely lighted, with an additional spotlight to illuminate the Brazilian flag upon the masthead (Hickam, Jr. 1989:43; Gentile 1993:32).

Meanwhile, Heinz-Otto Schultze arrived in American waters on 14 February in command of U-*432*. Schultze's arrival off Hatteras in the smaller Type VII boat ushered in a new phase of German operations in American waters. The original U-boat sortie to the US coast consisted of larger, long-range Type IXs. Only these boats had sufficient fuel capacity to travel round-trip and operate independently so far afield. The smaller, but considerably more numerous, Type VIIs were not nearly as efficient. With initial operations so successful in US waters, however, Admiral Döenitz opted to test a Type VII deployment using underway refueling to bolster their range and endurance. Thus, having completed an underway-replenishment, U-*432* became the first Type VII to refuel at sea during American patrol, proving that the smaller Type VIIs were capable of crossing the Atlantic and operating an effective patrol off the US coast. Germany's U-boat command had considerably more Type VIIs available than Type IXs, meaning they now had a much larger fleet to draw upon for American operations (Blair 1996:502-503).

As auspicious as U-*432*'s patrol to America was for the Germans, Schultze's first choice of merchant vessel targets was less fortunate. The U-boat skipper attacked two obviously flagged Brazilian ships, *Buarque* and *Olinda*, which earned Germany stern rebukes and threats from Brazilian president Getulio Vargas (Blair 1996:503). *Buarque's* fate was decided when, just before midnight on 14 February, the conspicuously large, lighted ship sailed into U-*432's* crosshairs.

Not only was the vessel carrying assorted cargo items, the ship also carried 11 passengers, some of whom were Americans, intending to disembark in New York. As a result, the ship conveyed more people than would normally be present on a merchant ship, a factor which added to the chaos that ensued following the first torpedo strike. Homer Hickam (1989:43) recorded Chief Radio Operator Cyniaco Sfrippini's account of the attack:

> …[he] was in his cabin when a torpedo from the U-*432* struck the starboard bow. The *Buarque* shuddered its length and then plunged forward as if it had been smashed by a gigantic wave. Sfrippini huried to the deck where he was hailed by Captain Moura and ordered to the radio room to send SOS signals. Sfrippini left at a run and was soon at his console, steadily tapping out the emergency signal, all the while feeling the sickening sensation of the ship sinking beneath him.

An SOS message was being broadcast, passengers and crew were making frantic efforts to get off the now-darkened ship. Despite the dark conditions, and language barrier between American passengers and Portuguese-speaking crew, the entire compliment of 73 crew and 11 passengers made it into the ship's 4 lifeboats; the last person onboard Buarque was Captain Moura who used a fall line to hastily plunge himself into the last lifeboat (Hickam, Jr. 1989:43-44; Gentile 1993:32).

Despite Radio Operator Sfrippini's call, rescue ships did not arrive on the scene until well after daybreak. In the process, the 85 survivors spent the night tossing in cold, rolling winter seas. Despite surviving the ship's sinking, one passenger died in the night due to hypothermia and exposure. The remaining survivors, dispersed and drifting among the 4 life boats, were picked up the over the course of 2 days as USCGC *Calypso*, USCGC *Rush*, and USS *Jacob Jones*, which were dispatched to find them and bring them back to Norfolk, as well as merchant ship *Eagle* that happened upon one of the lifeboats (DIO 1987:79-81; Hickam, Jr. 1989:43-45).

7.8.2 Archaeological Site Description

Despite the initial torpedo attack that disabled *Buarque* and compelled all 85 people onboard to abandon ship, the vessel did not sink immediately. The ship settled bow-down in heavy seas, but remained sufficiently afloat for the crew to load and lower all four lifeboats. Meanwhile, U-*432* remained at the surface and surveyed the damaged vessel. Once confident that all persons had abandoned the ship, Schultze ordered another torpedo fired, this one hitting the freighter square amidships and causing a secondary boiler explosion. Thereafter, the vessel quickly sank by the bow (Hickam, Jr. 1989:44).

The attack took place in the waters off the Northern Outer Banks. Here, several vessels were reported lost in deep water and far enough from shore to preclude reference to diagnostic landmarks, factors which confounded subsequent Naval and Coast Guard efforts to identify the locations of these vessels during and after the war. Also lost in the vicinity were *Allan Jackson*, *Chenango*, *Equipoise*, and a pre-war casualty *Mexicano*. The latter was a British-owned tanker built in 1893 and lost on 17 September 1903 during a storm off the Northern Outer Banks. Only 7 of the 22 crewmembers were rescued, and the ship's final resting place was never ascertained (see Lloyd's Register of Shipping 1902; Hocking 1969:469-470).

Likewise, the Coast Guard and Navy were unable to definitively identify vessel remains in the area (see DIO 1944:30-31), though they seemed to narrow the potential sites to those of *Buarque* and *Equipoise*; presumably, they had no knowledge of tanker *Mexicano's* loss in the area nearly 40 years prior. General characteristics for each of these potential identities are given in Table 7-9. Remote sensing data collection is needed in the vicinity of the reported locations of these northern, deep-water sites to identify archaeological remains, if present, and characterize the sites.

Table 7-9 General Characteristics of Unlocated / Undetermined Vessel Identifications off Northern Outer Banks

Name	Type	Length (ft)	Beam (ft)	Engine
Allan Jackson	Tanker	435	56	Comp. Steam (3)
Buarque	Freighter	390	54	Steam Turbine
Chenango	Freighter	342	46	Comp. Steam (3)
Equipoise	Freighter	430	54	Comp. Steam (3)
Mexicano	Tanker	270	38	Comp. Steam (3)

7.9 Byron D. Benson

Figure 7-73 *Byron D. Benson* on 5 January 1942, location unknown.
Source: Steamship Historical Society of America

Table 7-10 General Characteristics of *Byron D. Benson*

Characteristics	*Byron D. Benson*
Year of Build/Type/Hull #	1922/Tanker/12
Date Lost	5 April 1942
Position & Depth	28 miles E of Duck, NC 105 ft
Ship Characteristics	Length: 465.4' Breadth: 60.2' Depth: 36.0' Gross Tonnage: 7,953
Cargo	91,500 barrels of crude oil
Survivors	27 (37 Total on board [10 dead])
Owner	Tide Water Associated Oil Company, New York, NY
Builder	Oscar Daniels Company, Tampa, FL, USA
Former Names	N/A
Lloyd's Register Details	Steel, 1 Screw, 2 decks and Shelter Deck, Machinery Aft, Oil-fired Steam, Quadruple-expansion engine, 3 Scotch Boilers, Flat Keel
Port of Registry/Flag	Wilmington, Delaware/USA
Sunk by	U-*552* (Erich Topp)
Data Collected	ADUS survey 2011; diver reconnaissance 2016.

7.9.1 History

Tanker *Byron D. Benson* began its service life in the small extension yard of the Oscar Daniels Company in Tampa, Florida (Figure 7-73, above and **Error! Reference source not found.**). Based in Chicago, the Oscar Daniels Contractors and Engineers Company created this satellite yard mostly to fulfill contracts from the US Shipping Board, starting in 1918. Tanker *Byron D. Benson*, ordered by Tidewater Oil Company, was the second to last ship the yard made before closing in 1922 (Figure 7-74; Lloyd's Register of Shipping 1921). From these humble beginnings, the tanker would become one of the most gruesomely spectacular and iconic tanker losses along the North Carolina coast as the ship remains adrift for days, its burning cargo sending "…a great smoke cloud covering hundreds of square miles and casting a pall along the entire North Carolina coast" (Figure 7-75 through Figure 7-77; Hickam, Jr. 1989:123).

Before its fateful meeting with Erich Topp's U-*552*, however, the vessel was already involved in U-boat activities along the North Carolina coast. In late February 1942, as Kplt. Heinz-Otto Schultze's U-*432* was demonstrating the effectiveness of a refueled Type VII in American waters, *Byron D. Benson* was running the coastal routes between the Gulf of Mexico and Mid-Atlantic ports. In the early morning hours of 27 February, U-*432* torpedoed the gargantuan freighter *Marore* as it passed Wimble Shoals, enroute to Baltimore. As the vessel sank, its crew of 40 escaped into 3 lifeboats. The following day, various ships began sighting and picking up survivors, including passing tanker *Byron D. Benson*. Also on the scene was *John D. Gill*. Little did *Byron D. Benson's* crew suspect that this same locale would, in just over a month, be the scene of their own ordeal (DIO 1987:91; Hickam, Jr. 1989:297).

Figure 7-74 Image of *Byron D. Benson* a few months prior to being sunk off North Carolina.
Source: Mariners' Museum and Park

Between 14 and 26 February, Kplt. Schultze in U-*432* sank 6 ships for a total of 27,900 tons of shipping lost. At the time it was the best single-patrol performance by a Type VII boat (no doubt aided by the underway-refueling the boat received, which extended the time it could operate off the American coast). Thirteen more Type VIIs operated in American waters during late February, and by March they were becoming the predominate U-boat type patrolling. U-boat commanders quickly realized the easy pickings awaiting them off the US coast. By the end of March, Johann Mohr in U-*124* (Type IXB) had sunk 7 ships for 42,048 tons of shipping, supplanting Schultze for most tonnage of shipping claimed in a single American patrol (Blair 1996:503-539).

Not far on the heels of Mohr was decorated U-boat captain Erich Topp, who inaugurated his arrival in the Eastern Sea Frontier with the sinking of tanker *Ocana* (24 March) along the Canadian coast and freighter *David H. Atwater* (2 April) off the Maryland coast. Next, Topp brought U-*552* to Hatteras and continued what would later become the most effective patrol of a Type VII in American waters. The first ship attacked in North Carolina waters was 465-ft tanker *Byron D. Benson*, on 5 April. In the following days, Topp remained off Hatteras and sank three additional ships: *Atlas*, *Tamaulipas*, and *British Splendour*.

U-*552's* attack on *Byron D. Benson* was devastating. Immediately, the tanker burst into flames. Ten crew members were lost in the fiery inferno that consumed the ship; many of the remaining 27 crew survived by hurriedly jumping overboard. Once abandoned, the burning hulk of *Byron D. Benson* continued to drift and burn for 3 additional days. That interval resulted in some of the most haunting and recognizable photographs of the merchant vessel casualties along the North Carolina coast during the war, as shown in Figure 7-75 through Figure 7-77 (DIO 1987:212; Hickam, Jr. 1989:121-299; Blair 1996:539).

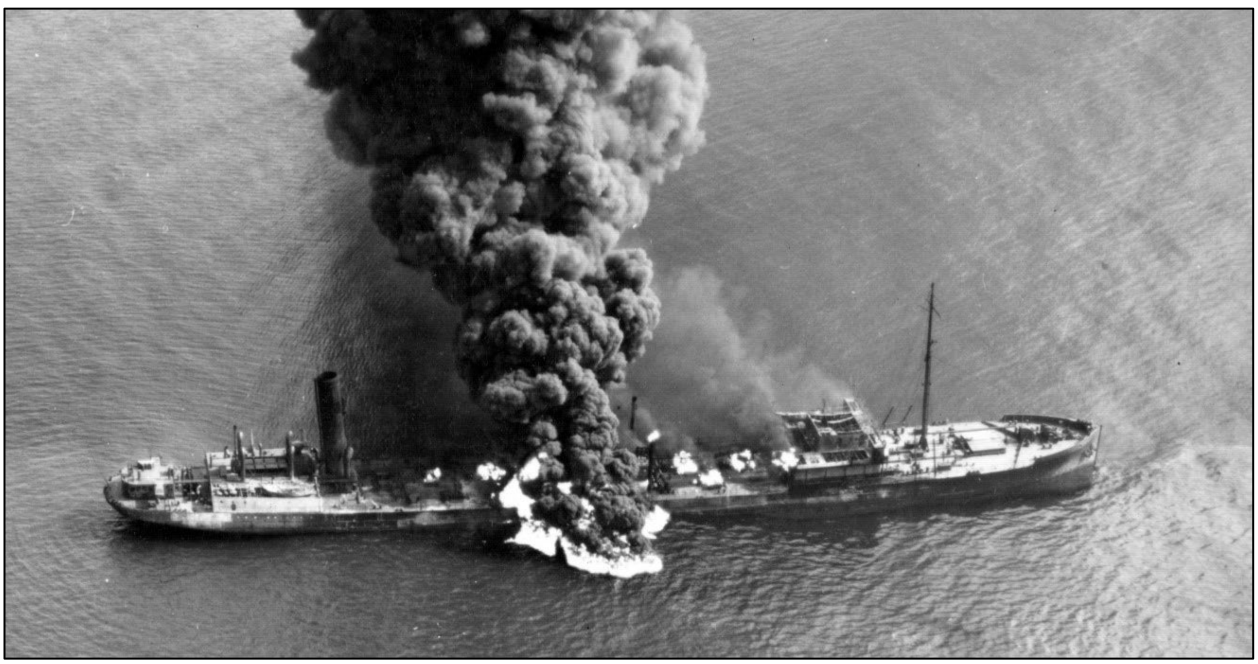


Figure 7-75 ***Byron D. Benson*** **burning after being torpedoed by U-*552*.**
Source: NARA

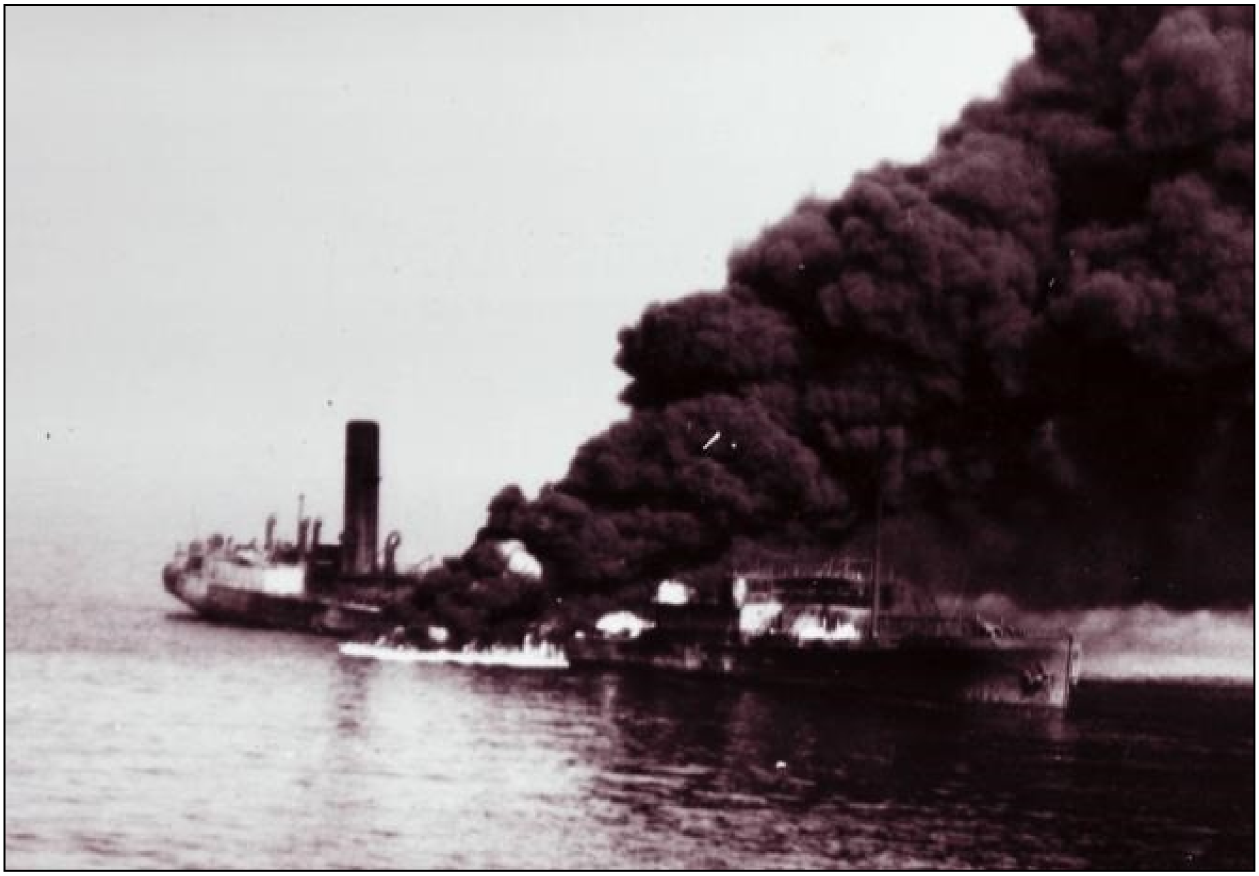


Figure 7-76 ***Byron D. Benson*** **burning along the Northern Outer Banks.**
Source: NARA

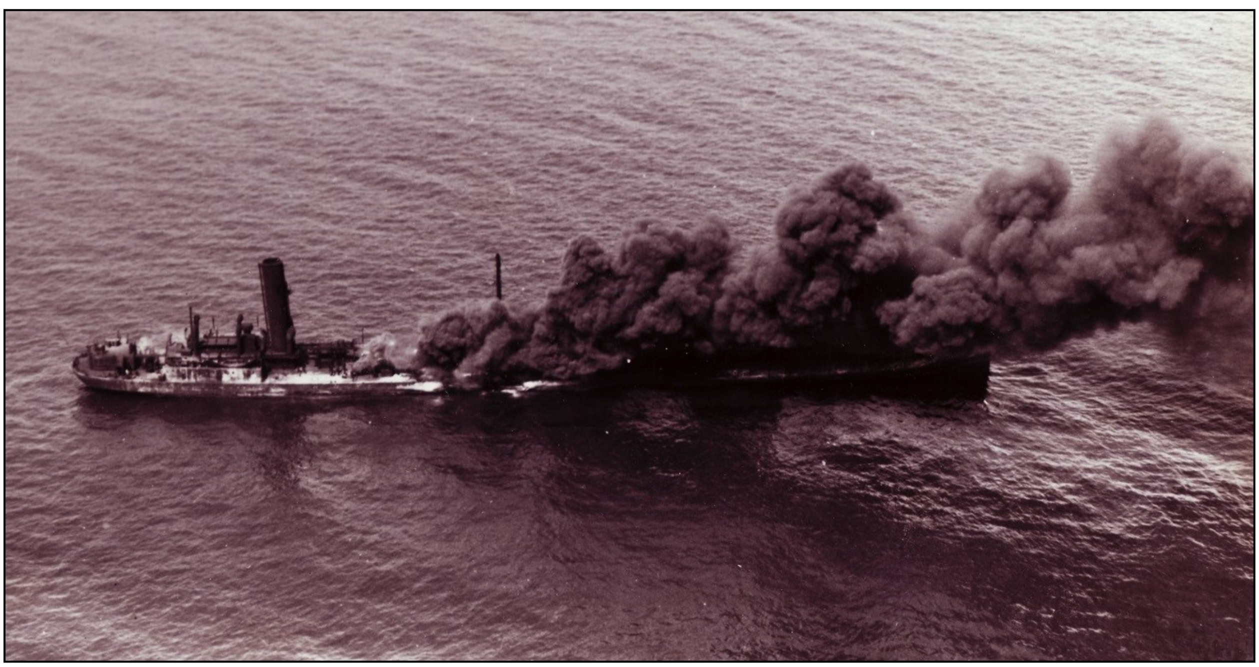


Figure 7-77 ***Byron D. Benson*** **continues burning after a torpedo attack.**
Source: NARA

7.9.2 Archaeological Site Description

In the years following its loss, the US Navy and Coast Guard were unable to definitively locate the vessel's remains. In the USCGC *Gentian* survey report, the only position information listed for *Byron D. Benson* were observations of its last known position, mainly by aircraft that encountered the drifting, burning hull. The surveyors could not produce a definitive sinking location, and believed the tanker was lost beyond the 100-fathom curve as it was last seen drifting seaward (DIO 1944 and 1945).

The remains of *Byron D. Benson* were separated amidships in just over 100 ft of water offshore of the town of Kitty Hawk. Figure 7-78 shows a plan-view export of the Reson 8125 scaled multibeam survey conducted at the site in 2011. Profile and isometric views, also exported and rendered from the ADUS multibeam survey, are shown in Figure 7-79. The plan view clearly shows a large break-down section midships consistent with damage caused by U-*552's* torpedo strike. This damaged section is also apparent in the historical images of the tanker burning within the same area.

The bow section measured approximately 219 ft in length and 73 ft at beam, followed by a 70-ft long featureless amidships section. The stern section extended approximately 238 ft in length and 76 ft at beam. The aft-most section of the stern, approximately 56 ft in length, contained the remaining machinery.

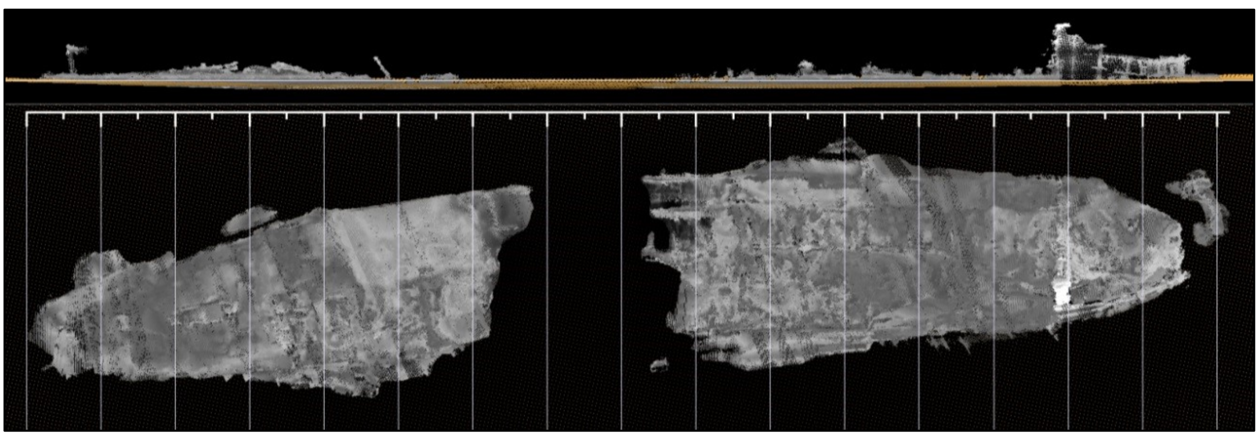


Figure 7-78 Multibeam SONAR visualization of the *Byron D. Benson* wreck site scaled in 10-m grid.
Source: ADUS

Archaeologists conducted a reconnaissance dive on the stern portion of the site in September 2016. Divers observed areas of relief in the stern section including remains of the triple expansion engine head (Figure 7-80). The tanker's remains were wire-dragged in 1945 and there was not much vertical relief at the site. Astern, the steering quadrant, engine machinery, and crankshaft were extant and visible. Likewise, portions of the internal, compartmentalized fuel cargo tanks were also visible along both bow and stern sections. The bow section also featured some relief, with a small debris field extending around the area.

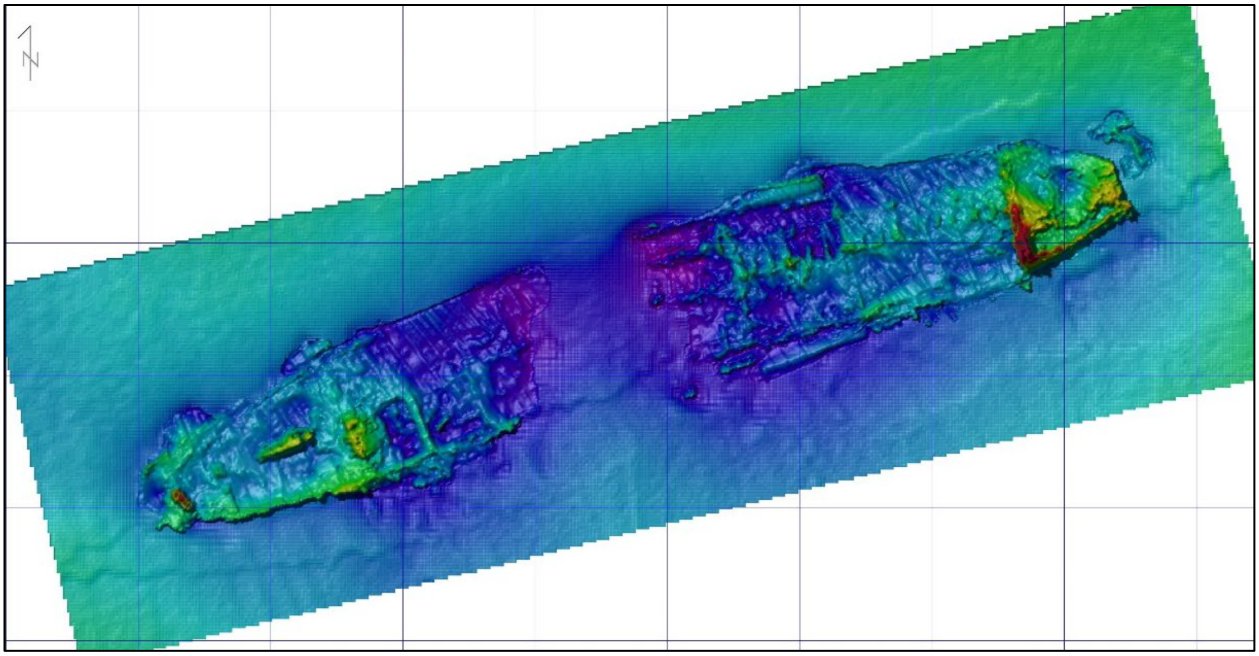


Figure 7-79 Reson 8125 scaled multibeam survey of *Byron D. Benson* wreck site 455 kHz 6-mm resolution.
Source: ADUS

Figure 7-80 Remains of the triple expansion steam engine.
Source: BOEM

7.10 Caribsea

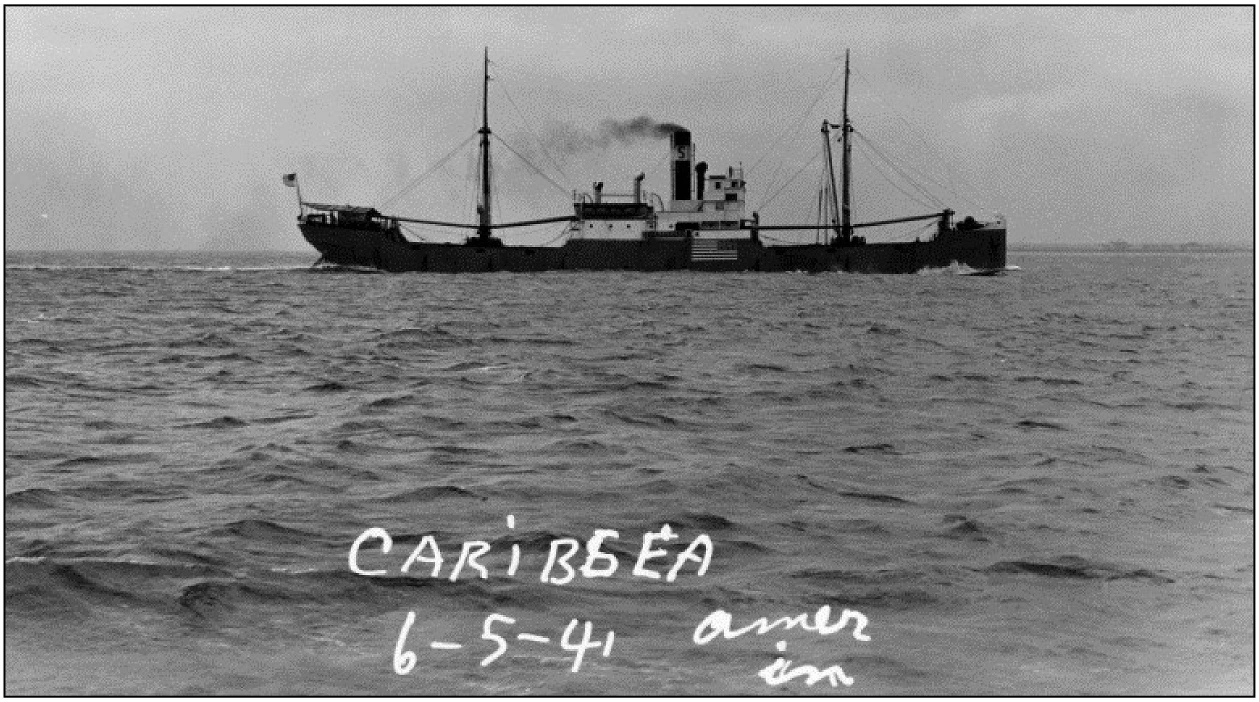


Figure 7-81 *Caribsea* prior to WWII.
Source: Mariners' Museum and Park

Table 7-11 Characteristics of *Caribsea*

Characteristics	*Caribsea*
Year of Build/Type/Hull #	1919/Freighter/26
Date Lost	11 March 1942
Position & Depth	15 miles east of Cape Lookout 90 ft. depth
Ship Characteristics	Length: 251' Breadth: 43.7' Depth: 25.8' Gross Tonnage: 2,609
Cargo	3,600 tons of Manganese Ore
Survivors	28 Total Crew [21 dead and 7 survivors]
Owner	Stockard Steamship Company
Builder	McDougall Duluth Shipbuilding Company, Duluth, Minnesota
Former Names	*Lake Flattery* (1919); *Buenaventura* (1922); *Caribsea* (1940)
Lloyds Register Details	1 deck; 2 tiers of beams; underwater signaling system; fitted for fuel oil; triple expansion steam engine.
Port of Registry/Flag	New York/USA
Sunk by	U-*158* (Erwin Rostin)
Data Collected	ADUS Survey 2011; video and photography collection 2013; site plan 2014.

7.10.1 History

Caribsea was classified as an ocean-going cargo ship, one of many Laker-style steamships (Table 7-11, above, and Figure 7-81 through Figure 7-83). These vessels were prominent as an "economical medium-sized freighter," built of steel with two full-length decks and a top boat deck. They were also popularly referred to as 'three island types' because of the three individual decks located forefront, amidships, and aft of the vessel. *Caribsea's* dimensions measured 251 ft long, a 43 ft beam, and a draft of 25 ft (The American Marine Engineer 1919:20; *Marine Review* 1920).

On 2 March 1942, *Caribsea* departed Santiago, Cuba bound for Norfolk, Virginia with 3,600 tons of manganese ore. As the vessel traveled north with its heavy, combustible cargo, *Caribsea* utilized blackout procedures and safety precautions meant to avoid U-boat confrontation. Likewise, the US Navy ordered all vessels travelling coastwise to pass Cape Hatteras during daylight when the likelihood of a U-boat attack was substantially reduced. Therefore, on 10 March, as the vessel approached Cape Lookout under cover of night, the ship reduced its speed to 4 kts in order to make Diamond Shoals by daybreak. Meanwhile, as the crew of *Caribsea* continued along this course, U-*158*, under the command of Kplt. Eriwn Rostin, maintained patrol off Cape Lookout, to spot passing merchant ships.

At 0100 hours on the morning of 11 March 1942, *Caribsea* was approximately 14 miles off Cape Lookout Lighthouse. Changing course to approach the shoals off Cape Hatteras, orders were given to routinely check the Lighthouse bearings to prevent inland drifting (Manolis 1949:87). Less than an hour later, several members of the crew noticed a ship-like structure to the starboard side of *Caribsea's* bridge, before the ship was rocked by a torpedo strike. The captain later described how he "hardly had time to turn around before the second torpedo struck" (*The Washington Post* 1942a:3, Manolis 1949:87).

Figure 7-82 ***Caribsea*** **as** ***Buenaventura*****, date and location unknown.**
Source: Mariners' Museum and Park

Figure 7-83 ***Caribsea* on 26 January 1942.**
Source: Steamship Historical Society of America

As seawater flooded the foredeck, *Caribsea's* second mate sounded the alarm to abandon ship. There was no time to launch the lifeboats. The ship and its 3,600 tons of manganese ore, along with 21 crewmembers, sank in less than 2 minutes (*The Washington Post* 1942a:3; Bunker 2006:39; Manolis 1949:88). Fireman Hector Aranda, the last crewmember to leave the ship, recalled that "None of us had time to do anything but get out of our bunks, climb to the deck and jump into the sea. I think the six men in the engine room were either killed or trapped by the second torpedo and were unable to escape" (*The Washington Post* 1942a:3). After drifting for approximately 10 hours, the 7 surviving crewmembers of *Caribsea* were spotted and picked up by the steamship *Norlandia* (Manolis 1949:105).

Meanwhile, Kplt. Erwin Rostin's U-*158* continued to sink merchant ships, subsequent targets including *John D. Gill* and *Ario* during the remainder of the U-boat's March war patrol. At the conclusion of their second American patrol in June 1942, Rostin and his crew had sunk 17 merchant ships, totaling 93,342 tons, a two-patrol casualty record not exceeded by any other U-boat during the entire Battle of the Atlantic (Blair 1996:612).

Following the sinking of *Caribsea*, two strange phenomena were experienced by the Ocracoke community a mere 43 miles away. On 14 March 1942, Chris Gaskill was walking the beach along the Island's southern end when he spotted something in the surf. Upon further investigation, Chris discovered it was some sort of framed certificate. Upon further inspection, he was surprised to find the certificate was, in fact, an official license belonging to his cousin, Jim Gaskill, third mate on *Caribsea* (Hickam, Jr. 1989:61-62; Duffus 2012:148). The next day, the Gaskill family was met with yet another eerie occurrence. An out of town guest staying at the Gaskill family-owned Pamlico Inn came across a floating piece of wood bumping up against one of the pilings off the inn's pier. Once the debris was retrieved, *Caribsea* was discovered upon the downward facing side, a piece of wreckage confirming the ship's fate among the local community (Hickam, Jr. 1989:61-62; Duffus 2012:148).

7.10.2 Archaeological Site Description

Caribsea rests in 85 ft of water, approximately 15 miles north of Cape Lookout Inlet. During 2011, several remote sensing data products were acquired at *Caribsea*, including high-resolution multibeam. This survey resulted in two distinct data products: a georectified plan-view image and a rendered 3D point cloud model. Each provided detailed position and diagnostic information on the shipwreck site and its primary features (Figure 7-84). This imagery served as an archaeological baseline for future, more detailed, documentation efforts.

The ship's remains site measured 230 ft long by 60 ft wide with 20 ft of vertical relief above the seafloor. The main features included intact bow and stern sections, along with the triple expansion steam engine and two Scotch boilers located amidships. The shape of the hull was recognizable due to the outer hull plating and framing that rises up in some areas of the site an excess of 15 ft off the seafloor.

While the georectified imagery served as a fundamental visual representation of the wreck site, the data were further manipulated to generate a point-cloud model offering more robust visualization capabilities within a specialized ADUS 3D modeling interface. A 3D multibeam model of *Caribsea* was acquired utilizing this *Wrecksight* software (Figure 7-85 and Figure 7-86). Within this interface, researchers could move around the site virtually, approaching features from numerous isometric angles.

In 2014, one of the primary focuses of the team's fieldwork was the complete documentation of *Caribsea*. In partnership with the avocational diving group BAREG, a detailed site plan was produced (Figure 7-87). The resulting site plan identified structural components and diagnostic features such as deck machinery, hatches, hull plating, and cargo gear. Additionally, the underlying interpretation and data embedded within the site plan enabled a more geospatial understanding of the assemblage and transformation of the shipwreck site.

The bow section of the wreck site included the stem post that rises up 20 feet from the sand (Figure 7-88). The forward decking and framing were mostly intact but appeared to exhibit signs of active corrosion in the form of various sized holes and structural decay. An anchor windlass, chain, and hause pipe were located at the forward part of the bow. The large windlass added substantial weight to the upper decking (Figure 7-89). This variable could influence the transformation of the wreck site and eventually result in the complete collapse of the forward bow section. The port and starboard bow anchors were missing from the wreck site.

Aft of the bow was an assemblage of unidentifiable structural debris that was mostly covered in sand, along with areas of conglomerated manganese ore. The vertical outer hull varied in height from 3 to10 ft and in some places had eroded down to the sand. Some areas of outer hull plating have collapsed at the bilge and fallen on either side of the wreck site. Smaller machinery components and cargo gear pieces including piping, masts, and ladders, were located in the debris assemblage. At amidships, *Caribsea's* triple expansion engine and two Scotch boilers rose up above the seafloor 20 ft (Figure 7-90). These components had minor corrosion effects, but appeared to be in relatively stable condition. Engine auxiliary pieces were identified amongst the debris assemblage on the port side of the engine.

At the stern end of the wreck site, the outer hull structure remained mostly intact. This section had many features including piping, cargo gear, and machinery pieces. The outer hull framing varied in height from 3 to 10 ft and continued all the way to the end of the extant remains. The upper deck plating had largely deteriorated and collapsed to the seafloor beneath the existing framing. In some areas this had created an overhead environment. While the rudder and rudder post were both present (Figure 7-91), the steering shaft and the propeller were missing from the site.

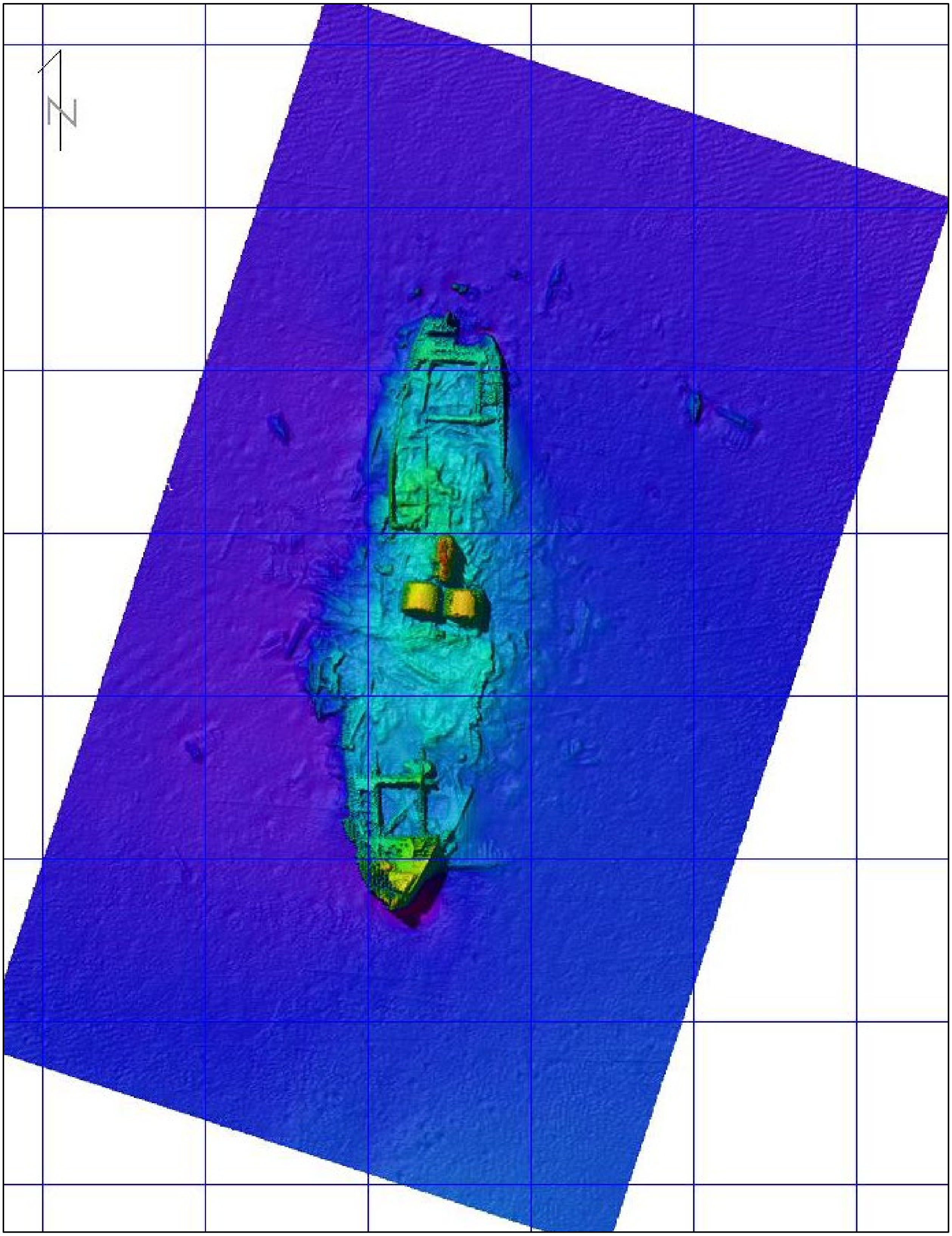


Figure 7-84 Georectified high-resolution image of *Caribsea* 455 kHz 6-mm resolution.
Source: ADUS/NOAA

Figure 7-85 Profile view of high-resolution multibeam model of *Caribsea* as seen in WreckSight scaled in 10-m grid.

Source: ADUS

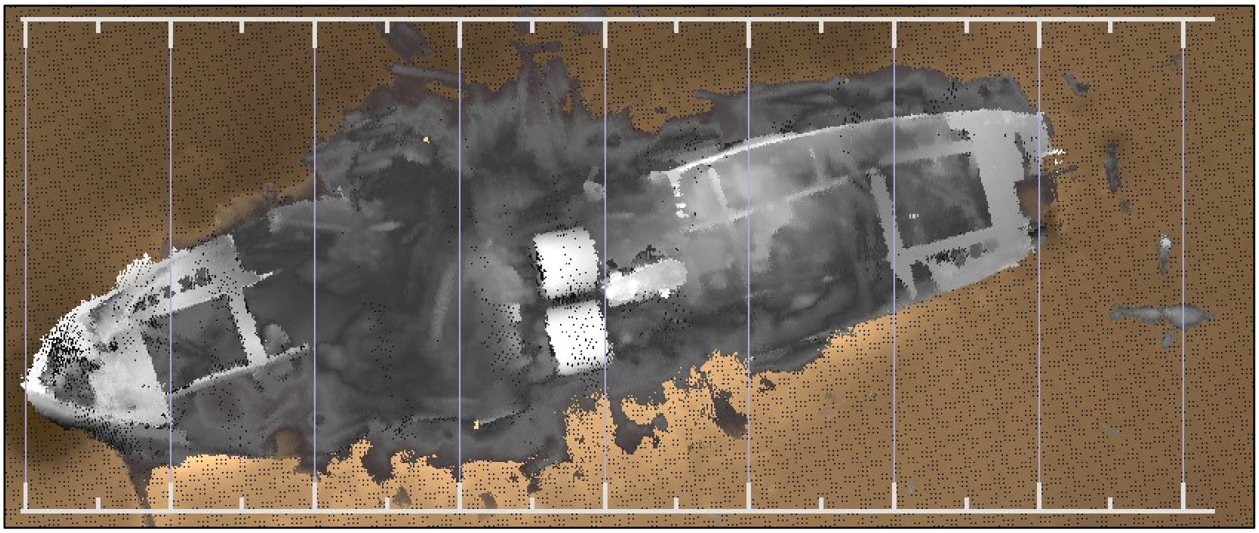


Figure 7-86 Plan view of high-resolution multibeam model of *Caribsea* as seen in WreckSight scaled in 10-m grid.

Source: ADUS

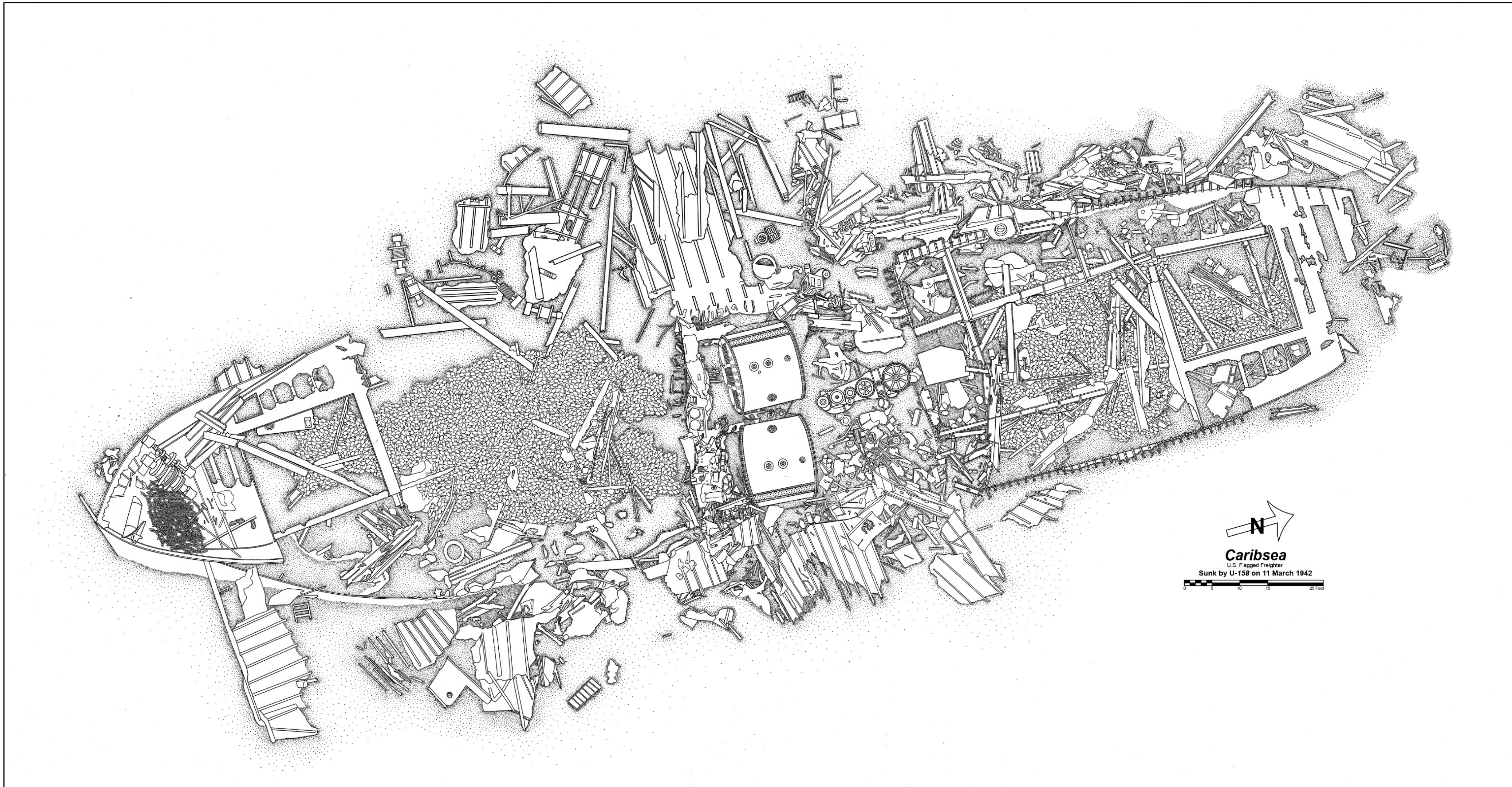


Figure 7-87 Plan view site plan of *Caribsea* collected during 2014.
Source: NOAA

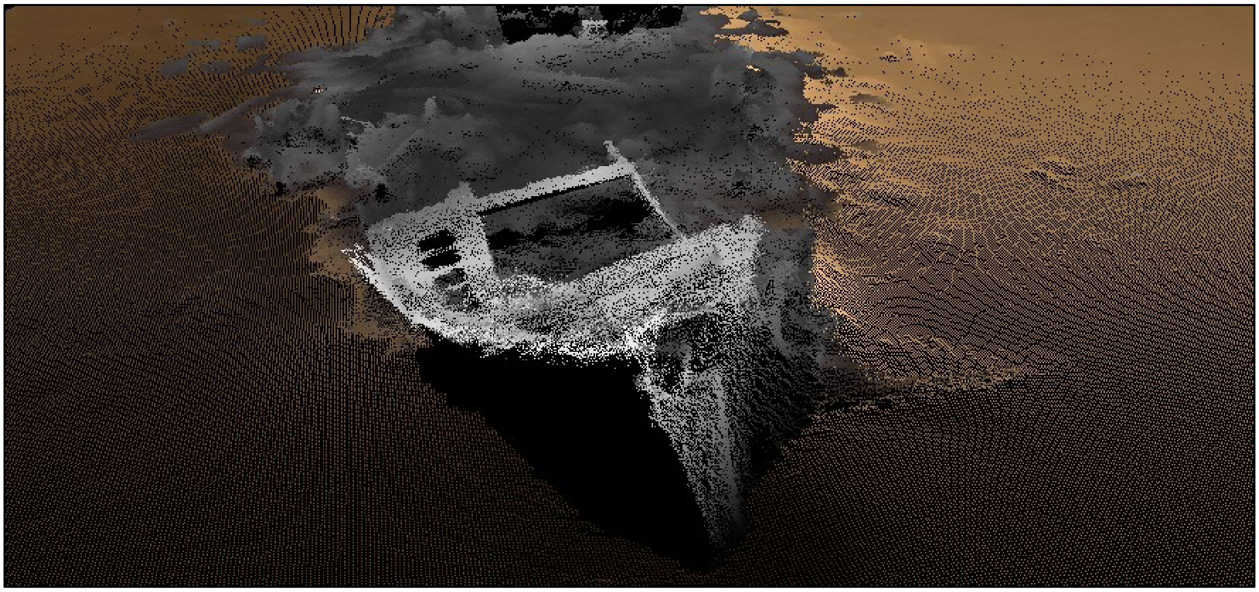


Figure 7-88 ***Caribsea*** **starboard bow section.**
Source: ADUS/NOAA

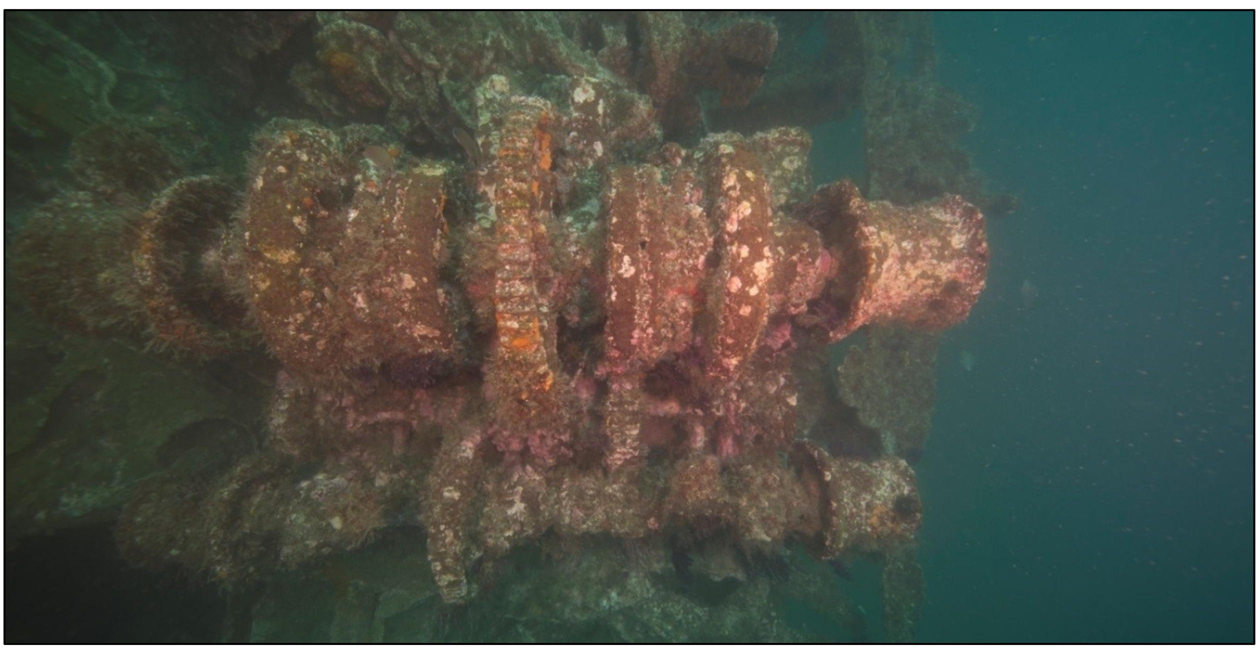


Figure 7-89 Anchor windlass located at the bow section of *Caribsea*.
Source: NOAA

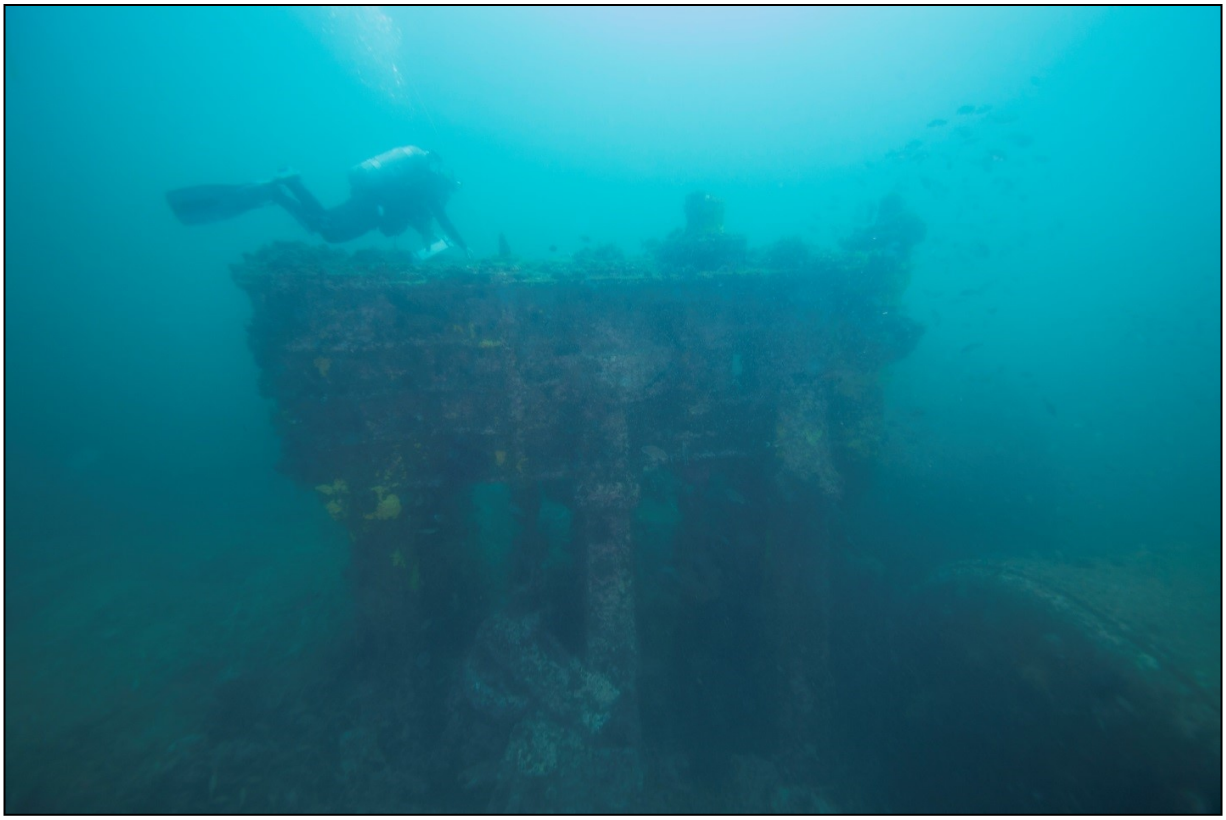


Figure 7-90 Triple Expansion engine and two Scotch boilers of *Caribsea*.
Source: NOAA

Figure 7-91 Rudder and rudder post in the stern section of *Caribsea*.
Source: NOAA

7.11 Cassimir

Figure 7-92 *Cassimir* on 11 February 1942, location unknown.
Source: Mariners' Museum and Park

Table 7-12 Characteristics of *Cassimir*

Characteristics	*Cassimir*
Year of Build/Type/Hull #	1920/Hog Island, Three Island Freight Steamer /220574
Date Lost	26 February 1942
Position & Depth	Approximately 50 miles south of Cape Lookout Shoals at 115 ft
Ship Characteristics	Length: 390' Breadth: 54.2' Depth: 27.8' Gross Tonnage: 5,030
Cargo	Molasses
Survivors	29 Survivors, 7 lives lost (total crew: 36)
Owner	Cuba Distilling Co. International
Builder	American International Shipbuilding, Hog Island, PA
Former Names	N/A
Lloyd's Register Details	DR Geared Steam Turbine built by General Electric; Fitted for fuel oil; carrying petroleum in bulk.
Port of Registry/Flag	Baltimore, MD. USA.
Sunk by	Collision with S.S. *Lara*
Data Collected	R/V *Nancy Foster* Multibeam 2010

7.11.1 History

Cassimir was originally built under orders from the Emergency Fleet Corporation to serve as a shipping freighter during WWI (Table 7-12 and Figure 7-92, above). The vessel was constructed as part of 110 nearly identical vessels to be built quickly to maintain the vital flow of materiel for the war effort. These ships, built by American Shipbuilding International's yard at Hog Island, Pennsylvania, became affectionately known as 'Hog Islanders.' Such ships were characterized by a three-island design and were well-built, very seaworthy, and notably unattractive (Nauticus 1920:18; Gillen 2015:187).

Cassimir was launched on 8 June 1920, and like many Hog Islanders, was never used in the service for which it was initially intended due to the signing of the Treaty of Versailles in June 1919. Consequently, such ships entered the stream of peacetime commerce. However, at that time there was a scarcity of tankers. Despite having just been built as a freighter, *Cassimir*, along with 6 other newly constructed Hog Islanders, went to Globe Shipbuilding Company's Baltimore yard to be retrofitted as tankers for the oil and molasses trades. By December 1920 *Cassimir* had longitudinal bulkheads installed and all necessary angles and swash plates placed to enable the transport of crude oil. The shipping board in turn sold these vessels for $184.00 per deadweight ton. *Cassimir* was acquired by the Cuba Distilling Company to engage in the molasses trade (Shipping 1920a:90; 1920b:72).

During the interwar period, *Cassimir* was owned and operated by the Cuba Distilling Company, carrying predominantly molasses. On 21 February 1942, *Cassimir* was carrying a full cargo of Cuban invert molasses out of Santiago, Cuba northbound for Baltimore, Maryland. The ultimate destination of the cargo was the Curtis Bay Distillery of United States Chemicals, Inc., the parent company of Cuba Distilling Company. While vessel and destination were owned by the same organization, the cargo itself was owned by and being directed by the Defense Supplies Corporation. Upon arrival at Curtis Bay, it was to be distilled into alcohol to be used in the manufacture of smokeless powder and other war material (Nordling v. Gibbon 1945:62 F. Supp. 932). The Defense Supplies Corporation was:

> a corporate instrumentality and agency of the Government, and was used and empowered by the Government to purchase and acquire, among other things, materials, drugs, commodities and all things necessary to it in the prosecution of the war with Germany and Japan (Nordling v. Gibbon 1945:62 F. Supp. 932).

On 23 February 1942, the S.S. *Lara*, a single screw steel freighter 314 ft long and 44 ft abeam, was southbound from New York. Owned and operated by Grace Line, Inc. *Lara* was loaded with general cargo heading for Barranquilla, Columbia. Both *Cassimir* and *Lara*, in accordance with instructions from the United States Navy, were sailing pre-approved routes with all navigation lights completely blacked out (The *Cassimir* 1943:55 F.Supp. 822).

In the very early morning of 26 February 1942, the paths of these two ships would intersect with disastrous results. The moon had just set and the night was very dark. Seas were moderate with winds coming out of the west at roughly 4 to 5 on the Beaufort Wind Scale. Both ships were making way at nearly the same speed, *Cassimir* at 11 kts and *Lara* steaming at just over 10 kts (The *Cassimir* 1943:55 F.Supp. 822).

The Chief Officer of *Cassimir* was on watch with one able seaman and another at the helm when they first sighted *Lara*. They immediately turned the helm hard to port and turned on both the range and sidelights. Concurrently, Lara spotted *Cassimir* on a nearly opposite course and suddenly observed the range and starboard green sidelight of *Cassimir* illuminate. *Lara's* helmsman immediately put the vessel hard to starboard, but did not blow a whistle to indicate course. It was just a few moments after each sighted the other that Lara sounded a loud danger signal followed by three short blasts signifying full speed astern. *Cassimir* responded with several short blasts and rang the general alarm. None of these measures helped. At 0540 hours, the bow of Lara slammed into *Cassimir's* starboard side (The *Cassimir* 1943:55 F.Supp. 822).

A large hole was ripped through the hull of *Cassimir* just aft of amidships instantly flooding the engine room knocking out controls. It quickly became apparent *Cassimir* was going to sink. The Captain called for lifeboats to be lowered and issued an order to abandon ship. In the accident the Chief Officer and 6 other crew were lost. *Lara*, damaged but stable, stood by and recovered the survivors (The *Cassimir* 1943:55 F.Supp. 822; Cuba Distilling Co. v. Grace Line 1944:143 F.2d 499).

Historically, following the loss of *Cassimir*, the courts determined that the collision 'was purely the result of marine peril and not the result of a warlike operation' (Nordling v. Gibbon 1945:62 F. Supp. 932). However, this point was argued over the matter of a $5,000 war-risk insurance policy for the life of Thor August Lindberg, one of *Cassimir's* fated crew. They argued that given the cargo carried was intended as war materiel and both *Cassimir* and *Lara* were sailing under blackout orders, that this loss was inherently related to wartime activity and had those circumstances not been the case, it was unlikely *Cassimir* would have been lost. The courts recognized problematic language in the policy citing the phrase 'other warlike operations' as potentially inclusive of the carriage of cargo, but ultimately determined that given the cargo was in unprocessed form, it was not of immediate use to the government (Nordling v. Gibbon 1945:62 F. Supp. 932). The case was dismissed, however this vessel is still included in this report as it was clearly an ancillary result of the Battle of the Atlantic and is representative of the 'fog of war' that hung over the movement of ships and convoys during this time.

7.11.2 Archaeological Site Description

The team investigated *Cassimir* in 2010 and 2016 during which multibeam sonar surveys were conducted (Figure 7-93 and Figure 7-94). The 2010 survey data were collected with a Simrad EM-1002 transducer at 95 kHz and the 2016 survey data were collected with a Reson 7125 at 400 kHz. The resolution does not allow for a comprehensive assessment of the site beyond detailed positioning and general layout of three sections: an intact bow separated by a featureless sandy area, the amidships engineering area, and the stern. No diving operations were conducted at this site. The wreck site of *Cassimir* is mostly contiguous and oriented ESE to WNW, bow to stern, situated upon its keel. The bow section is separated by an expanse of sand approximately 80 ft in length. The bow section measures approximately 42 ft in length and 35.35 ft abeam, and is oriented with the stem toward the NE. Aft of the bow section and the sand gap, the remains of the wreck site measure over 315 ft in length, with a site scatter of approximately 70.47 ft at beam. Both the bow and stern sections provide areas of high relief, with the bow section being the most intact.

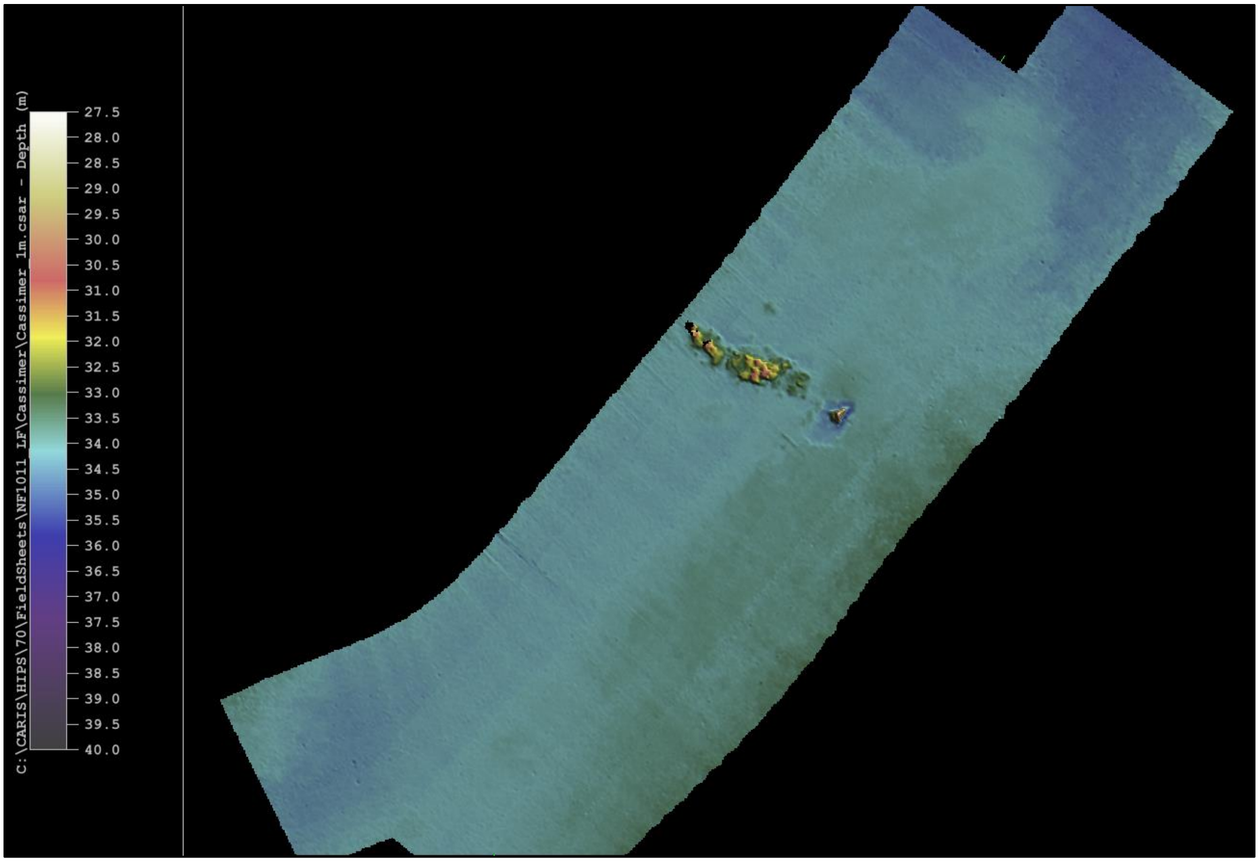


Figure 7-93 ***Cassimir*** **wreck site gridded at 2-m resolution from Simrad EM-1002.**
Source: NOAA R/V *Nancy Foster*

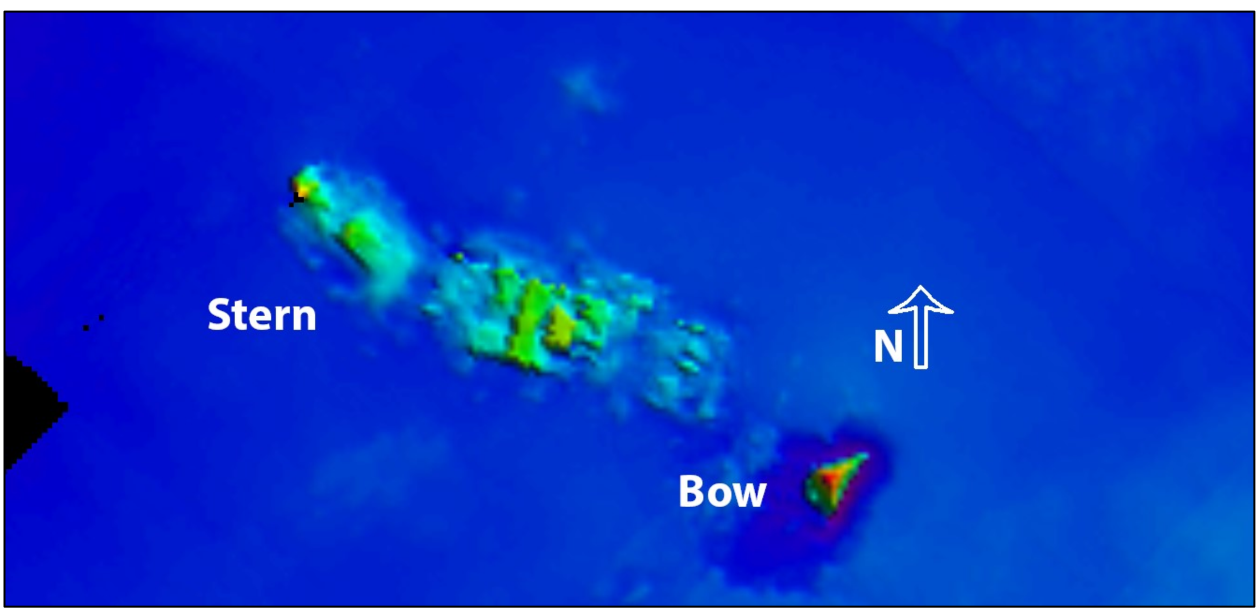


Figure 7-94 ***Cassimir*** **multibeam from Reson 7125 400 kHz, 0.25-m grid.**
Source: NOAA R/V *Thomas Jefferson*

7.12 Chenango

Figure 7-95 Survivors Terrence J. Bradley (left) and Joseph Dieltens being spotted by US Coast Guard personnel. Source: NARA

Table 7-13 Characteristics of *Chenango*

Characteristic	*Chenango*
Year of Build/Type/Hull #	1918/Freighter/594
Date Lost	21 April 1942
Position & Depth	Reported Northern Outerbanks, Site not identified during present study. Depth: 140 ft
Ship Characteristics	Length: 342.3' Breadth: 46.8' Depth: 22.8' Gross Tonnage: 3,014
Cargo	Manganese ore
Survivors	1 (35 Total on board [1 survivor])
Owner	United States Maritime Commission
Builder	Irvine's Ship Building and Dry Dock Co., West Hartlepool, UK
Former Names	*Kurrika* (Vaasan Laiva O/Y, 1933-1940) *Newaster* (Aster Shipping Co., 1919-1933) *War Hamlet* (The Shipping Controller, UK, 1918-1919)
Lloyd's Register Details	One deck, one triple expansion steam engine
Port of Registry/Flag	New York/USAPanama/Panamanian
Sunk by	U-*84* (Horst Uphoff)
Data Collected	n/a

7.12.1 History

Little is known about *Chenago*'s service history and career prior to the WWII. In fact, its involvement in the Battle of the Atlantic was nearly relegated to historical mystery if not for the somewhat miraculous rescue of the ship's two surviving crew members (Table 7-13 and Figure 7-95, above). Following a devastating attack by U-*84*, the vessel rapidly sank taking down all but two of its crew. The survivors were adrift for 12 days before the Coast Guard rescued them, both noted as "…starved, semiconscious, emaciated, and delirious" (Lt. Cmdr. Burke 1942). One later died in hospital, leaving only a sole survivor and an uncertain positioning of *Chenango's* final remains. Until the survivors were rescued, there was no administrative knowledge of the vessel's loss. The Eastern Sea Frontier War Diary (DIO 1987:298) recorded the event as follows:

> 1455 hours [2 May, 1942]: CG plane brought two survivors of SS *Chenango* in to Elizabeth City picked up from life raft at (position). This ship not previously reported, was torpedoed 20 April while en route from St. Thomas to Baltimore. Ship sank in about one minute, no boats launched. 35 others of crew missing. Survivors in bad shape.

Thus, had these two crew members not managed to escape their sinking ship, or had they perished during their 12 day ordeal adrift at sea, even these scant details surrounding *Chenango's* loss may have never been known. The vessel would simply have been reported lost somewhere between St. Thomas and Baltimore (see Figure 7-96 through Figure 7-98).

The German administrative records were likewise vague on *Chenango's* sinking. During the American patrol of U-*84*, only two ships—*Nemanja* and *Chenango*—were sunk. After the sinking of the latter, U-*84's* commander, ObltzS. Horst Uphoff, reported 4 days later to the German Submarine Command: "Sunk: 21.4 [21 April] in DC 1314 freighter of 4,000 BRT course for Hatteras" (Befehlshaber der Unterseeboote [BDU] 1942a:32). In cases where the U-boat commander can clearly see the vessel's name or otherwise ascertain its identity and nationality, such as interrogating survivors in their lifeboats, these details are recorded. In the case of *Chenango*, where the vessel sank quickly, no lifeboats were launched, and only two survivors escaped—with ObltzS. Uphoff making no reported attempt to contact them—no such details for *Chenango* were recorded.

The position provided in the BDU report, based on a coded quadrant-map reference system used by the Germans, listed a location 45-50 miles SE of Cape Hatteras. Coast Guard rescue personnel, however, picked up the survivors at a location reported as "100 miles off Hatteras" (Lt. Cmdr. Burke 1942). Neither position was very specific, and the 1944 survey of USCGC *Gentian* echoed this ambiguity, noting:

> CHENANGO: 1786 NT cargo vessel. Sunk 20 April 1942 at reported position 60-80 miles Southeast of Cape Henry, Va. search by GENTIAN negative. Re-evaluation of survivor's report places sinking several hundred miles further south (DIO 1945).

Thus, the vessel's final resting place is yet to be definitively ascertained. Sport divers, however, visit a shipwreck site off the Northern Outer Banks which they commonly refer to as being *Chenango*.

Figure 7-96 US Coast Guard personnel approach the raft of Bradley and Dieltens.
Source: NARA

Figure 7-97 Terrence Bradley is offloaded from a Coast Guard airplane for medical treatment in Norfolk, Virginia.
Source: NARA

Figure 7-98 Bradley being loaded into an ambulance.
Source: NARA

7.12.2 Archaeological Site Description

The remains of a vessel commonly referred to as *Chenango* rest in 140 ft of water approximately 50 miles offshore of the town of Corolla, 55 miles ESE of the North Carolina/Virginia border. Researcher Gary Gentile (1993:50-52) reports that the American government learned of the vessel's final location after the war and, in 1956, dispatched a vessel to wire-drag the remains down to a clearance of 100 ft from the surface. At this location, Gentile describes the remains of a vessel seldom visited due to the remote location with respect to coastal inlets along the North Carolina and Virginia borders. Here, the remains of a vessel, which apparently broke into two sections, are oriented perpendicular to one another, separated by a 40 ft gap. Both sections are upside down, with a slight degree of vertical relief from the seafloor. Along the stern section, boilers and machinery are visible, features consistent with the details of *Chenango* recorded in its Lloyds Register of Shipping listing. Gentile also reported seeing a crank shaft extending out of the vessel's stern, but missing its propeller.

It is unclear, however, if this vessel's reported association with *Chenango* is based on an assemblage of physical data, such as overall and feature-based measurements, diagnostic features or artifacts, or simply its association with historically reported activities in the area. Mainly, the District Intelligence Office, Fifth Naval District's 1945 report positioning *Chenango*'s remains 60-80 miles south of Cape Henry, Virginia, provide the most compelling circumstantial evidence placing the freighter in the area. Yet, the wide difference of locational information between American and German sources does not support this position. Given the ambiguity of several other vessel losses in the area and some commonalities in the size and equipment types upon these vessels, additional information regarding the remains at this location are needed to assess a positive identification as *Chenango* – or any other vessel.

This location was not visited during any of the 2008 to 2015 field operations. The distance between this area and the core study area of this survey (Cape Hatteras and Cape Lookout vicinity) meant that most of the survey operations conducted therein were performed opportunistically during transits through the area. As a result, time simply did not avail to survey all the vessel remains along the Northern Outer Banks. Consequently, future survey efforts in this area should focus on identifying the vessel at this location.

7.13 Chilore

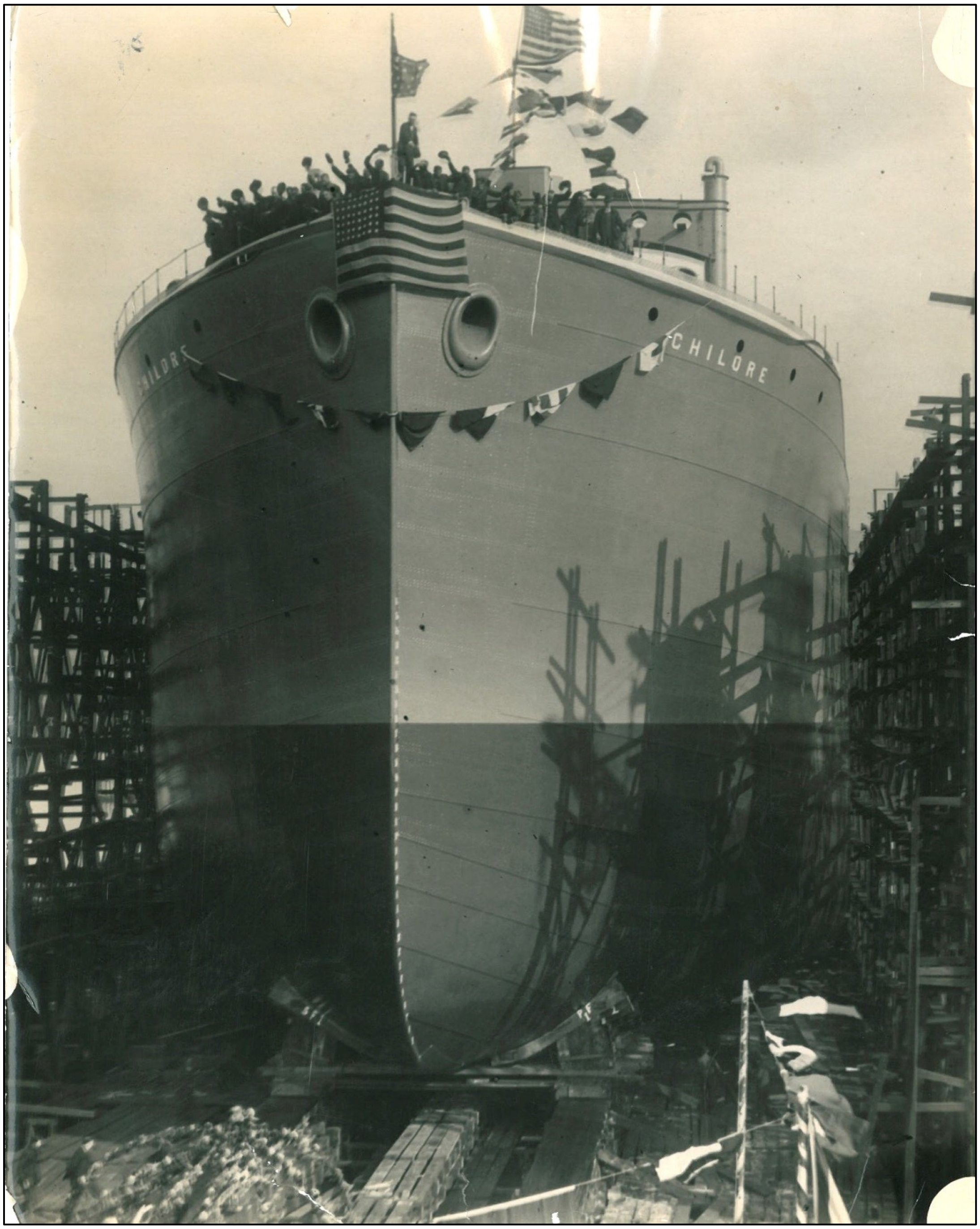


Figure 7-99 Image of *Chilore* at launch.
Source: MNMS Collection

Table 7-14 Characteristics of *Chilore*

Characteristics	*Chilore*
Year of Build/Type/Hull #	1922/Freighter/5309 A
Date Lost	15 July 1942 (initial attack) 23 July 1942 (sunk)
Position & Depth	Approximately 50 miles offshore Virginia Beach at 46 ft
Ship Characteristics	Length: 549.6'; Breadth: 72.2'; Depth: 40.5'; Gross Tonnage: 8,310
Cargo	Dry Goods and water ballast
Survivors	56
Owner	Ore Steamship Corporation
Builder	Bethlehem Shipbuilding Corp. Ltd., Alameda, CA
Former Names	N/A
Lloyd's Register Details	Steel (stl)/Steam Screw (St. s)/Twin screw/Solid Bronze Propeller(s) (SBP)/1 deck/Longitudinal Framing; Tailshaft fitted with Continuous Liner (CL)/Radio telegraph/Machinery Aft Engine: two steam turbines single reduction geared (SR) to two screw shafts/5000 SHP/4 cylinders (2 per engine)
Port of Registry/Flag	New York, USA
Sunk by	U-*576* (and Hatteras minefield)
Data Collected on Site	ADUS Multibeam 2011

7.13.1 History

At the time of launch in 1922, *Chilore* was the largest merchant vessel ever built on the Pacific coast of the United States (Table 7-14 and Figure 7-99, above). *Chilore* was contructed for the Ore Steamship Co. of New York by Bethlehem Shipbuilding at their Alameda California plant and slipped down the ways on 28 November 1922. With two sets of Curtis turbine engines *Chilore* could make 11.5 kts. The vessel had a deadweight of 20,000 tons, was 72 ft abeam, and had a depth of just over 40 ft. There is some discrepancy in the reported length of the vessel; the yard and historic periodicals at the time of launch state the vessel 571.5 ft long, while Lloyd's states 549.6 ft. The authors accept the survey by Lloyd's as the most historically accurate (*Pacific Mining News* 1922:252-253; *Weekly Commercial News* 1922:9).

The vessel was constructed as a combination coal and ore carrier, and its cargo-handling equipment represented the state of the art at the time, able to fully load 20,000 tons of ore in 5 hours. *Chilore's* primary service for the Ore Steamship Co. was running shipments between New York and the west coast of South America. Outbound trips typically carried coal and return trips carried ore. The transit from New York to Cruz Grande was scheduled to take 17 days. During its nearly 20 years of service, *Chilore* never changed ownership and maintained its original name (*Pacific Mining News* 1922:252-253; *Weekly Commercial News* 1922:9).

In July of 1942 amidst months of war along the east coast, *Chilore* assembled at Hampton Roads along with 21 other vessels, constituting Convoy KS-520. Among these vessels is the convoy flagship, Panamanian freighter *J. A. Mowinckel*. When these two vessels departed Norfolk at 1630 hours on 14 July 1942, their fates along with 19 other merchant ships (two of the original 21 did not depart) were now intertwined (DIO 1987:411).

Escorted by 5 military vessels and provided continuous air coverage, the convoy moved southward and rounded Cape Hatteras at 0700 hours EWT on 15 July. At around 1600 hours amidst a slight swell, the escort vessel USCGC *Triton* picked up a sonar contact and delivered a depth charge attack. The attack was fruitless but 20 minutes later, a giant column of water erupted skyward from the *Chilore*, a great explosion had occurred, followed by a second eruption beneath *Chilore* just one minute later. *Chilore* had been struck by two torpedoes launched from the U-*576* (DIO 1987:412).

US Navy Captain Newton Nichols was acting as convoy commodore stationed aboard *J.A. Mowinckel*. Upon observing the attack on *Chilore*, Nichols had no time to react before J.A. Mowinckel was then struck by a third torpedo. The force of the explosion knocked men off their feet, shattered china in the galley, and killed one man instantly while injuring another 20. A 20 x 20 ft hole was blown in the stern and the ship's steering machinery was completely gone (DIO 1987:412).

A mere two minutes later a fourth torpedo struck yet another vessel in the convoy. The smaller Nicaraguan flagged freighter *Bluefields* was struck amidships and began sinking fast. With the attack over, the convoy escort snapped into action. Two Navy Kingfisher aircraft dropped out of the clouds and dropped a series of depth charges on the U-boat, while the Naval Armed Guard Crew aboard *Unicoi* opened fire and escort vessels continued searching and dropping depth charges (ComScorn Nine 1942; DIO 1987:412; Gannon 1990:384).

Chilore and *Mowinckel*, despite being severely damaged, were still afloat but *Bluefields* slipped beneath the surface by 1700 hours EWT. After securing the corvette *Spry* as an escort for the two stricken vessels, they were permitted to run for the safety of the North Carolina shoreline while the convoy continued south. Since the attack destroyed *Mowinckel's* steering machinery, the master had to steer using its engines, which caused the vessel to follow a wavering course. With *Spry* in the lead, the vessels began their journey towards shore (DIO 1987:411-421; Hickam, Jr. 1989:285- 287; Blair 1996:626-627). For a more detailed discussion of the battle of Convoy KS-520, see Section 5.4.1.

The route chosen by the commodore to take the vessels to shore put them on a direct path to Hatteras Inlet. This path, also led them directly through the danger area discussed in Notice to Mariners 175. Unfortunately, the notice only referred to a danger area and many mariners simply thought this zone had become a graveyard of sunken ships and underwater hazards, not a minefield. While *Spry's* commander knew the danger area was a minefield, he did not know exactly where he was since he had taken part in the hunt to find the submarine that attacked the convoy. By doing so, he had made so many changes in position and speed that he could not plot *Spry's* exact location. Using dead reckoning, the commander accidently plotted all three vessels 60 miles south of where they actually were. Had the vessels really been at this point, the course of 315° the vessels followed would have allowed them to reach shore south of the danger area (DIO 1942:10, Chap. 5; DIO 1987:413-415). Adding to the confusion was that the Convoy Commodore aboard *Mowinckel* knew exactly where the ships were but had a rather hazy recollection about anchoring around Hatteras, and the master of *Mowinckel* claimed he was told the restrictions around Hatteras no longer applied (DIO 1987:415).

With this misinformation, the three vessels took the most direct course toward land. As the vessels continued towards shore, the commander of *Spry* became uneasy about the route's proximity to the minefield and radioed *Mowinckel* to get their position. *Mowinckel* responded that they were 20 miles SE of Hatteras Inlet. Fearing the ships would end up in the minefield, *Spry's* commander suggested a route change that would bring the ships well south of Hatteras. The crew aboard *Mowinckel* heard this transmission incorrectly and when they plotted the course they heard transmitted, realized it would take them north of Hatteras and through dangerous waters, so they kept their heading and did not send a response to *Spry*. Although still uneasy about the situation, the commander of *Spry* decided not to resend his transmission because he did not want to question the Convoy Commodore's decision since the Commodore, although retired, was a senior officer. Shortly after, the three vessels passed one of the patrol boats stationed on the outskirts of the minefield.

Seeing that the merchant ships were led by a naval vessel, the patrol boat decided not to contact the small convoy and resumed its patrol. As the ships closed on the minefield, a blimp began dropping smoke bombs to alert the convoy to the danger they were heading toward, but the Commodore assumed the blimp was just warning them that submarines were in the vicinity and continued steaming ahead.

In a final warning, the crew of patrol boat *PC-462,* which had just returned from taking gasoline to a YP boat that ran out of fuel at sea, attempted to chase down the three vessels, signaling as fast as they could and even firing the boat's guns into the air. Unfortunately, the vessels continued on their way and at 2000 hours EWT, several loud explosions shook the night air. *Chilore* and *Mowinckel* had both passed over contact mines in the Hatteras minefield and been shaken by explosions, while *Spry* escaped danger. While the two merchant crews, fearing they had been torpedoed, abandoned ship, *PC-462* caught up to *Spry* and informed the commander of the danger. The commander of *Spry,* realizing for the first time where he actually was, knew he could do nothing for the merchant ships and followed *PC-462* out of the minefield before heading south to regain convoy KS-520.

The crews of *Chilore* and *Mowinckel* soon reached shore in lifeboats, while the merchant ships remained afloat within the minefield. Over the next few days, channels were swept to the vessels so that they could be towed in and salvaged. On July 19, three tugs were sent to recover the merchant ships, but at 1630 hours EWT, one of these, *Keshena,* struck a mine and sank almost instantly. Finally, the remaining tug removed *Chilore* and *Mowinckel* from the minefield and brought them to Ocracoke for basic repairs before they were sent to Hampton Roads for salvage. Unfortunately, the *Chilore's* terrible saga was not complete until 1700 hours EWT on July 23, when the vessel capsized and sank while being towed past Cape Henry. *Mowinckel,* on the other hand, made it safely to Norfolk (DIO 1942:8, Chap. 5; SOC 1946; DIO 1987:415-419).

These events were the last needed to convince the Commandant Fifth Naval District (ComFive) to begin lobbying for removal of the minefield. ComFive suggested to Admiral Adolphus Andrews, Commander Eastern Sea Frontier (CESF), that the minefield could be replaced with anti-torpedo netting. Admiral Andrews agreed with this suggestion and on 21 July 1942, forwarded the proposal on to Admiral King, Commander in Chief, United States Fleet (COMINCH), with his personal approval. Andrews further stated that he had never been in favor of the minefield and its usefulness was obsolete. In fact, the convoy system along the coast had been initiated before the minefield was completed, nearly relegating it pointless from the beginning. CESF also added that the term 'danger area' might be giving merchant captains a false sense of security because they did not realize the area was mined. Admiral King sent his response on 4 August, stating that anti-torpedo netting was not practical in the waters around Hatteras and the minefield would remain. He did capitulate, however, that the area could be declared mined so that merchant shipmasters would understand the severity of straying into those waters. An additional problem with the minefield soon became evident as well.

The small vessels that were patrolling the minefield required constant maintenance at the section base on Ocracoke and often could not be put to sea if the weather worsened. The wear and tear on the vessels and crews also seemed superfluous since only one merchant ship used the anchorage between 6 August and 6 November. Andrews again petitioned Admiral King on 6 November to allow the minefield to be swept and deactivated, but to allow the area to still be referred to as a danger area on charts and not reveal the mines were gone (DIO 1942:8-11, Chap. 5). King retorted, saying that minesweepers could not be spared because they were in such constant demand at the time for maintaining swept channels at the entrance to important harbors and that the matter would be taken up again the following spring (DIO 1942:11, Chap. 5). In April 1943, CESF again pressed the matter with COMINCH, this time employing an entirely new tactic. Andrews noted that no vessel had been lost to U-boats in Frontier waters since 15 July 1942, and that the minefield was destroying the economy of the Outer Banks. The later argument was based on the

Department of the Interior‘s Deputy Coordinator of Fisheries stating that restrictions on fishermen in the area had already decreased the catch by a staggering 80,000,000 pounds.

On 21 April 1943, Admiral King agreed that the minefield should be removed but left removal of the mines to the Fifth Naval District. Removal was begun on 7 June and, despite the fact that many mines would not fire and heavy storms hindered the operation, the work was completed by 25 September. Although only 1,303 of the 2,500 mines originally laid were recovered, CESF considered the operation a success. Due to the undetonated mines, however, the area continued to be labeled a danger area through the rest of the war and is still labeled as such today. With the sweeping of the minefield, a destructive chapter in Fifth Naval District waters was closed (DIO 1944:11-13, Chap. 5). The ESF would sum up the minefield's history most succinctly:

> Thus ended the Battle of the Hatteras Mine Field. In retrospect, it is easy enough to consider that the sanctuary failed to accomplish its intended purpose of saving ships from submarines; that to the contrary, four ships were lost. On second thought, however, it is clear that the project was undertaken at a time when one could not predict the manner in which the U-boat campaign would develop; the simple fact was that there were not enough escort and patrol vessels or planes to drive the subs from our shore, and that some kind of defense had to be made as a stop-gap. That was exactly the function of the Hatteras mine-protected sanctuary. Considering the outcome, it is fortunate that the shift of U-boat concentrations permitted the well-intentioned sanctuary to pass into ―innocuous desuetude (DIO 1944:13, Chap. 5).

Although the Hatteras Minefield never lived up to the expectations placed upon it by the naval high command, it was not necessarily because the minefield was not effective but more likely because the minefield was replaced by the more effective coastal convoy system. By this time, effective convoy routing effectively ended the U-boat threat of the East Coast. In 1942, there would be increased success in the Gulf of Mexico for a period shortly after, but the major threat was gone.

7.13.2 Archaeological Site Description

The *Chilore* wreck site is the only vessel included in this report that is not located in North Carolina waters. Due to the circumstances of its loss, it ultimately sunk off Cape Henry near Virginia Beach, Virginia, though its fate was decided by events that took place off Cape Hatteras.

The vessel is located in shallow water near one of the busiest shipping lanes on the east coast. Following its loss it did pose a potential threat to navigation and was dynamited and wire-dragged to reduce the vessel's height off the seabed (Figure 7-100; Chewning 2008).

High tidally influenced currents and very low visibility surround this site; when the team attempted to investigate the site, it was impractical to conduct diving operations. As such, the only data recovered on site was from a 455 kHz multibeam with a Reson 8125 transducer.

Because of site disarticulation very few identifiable features in the sonar imagery can be discerned. The hull is in one piece from stem to stern but is reduced at just the very bottom of the hull. At the stern, at least one boiler, which is dislodged from its mount and lying face up, can be seen (Figure 7-101). Amidships, outboard of the main hull on the starboard side, there is a multicomponent cylindrical object. This feature could be a component of the engine, or may be a sunken marker buoy. The vessel is oriented almost North/South, with the bow to the North (Figure 7-102). Along the starboard side of the hull there is some sediment accretion and on the port side significant scour is seen. The high tidal currents in the region contribute to this and there are likely areas of debris in the immediate vicinity of the wreck that experience episodic covering and uncovering of sediment.

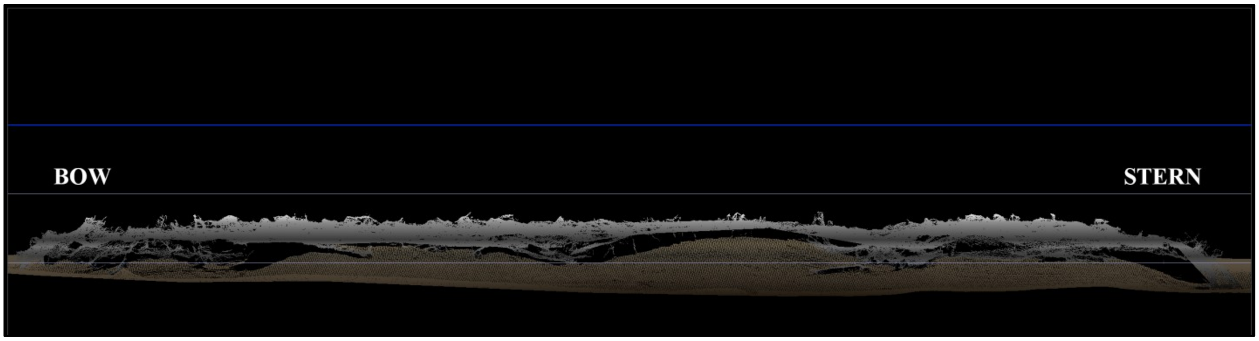


Figure 7-100 Profile view of *Chilore* wreck site showing very low relief.
Source: ADUS/NOAA

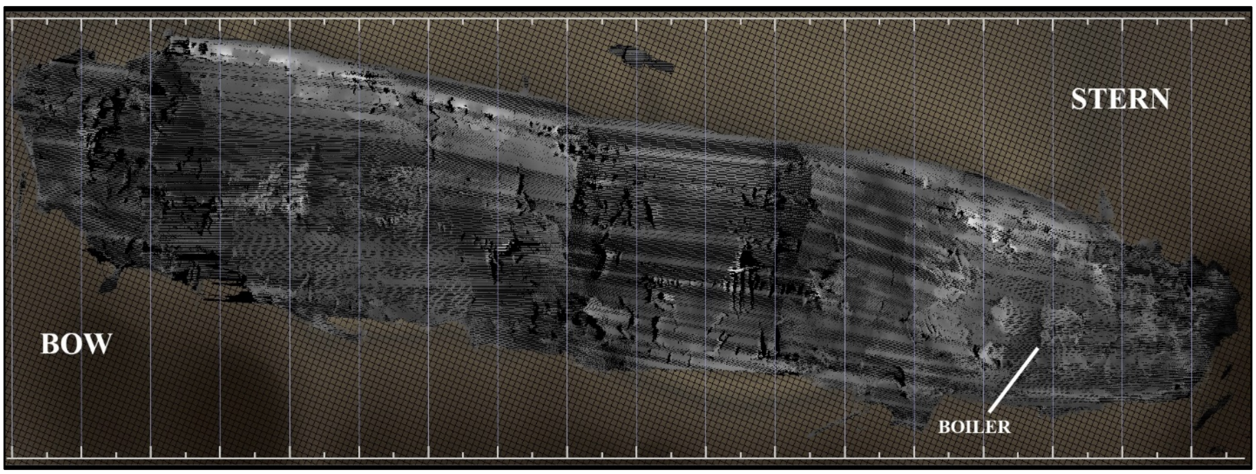


Figure 7-101 Plan view image of *Chilore* wreck site.
Source: ADUS/NOAA

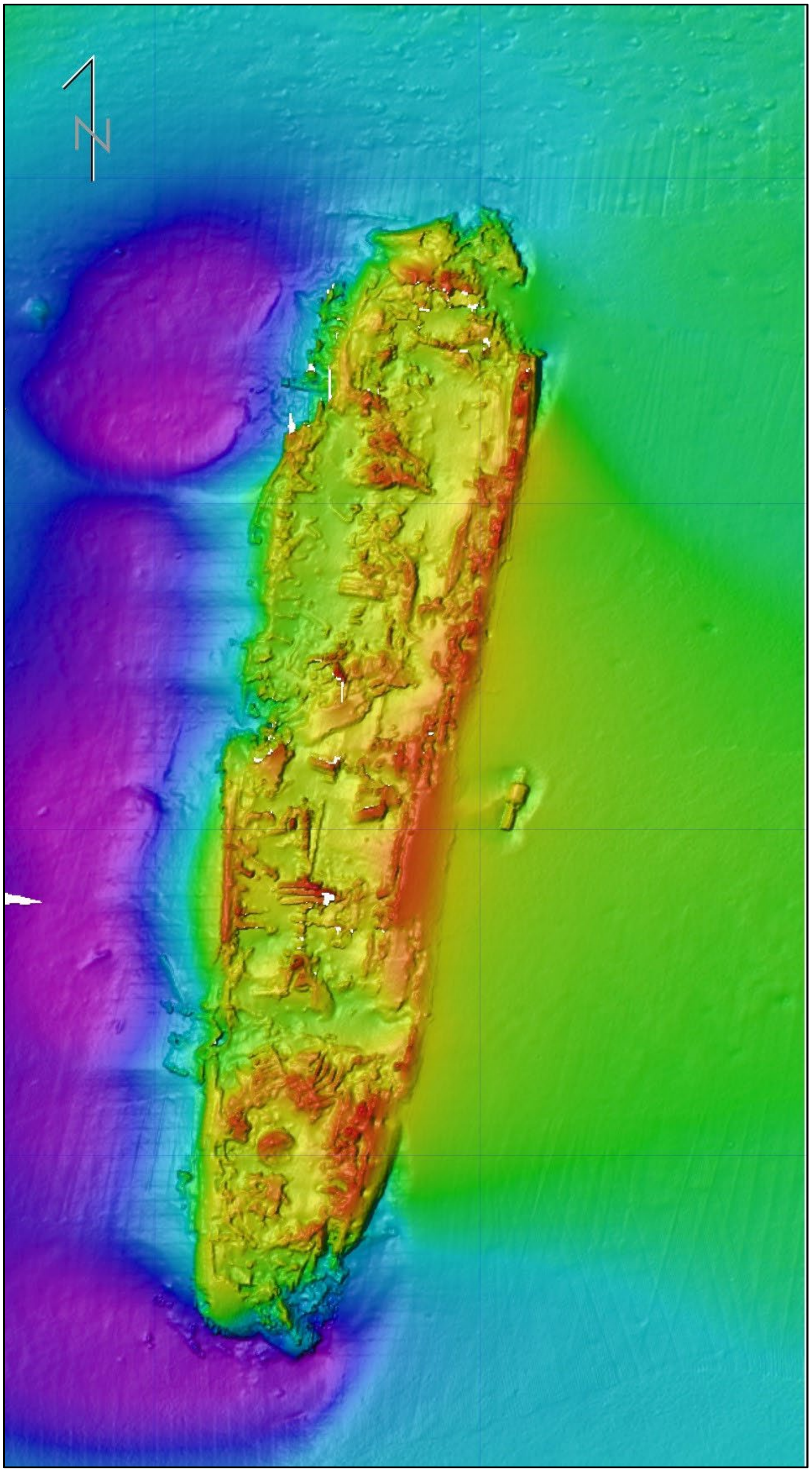


Figure 7-102 455 kHz Multibeam image of the *Chilore* wreck site.
Source: ADUS/NOAA

7.14 Ciltvaira

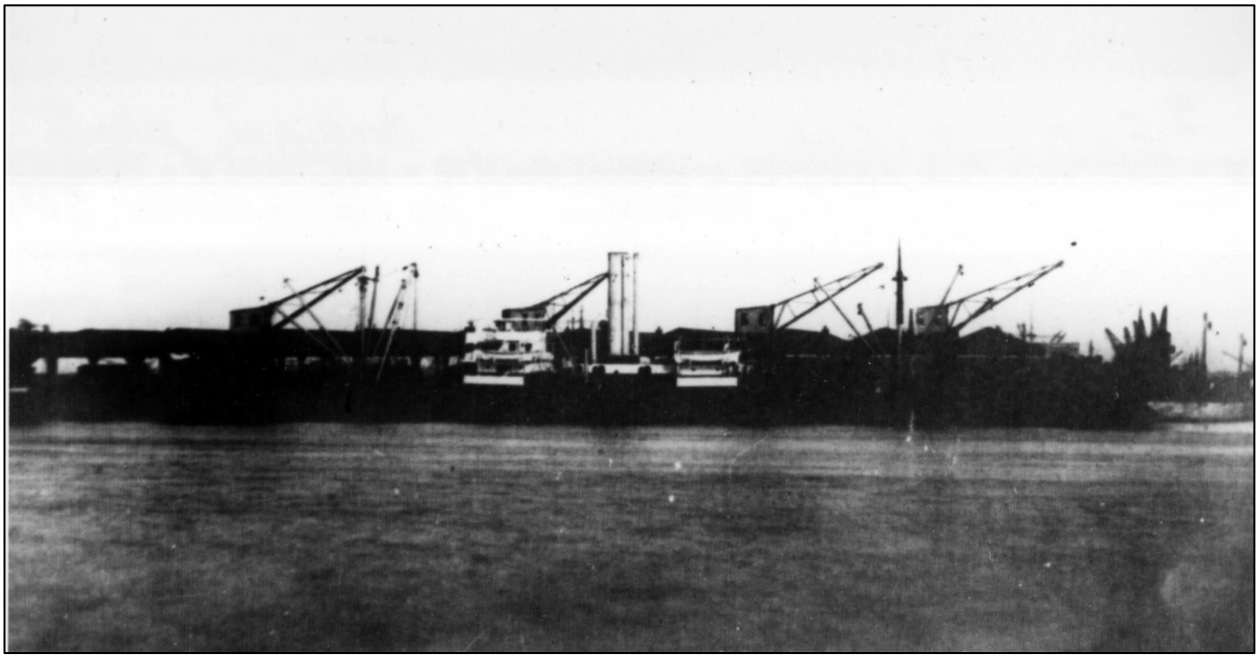


Figure 7-103 *Ciltvaira* pictured as *President Bunge*, date and location unknown.
Source: Steamship Historical Society of America

Table 7-15 Characteristics of Ciltvaira

Characteristics	*Ciltvaira*
Year of Build/Type/Hull #	1905/Cargo Ship/427
Date Lost	19 January 1942
Position & Depth	Reported 16 miles NE of Cape Hatteras, NC; site not located during this effort.
Ship Characteristics	Length: 346.7'; Breadth: 50.8'; Depth: 23' Gross Tonnage: 3,779
Cargo	6,200 tons of newsprint
Survivors	30 (32 Total on board [2 dead])
Owner	Latvian Shipping Company
Builder	J.L. Thompson & Sons Ltd., Sunderland, UK
Former Names	Vironia (Estonia, 1932-1935) Twyford (British Steamship Co., UK, 1924-1932) President Bunge (Cie Royale Belgo-Argentine, 1907-1924) Endsleigh (Endsleigh Steam Ship Co. Ltd., UK, 1905-1907)
Lloyd's Register Details	One deck, web frames, one triple expansion steam engine, 2 Scotch boilers
Port of Registry/Flag	Riga/Latvia
Sunk by	U-*123* (Reinhard Hardegen)
Data Collected	n/a

7.14.1 History

The 37-year career of freighter *Ciltvaira* spaned an impressive cross-section of early 20th century European maritime history (Table 7-15 and Figure 7-103, above). Construction of the vessel, originally named *Endsleigh*, took place in the J.L. Thompson and Sons shipyard of famed UK shipbuilding city Sunderland. Shipyards along the Rivers Wear and Tyne were hotbeds of maritime innovation and shipbuilding might for the UK, spanning both the 19th and 20th centuries. During *Endsleigh's* construction, nearby Newcastle Yard was producing the largest vessel in the world at the time: RMS *Mauretania*. Upon its completion in March 1905, *Endsleigh* was delivered to the steamship company of the same name, UK-based Endsleigh Steam Ship Company. The freighter served for two years under the British flag before being sold to Belgian shipping interest Royale Belgo-Argentine, and renamed *President Bunge*. There, the cargo ship maintained transatlantic service between Belgium and South America until 1924 (Lloyd's Register of Shipping 1905; 1916-1925).

The vessel returned to British ownership in 1924 when it was sold to the British Steamship Company and renamed *Twyford*. Between 1932 and 1935, the vessel was shuffled around under an array of steamship companies, being first shifted to an Estonian affiliate of British-based shipping conglomerate Watts, Watts & Company (also the official managers of *Twyford* during its service to British Steamship Company and administrative successors to the same) in 1932. Under the ownership of Tallinn-based company N.C. Pihlakas, the vessel's named changed once more to *Vironia*. This service, however, was brief and the ship was brought back into British registry in 1934, again as *Twyford*. Shortly thereafter, it was sold entirely from Watts, Watts & Company management into the ownership of the Latvian Shipping Company where it remained until it's sinking in 1942. With this sale came the vessel's final change of name and registry: Riga-based *Ciltvaira* (Lloyd's Register of Shipping 1924-1942).

For the next four years *Ciltvaira* operated as a flagged vessel of the sovereign Latvian state (Figure 7-104). When it left Riga in 1939, it would be for the last time. On 17 June 1940, Soviet Union troops occupied and forcibly annexed Latvia. Following the annexation, all former Latvian-flagged vessels were recalled for reflagging, and the families of non-compliant crews were threatened with deportation. All Latvian merchant vessels were directed to return as soon as possible. Despite this coercion, eight Latvian ships refused to return and continued to operate throughout WWII under their original, 'free' Latvian flag. Of these eight ships—*Everasma*, *Abgara*, *Everalda*, *Regent*, *Everelza*, *Kegums, Everagra*, and *Ciltvaira*—only two survived the war; the balance were sunk by Axis forces (Lyons 2003; Semans 2004).

During the war, as Latvian territory toggled between Soviet and German control, the only remnants of the former Republic of Latvia, besides the officers and crews of the ships themselves, were two embassies in the United States and England. As a result, most of the Latvian sailors were granted US citizenship and did not return to Latvia following the war, since the territory remained under Soviet rule. Instead, nearly all of the surviving sailors vanished into obscurity following the war; it is unknown if any of the 164 sailors reported onboard the 8 vessels were even alive as of 2003 (Lyons 2003; Semans 2004).

Throughout their rule of Lativa, which ended in 1991, official Soviet propaganda suppressed any information regarding the participation of these merchant mariners during the war effort; they only received widespread notoriety when, in 2003, journalist Alex Krasnitsky published a series of stories in the Latvian *Chas* newspaper chronicling the histories of each of the 'free' Latvian vessels. Since *Chas* was only printed in Russian, Krasnitsky's stories are herein cited as they appeared in English-based news affiliates (Lyons 2003; Semans 2004).

Figure 7-104 Image of *Ciltvaira* reportedy in Riga in 1939.
Source: Lyons 2003

In the early morning hours of 19 January 1942, *Ciltvaira* was traveling coastwise off the Outer Banks of North Carolina from Norfolk with a load of paper, bound for Savannah, Georgia. As they departed Norfolk, the officers and crew did not receive any official notice of the incoming reports of U-boat activity along their planned route. In fact, German U-boat attacks along the American coast started only a week prior, and didn't reach North Carolina until the day of *Ciltvaira's* departure. Likewise, the ship's captain, Karl Skerbergs, felt the aging freighter was too small and unimportant to be targeted by U-boats. Thus, the ship travelled fully lighted on a direct (non-zig-zagging) course southward (Hickam, Jr. 1989:14-15; Gannon 1990:261-262)

As the ship approached Hatteras, most of the vessel's 32 crew members, including the captain, were asleep until a loud explosion sent shockwaves through the ship. A single torpedo from Reinhard Hardegen's U-*123* struck the freighter's port side around the engine room. The resulting blast was sufficient to disable the propulsion system, rupture the boilers, and immediately kill the 2 crew members on duty in the area. Simultaneously, the ship's No. 2 hold was rapidly flooding. Meanwhile the ship's company was responding to the attack by gathering and manning the lifeboats. Having rushed out of bed, most were still in their underwear. By the time the crew abandoned ship, 30 of the 32 crewmembers had safely made it off *Ciltvaira*; included were the ships' cat and dog (Hickam, Jr. 1989:14-15; Gannon 1990:261-262).

The freighter's remains, however, persisted. Several hours after abandoning ship, with daylight breaking, the crew could still see the ship afloat (Figure 7-105). A decision was made: the captain and eight other volunteers would re-board the ship and secure the crew's passports, paperwork and documents, and clothing for the crew that had hastily abandoned ship in their underwear. Meanwhile, two passing ships, tanker *Socony-Vacuum* (flagship of the oil company of the same name and fleet member of *Ario* and

Atlas) and Brazilian freighter *Bury* stopped to render assistance. Both took on survivors and the latter tried, unsuccessfully, to tow the damaged hulk northward. *Bury* broke these efforts off and took the 9-person detachment onboard *Ciltvaira* to New York, while the remaining survivors travelled to Charleston, South Carolina onboard *Socony-Vacuum* (Lloyd's Register of Shipping 1942; Hickam, Jr. 1989:14-17; Gannon 1990:261-262).

After being abandoned by its crew, the US Navy also made attempts to tow *Ciltvaira's* damaged remains out of the shipping lanes. Figure 7-106 through Figure 7-110 show a US Navy vessel circling the ship as the freighter continued to sag and break amidships. These efforts, however, were abandoned and the ship was left to its inevitable fate. Official reports following the war simply noted "derelict [ship] was last sighted drifting seaward beyond 100-fathom curve" (DIO 1945). *Ciltvaira's* remains have not been definitively located; though, over the years, several sites along the North Carolina coast have been investigated as possibly belonging to the Latvian freighter.

The sinking of *Ciltvaira* sometime after 20 January would be the last official sinking credited to Reinhard Hardegen's first war patrol while in US waters. The Latvian freighter was not, however, the last ship attacked by *U-123*. Instead, Hardegen concluded the first U-boat mission of Operation Paukenschlag (Drumbeat) by returning to a tanker that he and his crew had been in the process of shelling with their deck gun prior to spotting *Ciltvaira*. As their patrol wound to a close, the commander was trying to make the most of the boat's remaining torpedoes. Under cover of darkness, a surface gunnery attack against tanker *Malay* was attempted to save a torpedo. As circumstances availed, Hardegen opportunistically expended U-*123's* second-to-last torpedo on *Ciltvaira*; the U-boat had only a single torpedo remaining and had not completed the sinking of *Malay*. In fact, while U-*123* broke off its attack to sink *Ciltvaira*, *Malay*'s crew managed to put out most of the fires caused by the U-boat artillery strikes. Simultaneously, radio traffic from both *Malay* and *Ciltvaira* quickly alerted passing ships and the American naval forces of the U-boat's presence. Dawn was breaking. U-*123* opted to break off the attack; they motored back to *Malay* and, with their last torpedo, made one final run on the unarmed tanker (Gannon 1990:259-264).

Figure 7-105 *Ciltvaira* damaged and adrift after being attacked by U-*123* in January 1942.
Source: NARA

Figure 7-106 *Ciltvaira* following the attack by U-*123*.
Source: *New York Times* 1942a

Figure 7-107 The sagging remains of *Ciltvaira*, broken amidships and sinking.
Source: NARA

Figure 7-108 View of damaged *Ciltvaira*'s bow.
Source: NARA

Figure 7-109 US Navy ship circles the freighter's damaged hull.
Source: NARA

Figure 7-110 US Navy tug astern of sinking *Ciltvaira*.
Source: NARA

The tanker, as it turned out, had been traveling in ballast back to the Gulf of Mexico. Despite both the torpedo attack and shelling from U-*123's* deck gun, the vessel did not contain a volatile cargo that typically erupted into flames and consumed the ships which carried them. Instead, the ship's empty internal tanks offered a sort of protective compartmentalization whereby the flooding and damage from the torpedo and shells became manageable. As a result, after fighting small fires, *Malay* was able to make way under its own power, and entered Hampton Roads, Virginia, for repairs. U-*123*, however, had not lingered to observe the tanker's fate. With daylight approaching, radio waves buzzing, and some minor mechanical damage of the U-boat itself, Hardegen gave the order to set course for France. He assumed *Malay* would inevitably sink and radioed his presumed success to BDU accordingly (Gannon 1990:259-264).

For their first foray into US waters, the crew of U-*123* claimed 8 ships sunk for an estimated total of 53,860 gross tons. Commander Hardegen radioed BDU to this effect and received an enthusiastic reply from Döenitz. The reality of this patrol, however, was that the U-boat had actually only sunk 7 ships for approximately 46,744 tons total, subtracting the presumed sinking of *Malay*. Despite the discrepancy, Hardegen's patrol was sufficient to earn him the coveted Ritterkruez (Knight's Cross decoration). Headquarters radioed an announcement of this award to the boat and an impromptu ceremony was conducted while still underway to France. Not one to miss an opportunity, Hardegen also sank two additional ships with gunfire outbound off Bermuda before making it back to France. Thus, U-*123* returned to Lorient on 9 February 1942, with a string of tonnage pennants hoisted upon the periscope, and homemade ornaments displayed to celebrate their Ritterkruez awards (Hickam, Jr. 1989:17-19; Gannon 1990:276-300; Blair 1996:727).

Though several U-boat commanders were to supersede both the numbers of ships sunk and total tonnages claimed by U-*123* during their two American patrols, the recognition and praise received by Hardegen and U-*123* following this first patrol was substantial. In part, the symbolic value of being the first U-boat to return from American waters was as important as also being the most effective U-boat in this initial group. The return of U-*123*, their success, and the experience of operating in American waters that they brought back to BDU would mark a watershed moment for the German U-boat arm.

7.14.2 Archaeological Site Description

To date, the remains of *Ciltvaira* have not been definitely located. Over the years sport divers off the North Carolina coast have suggested several sunken freighters to be the *Ciltvaira*. In his dive guide series from 1985, Roderick Farb (Farb 1985:52-53) describes a location:

> 10 miles offshore near Avon in 120 ft of water with her uppermost deck at 75 ft. from Oregon Inlet, the wreck site is 31 miles out to sea on a heading of 150 degrees… The *Ciltvaira's* engine and boilers are prominent and the bow is more or less intact but the wreck is very broken up forward of amidships to the stern.

This description lacks any specific position information save the triangulated coordinates which roughly coincide with the vague administrative reports of the vessel's sinking throughout US naval records. It is most likely, therefore, the same site commonly referred to as the 'Green Buoy Wreck.' Also in approximately 120 ft of water, with a high degree of relief, and roughly 30 nautical miles from Oregon Inlet, but 18, not 10 miles offshore of Avon, the Green Buoy Site has alternatively been referred to as both *Ciltvaira* or *Mirlo*, a casualty from the First World War.

Researcher Michael C. Barnette (2006:76) reviewed both of these potential identities and concluded that neither was correct. Instead, he proposed the site was most likely that of British tanker *San Delfino*. Most conspicuously, the 'Green Buoy Wreck' has a large, stern-mounted deck gun (Figure 7-111). No armaments whatsoever were present onboard *Ciltvaira*, as evidenced both in the photos obtained from the NARA, and the statements made by its crew following the freighter's sinking. Upon landing at Charleston, South Carolina onboard *Socony-Vacuum*, Radioman Rudolph Musts (in Gannon 1990:262) was quoted as saying "We couldn't fight back this time, but probably our next ship will be armed. It will be different then. You will see what we can do when the devils attack."

The sonar data and diver observations made at the 'Green Buoy Wreck' in 2013 supported Barnette's interpretation of the remains. Georeferenced sonar data revealed the site's dimensions were in excess of 400 ft long, though highly disarticulated in some areas. Nevertheless, a contiguous amount of remains greater than *Ciltvaira's* 346 ft of length further ruled out the Latvian freighter. Likewise, the team in 2014 observed the same features Barnette reported: a single boiler (as opposed to *Ciltvaria's* 2 Scotch boilers) and a large, in-line diesel engine (as opposed to *Ciltvaira's* triple expansion steam engine). Thus, these remains were not consistent with *Ciltvaria* and were, in fact, consistent with those of *San Delfino*.

More confounding, perhaps, are the results obtained when reviewing the historical accounts and the various positions reported within US Navy and Coast Guard records. Post-war Coast Guard records place the vessel's final remains along the same latitude as the town of Avon, in shallow waters inshore of the remains of *City of Atlanta* (also torpedoed by U-*123*). Yet, no official wreck or obstruction has ever been detected in the area, which is highly unlikely given the shallow water and amount of traffic through the area. Put another way, if this official report was even close, the vessel would have presumably already been located in this vicinity. Rather, the simple fact is that the vessel drifted for days after being attacked and, despite two attempts to tow the hulk inshore, "…was last sighted drifting seaward beyond 100-fathom curve" (DIO 1945). Its final sinking took place without witness, and at the mercy of the powerful, unpredictable currents north of Cape Hatteras.

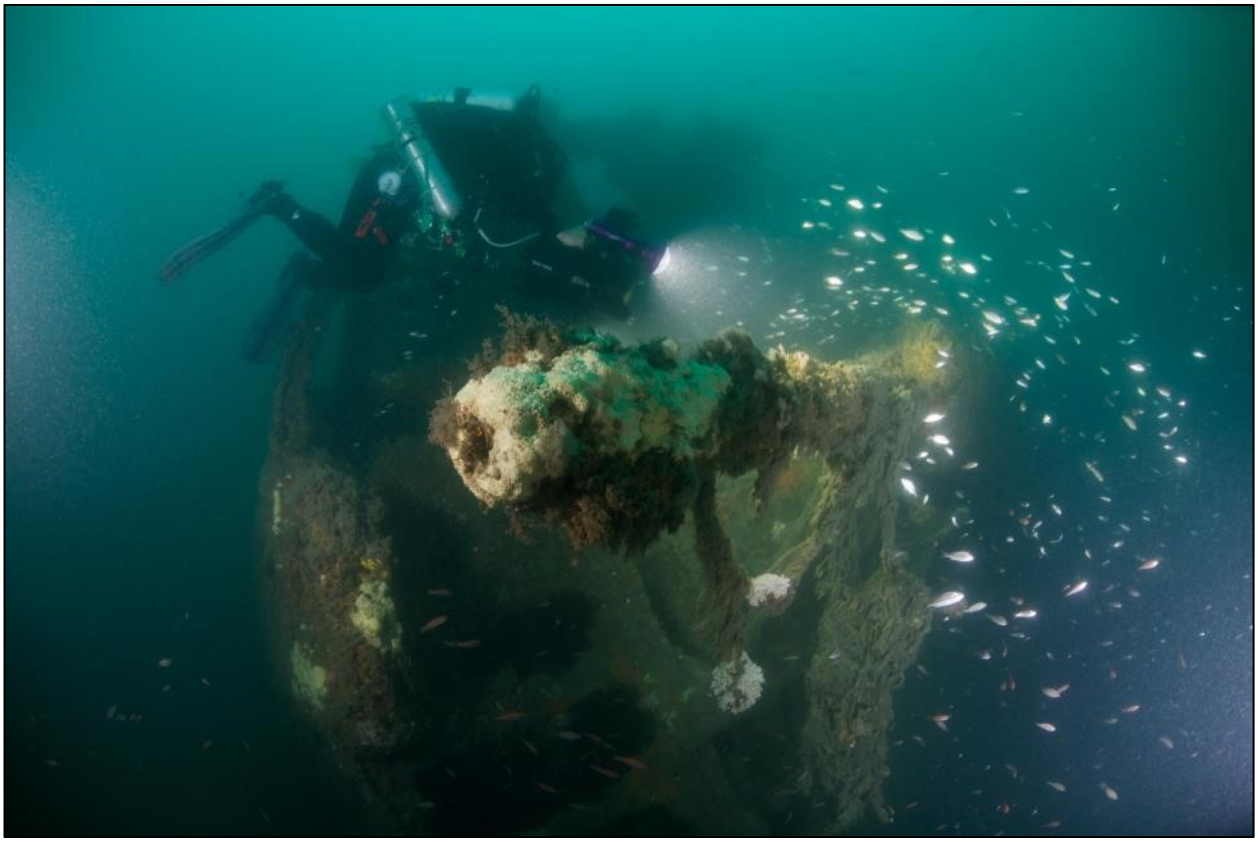


Figure 7-111 Stern-mounted gun at "Green Buoy Wreck" site.
Source: NOAA

Despite the uncertainty surrounding the final sinking location, the vessel's long service life and resulting documentary records offer a wealth of physical data with which to evaluate potential archaeological sites. Namely, the freighter was somewhat distinct for its (relatively) small size compared to newer-built craft lost off North Carolina. Likewise, its construction as a freighter, not a tanker, means the general arrangement of its boilers and machinery will also be distinguishable and diagnostic. Details of structural items and deck arrangements can likewise be evaluated in comparison to photographic records and listings in the Lloyd's Register of Shipping. Knowledge of the damage sustained during the attack will also aide interpreting a given set of archaeological remains. Taken as a whole, existing historical data on *Ciltvaira* will lend to rapid assessment of potential sites, when and if they are located.

7.15 City of Atlanta

Figure 7-112 ***City of Atlanta*** **underway in 1904, location unknown.**
Source: Steamship Historical Society of America

Table 7-16 Characteristics of *City of Atlanta*

Characteristics	*City of Atlanta*
Year of Build/Type/Hull #	1904/Freighter/324
Date Lost	19 January 1942
Position & Depth	17 miles NE of Cape Hatteras, NC 90 ft
Ship Characteristics	Length: 377.5'; Breadth: 49'; Depth: 15.8' Gross Tonnage: 5,269
Cargo	2,780 tons of general cargo, mainly foodstuffs
Survivors	3 (46 Total on board)
Owner	Ocean Steamship Company, Savannah, GA
Builder	Delaware River I.S.B. & Engineering Works, Chester, PA, USA
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, Steam Screw (St.s), Single Screw, 3 decks, Triple-expansion steam engine, 4 Scotch Boilers
Port of Registry/Flag	Savannah, GA/USA
Sunk by	U-*123* (Reinhard Hardegen)
Data Collected on Site	ADUS 2011; photo and video 2013.

7.15.1 History

After completion in 1905, *City of Atlanta* was in the continuous service of the Ocean Steamship Company of Savannah until its loss in 1942 (Table 7-16 and Figure 7-112, above). During this time, *City of Atlanta* was a regular part of the Savannah Line, which typically operated between Savannah, Philadelphia, New York, and Boston to the North, and Fernandina and Jacksonville to the South (Figure 7-113 through Figure 7-115). For a brief period, 1934-1936, the vessel was certified for passenger service. During the war, however, the vessel had reverted to carrying cargo only (Lloyd's Register of Shipping 1934-1935; Hurd 1942; Gannon 1990:256).

Even through the steady times, however, the steamer managed to gin up some serious misfortunes. At 5-year intervals starting in 1920, *City of Atlanta* collided with and sank three different vessels. The first collision occurred with the concrete-hulled *Cape Fear* off Narragansett Bay, RI (Figure 7-116). The victim, one of the original experimental concrete hull designs produced by the Liberty Shipbuilding Company in Wilmington, North Carolina, was broadsided by the (relatively) enormous freighter. Instead of bending, the brittle concrete hull shattered and *Cape Fear* sank in less than 5 minutes. Only half of the 34-person crew was saved. Then, 5 years later in a dense fog bank off York Spit, (Baltimore) *City of Atlanta* hit the barge *Juniper*, again resulting in the latter's sinking. The next unsuspecting encounter took place 47 miles off the coast of Barnegat, New Jersey in 1930. Here, *City of Atlanta* hit schooner *Azua* and the other vessel sank (Ignasher 2010:30-32).

In early January 1942, as war crept closer to American shores, the steamer maintained its normal route between New York and Savannah. By 11 January the first wave of 6 Type IX and, shortly thereafter, 10 Type VII U-boats arrived and commenced attacks upon merchant shipping in American waters. The first hostile actions were credited to Kptl. Reinhard Hardegen with U-*123's* sinking of *Cyclops*. Many more ensued in the following days, as each arriving U-boat found easy hunting. Meanwhile, as a result of the disorganized and anemic response which characterized the American government's initial reaction to U-boat attacks, some ships received sailing instructions with U-boat precautions, while others did not. The captain of *City of Atlanta* had been provided instructions to black out the ship, and the vessel travelled cautiously down the coast at a speed of 11 kts (Gannon 1990:242-256; Blair 1996:727).

Captain Lehman Urquart's diligence in readying *City of Atlanta* for a dangerous passage, however, was to no avail. U-*123's* commander recalled that, while on station off Hatteras in January, ships were so numerous that those passing while blacked out could be silhouetted against those traveling fully lit, or the numerous lighted navigation buoys; for the U-boat commander it was simply a matter of picking the most desirable (generally the largest) target to pursue. On the night of 19 January, it was a large, passing freighter: Hatteras-area regular *City of Atlanta*. Kplt. Hardegen ran a parallel course with the ship, overtaking it and positioning U-*123* just ahead of the vessel. Hardegen then maneuvered so as to bring the bow of the U-boat around and a single torpedo was fired from a very close 250-m range. After a short run, the torpedo found its mark. A massive explosion tore through *City of Atlanta's* stern and sent a shock wave that knocked the U-boat's crewman off their feet and sent debris flying past the lookouts atop the conning tower (Gannon 1990:255-256).

For the crew onboard *City of Atlanta*, it was a quiet, moonless night. Thirty-three of the 47 crew were asleep as the vessel rounded Wimble Shoals and was preparing to turn for Hatteras; they were close enough inshore to be within sight of land. Suddenly, a violent explosion rocked the ship and crashed through the port side, No. 3 hold, and the engine room bulkhead. A frantic mix of chaos ensued. Crew who were asleep came on deck; the captain was passing orders to lower lifeboats; attempts were made to lower boats, but all were jammed; the ship began a dramatic list to port. Less than 10 minutes elapsed between the torpedo strike and the ship rolling and submerging beneath its frantic crew (Hurd 1942; Gannon 1990:256-257).

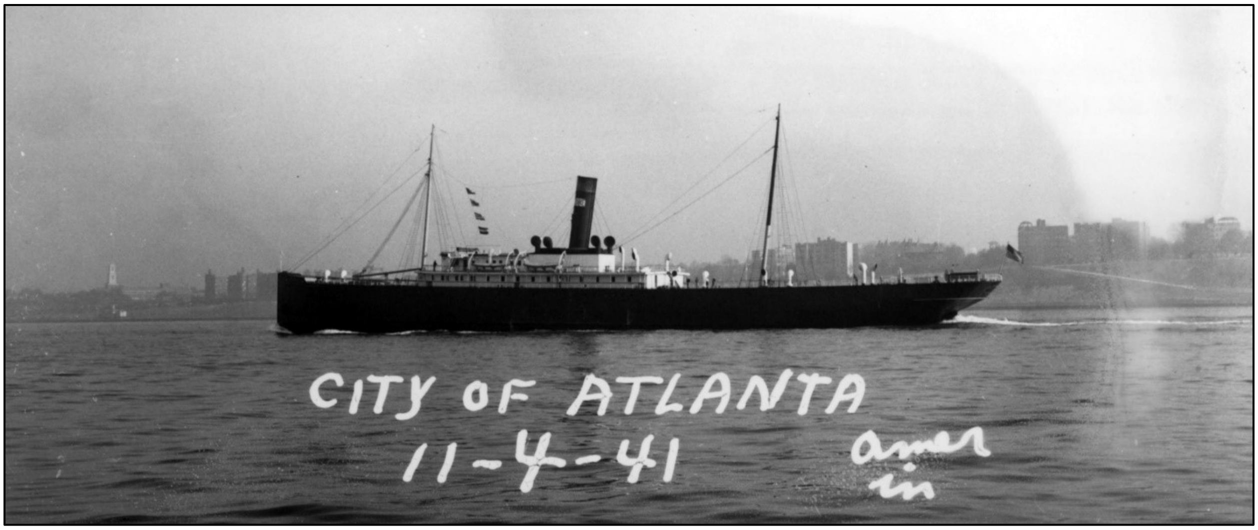


Figure 7-113 Portside view of *City of Atlanta*.
Source: Steamship Historical Society of America

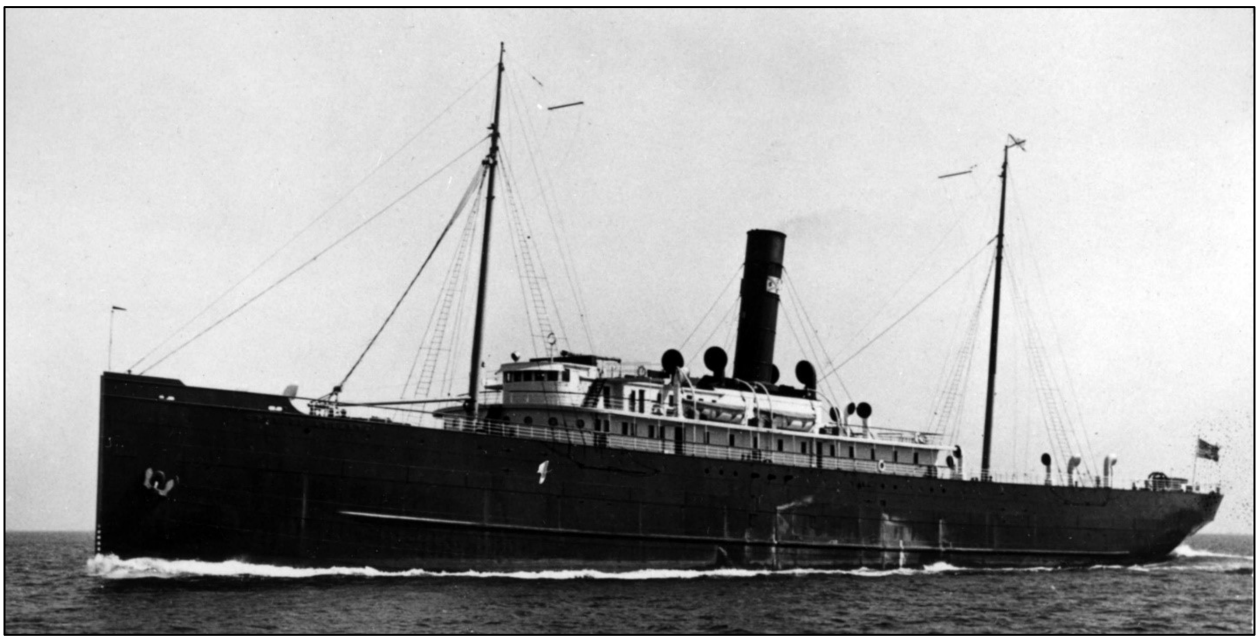


Figure 7-114 Portside view of *City of Atlanta*.
Source: Steamship Historical Society of America

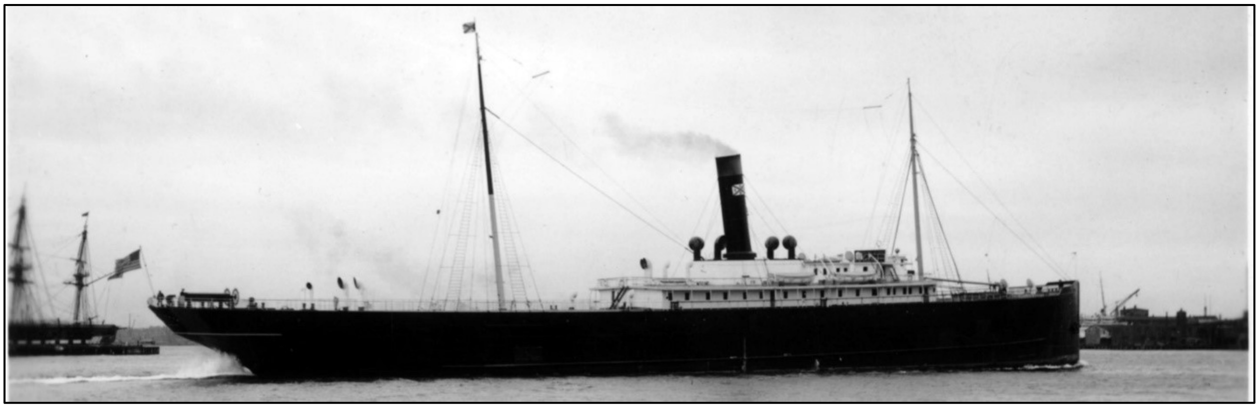


Figure 7-115 Starboard view of *City of Atlanta*.
Source: Steamship Historical Society of America

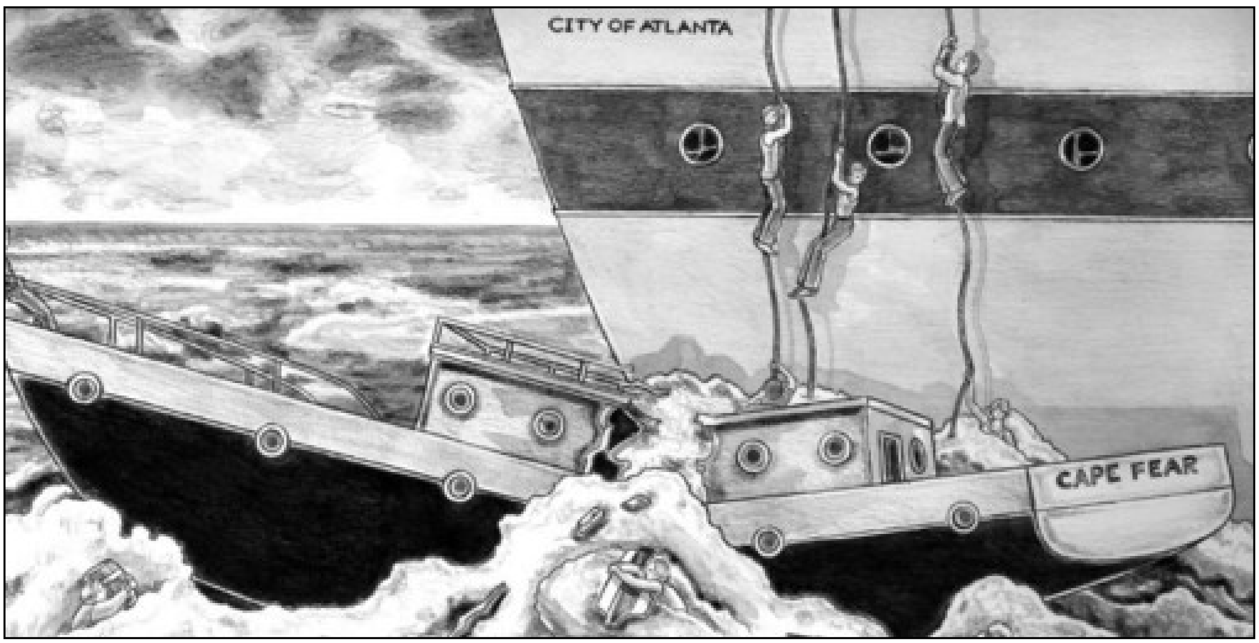


Figure 7-116 Collision between *Cape Fear* and *City of Atlanta*.
Source: Illustration by Bill Gallagher Jr, in Ignasher 2010:31

It was estimated that only 19 crew made it off the ship. Yet, without any lifeboats to board, they were relegated to floating upon miscellaneous debris. Many simply floated upon the water with their lifejackets. The January air was cold, and the nearshore water was, likewise, very cold. One by one, hypothermia set in. By 0830 hours the following morning, as northbound freighter *Sea Train Texas* spotted the wreckage and survivors, only three of the crew remained: Second Officer George Tavelle, oiler Robert S. Fennell, Jr., and oiler Earl Dowdy (Figure 7-117).

Figure 7-117 Two surviving crewmembers from the wreck of the *City of Atlanta*. Robert Fennell (left), and George Tavelle, the Second Officer.
Source: *New York Times* 1942a

7.15.2 Archaeological Site Description

City of Atlanta's remains sank in the shallow, nearshore waters between Wimble and Diamond shoals. As reported by the crew, the hole in the ship's hull resulting from U-*123's* torpedo caused massive flooding, resulting in an abrupt list to port. As the vessel sank, however, it must have remained upright to some degree, as masts were reported on numerous occasions at the location as late as 30 March 1942. The remains were not seen again until being relocated by USCGC *Gentian* on 21 June 1944 (DIO 1945:24).

In the interim, the same records indicated that a surface ship developed a sonar contact at the site in May 1942, and, believing it to be an enemy submarine, conducted depth charge attacks upon the freighter's remains. To determine if the vessel's remains posed a hazard to navigation, a Navy dive team was deployed to inspect *City of Atlanta* between 21 and 24 June 1944. Both diver observations and drop-camera photographs revealed an extreme listing as much as thirty degrees off center, presumably to its port side. After the diving operations concluded, USCGC *Gentian* re-surveyed the vessel's remains and ultimately determined that wire-dragging was necessary to ensure clearance below 40 ft depth. To this end, dragging operations were conducted and established a mean low water clearance of 43 ft on 24 July, 1944 (DIO 1945:24).

Detailed accounts from the ship's surviving crew, its proximity to visual landmarks, as well as its location in shallow water, combined with the Navy and Coast Guard's efforts to locate and evaluate the site, all resulted in *City of Atlanta's* final resting place remaining well known after the WWII. Likewise, it is presently still marked on navigation charts.

Divers first visited the site during field operations in 2010. The site rests in approximately 80 ft of seawater and consisted of a linear arrangement of generally contiguous vessel structure. Terminal ends were oriented almost exactly east to west, with the bow resting at the eastern portion of the site and the stern at the western portion. A large circular structure is the most characteristic feature at the stern, which is part of the vessels' steering mechanism (Figure 7-118). Engine and boilers are extant amidships with the prop shaft running aft to the propellers (Figure 7-120). While the site is generally flattened, there are three areas of higher relief: the boilers, the bow, and the stern sections. Amidships the engines stand just over 13 ft off the bottom (Figure 7-119). Likewise, the bow section is nearly 14 ft off the bottom and just the stern rises approximately 12 ft.

The location of this site along the northwestern boundary of the Gulf Stream and Labrador current contribute to highly variable water current, visibility, temperature, and multiple stratifications of the water column. The geological substrate, however, is consistent and the bottom is very flat and mostly a uniform sandy plane.

Due to the site's somewhat remote location, *City of Atlanta* was selected for high-resolution multibeam documentation in 2011. This approach offered the quickest way to capture detailed physical data across the entire archaeological site, the results of which are shown in Figure 7-121. Here, a planview export of the Reson 8125 multibeam sonar data, exported at a resolution of 6 mm, clearly shows the four Scotch boilers and machinery amidships, the broken down, mostly empty cargo hold areas, and the intact bow and stern sections. Additional processing of the data resulted in the 3D point cloud visualizations shown in Figure 7-122. Within this interface, researchers can 'virtually' move around the vessel's remains while also measureing and characterizing prominent features. The four boilers measure 11.5 ft in length, the wreck site overall measure over 422 ft in length, and the debris field at its widest point is 108.5 ft.

Figure 7-118 Stern section of *City of Atlanta* as seen in 2010, with part of the steering gears visible.
Source: NOAA

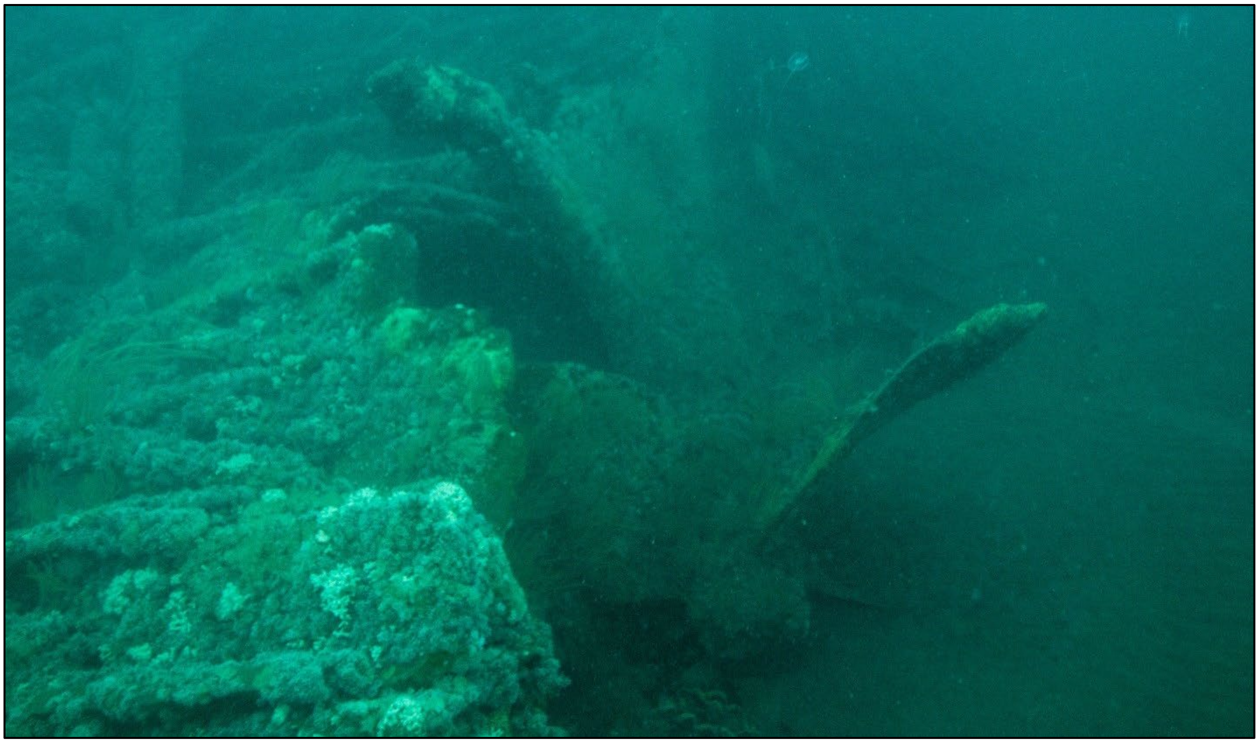


Figure 7-119 Stern post and propeller on *City of Atlanta*.
Source: NOAA

Figure 7-120 Boilers found amidships on *City of Atlanta*.
Source: NOAA

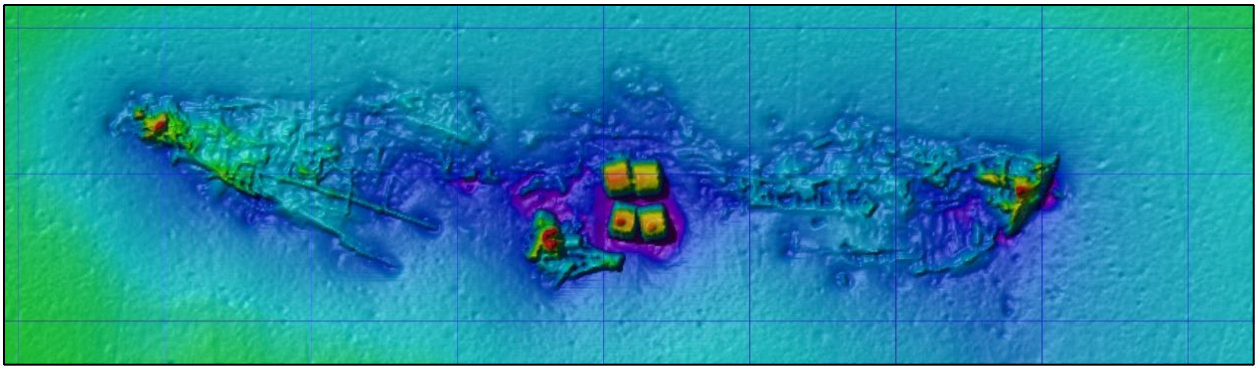


Figure 7-121 Reson 8125 scaled multibeam survey of *City of Atlanta* wreck site.
Source: ADUS

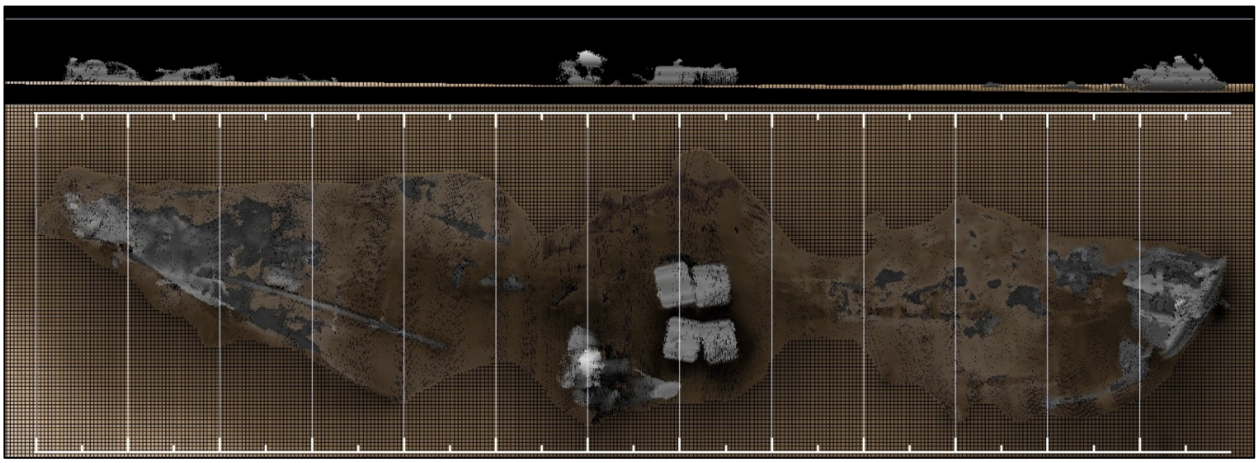


Figure 7-122 Multibeam SONAR visualization of the *City of Atlanta* wreck site scaled in 10-m grid.
Source: ADUS

7.16 City of New York

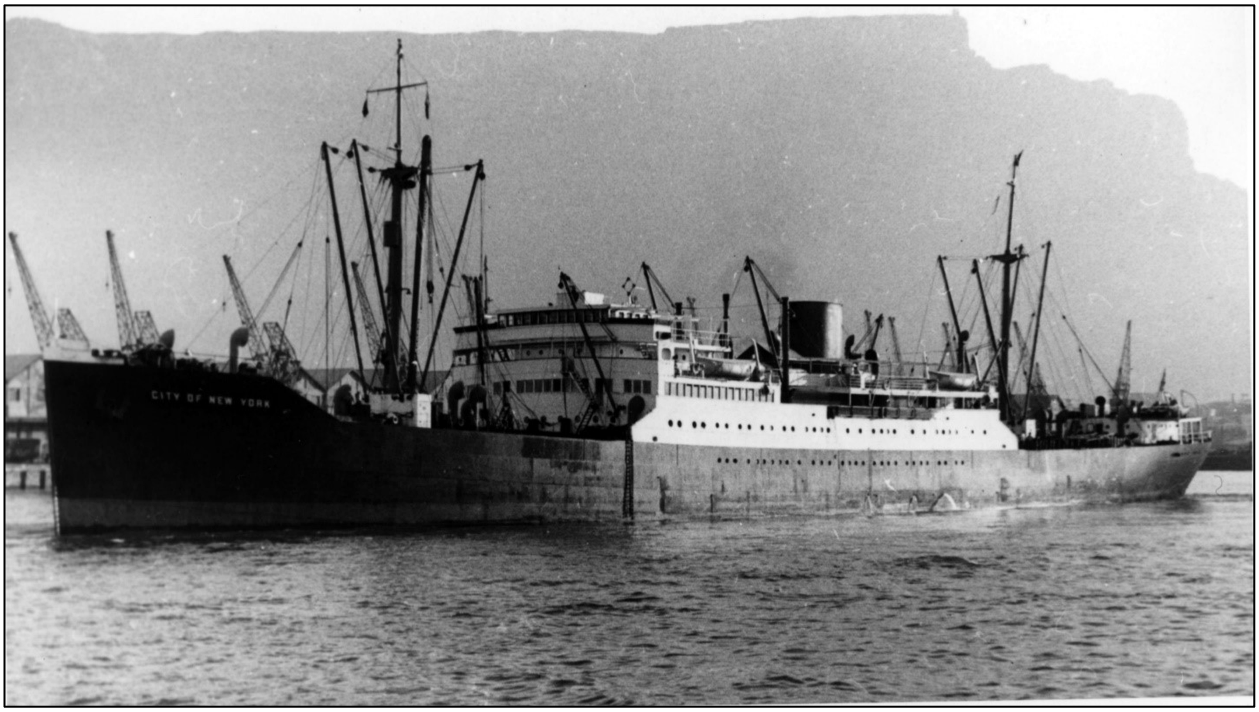


Figure 7-123 Combination freighter and passenger ship *City of New York*.
Source: Steamship Historical Society of America

Table 7-17 Characteristics of *City of New York*

Characteristics	*City of New York*
Year of Build/Type/Hull #	1930/Passenger and Cargo/116
Date Lost	29 March 1942
Position & Depth	Reported 45 miles E of Cape Hatteras, NC; site not officially located during this effort.
Ship Characteristics	Length: 450.9’ Breadth: 61.8’ Depth: 24’ Gross Tonnage: 8,272
Cargo	6,612 tons of chrome ore, wood, wool, hides, passengers
Survivors	120 (146 Total on board [26 dead]) Estimate.
Owner	American South Africa Line, Inc.
Builder	Sun Shipbuilding & Drydock Co., Chester, PA
Former Names	N/A
Lloyd’s Register Details	Steel (Stl) hull, three decks, twin screw, dual shaft, two 8 cylinder 2S C.S.A diesel engines, refrigerated machinery
Port of Registry/Flag	New York, NY
Sunk by	U-*160* (Georg Lassen)
Data Collected on Site	N/A

7.16.1 History

The combined passenger and cargo ship *City of New York* was constructed in the Chester, Pennsylvania yard of the Sun Shipbuilding and Drydock Company (Table 7-17 and Figure 7-123, above). Tankers were the company's mainstay ship production type, including *Australia* completed two years prior to *City of New York*. Though, by 1930 the yard was capable of building any set of general arrangement plans (see Figure 7-124). These 'standardized' plans represent the cumulative development of American shipbuilding designs as of 1920, where the differences between tankers, freighters, combined freight and passenger ships, and many others, are clearly distinguishable. As a result, the layout of the passenger/cargo combination ship—*City of New York* and even *City of Atlanta* (circa 1904 from Delaware River Iron Shipbuilding Co.)—had taken on quite a distinct design. The large 450-ft steel freighter featured three decks, twin eight-cylinder diesel engines, and had both the upperworks of an accommodating passenger vessel and the inboard design of a large freighter (Figure 7-125; Webster 1920; Lloyd's Register of Shipping 1930-1942).

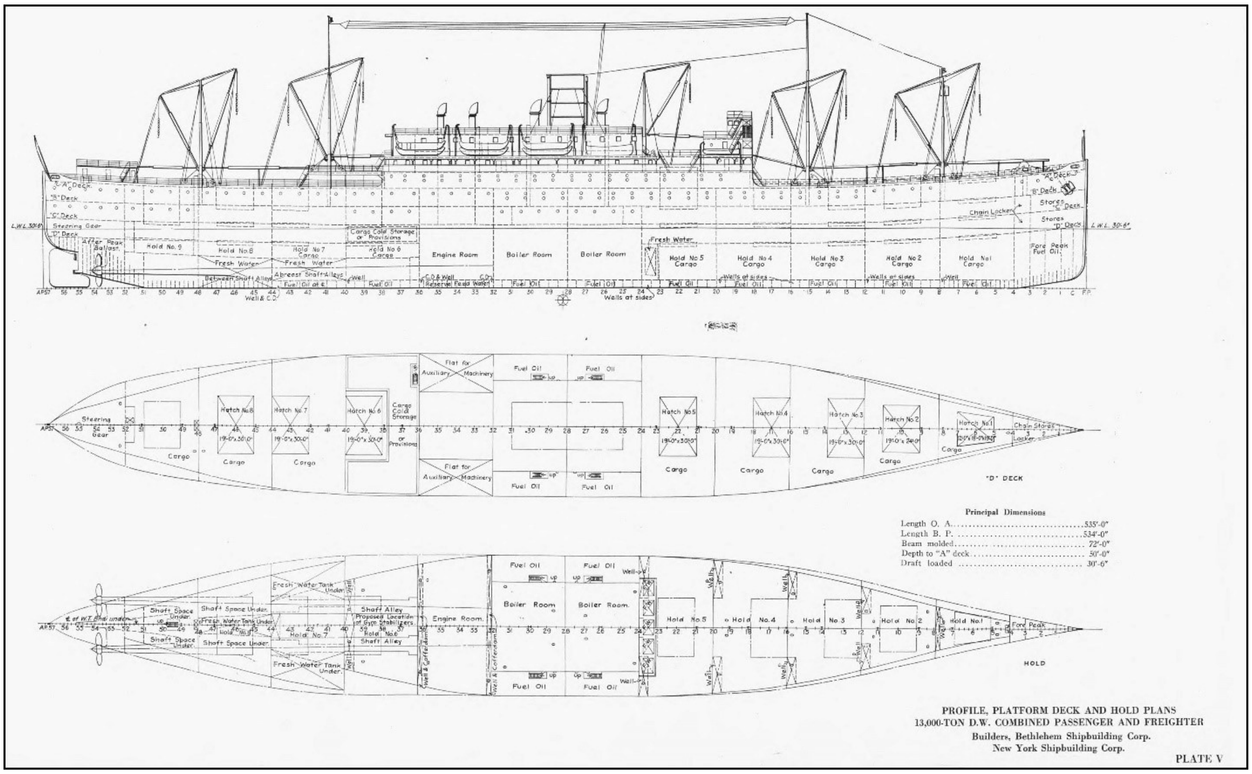


Figure 7-124 General arrangement for a Passenger/Freighter ship.
Source: Webster et al. 1920

The general arrangement features an enlarged bridge deck with both the wheelhouse itself and the passenger cabin areas. Flanking the bridge/cabin deck on both sides is the cargo area and associated rigging for loading and unloading (Figure 7-126). These upperworks are in stark contrast to the reduced bridge decks of tankers and freighters, where the necessity of accommodating passenger areas was not an issue. Historical images of *City of New York* clearly show this arrangement, with a single set of rigging over the fore and aft spaces. *City of New York* also featured a built-up quarter or poop deck.

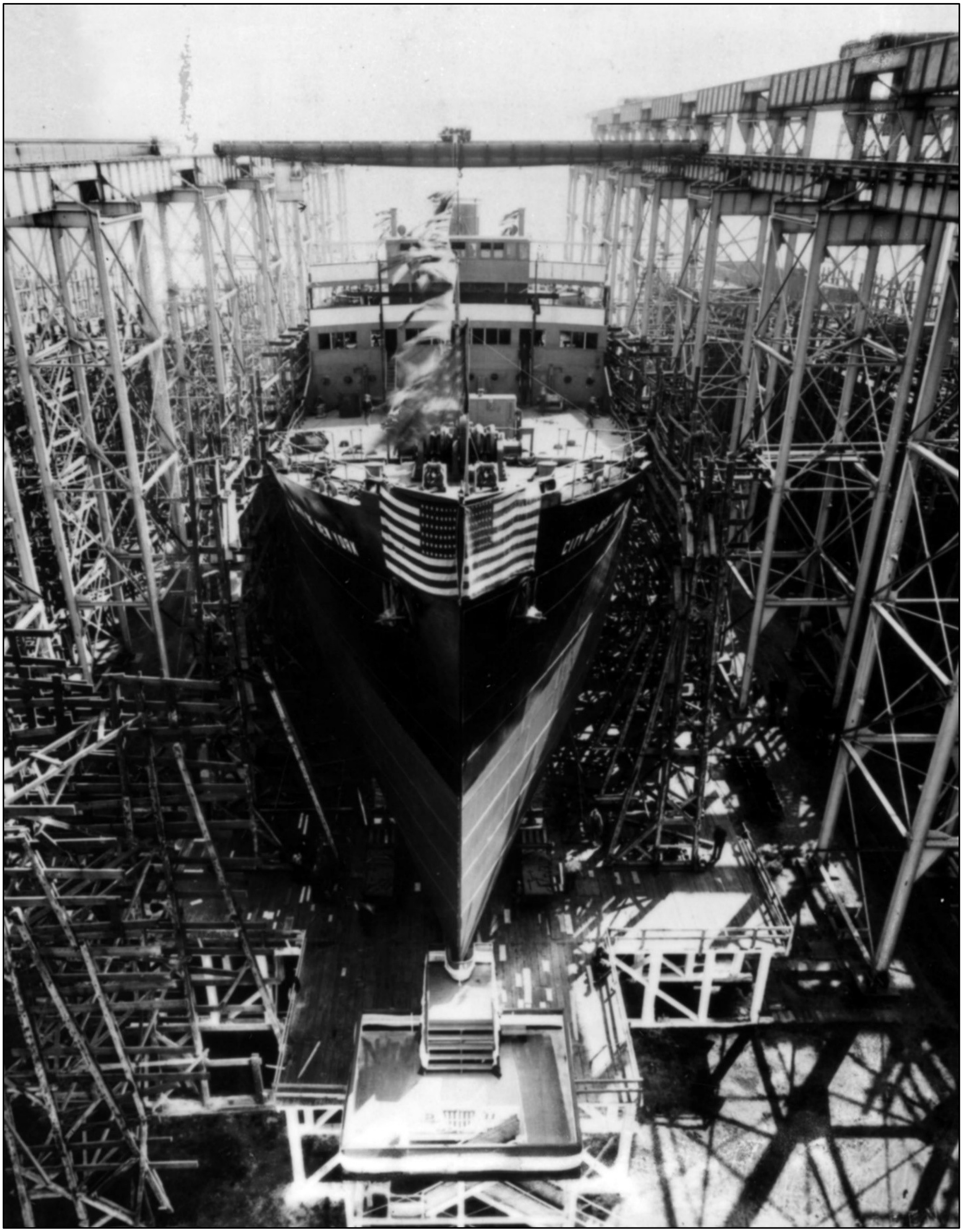


Figure 7-125 Construction underway on *City of New York* in the Sun Shipbuilding yards.
Source: Steamship Historical Society of America

Following the ship's completion, it entered service as part of the American South African Line fleet. It remained in service there for 4 years before getting a passenger endorsement from Lloyds (which it maintained through 1941). Several passengers were onboard on 3 March 1942, when *City of New York* departed South Africa. Twenty-three days later, and 2 days out from New York, U-*160* spotted and fired two torpedoes into the ship at 1350 hours, 29 March. The ship quickly began to sink (Lloyd's Register of Shipping 1930-1944; Hickam, Jr. 1989:141-143).

The crew only had time to get a partial distress call out, though this likely saved many. Traveling far offshore on their American/South African route, the survivors would not likely have been spotted by ships traversing the coastal shipping lanes. Instead, their distress call garnered a swift rescue response by the Coast Guard and Navy. Destroyer USS *Roper*, at the time patrolling only 85 miles away, was dispatched to the scene. Less than an hour after the distress call a Navy PBY aircraft arrived at the reported sinking location, searched, but found nothing (DIO 1987:101-244; Hickam, Jr. 1989:143).

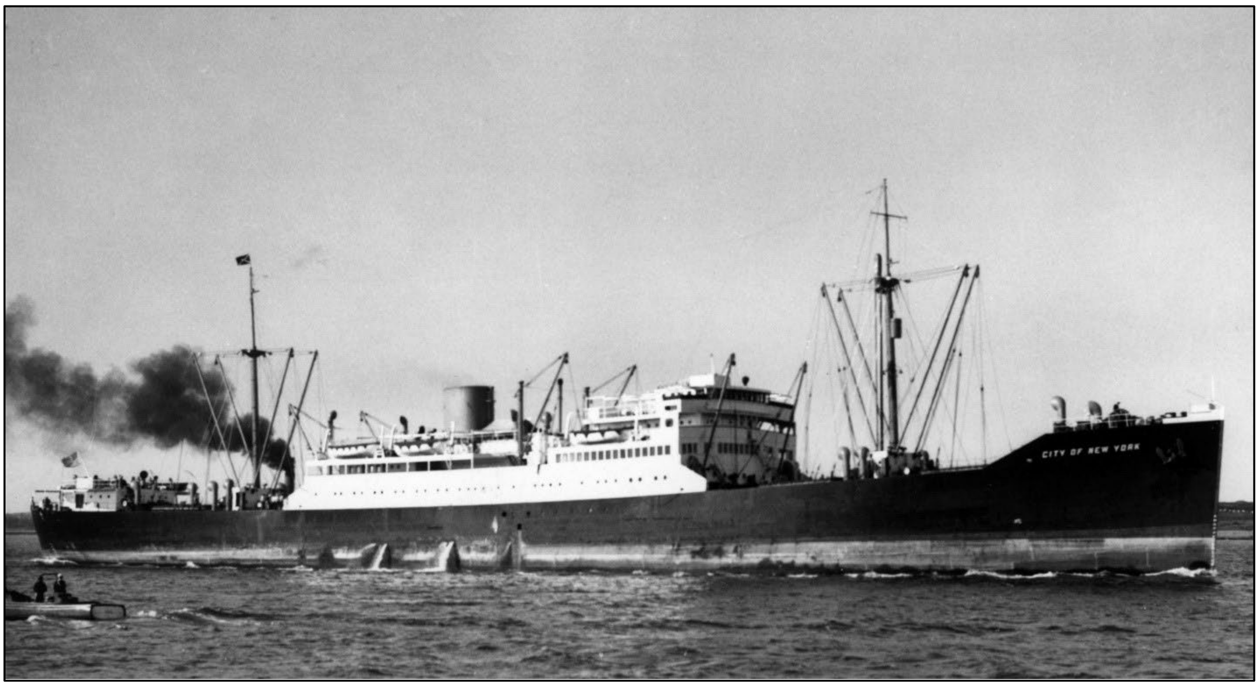


Figure 7-126 Starboard side profile of *City of New York*.
Source: Steamship Historical Society of America

Most of the survivors would spend a day and a half in the water before their lifeboats were spotted. Historian Homer Hickam recorded, in detail, the rescue operations undertaken by the first ship on the scene: USS *Roper*. An item of great concern to the destroyer's Captain was the great peril that a slow, methodical rescue operation would pose to his ship and crew; it would essentially make the destroyer a sitting duck for any nearby U-boat. Already, U-boats had sunk two American destroyers—USS *Reuben James* and USS *Jacob Jones*—ships whose fates were well known among the officers and crew of USS *Roper*. Nevertheless, the ship's commander would not leave *City of New York's* survivors to an uncertain fate so far out to sea, especially considering the number of civilians among them (Hickam, Jr. 1989:141-142).

Thus, it was just after midnight that a lookout onboard USS *Roper* spotted a blinking light making the SOS signal. Cautiously, in part fearing it was a trick by a U-boat to lure them closer, the destroyer proceeded into the area. There, they found a lifeboat with 27 survivors from which the signal originated. Next, as Hickam (1989:142) reported:

> At 0240 hours, a red flare was spotted and the *Roper* stopped beside a liferaft, several men clinging to it. Two more liferafts appeared out of the gloom just as the soundman yelled back a solid contact. It was a U-boat, the soundman was sure of it. Nervelessly, Howe kept the *Roper* stopped until 9 more crewmen were picked up and only then ordered a single depth charge dropped to cover the destroyer's slow movement forward. A few minutes later, there was another red flare and 12 more survivors were brought aboard. At 0430 hours, another flare brought the *Roper* to a lifeboat crammed with 22 survivors, one of them a newborn baby!

The child, son of Yugoslavian refugee Desanka Mohorovicic, was named in honor of the vessel which came to their rescue: Jesse Roper Mohorovicic (Figure 7-127). In addition to being delivered under dire circumstances in a lifeboat without any assurance of quick rescue or receipt of advanced medical care, the doctor who performed the delivery, *City of New York's* Dr. L. H. Conly (Figure 7-128), did so with two broken ribs under a makeshift canvas shelter amid a rolling, stormy sea.

Upon being rescued and brought aboard USS *Roper*, the destroyer's crew and officers were stunned to learn of the newborn baby's entry into the world; they were also stunned to learn that the baby's mother was none other than the wife of an exiled Yugoslavian government official already in the United States; thus the crew not only rescued a newborn baby, but also the wife of an important government official. Learning of this situation, the crew took up a collection and raised $200 for the mother and child. USS *Roper* continued search efforts through the night, ultimately finding 70 passengers and crew (DIO 1987:162; Hickam, Jr. 1989:143-144).

The navy had also dispatched another destroyer, USS *Greer*, to the area following USS *Roper's* initial reports. Entering the area on 31 March, by mid-day the ship located a lifeboat with an additional 26 survivors which, combined with the 70 brought ashore by USS *Roper*, accounted for 96. The following day, navy tug *Acushent* arrived in Norfolk with another 30 survivors, one of which was *City of New York's* captain. Upon arrival, he was briefed upon the status of the rescue operation and noted that the lifeboat containing the First Officer and approximately 20 women and children had yet to be accounted for (DIO 1987:162-206).

The mystery of the missing lifeboat was solved 10 days later when a patrol blimp spotted the final lifeboat. Using a semaphore, the officer onboard signaled up to the blimp: 'New York 12 days.' The boat, however, only contained 8 individuals, two of whom were dead, a child, and one of the ship's officers. A coast guard cutter was dispatched to the area, and the blimp remained to verify their safe rescue (DIO 1987:101-244). Of approximately 20 persons on board this lifeboat indicated by the captain, only 6 remained alive. Combined with the 126 persons landed by USS *Roper*, USS *Greer*, and *Acushent*, a total of 132 persons were picked up from *City of New York*. Review of the historical records, however, reveal some ambiguity as to how many total people were onboard *City of New York* during the trip between South Africa and New York, and also how many total survivors made it ashore.

If the ship's Captain remembered exactly 20 people being on the missing lifeboat it would make for a total of 146 people onboard (the remainder being the 126 confirmed who were rescued between 31 March and 1 April). Historian Clay Blair (1996:520), however, only reported 124 onboard, a figure at odds with official record in the Eastern Sea Frontier War Diary (DIO 1987). Similarly, historian Homer Hickam's narrative focuses solely upon the involvement of USS *Roper* and does not detail any rescues made by either USS *Greer* or *Acushent*. Thus, the most complete record is that of the ESF War Diary which confirms the first 126 survivors (Figure 7-129 through Figure 7-131) followed by an additional 8 (2 dead among them) persons rescued 12 days after *City of New York* sank. As a result, only 134 people are accounted for, with ambiguity as to the discrepancy between the Captain reporting 20 people missing on a lifeboat when only 8 were found. David Stick (1952:236-237) reported a total of 138 onboard. A more thorough review of historical records is needed, therefore, to clarify how many people were originally on board, how many were rescued, how many lived, and, of course, taking into account that one survivor was a newborn child delivered while in a lifeboat.

Figure 7-127 A nurse escorts one-day-old newborn Jesse Roper Morohovicic to St. Vincent's Hospital in Norfolk, Virginia.

Source: NARA

Figure 7-128 Survivor Dr. Leonard H. Conly rests with two broken ribs. Dr. Conly delivered the baby Jesse Roper Morohovicic in a lifeboard while awaiting rescue following the sinking of *City of New York*.

Source: NARA

Shortly after landing survivors, USS *Roper* was rapidly re-deployed back on patrol duty off the Outer Banks area. After one day in Norfolk, they returned offshore for a 5-day patrol. The destroyer encountered many burned-out ship hulks, but not a single U-boat. Their officers and crew were growing despondent at their complete inability to provide effective deterrence against U-boats. Another return to Norfolk was followed by another quick turnaround to get back into patrol station. On 13 April, USS *Roper* departed Norfolk once more. This would prove a historic voyage, as shortly after midnight on 14 April, USS *Roper* found, fought, and sank U-*85*, becoming the first US vessel to sink a U-boat during the Battle of the Atlantic (Hickam, Jr. 1989:147-15).

7.16.2 Archaeological Site Description

Since its loss, *City of New York* has not been located in any official capacity. The ship eludes mention in any of the post-war survey reports, where their main focus was vessels lost in shallow water posing hazards to navigation. Instead, the sinking of *City of New York* took place in an area 40-50 miles off Cape Hatteras, presumably beyond the 100-fathom curve and in deep water. Evaluating potential sites, however, should be aided by the relatively distinct characteristics of the ship. Its large size, unique design characteristics (those of a combined passenger ship and freighter) and distinct propulsion system (twin diesel engines driving twin propellers) will help establish a candidate site's identity as *City of New York.* At present, no prospective sites exist.

A robust historical record, including the deck logs from USS *Roper* and USS *Greer*, as well as position information within the ESF War Diary and BDU logs, would provide enough position information to construct geospatial predictions as to the vessel's final location. Based upon this modeling, an assessment could be made as to the feasibility of conducting an exploratory remote sensing operation to locate the ship's remains.

Figure 7-129 Passenger who survived the sinking of *City of New York* being helped down a gangway from rescue ship to land.
Source: NARA

Figure 7-130 A young passenger was among the survivors of *City of New York*.
Source: NARA

Figure 7-131 Crew members of *City of New York* on their way to Naval Receiving Station in Norfolk, Virginia.
Source: NARA

7.17 Dixie Arrow

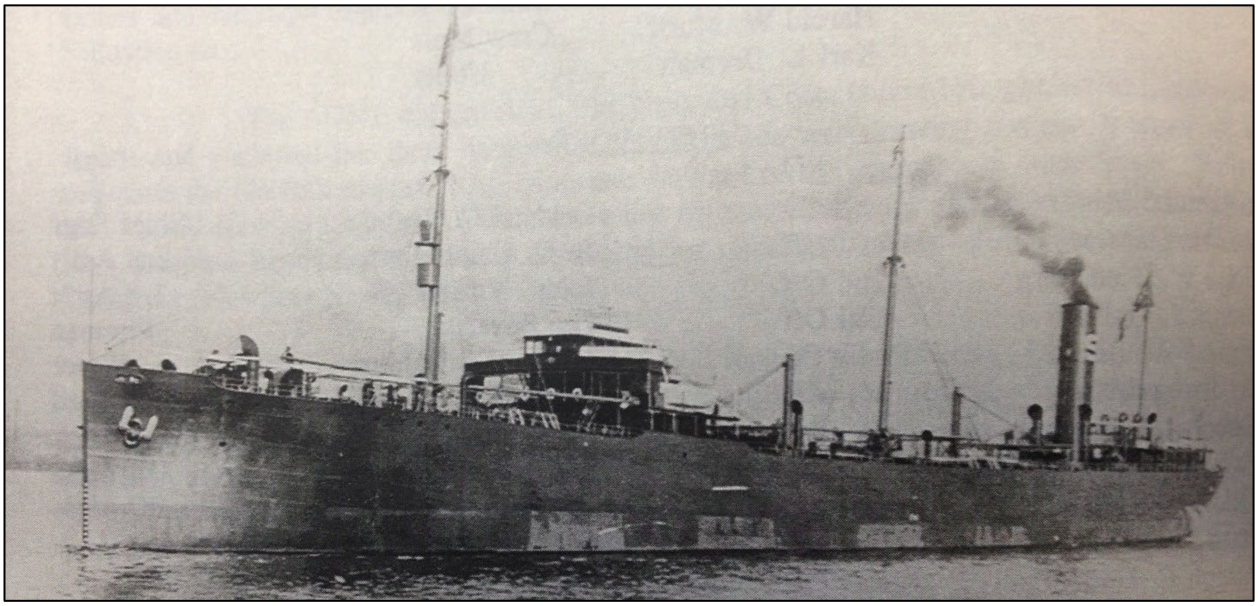


Figure 7-132 Photograph of *Dixie Arrow* prior to WWII.
Source: Mobile Shipping Company

Table 7-18 Characteristics of *Dixie Arrow*

Characteristics	*Dixie Arrow*
Year of Build/Type/Hull #	1921/Tanker/266
Date Lost	26 March 1942
Position & Depth	Approximately 20 miles south of Hatteras at 90 ft depth
Ship Characteristics	Length: 468.3' Breadth: 62.7' Depth: 32' Gross Tonnage: 8,046
Machinery	Quadruple expansion steam engine (15" 23" and 39" x 28") – 3,200 HP 3 Scotch Boilers
Cargo	86,136 barrels crude oil
Survivors	22 (33 total crew [11 dead and 22 survivors])
Owner	Socony Vacuum Oil Co. Inc., NY
Builder	New York Shipbuilding Corporation, Gloucester City, NJ, USA
Former Name	N/A
Port of Registry/Flag	New York/USA
Sunk by	U-*71* (Walter Flascheenberg)
Data Collected	Still and video photography collection 2010; high-resolution Reson multibeam imagery 2011; site plan 2015. Listed on NRHP

7.17.1 History

The single screw steam tanker *Dixie Arrow* was built in Gloucester City, New Jersey by New York Shipbuilding Corporation (Table 7-18 and Figure 7-132, above). The vessel's keel was laid on 11 August 1920 and it was launched almost a year later on 29 September 1921 (*Pacific Marine Review* 1922:88). It measured 468.3 ft long by 62.7 ft wide and 26.0 ft deep with gross and net tonnage of 8,046 tons and 4,960 respectively, and 7,834 tons under deck.

Dixie Arrow was a steel-hulled tanker with two masts, two decks, and a shelter designed to carry petroleum in bulk with aft positioned machinery. It was constructed with transverse framing as well as longitudinal framing for increased hull rigidity and strength. The tanker's construction was supervised by George Bucham and A.A. James. It had a 100A1 vessel rating, which meant that the tanker was constricted under a Lloyd's Register survey; it was suitable for seagoing service, and fit to carry dry and perishable goods. *Dixie Arrow's* rating also certified that it had good and efficient anchoring and mooring equipment. The tanker had 10 double main cargo tanks that could carry 4,000,000 gallons of commercial oil and 400,000 gallons of fuel oil that allowed the vessel to steam for 46 days (Lloyd's Register of Shipping 1930:DIS-DOB; *Nautical Gazette* 1921a:464; *Philadelphia Inquirer* 1921a).

The New York Ship Building Corporation also built *Dixie Arrow's* 3,200-horsepower four cylinder quadruple expansion steam engine. The engine was a four crank, direct acting surface condensing type with steam supplied by three single ended Scotch boilers. The engine propelled the loaded tanker at a speed of 11 kts. The tanker could accommodate a crew of 62 men (*Philadelphia Inquirer* 1921a). *Dixie Arrow* was equipped with all the latest technological advancements such as electric lights and a radio direction finder.

Dixie Arrow's builders, the New York Shipbuilding Corporation was also known also as New York Ship. It began in 1899 by Henry G. Morse, with the financial support of Andrew Mellon and Henry Frick. It was called New York Shipbuilding because it was originally intended to be located on Staten Island but it was cheaper to build the operation in New Jersey. In 1916, American International Corp. and W. R. Grace bought the business and expanded it for the war effort that included a relationship between the corporation and the USSB who contracted with them to manage the Gloucester city yard that built the *Dixie Arrow*. Known as the south yard, it was actually owned by the USSB. This yard included 4 building berths and covered over 36 acres. It was much smaller than the yard in Camden that the New York Shipbuilding Corporation actually owned which included 19 building berths and covered 129 acres. New York Shipbuilding Corporation's south yard had been built for WWI war purposes at a cost of $10,000,000 but just as work started, the war ended. By September 1921 they had built 4 combination liners for the Shipping Board and 4 tankers, including *Dixie Arrow*. *Dixie Arrow* was the fourth of a contract for 4 tankers between the Standard Transportation Company and the New York Shipbuilding Corporation (*Nauticus* 1921:17). The other 3 tankers were the *Yankee Arrow*, *Empire Arrow*, and *Levant Arrow*.

Between 1916 and 1921, 12 "Arrow" ships in total were built that measured roughly the same size. New York Shipbuilding Corporation built 8 of them and Bethlehem Steel Company of Quincy, Massachusetts built the remaining four. The *Standard Arrow* was the first "Arrow" vessel built in May 1916 by the New York Shipbuilding Corporation. In the *Mobile Book of Ships*, author Arthur Gordon discussed the importance of the "Arrow" ships on page 106.

> They were a combination bulk-oil and general cargo carriers. The main deck of these steamers was pierced with removable hatches, giving access to a 'tween-deck' space which ran the length of the ship. This was the case for general cargo. The tanks for bulk oil were in the lower holds. These vessels, in their day, were considered to have reached the height of the reciprocating-engine ship in efficiency and all-round tanker performance.

During WWI many ship-owners and builders started launching ships in a series all having the same design to save on production costs, construction time, and materials. These standardized ships additionally saved on personnel expenses since crews could easily be moved around from vessel to vessel without needing to be retrained (Gardiner 2000:67). T-2 tankers as well as liberty and victory ships were later examples of this standardized process.

Dixie Arrow was the last of the "Arrow" ships built. The tankers were designed for the foreign petroleum trade between California and Asia as well as India and were known for their round-the-world trips. *Dixie Arrow* spent less time than any other "Arrow" ship in the trade for which it was designed, however. Many of the tanker's routes were changed to domestic coastal routes later in the 1930s as the world got closer to the outbreak of WWII. The ships were brought back closer to home since their design of being both a general cargo carrier and bulk oil carrier proved to be versatile and efficient (Gordon 1991:30, 106-107).

On 23 November 1921 *Dixie Arrow* completed its trials and on 29 November it officially delivered to its owners the Standard Transportation Company (*Pacific Marine Review* 1922:88; *Philadelphia Inquirer* 1921b). *Dixie Arrow's* first year of service took it on one of its longest trips of its career, from New York through the Panama Canal to the Orient. In late 1921, *Dixie Arrow* loaded 10,000 tons of fuel oil and departed New York. It sailed through the Panama Canal with a stop in Colon and then another stop in San Francisco to pick up water and bunker before finally making it to Hong Kong. After offloading its cargo it loaded a new cargo of coconut oil in Manila before heading back to New York. Normally a tanker might sail home in ballast but instead its owners saw a way to increase profits and loaded *Dixie Arrow's* hold with a non-traditional cargo. "This incident is not a precedent, frequently Standard Oil company tanks coming from the Orient bring vegetable oils from principally nuts and what is known as China wood oil as well as stopping at the islands and bringing coconut oil" (*Port Arthur Daily News* 1922). This trip took over 6 months to complete and was a testament to the "Arrow" ships' seaworthiness and range. *Dixie Arrow* then sailed in ballast from New York to Port Arthur, Texas where it picked up another load for the Hong Kong. The tanker departed on 7 October 1922 with 95,000 barrels of refined oil. It again stopped in San Francisco on its way to Hong Kong (*Galveston Daily News* 1922). The tanker would steam to Hong Kong once more and end up back in San Francisco in February 1923 before changing its service to supplying American ports. The tanker would then concentrate on two main routes for the next 8 years.

In 1923 *Dixie Arrow* was withdrawn from its foreign service and moved to the domestic petroleum trade. The Great Depression caused most of the "Arrow" ships to be moved back to home to focus on coastal routes. Between 1923 and 1931 *Dixie Arrow* serviced the three largest oil producing and consuming centers of the United States: the North Atlantic states, states bordering the Gulf of Mexico, and the Pacific Coast States, particularly California. In 1923 new oil fields opened up in the Los Angeles area and the intercoastal oil trade through the Panama Canal from the Pacific to the Atlantic shore began immediately. *Dixie Arrow's* owners seized this new market and enlisted *Dixie Arrow* in this route (Ratcliffe 1985:56).

Dixie Arrow's normal route for the rest of its career until its loss in 1942 was between Texas and the Atlantic states of New York, Massachusetts, and New Jersey. The tanker stopped in Texas at the Magnolia Petroleum Company's docks, which was an affiliate of *Dixie Arrow's* owners the Socony-Vancuum Oil Company, as well as the Humble Oil and Refining Company's piers to load. Texas coastal ports of Galveston, Houston, Beaumont, Texas City, Port Arthur, and Sabine served as a launching ground for the movement of petroleum tankers. The primary cargo shipped out of Texas was crude with gasoline being frequently carried also. It is likely that during *Dixie Arrow's* return trips to Texas, it sailed in ballast (Ratcliffe 1985:80).

Dixie Arrow's coastal route did not change with Europe's entrance into WWII in September 1939 or the United States' entrance into WWII in December 1941. Both military and non-military consumer demand increased during WWII and the United States needed a strategy to deal with the petroleum transportation problem. The outcome was the establishment of the Petroleum Administration for War to oversee the activities of the wartime petroleum industry, including conservation, research, allocation, and shipment (Frey and Ide 1946:84-85). With U-boats actively sinking tankers off the American coast starting in 1942, the oil refineries needed a consistent supply of crude for processing. This shortage threatened the production of petroleum for the war. The Gulf Coast states had a surplus of crude and refined products but there were not enough available tankers to transport it. *Dixie Arrow* was one of the tankers that was employed to routinely travel back and forth between Texas and northeast states (Frey and Ide 1946:216-217).

During WWII, *Dixie Arrow* operated in locations susceptible to attack either from air or by sea. The vessels owners, the Socony Vacuum Company, suffered many losses during WWII. Thirty-two of its vessels were lost due to torpedoes, mines, or collisions. An additional 18 ships were damaged from enemy torpedoes or mines but repaired and put back into service. To safeguard its vessels, oil companies employed many defensive mechanisms, such as sailing in convoys or outfitting with weapons. Unfortunately, due to *Dixie Arrow's* coastal routes up and down the eastern seaboard, it did not sail with convoys and was also not equipped with weapons. To combat U-boat attacks to merchant vessels along the American East Coast and in the Gulf of Mexico, a coastal convoy system was established in 1942 but it was not fully up and running until that summer (Gordon 1991). By May 1942 there was a major convoy route running between Key West and New York along with its return line back to Key West (KN-NK). Two subsidiaries of that line were in place by August and September including one that ran between Key West and Galveston/Houston and back (KH-HK) as well as another line between Key West and Pilottown/New Orleans and back (KP-PK). *Dixie Arrow* would have used these convoy lines if they had been in place during its operation in WWII (Roscoe 1953:133-134). *Dixie Arrow* was sunk in March 1942, prior to the establishment of a protective convoy.

In clear weather on 19 March 1942 *Dixie Arrow* departed Texas City, Texas with a cargo of 86,136 barrels of crude for Paulsboro, New Jersey under the command of Captain Anders M. Johanson. "The *Dixie Arrow* was known to be a good ship to work aboard. Johanson was a kind and gentle man and also a first-rate shiphandler. He had seen to it that his ship had the best cook available and that work schedules were reasonable. The crew was, as a result, a close knit, hard-working group, considered by the company to be one of its most efficient" (Hickam, Jr. 1989:99). *Dixie Arrow* continued its unescorted voyage north up the east coast and into the U-boat patrolled waters off North Carolina. "Johanson was very much concerned about taking his ship past Hatteras. He had remarked to his chief engineer that he had been instructed to follow the 40-fathom curve, a very difficult task considering the many ships in the vicinity, all traveling blacked out and as rapidly as possible" (US Coast Guard 1945:34; Hickam, Jr. 1989:99).

U-*71* moved into the waters off Cape Hatteras as a replacement for the U-*124* and by 26 March was actively on patrol and had already sunk one vessel, the freighter *Oakmar*, 300 miles off North Carolina. Its captain, *Kapitänleutnat* Walter Flachsenberg, "was about to dive and sleep for the day when his lookout spotted some masts on the southern horizon. The sun was up but Flachsenberg waited to see if the vessel was of interest. It was. A tanker! Almost disbelieving his eyes, Flachsenberg saw it was entirely alone. He ordered the U-*71* down and began to maneuver to get the tanker between him and shore" (Hickam, Jr. 1989:99). Around 0800 hours on 26 March the U-*71* fired two torpedoes at *Dixie Arrow* 12 miles southwest of Diamond Shoals Light near Cape Hatteras, North Carolina (NARA 1941-1946, US Coast Guard RG 26, Box 5).

Dixie Arrow's crew had no warning and were unprepared for U-*71*'s violent attack. They had been sailing northward at 10.5 kts in clear, calm, and smooth seas with a gentle breeze when hit. Its base course was set at 30 degrees but it performed a zig zag pattern (altering course 45 degrees every 6-9 minutes) to provide some defensive measures against the U-boats. *Dixie Arrow's* crew was positioned around the ship to serve as lookouts and it had a ship sailing ahead of it and another one sailing 10 miles behind it. Able seaman Oscar Chappel was at the helm and spotted the U-*71* but had no time to give out a warning (Hickam, Jr. 1989:99). Within seconds two torpedoes struck *Dixie Arrow's* starboard side. The first one hit just below the deck house, destroying it; the second one hit just aft of where the first one hit (National Archives US Navy RG 38, Box 221). Chappell could see that several men were stranded on the bow with flames approaching and preventing their escape (Figure 7-133 and Figure 7-134). Crewmate and survivor Paul Myer's described the selfless act that saved many of the crew:

> [Chappell] was at the wheel. Fire was shooting up all about him, he saw several men trapped by the flames that the wind was blowing toward them. He turned the ship hard right which took the flames off the men on the bow but threw them directly upon himself. He lasted only a few minutes after that. He died at the helm (*New York Times* 1942g).

"... eight men were believed instantly killed when trapped below deck in the dining cabin. Another dies when his life raft drifted into a pool of burning oil and still another was killed when the explosion hurled him against a davit" (*New York Times* 1942). Captain Johanson came out of his cabin in full dress uniform and headed to the bridge after the first two torpedoes. Before he made it very far, a third explosion was heard, and Captain Johanson was never seen again. First assistant engineer, William R. Wolfe, shut down the engines and set the vessel helplessly adrift. The surviving crewmen had to jump into the water to escape the flames and swim for their lives (DIO 1987:25; Hickam, Jr. 1989:100-101).

Only one of *Dixie Arrow's* four lifeboats (No. 4) was successfully launched with 8 men onboard. After a half an hour, a Navy seaplane and the destroyer USS *Tarbell* (DD142) arrived on scene. The plane immediately dropped two bombs on the U-boat and instead of immediately picking up the survivors, the destroyer began hunting the U-*71* and dropped a series of depth charges (Blair 2000:519). "The U-*71* shook from end to end, bracketed by the *Tarbell*'s depth charges. Flachsenberg began to zigzag his U-boat, turning violently this way and that. Above, the sounds of the destroyer came nearer and then faded. Flachsenberg ordered full power. The U-*71* ran for her life" (DIO 1945:35; DIO 1987:25; Hickam, Jr. 1989:101).

The *Tarbell* stopped its pursuit and rescued the men in the lifeboat along with 14 others who were in the water. They were taken into Morehead City, North Carolina but soon transferred to Norfolk, Virginia for better accommodations. Within an hour of the incident, the ship broke in two near amidships but remained afloat on fire for several hours before sinking the night of the 26th. Eleven of *Dixie Arrow's* crew, including 4 deck officers, the radioman, 6 unlicensed seamen, and its captain, did not survive. They died from the initial torpedo explosions as well as from the resulting fire (NARA, US Navy RG 38, Box 221).

Subsequent to its loss, *Dixie Arrow* was repeatedly observed by aircraft with three masts protruding above the surface, which were used as bombing targets for training planes. The last mast was bombed and submerged in late 1943 and in the summer of 1944 the wreck was reduced as a navigation hazard by the Navy Salvage service. In 1945, Navy divers recovered the tanker's bell, and it was later presented to the "Arrow" ship's designer Nicholas Pluymert. He dedicated the bell to Oscar Chappel. "When the bell of the *Dixie Arrow* is tolled. Let it toll for Oscar G. Chappell, Able-bodied Seaman, who for his great deed, was posthumously awarded the Distinguished Service Medal of the United States Merchant Marine" (US Coast Guard, War Action Casualties 1945 :39; DIO 1944:36-37; Gordon 1991).

The U-*71* led a very successful career that included not only sinking the *Dixie Arrow* but 5 other vessels for a total tonnage of 38,894 gross tons. The type VII-C submarine had been ordered on 25 January 1939 but was not launched until 31 October 1940 from the shipyard of F. Krupp *Germaniawerft* AG Kiel, Germany. During the war U-*71* participated in 10 war patrols covering 366 days, with captains Walter Flachsenberg and Hardo Rodler von Roithberg. The war patrols lasted anywhere from 19 days to 52 days. U-*71* was on its 5th patrol when it sank its third victim, the *Dixie Arrow*. It was taken out of service and scuttled on 2 May 1945 in Wilhelmshaven, Germany (Brechtelsbauer 2013a; Marx and Delgado 2013c).

Figure 7-133 The *Dixie Arrow* ablaze, broken amidships, and sinking.
Source: The Mariners' Museum and Park

Figure 7-134 *Dixie Arrow* sinking engulfed in flames.
Source: NARA, 1941-1845

7.17.2 Archaeological Site Description

Dixie Arrow lies partially buried on a flat sand plain on the continental shelf 15 miles SSE of Hatteras Inlet, North Carolina. The ocean seafloor is comprised of sand with only a slight slope to the southeast. The shipwreck lies near the western margin of the Gulf Stream making it subject to changes in current velocity and direction. *Dixie Arrow* rests in an average of 90 ft of water. Remains of the wreck consist of a contiguous hull that rests upright on its keel. Like many other vessels in this depth range, it has been wire-dragged to reduce the hazard of navigation. Consequently much of the hull structure has been reduced over the length of the hull, particularly in the amidships section.

In 2010, *Dixie Arrow* was the subject of extensive photo and video documentation (Figure 7-134). Due to the size of the site and time allotted, a full-scale site plan was not possible. However, this preliminary investigation established a baseline for subsequent site investigation. In 2011, a high-resolution multibeam survey was conducted on the site (Figure 7-135). A georectified image of *Dixie Arrow* for GIS purposes was produced to provide detailed positioning on the shipwreck site. Additional processing of the data rendered a 3D model of *Dixie Arrow* used for further site analysis and to inform manual mapping (Figure 7-137 and Figure 7-138).

The site measures 493 ft long (the contiguous hull measures approximately 470 ft) by 88 ft wide with 25 ft of vertical relief above the seafloor at the bow and the engines. The vessel is contiguous from its stern all the way to its bow with the highest relief in the bow section where the forward tanks are located. Its engine, boilers, and associated machinery are in place as well as its rudder and propeller.

Astern, the boilers and engine are the most prominent pieces observed, along with the condenser that rests on the portside of the engine (Figure 7-139 and Figure 7-140). The observed orientation of the condenser changed over subsequent years. Given its mass, significant force would be required to move it. The triple expansion steam engine provides the highest relief for the site. On both sides of the engine are the scattered remains of the machinery spaces; pipes, valves and fittings of all size and description. The propeller is also still discernable; however, it is mostly buried in the sand (Figure 7-141). The triple expansion steam engine and three boilers are still in place along with the shaft and propeller. The engine, while largely intact, shows evidence of damage to the low pressure cylinder house as well as the steam transfer trunking which is broken in the center. In general, the stern area is largely broken up but rises above the seafloor to 25 ft with many features visible such as bollards, a windlass, pumps, pipes, and hull features including hull plates, bulkheads, and frames. The propeller is mostly buried in sand with only one blade visible with the rudder standing upright behind it. The stern superstructure has collapsed onto the seafloor next to the main wreck structure and lies upside down mostly buried in the sand.

In partnership with BAREG, a detailed site plan was produced (Figure 7-142), which identifies structural components, diagnostic features, such as deck machinery, hatches, hull plating, and structural components. The bow section includes portions of the stem that rises up 25 ft and sections of the forward deck and outer hull structure. The forward deck and outer hull structure have started to collapse both within and outside of the wreck site. The inside of the bow contains the chain locker, including two large chain piles, and hawse pipes just forward of where the forward deck has collapsed into the sand. Smaller machinery pieces such as the windlass and cargo pumps are also located at the bow (Figure 7-143).

Aft of the bow section bulkhead the vessel flattens out. On the starboard side a large spare anchor is located amongst the debris that characterizes this section. Amidships, *Dixie Arrow*'s remains have mostly fallen inside the hull, leaving only sections of disarticulated debris along with small sections of intact frames and hull plating. The vertical outer hull varies in height from 3 to 10 ft and continues all the way to the boilers. A small amount of deck beams, bulkheads, and cargo tank wall sections are in place and illustrate the grid-like structure of the hulls athwartships and longitudinal beams (Figure 7-144).

The tanker's internal structural components are visible in areas where the rest of the decking components are missing. The cargo has long since been lost and there is no significant oil remaining at the site. The upper superstructure is not intact, and the remaining fragments appear to be scattered amongst the collapsing hull structure and debris assemblage. The amidship section of the wreck site exhibits significantly more damage than the bow and stern sections. Although the bottom of the hull appears intact from stem to stern, it is known that during the sinking event the keel had snapped and the vessel was severed. Evidently there was never a complete separation, and as the vessel settled onto the seabed it regained its general layout. Despite this, there is an area amidships where observable damage to the floor beams and longitudinal keelsons are evident. Likewise there are areas just aft of the bow section where further damage to the outer hull plates may indicate the areas that coincide with torpedo strikes. This site was listed successfully on the NRHP as a result of this project (Marx and Delgado 2013c)

Figure 7-135 Divers on the engine section of *Dixie Arrow* in 2010.
Source: NOAA

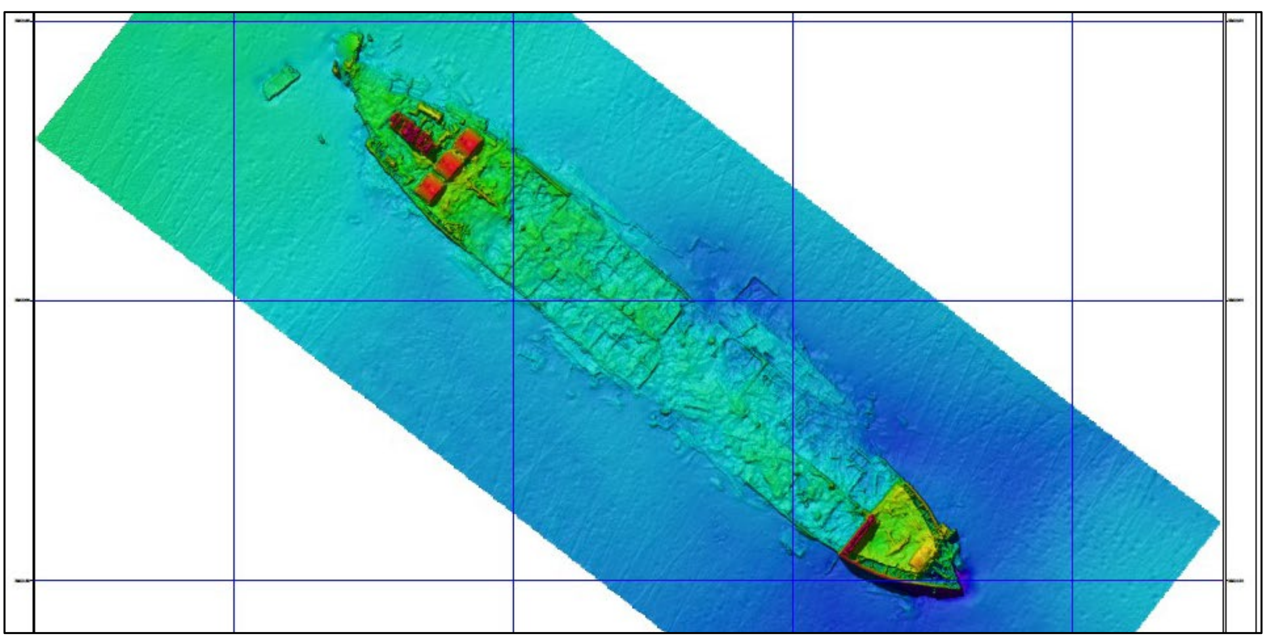


Figure 7-136 Reson 8125 455 kHz scaled multibeam survey of *Dixie Arrow*.
Source: ADUS Ltd.

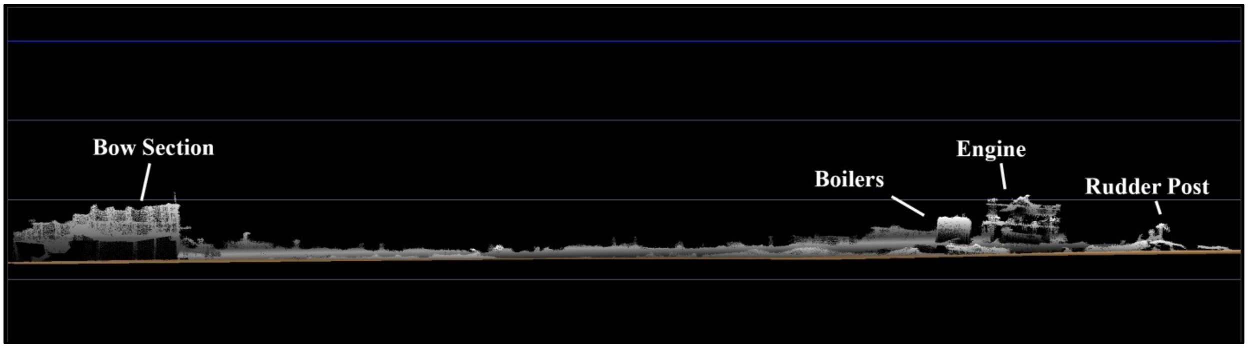


Figure 7-137 Profile view of high-resolution multibeam model of *Dixie Arrow* as seen in WreckSight.

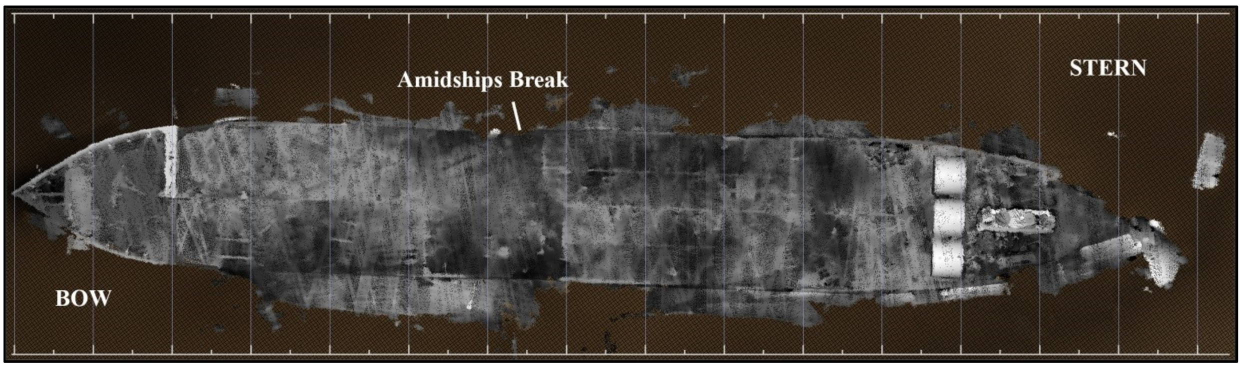


Figure 7-138 Plan view of high-resolution multibeam model of *Dixie Arrow* as seen in WreckSight.

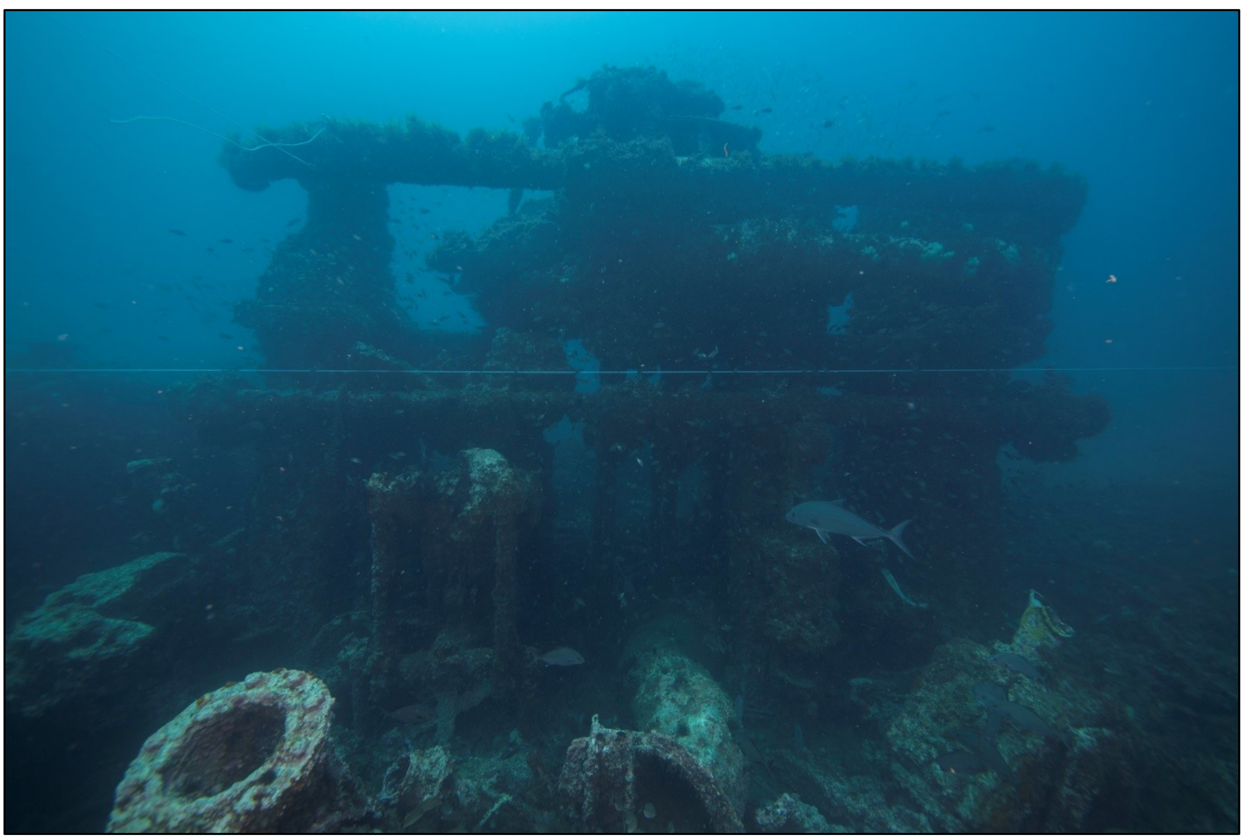


Figure 7-139 Quadruple Expansion engine of *Dixie Arrow* during 2010.
Source: NOAA

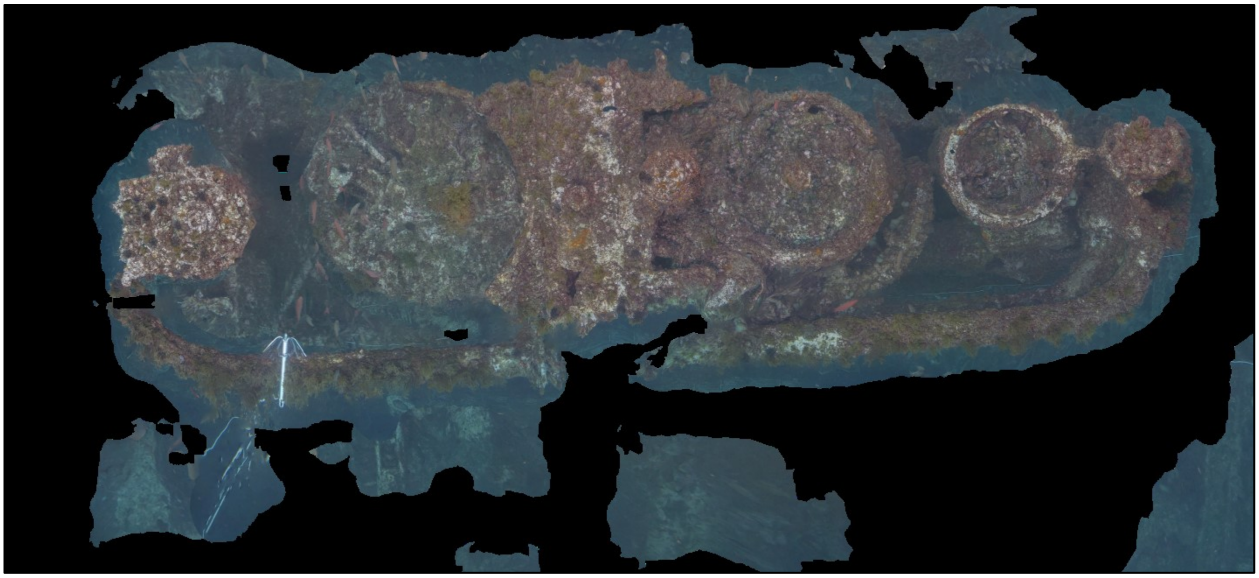


Figure 7-140 Orthographic photomosaic plan view of elements of the *Dixie Arrow*.
Source: NOAA

Figure 7-141 Propeller of *Dixie Arrow* located in the stern section of the wreck site.
Source: NOAA

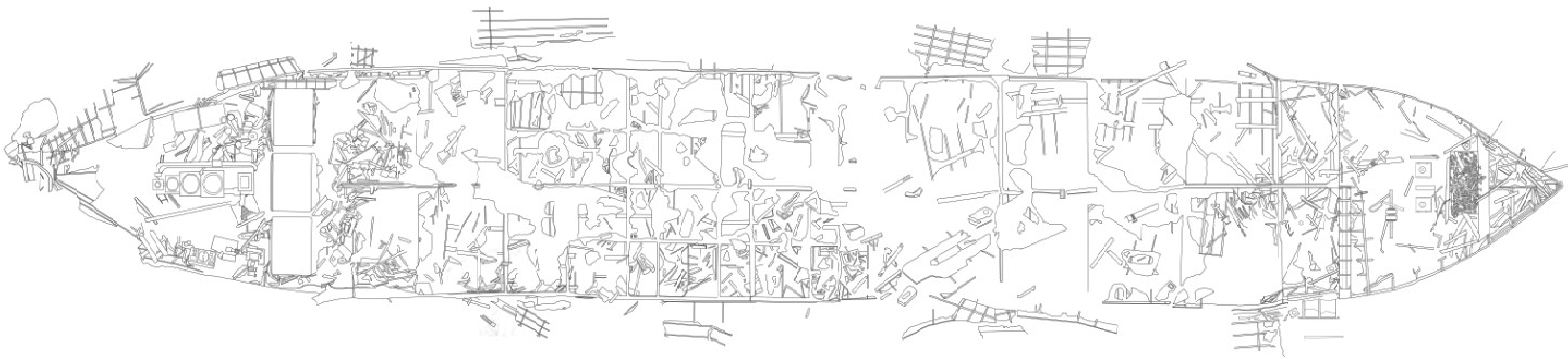


Figure 7-142 Plan view of site plan of *Dixie Arrow* collected during 2015.
Source: BAREG/NOAA

Figure 7-143 Bow section of *Dixie Arrow* that rises up 30 ft from the seafloor.
Source: NOAA

Figure 7-144 Transverse and longitudinal deck beams in the midship section of *Dixie Arrow*.
Source: NOAA

7.18 E.M. Clark

Figure 7-145 *E.M. Clark*, dated 19 September 1941, location unknown.
Source: NARA

Table 7-19 Characteristics of *E.M. Clark*

Characteristics	*E.M. Clark*
Year of Build/Type/Hull #	1921/Tanker/49
Date Lost	18 March 1942
Position & Depth	25 miles S of Cape Hatteras, NC 260 ft
Ship Characteristics	Length: 499.2' Breadth: 68.1' Depth: 30.5' Gross Tonnage: 9,647
Cargo	118,725 barrels of heating oil
Survivors	40 (41 Total on board [1 dead and 40 survivors])
Owner	Standard Oil Co., New York
Builder	Federal Shipbuilding Co., Kearny, NJ
Former Names	*Victolite* (Imperial Oil Co., Canada 1921-1926)
Lloyd's Register Details	Steel (Stl) hull, twin screw, three decks, aft positioned machinery, triple-expansion six-cylinder steam engine (T.6Cy), Engine 676 NHP
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	Photo and video 2010, 2012; photomosaic, site plan, and MB 2016. Listed on NRHP

7.18.1 History

The tanker *E.M. Clark* was built as *Victolite* in Kearny, New Jersey by the Federal Shipbuilding Company (Table 7-19 and Figure 7-145, above). Its keel was laid on 22 July 1920 and it was subsequently launched on 14 June 1921. Its sponsor was Mrs. C.O. Stillman, wife of the president of the Imperial Oil Company of Ontario, Canada (*Pacific Marine Review* 1921:511; *American Shipping* 1921:48). It measured 499.2 ft long, 68.1 ft wide, and 30.5 ft deep with a gross tonnage of 9,647 tons. Its official builder's identification number in the yard was 49. *Victolite* was a steel hulled tanker with three masts and three decks designed to carry petroleum in bulk with a shelter deck, straight stem, and aft positioned machinery. The three masts all had antennas with the forward and aft mast fitted with beams and hoists for lifting. *Victolite* had three deck structures: a poop deck at the stern, a bridge deck just forward of amidships, and a forecastle deck at the bow. It had longitudinal and web framing with a 100A1 vessel rating, which meant the tanker was constricted under a Lloyd's Register survey, was suitable for seagoing service, and was fit to carry dry and perishable goods. This rating also certified that *Victolite* had good and efficient anchoring and mooring equipment. Its mooring equipment consisted of a Hyde steam windlass, 300 fathoms of 2-5/8 inch diameter chain, three bower anchors (one stockless Dunn and two Trotman), a Trotman stream anchor, and a Trotman kedge anchor (Figure 7-146 and Figure 7-147) (Lloyd's Surveyor Report 1921; Lloyd's Register of Shipping 1925:VIC).

Federal Shipbuilding Company built *Victolite* with steel from the Carnegie Steel Company with a double bottom under the engine spaces and water tight bulkheads that extended up to the upper deck. Its flat steel keel plates along its bottom ranged from 0.82 inches thick near the bow and stern to 1.1875 inches thick amidships. Its cargo capacity was 119,414 barrels or 5,015,388 gallons. Its tank system consisted of peak tanks, deep tanks, double bottom tanks, fuel oil tanks, and cargo tanks. The interior tank spaces and bilge were coated with cement or bitumastic enamel to prevent corrosion. Cofferdams were in place between tanks to isolate individual tanks to avoid contamination and reduce fire risk. Four water ballast tanks (25-ft long fore peak tank, 24-ft long aft peak tank, 67-ft long aft deep tank under the engines, and 54-ft long forward deep tank) held over 1,200 tons (Lloyd's Surveyor Report 1921).

Federal Shipbuilding Company also constructed *Victolite's* two vertical reciprocating triple expansion steam engines. The cylinders on each engine measured 20.5 inches, 35 inches, and 6 inches with a 42-inch stroke and 676 nominal horsepower. The tanker was also outfitted with a donkey boiler and engine to run its pumps and additional auxiliary equipment. Pumps were located in the bilge, engine room, cargo pump room, forward pump room, and forward hold. Three 11-ft long, 16-ft diameter, steel cylindrical Scotch marine boilers, constructed by Federal Shipbuilding Company out of Carnegie and Illinois Company steel, generated steam for *Victolite's* engines. The total heating surface was 9,576 square ft equipped with a Howden forced draft and mechanical burner. They produced steam at a working pressure of 210 pounds, were oil-fired, made 90 revolutions per minute, and propelled the tanker to a speed of 11 kts (Lloyd's Surveyor Report 1921; Lloyd's Register of Shipping 1925:VIC).

Victolite's builder, Federal Shipbuilding Company, also known as the Federal Shipbuilding and Drydock Company, was active from 1917 through 1949. The yard was opened to support the buildup of vessels for WWI and expanded in the interwar years. During WWII, the United States government provided financial aid to the Company and they opened a second yard in Port Newark. Many ships for the United States' military as well as the Emergency Shipbuilding Program were launched from both the Kearny and Port Newark facilities to support the war effort. It was a subsidiary of United States Steel and the United Sates Navy eventually purchased the yards in 1948. The company launched 569 vessels including cargo ships, tankers, barges, destroyer escorts, and landing craft as well as more destroyers than any other builder besides Bath Iron Works before finally closing in 1949 (Colton 2014).

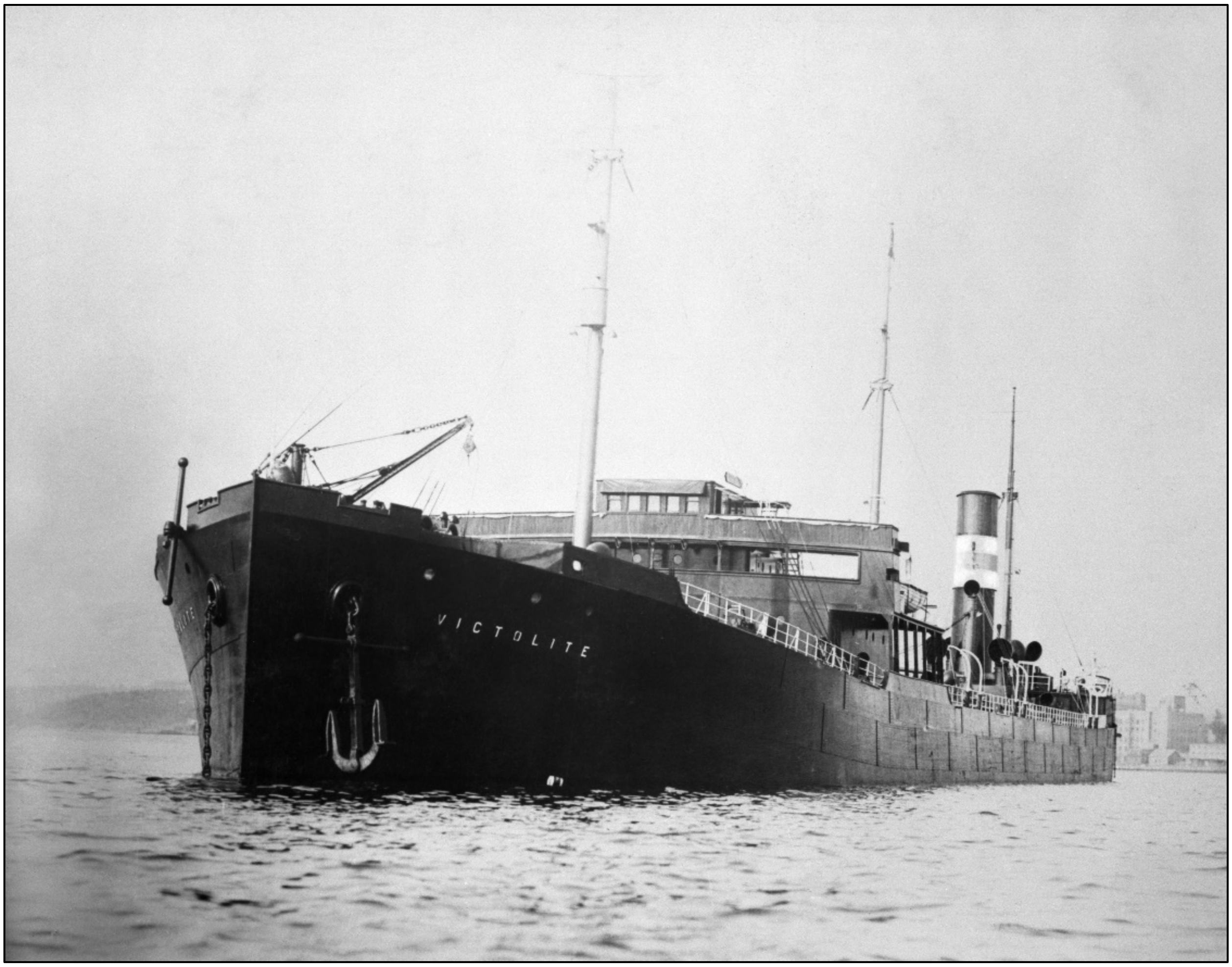


Figure 7-146 *Victolite* in 1928.
Source: Glenbow Archives IP-2d-73b

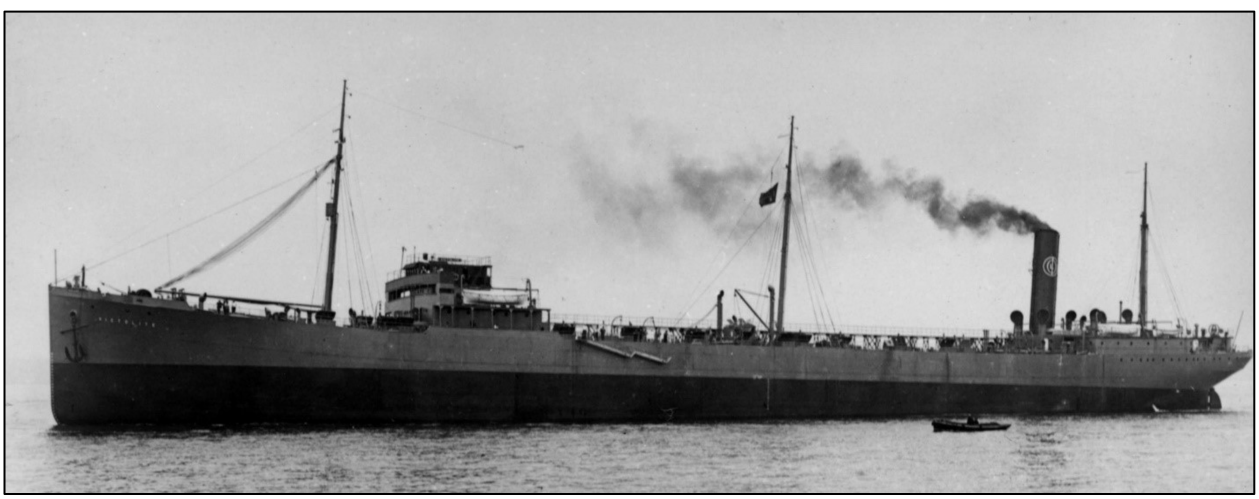


Figure 7-147 *Victolite* portside view.
Source: Steamship Historical Society of America

Victolite was equipped with all the latest technological advancements such as electric lights, submarine signaling equipment, and wireless radio. Two generators, driven by a 9-inch by 7-inch vertical reciprocating steam engine, produced 40 kilowatts, 110 volts, and 182 amps. It provided electrical power to run the wireless, lighting, and heating system throughout the tanker (Lloyd's Surveyor Report 1921; Lloyd's Register of Shipping 1937:COA-COK). The tanker was designed to operate with a crew of 60 people and had very nice accommodations - more than the law required. There was a separate room for each officer as well as three spare rooms. Two of the spare rooms had a detached bath with one assigned to a doctor and another to a purser, two positions not required on this class of vessel. The wheel house and chart room were located on the forward top flying bridge with the captain's cabin, captain's office, and wireless room sitting just below. Under the captain's quarters were the officers' rooms and spare rooms as well as the dining saloon. The rest of the crew's quarters were located aft above the engine room (*Marine Review* 1920:495).

After launch, a month was spent undergoing final outfitting and trials to ensure it met the requirements of Lloyd's surveyors. *Victolite* was officially delivered to its owners on 8 July 1921. It was the fourth in a series of five identical tankers constructed by the Federal Shipbuilding Company for the Standard Oil Company of New Jersey (*Marine Review* 1921:350). The Standard Oil Company of New Jersey had its original beginnings with Standard Oil. John D. Rockefeller formed Standard Oil in 1870 and it became the largest oil refiner in the world until it was broken up in 1911. The company's monopoly on the industry violated the Sherman Anti-Trust Act and the government forced it to divide into smaller independent companies. As a result of the dissolution, 33 separate entities emerged including two of the biggest: Standard Oil of New Jersey, or Esso, (which eventually became Exxon) and Standard Oil of New York, also known as Socony (which eventually became Mobil) (Vassiliou 2009:560). The Standard Oil Company of New Jersey became the largest and most powerful offshoot, but after 1911 it did not have a strong claim on domestic production. Instead it focused on domestic refining and owned many plants on the Atlantic Coast whose products were sold primarily to international markets (Larson, Knowlton, and Popple 1971:1).

Between 1921 and 1926 the Imperial Oil Company used the *Victolite* to move crude oil from Mexico, Peru, Nicaragua, Texas, California, and Louisiana to its refineries in Halifax, Nova Scotia. *Victolite* visited Talara, Peru most frequently, followed by Port Lobos, Mexico; Texas City, Texas; and San Pedro, California. Peru was a vital country to Imperial Oil's success in Canada. "…the record of operations in Peru has shown consistent increase in production of petroleum… Preliminary figures indicate production for the year [1922] of 4,386,938 barrels as compared with 2,825,579 barrels in 1921. Drilling operations are proceeding in Peru upon an extensive scale…" (*New York Times* 1923).

During 1925 *Victolite* mainly concentrated on servicing the petroleum trade between San Pedro (Los Angeles) California and Halifax, Nova Scotia. The Oakland Tribune covered news about one of the tanker's loads of 110,000 barrels and stated that it was one of three tankers with the largest consignments from Los Angeles over the week of 22 June 1925. In total, 32 tankers visited the port during that time and exported 2,190,766 barrels to all parts of the globe from Hawaii to Atlantic foreign ports. By this time, California was a major oil producer and the intercoastal oil trade through the Panama Canal required large loads to meet the demand. *Victolite* made one additional trip between Los Angeles and Halifax before Standard Oil Company of New Jersey purchased the *Victolite* in 1926 and renamed it *E.M. Clark* in honor of Mr. Edgar M. Clark of New York, vice president and director of the Standard Oil Company of New Jersey (Figure 7-148; *National Petroleum News* 1926:64).

The 1926-27 Lloyd's Register listed the *E.M. Clark* with dimensions of 499.2 ft long, 68.1 ft wide, and 30.5 ft deep with a gross tonnage of 9,647 and net tonnage of 6,020. Its official number was 225482 and the tanker was registered in New York. All other details about its construction remain the same as its original registry upon completion. Historical records do not indicate why the tanker's official number as well as dimensions and tonnage changed in 1926 as compared to 1920. *E.M. Clark's* ownership was transferred briefly to the Standard Shipping Company, the transportation subsidiary of the Standard Oil Company of New Jersey in 1927, before finally being owned outright by the Standard Oil Company of New Jersey in 1935 through its loss in 1942. Its homeport then became Wilmington, Delaware (Merchant Vessels 1927-28:62-63; Lloyd's Register of Shipping 1935-36:E). "To add a ship here or there for special reasons, or to transfer ships from one service or affiliate to another, was of course a normal part of Jersey tanker management" (Larson, Knowlton, and Popple 1971:208-209; Marx and Delgado 2013d).

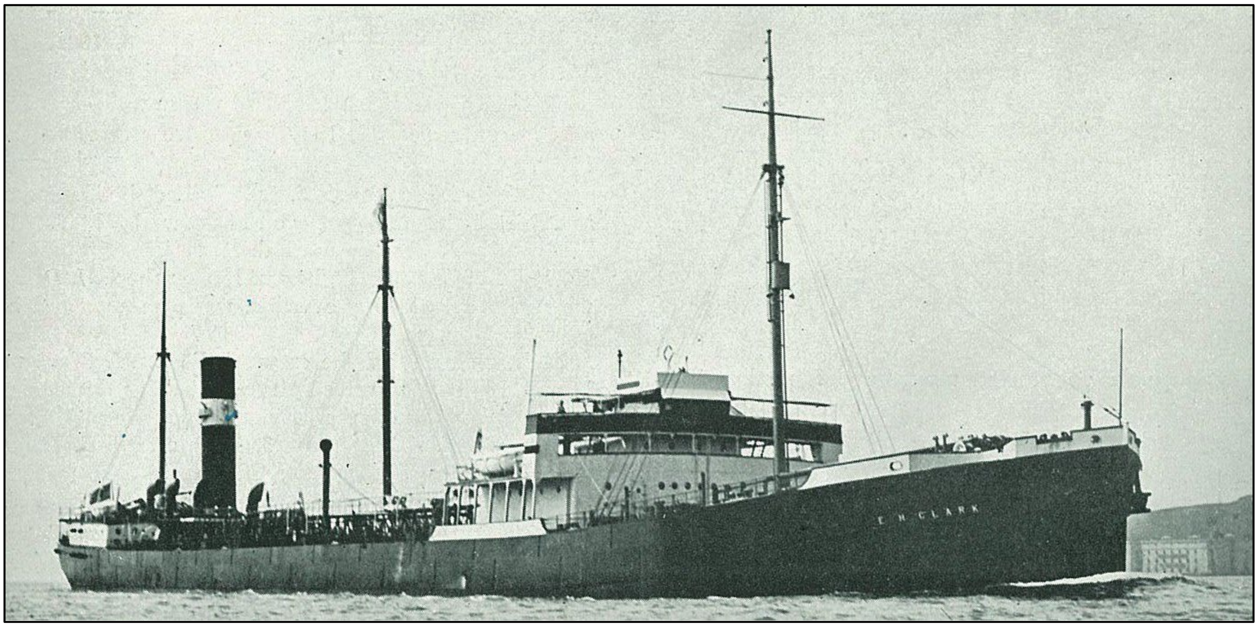


Figure 7-148 Image of *E.M. Clark* prior to WWII.
Source: Standard Oil Company (New Jersey)

Between 1926 and the beginning of WWII in 1939, *E.M. Clark* operated for Standard Oil Company of New Jersey whose tanker fleets dominated the market. "The tanker fleets of the Jersey organization provided physical links between affiliates on different continents and, being the lowest-cost carriers of oil, they also transported supplies between distant ports of a continent" (Larson, Knowlton, and Popple 1971:204). By October 1929 Standard Oil owned 92 tankers totaling 960,000 dead weight tons. These vessels were operated by all of its various affiliates including its main transportation arm, the Standard Shipping Company, who alone controlled 38 tankers. The fleet ranked second in the world's privately owned tonnage behind the Royal-Dutch Shell group that owned 145 tankers. Unlike many other tanker managers, the Standard Oil Company of New Jersey's fleet principally carried crude oil and other products only for its own company and were not open for private charter (Larson, Knowlton, and Popple 1971:204-205).

During WWII, *E.M. Clark* was part of a larger transportation network that carried petroleum products to support the Allied war effort both at home and abroad. It made 41 voyages carrying over 4 million barrels of petroleum products (Table 7-20). "In 1940, although the *E.M. Clark* was in the Patuxent tied-up fleet from August 14 to October 22, she made 13 voyages, including trips to Aruba, Buenos Aires, Guiria, and Las Piedras" (Standard Oil Company (New Jersey) 1946:144). For most of 1941 *E.M. Clark* was on the Gulf of Mexico to Atlantic states service except for one trip with a cargo of gasoline to Santos, Brazil. *E.M. Clark* completed two trips in 1942: from Caripito, Venezuela and Aruba to Baltimore, Maryland, and from Baytown and Texas City, Texas to St. Rose, Lousiana before departing on another voyage in March 1942.

Table 7-20 *E.M. Clark*'s Voyages during WWII

Year	Voyages	Barrels
1939	6	669,678
1940	13	1,450,068
1941	20	2,384,607
1942	2	308,119
TOTAL	41	4,812,472

Source: Standard Oil Company (New Jersey) 1946:145

On 11 March 1942 *E.M. Clark* left Baton Rouge, Louisiana for New York with 118,725 barrels of heating oil (both Esso heating oil and No. 2 heating oil) under the command of Captain Hubert Lovelace Hassell, Lt. Commander USNR. The Commandant of the Eight Naval District gave the captain and crew detailed confidential routing instructions to follow on its trip along with information about radio communications protocols. Routing orders stated that after leaving port the tanker should use Southwest Pass to exit the Mississippi River and then steer the usual route through the Gulf of Mexico while keeping 20 miles from the Tortugas. If the vessel passed Sand Key during the daylight it needed to pass close enough to speak to that station. After rounding the Florida Keys, *E.M. Clark* should pass 15 miles outside the aids to navigation from Sand Key to Cape Canaveral before sailing as close to shore as safety permitted between the Hetzel Shoal lighted whistle buoy off the east coast of Florida and the Barnegat Lightship off New Jersey. Once near New York the tanker should steer directly to the Ambrose Channel light vessel and speak to the patrol boat before entering the harbor. The routing instructions went on to state that *E.M. Clark* should pass Diamond, Wimble, and Winter Quarter Shoal in daylight. Except when in the Gulf of Mexico and west of the Tortugas, Captain Hassell should run darkened at the highest speed possible and zig-zag his course during bright moonlit nights and during all daylight hours. The zig-zag maneuver should be done no more than 3 miles right, or offshore, of the base course. The radio was only to be used in case of an emergency (NARA, US Navy Tenth Fleet RG 38 Box 315).

While heading north up the Atlantic coast *E.M Clark* encountered moderately rough seas as well as rain and lightning on 17 March. The visibility was 3 miles with southwest winds when Captain Hassell retired for the night at 0035 hours on 18 March. He left second mate Richard F. Ludden in command of the bridge with an able-bodied seaman at the wheel. There was a lookout positioned at the forecastle head, one on the main deck, and a third on the bridge. While the unarmed *E.M. Clark* was running blacked out on a course of 45 true and traveling at 10 kts, it was unexpectedly torpedoed at 0125 hours by the German U-*124*, under the command of Johann Mohr, 22 miles southwest of Diamond Shoal Lighted buoy off North Carolina (NARA 1941-1945, US Coast Guard RG 26, Box 6). Mohr had been successful since he arrived on the American coast on 16 March. Just prior to the *E.M. Clark*, his U-boat had sunk the Honduran vessel *Ceiba*, American tanker *Acme*, and Greek vessel *Kassandra Louloudis* all in two days. The U-*124* had also escaped from an attack by the American destroyer *Dickerson* that spotted it while picking up survivors from the *Acme* (Wagner 2010:64-66).

The first torpedo from U-*124* reportedly hit the *E.M. Clark's* port side at amidships 4 ft below the waterline near the #3 tank. The explosion was said to have blown the tank in, pushed the deck up, and brought down the foremast along with the radio antenna (NARA, US Navy Tenth Fleet RG 38, Box 315). This initial blast killed the sole casualty, Thomas J. Larkin (Standard Oil Company (New Jersey) 1946:148). Captain Hassell recounted his reaction to the explosion in a report filed after the sinking.

> Immediately after the explosion I proceeded to the bridge where I took charge from the second mate, who had already sounded the general alarm and ordered the engines 'Full astern and then 'Stop.' These orders were promptly complied with. I then went to the radio operator's room and

> assisted him in the attempt to rig the emergency antenna in order to send an SOS, as the regular antenna had been destroyed (Standard Oil Company (New Jersey) 1946:145; Gordon 1991:142).

The radio operator, Earle J. Schlarb, also recounted his initial experiences after the *E.M. Clark* was attacked.

> As I opened the door I breathed in a sharp, acrid odor of burnt powder in the companionway. Rushing up to the radio room, I turned on my flashlight and found the whole place in chaos... Going outside to the boat deck, I stumbled in the darkness over more wreckage. A flash of lightning showed the damage done by the torpedo; the lifeboat was a blasted heap of torn and twisted metal and splinters; a jagged hole yawned in the sagging deck. Awning and stanchion bars were smashed off and hanging loosely (Standard Oil Company (New Jersey) 1946); Gordon 1991:142).

Just as Schlarb started for the radio room to send a distress signal a second torpedo slammed into the tanker's port side between the #1 cargo tank and the forward dry cargo hold at the bow at 0129 hours (NARA 1941 - 1945, US Coast Guard RG 26 Box 6). By the time the second torpedo hit the tanker it was almost dead in the water. No fire resulted from the two torpedo hits but *E.M. Clark* was fatally wounded and sinking fast so Captain Hassell gave the orders to abandon ship. Thirteen men got into Lifeboat No. 1 and 26 men got into Lifeboat No. 4. Lifeboat No. 1 was lowered into the water with 13 men but returned back to *E.M. Clark* when wiper Glen Barnhart was seen standing on the railing. Barnhart jumped into the water and was picked up and helped into the boat. Out of the 41-man crew, 40 survived and were rescued. The only missing crewman was utilityman Thomas J. Larkin. It was assumed that he was killed by the first torpedo explosion while sleeping in the hospital room that was near the impact zone. Before going into Lifeboat No. 1, Hassell gathered all the confidential ship's papers and secret codes. He reported that he took the ship's papers with him and threw the codes overboard in a weighted bag (Gordon 1991:146).

By this time, *E.M. Clark* was bow down in the water; the sea was covered in oil making the men in the lifeboats sick from the fumes. It took about 10 minutes for the tanker to fill with water and plunge into the sea bow first (NARA 1941-1945, US Coast Guard RG 26 Box 6). As *E.M. Clark* sunk, the steam whistle that had been jammed open and blowing steadily since the second torpedo, made loud gurgling sounds as it slipped beneath the surface (Standard Oil Company (New Jersey) 1946). After the attack, the U-*124* surfaced and circled *E.M. Clark* and then its lifeboats for an hour and a half to observe the scene. The crew remarked in the sinking report about seeing the U-boat while waiting for rescue. "We saw the submarine heading for the stern of the ship as its yellow light silhouetted the torpedoed tanker in the darkness... The submarine's course could be followed by its light, which kept swinging back and forth over the place where the ship had sunk. Now and then the searching beam passed over our boat, but each time this happened we were hidden by wave crests" (Standard Oil Company (New Jersey) 1946). The submarine was last seen at 0300 hours heading northeast.

At 0700 hours on 18 March, the destroyer USS *Dickerson* rescued Lifeboat No. 1's 14 members. Some hours later, *Dickerson* also found Lifeboat No. 4 empty, and subsequently learned Venezuelan tanker, *Catatumbo*, had recovered its 26 occupants. The survivors were eventually transferred to Norfolk, Virginia. In addition to the loss of Thomas J. Larkin, several crew were severely injured (Standard Oil Company (New Jersey) 1946; Marx and Delgado 2013d).

7.18.2 Archaeological Site Description

The vessel remains rested on its port side; at 260 ft deep, *E.M. Clark* was the deepest and most challenging site investigated by the researchers during this survey. Working on the site required advanced technical diving using staged decompression. The research team investigated the site in 2010 and again in

2011. Given the time constraints of working at these depths, the survey approach consisted of photo and video documentation. A still image catalog and video, both standard and stereographic, were collected. A high-resolution photomosaic was produced from still imagery acquired for that purpose (Figure 7-149). Subsequently, these images and diver observations were compiled to create a detailed line drawing of the site (Figure 7-150 and Figure 7-151).

Due to the water depth in which the vessel rests, *E.M. Clark* was the best-preserved example of WWII tanker casualty within this study. The site had a very high degree of structural integrity and was largely intact from stem to stern. This level of preservation meets NRHP criteria due both to its integrity and its representativeness of the Battle of the Atlantic engagement, and indeed the site has been successfully listed on the register based on data collected during this survey (Marx and Delgado 2013d). The vessel size, observed site characteristics, and location all indicate that the site is the American tanker *E.M. Clark*. *E.M. Clark*'s overall site remains measured 499 ft by 40 ft wide with 50-60 ft of vertical relief above the seafloor, depending on variations in sedimentation. The site's main feature was the steel hull that is mostly intact lying on its port side. Exterior steel hull plates were in an excellent condition with small areas of localized deterioration. The wreck's highest point was the starboard side main deck edge that sits at least 50 ft off the seafloor. Any question as to the identity of the vessel was adequately answered by the observation of the welded steel letters spelling the vessel's name on the starboard bow aft of the anchors (Figure 7-152). This feature was difficult to discern in its entirety, due to marine growth that obscured portions of the individual letters. Nevertheless, the name was clearly recognizable and the identity is certain.

Both the bow's anchors were in place and visible in the hawse pipe with its port side anchor still secure in place by anchor chain (Figure 7-153). Both anchor chains ran up through the hawse pipes to the deck where they were wrapped over the windlass and continued down into the chain locker in the forecastle. The deck plating forward of the windlass at the bow remained largely intact. Aft of the windlass to the forward deckhouse footprint, the deck plating was deteriorated exposing both longitudinal and athwartships deck beams.

Between the windlass and forward deckhouse is the opening to the forward hold. The hatch combing remains intact and through this point interior access can be gained. This point corresponds exactly with one of the areas of torpedo damage. A large breach in the bottom of the hull is observable here, matching historical accounts of the second torpedo strike (Figure 7-154).

As built, *E.M. Clark* had two main deck structures. The forward deckhouse was by far the largest, containing the bridge and helm as well as staterooms. Just forward of the bridge was one of three masts. The remains of this mast are dislodged and lying on the seabed perpendicular to the main hull. Aft of the mast, a massive debris field associated with the disarticulated deckhouse is present (Figure 7-155).

The bridge structure had fallen to the seabed and only small sections remain intact on deck. The footprint where the deck structure would have met the deck is still evident. The debris field likely contains the remains of the bridge itself, including the helm and typical bridge-associated artifacts. Likewise, the debris field contained the remains of staterooms that likely contained smaller cultural artifacts associated with the crew and life aboard the vessel.

Along the main deck, several typical features are observable such as bits, cleats, railings, and lifeboat stanchions. On the main deck there are valves, pumps, and large pipes, all of which are associated with the loading and unloading of the liquid cargo of heating oil.

Figure 7-149 Completed photomosaic of the *E.M. Clark* wreck site, 2012.
Source: NOAA

Figure 7-150 Bow (left) and stern (right) details of *E.M. Clark*.
Source: NOAA

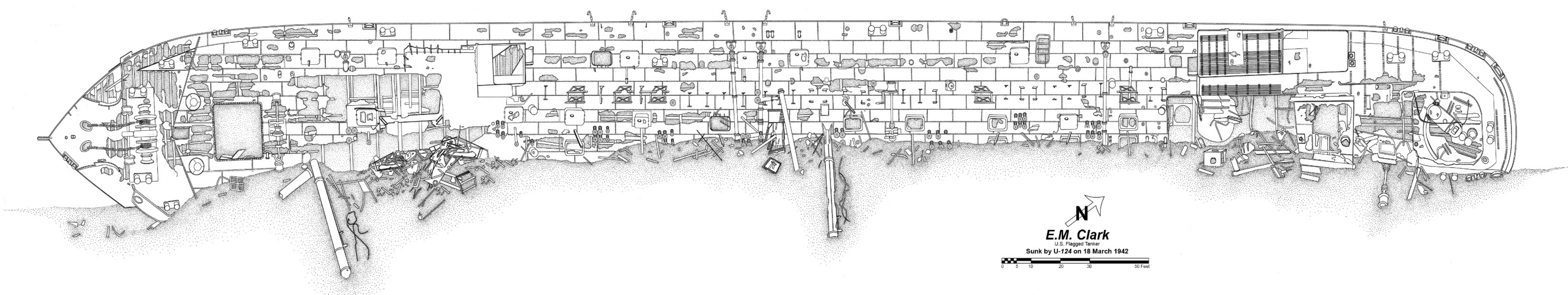


Figure 7-151 Line drawing showing details of the wreck of *E.M. Clark*, based on above photomosaic.
Source: NOAA

Astern, the deck structure above the engineering space has become a large debris field in a similar fashion as the forward deck structures, although one small portion of the first level of the deckhouse remained in its original position. In this area, access to the interior was also wide open; however, due to safety considerations with enclosed and overhead spaces, documentation of the interior was not conducted. The debris field consisted of disarticulated components of the deck structure above the engine and boiler space. Remnants of the smoke stack could still be seen on the seabed.

On the fantail, the most prominent feature was the steering quadrant, the assembly that lent a mechanical advantage to the manipulation of the rudder for steering the vessel. This feature was still in its original position and connected to the top of the rudder post (Figure 7-156).

At the stern of the vessel, the rudder, rudderpost, skeg, and starboard propeller were all evident and in their original position (Figure 7-157 and 7-158). The position of the rudder would have directed the vessel to port were it on the surface, however the rudder's present position was likely a result of gravity due to the position at which the vessel came to rest on the seabed. *E.M. Clark* had two propellers, of which only the starboard was visible. The port propeller was located underneath the vessel and buried in the sediment in unknown condition.

The overall wreck site of *E.M. Clark* was in remarkable condition. The level of preservation can be attributed in large part to the water depth in which the vessel lies. Having never posed a hazard to navigation, the site was never subjected to wire-dragging or the blasting that was conducted on many of the shallower sites in this survey. Likewise, surface conditions and high-energy events such as storms would have a diluted effect on the structure at these depths. Other vessels in this collection that can be said to be 'intact,' such as *Empire Gem* and *Lansing*, are completely turtled and predominantly only offer a view of the bottom of the hull. This leaves *E.M. Clark* as the single, best-preserved example of a tanker casualty during the Battle of the Atlantic which was observed during this study. Furthermore, the depth at which the site is located was, until perhaps the last 20 years, inaccessible to most scuba divers. As a result, it is possible that a higher proportion of smaller artifacts and cultural materials are still present and *in situ* on site, whereas shallower sites frequented by divers over the decades have often been looted. This site was successfully listed on the NRHP as a result of this survey (Marx and Delgado 2013d).

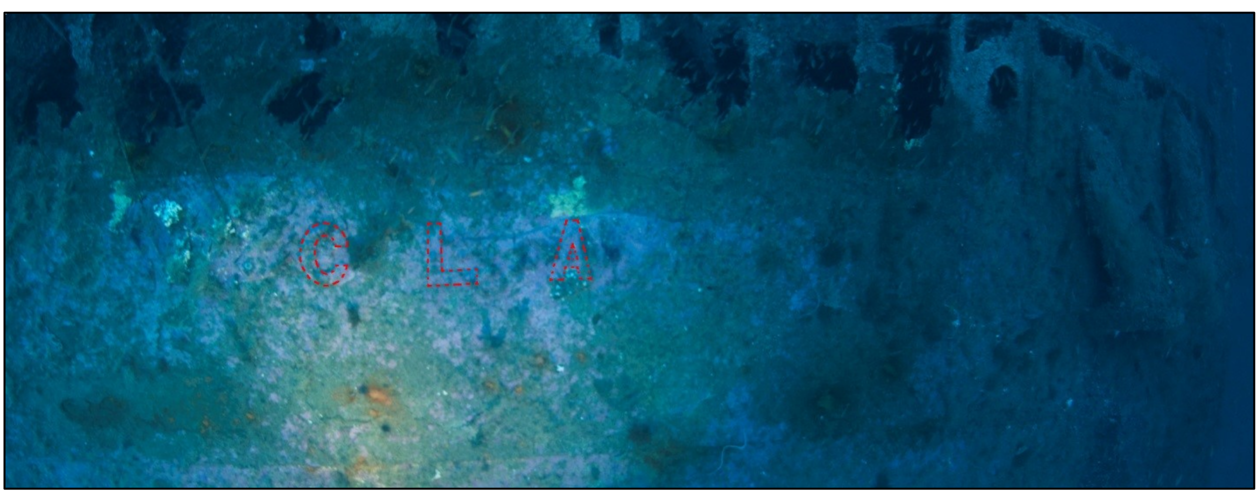


Figure 7-152 Image showing the observed nameplates on *E.M. Clark* outlined for clarity.
Source: NOAA

Figure 7-153 Bow of the *E.M. Clark*.
Source: Becky Kagan Schott, WHOI

Figure 7-154 Image of *E.M. Clark* torpedo damage as seen from the deck level looking towards the keel.
Source: NOAA

Figure 7-155 Forward deck structure debris field on *E.M. Clark*.
Source: Becky Kagan Schott, WHOI

Figure 7-156 Deck level at stern, showing exposed steering quadrant of *E.M. Clark*.
Source: NOAA

Figure 7-157 Stern view of *E.M Clark* showing propeller and rudder assembly.
Source: NOAA

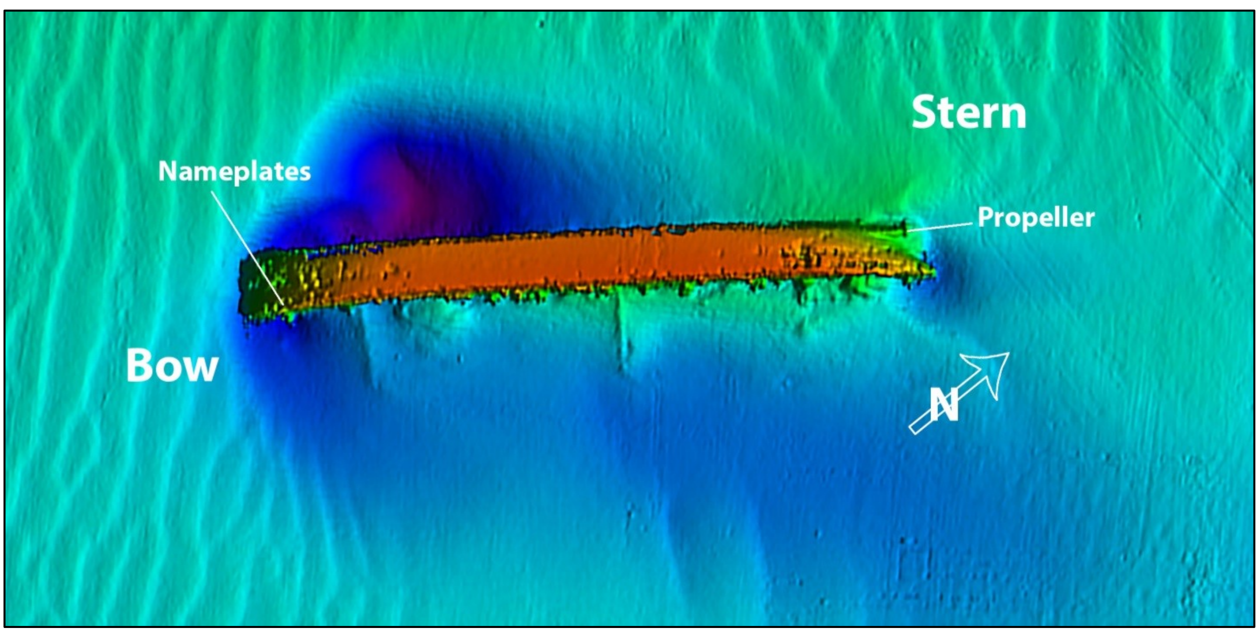


Figure 7-158 Multibeam survey of *E.M. Clark* from Reson 7125, 400 kHz gridded at 0.25 m.
Source: NOAA R/V *Nancy Foster*

7.19 Empire Gem

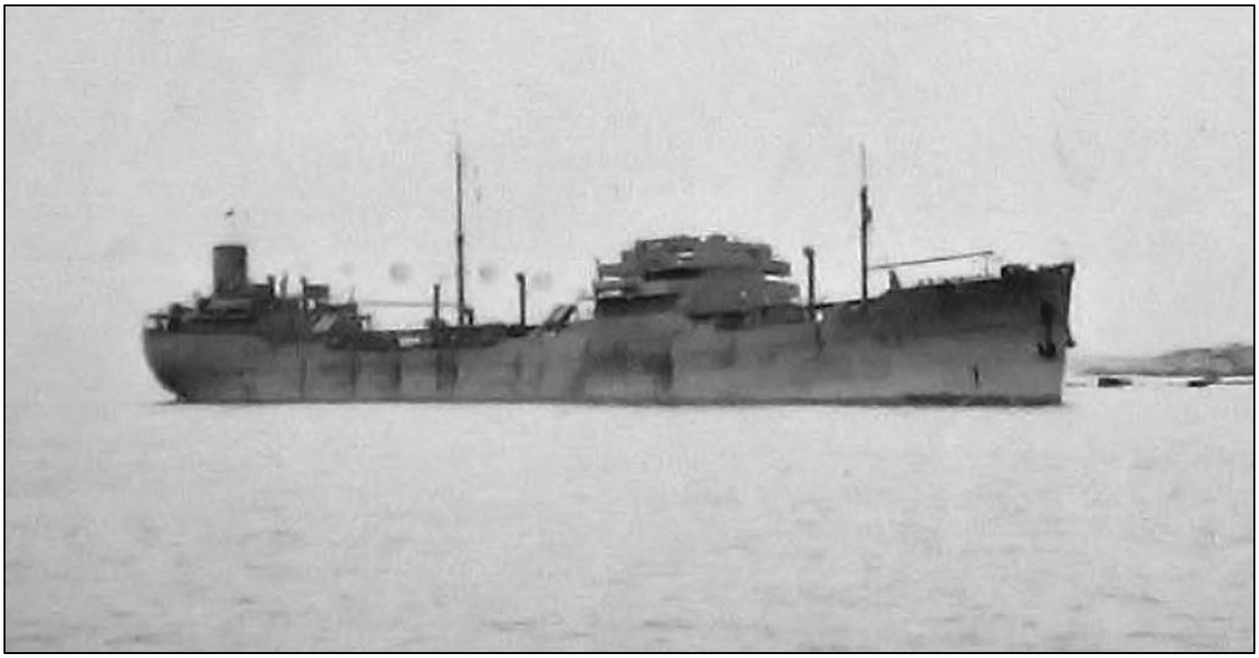


Figure 7-159 US Coast Guard identification photograph of *Empire Gem*, date and location unknown.
Source: NARA

Table 7-21 Characteristics of *Empire Gem*

Characteristics	*Empire Gem*
Year of Build/Type/Hull #	1941/Tanker/1045G
Date Lost	24 January 1942
Position & Depth	13 miles S of Cape Hatteras, NC 160 ft
Ship Characteristics	Length: 463.2' Breadth: 61.2' Depth: 33.1' Gross Tonnage: 8,139
Cargo	Oil, Type not positively identified
Survivors	2 (51 Total on board [49 dead and 2 survivors])
Owner	Ministry of War Transport, UK
Builder	Harland & Wolff Ltd., Belfast and Glasgow, UK
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, one deck, 2nd deck clear of cargo tanks, Cruiser Stern, longitudinal framing, oil engines
Port of Registry/Flag	Glasgow/UK
Sunk by	U-*66* (Richard Zapp)
Data Collected on Site	Mulitbeam 2010; AUV 2011. Screening Level Risk Assessment (NOAA 2012) Listed on NRHP

7.19.1 History

The tanker *Empire Gem* was built in Glasgow, Scotland by Harland and Wolff, Ltd. and launched on 29 May 1941 (Table 7-21 and Figure 7-159, above). It measured 463.2 ft long, 61.2 ft wide, with a 33.1-ft depth of hold. Its gross and net tonnage were 8,139 tons and 4,743 tons respectively, with an under deck tonnage of 7,234 tons. The builder's identification yard number was 1045G. Its official number was 168691 and its signal letters were BCNV. It was a single screw, steel hulled, two-decked motorship designed to carry petroleum in bulk; *Empire Gem* was the sister ship to the *Dingledale* (yard number 1044G). *Empire Gem* was built under a Lloyd's special survey and had an A1 rating vessel, meaning it was fit to carry dry and perishable goods. It had a cruiser stern with three deck structures: the poop at the stern, bridge in the middle, and forecastle at the bow. Four 24- or 25-ft long boats were placed on deck to serve as lifeboats. The vessel was constructed with electric lights, wireless radio, a direction finder, and an echo-sounding device (Lloyd's Surveyor Report 1941; Lloyd's Register of Shipping 1943:EMP).

Harland and Wolff built *Empire Gem* with a steel riveted hull and longitudinal steel framing in its bottom with transverse framing located in the poop and forecastle. At amidships the framing was spaced 31 inches apart. The engine room was strengthened with a double bottom combined with transverse frames. It had 17 watertight bulkheads extending up to its upper deck. J. Hastie and Co. supplied a steam hydraulic steering gear for the vessel with block and tackle on hand as an alternative method if steam pressure was lost. The steam windlass was manufactured by Emerson Walker (Lloyd's Surveyor Report 1941).

Empire Gem employed water for ballast in several onboard tanks. There were ballast tanks fitted under the engines in its double bottom, in cofferdams under the engines, as well as in the fore peak tank, aft peak tank, and forward deep tank (Lloyd's Surveyor Report 1941). Water ballast was common in vessels that had both full and light (in ballast) loads. This system ensured that the ballast did not take up any area that could be used for cargo, in turn maximizing cargo storage (Pollock 1884:15).

Harland and Wolff built *Empire Gem's* two heavy oil airless injection engines. The engines were powered by fuel oil stored in aft oil bunkers with additional storage in deep tanks forward. The four stroke, eight cylinder, single acting engines produced 502 nominal horsepower. The vessel was equipped with two steel, single ended return tube boilers which supplied steam for a donkey engine, auxiliary engines, compressors, and steering equipment. The boilers ran on the same fuel oil as the main engines with 150 pounds per square inch of pressure. The tanker's two electric generators ran off the auxiliary steam engine and each produced 110 volts, 20 kilowatts, and 182 amps with 650 revolutions per minute. All of *Empire Gem's* machinery was built under a special survey in accordance with plans approved by Lloyd's (Surveyor Report 1941).

After its launch, the British Ministry of War Transport equipped *Empire Gem* with defensive weaponry. Many merchant vessels that operated during WWII were furnished with some sort of armament to combat the U-boat threat and the *Empire Gem* was well supplied during its entire career as a petroleum tanker. It carried gear to combat aerial and submarine threats as well as impacts from undersea mines. The largest weapon onboard was a B.L. 4-inch MK VIII (No. 971) naval gun mounted on a platform at the stern. This was mainly used as an anti-torpedo or anti-submarine gun. Fifteen feet behind that was a 12 pound Q.F. MK IX (No. 6961) gun. Small arms consisted of four Marlin 0.30 caliber machine guns, two Savage Lewis 0.30 caliber guns, and one Lee Enfield 0.303 caliber rifle. *Empire Gem* carried degaussing gear to reduce the hull's magnetic signature, thus lessening the risk of triggering a magnetic mine. The ship carried two paravanes, towed underwater devices deployed from the ship's side by the yardarms, to neutralize contact mines. Paravanes cut a mine's anchor cable causing it to surface where it could be destroyed. Additional supplies included kites, smoke floats, flares, igniters, port fires, P.A.C. rockets, protective clothing, steel helmets, and gas masks (NARA 1939 - 1952, US Coast Guard RG 26 Box 50; Stirling 1941:108).

Empire Gem went into service as a petroleum tanker on 24 October 1941. The tanker was built for the British Ministry of War Transport and managed by the British Tanker Company (a predecessor of British

Petroleum or BP). The British Ministry of War Transport was part of the British government, formed in May 1941 to control transportation policy and resources. The agency merged the Ministry of Shipping and the Ministry of Transport to better organize wartime transport. Its United States equivalent was the War Shipping Administration , which worked to maximize the merchant marine efforts in support of Allied fuel and supply needs at home and abroad. Representatives of the British Ministry of War Transport were stationed all over the world to ensure coordination between countries. Through this process, the government could ensure that enough specialized vessels, such as the tanker *Empire Gem*, were active in the fleet and available for war duty (Adler 1944:201).

Empire Gem was one in a series of vessels known as "Empire" ships built expressly for the British government in response to WWII. In 1939, the Ministry of Shipping adopted a standard naming system for all merchant ships contracted by the government to be built in Britain. The prefix Empire was given to all the ships except very small types. This system applied to vessels acquired through purchase, requisition, or taken as a war prize. The Empire name also included tramp merchant ships acquired from the U.S. in 1941-42. Modern C2 and C3 type ships on lend-lease agreements to the United Kingdom during late 1941-42 received the moniker. Thirteen C1-type ships that were converted to British Infantry Landing Ships in 1943-44 went by "Empire …" (Mitchell and Sawyer 1990:vii). In total, three "Empire" ships were lost off North Carolina in WWII, *Empire Gem, Empire Dryden* and *Empire Thrush.*

Empire Gem's service was initially planned to provide "oil cargo service between English ports and Iran" (NARA, US Coast Guard RG 26 Box 50). Due to the changing situation as a result of WWII, *Empire Gem*'s operating route changed from its initial plans. The British government now directed merchant vessel movements through licensing or by requisitioning. The British Tanker Company could not keep up the shipments from Iran so they looked to shorter routes closer to home and the *Empire Gem* would sail to the United States instead of Iran.

> ...in the second half of 1940, as tanker losses to enemy action mounted, it became more necessary to conserve tanker tonnage by adopting the 'short-haul' principle, by which oil requirements were shipped from the nearest source of supply in order to save tanker tonnage. In the case of Britain, that meant reducing oil liftings from Iran in favour of nearer sources in the western hemisphere, mainly the USA... the last cargo of Iranian oil arrived in Britain in August 1941 (Bamberg 1994:217-218).

Empire Gem was ready for operation as a petroleum tanker in October 1941, though she would have a very short time in service. It departed from its homeport of Glasgow, Scotland on 24 October in ballast and headed to Liverpool, England where it joined convoy ON 30. The convoy, comprised of 53 merchant vessels and 13 escorts, left on 26 October and crossed the Atlantic for the United States. Under the command of Captain F. R. Broad, *Empire Gem* had 14 British officers and 38 British seamen onboard. The majority of convoy ships, including the *Empire Gem*, were of British nationality and traveling empty, in ballast (NARA, US Coast Guard RG 26 Box 50).

Following a trip in mid-December 1941, *Empire Gem* made a stop in Avonmouth, England, and returned for the United States. It sailed with convoy ON 48 that departed Liverpool on 19 December 1941. The convoy was comprised of 53 merchant ships and 11 escorts. *Empire Gem* arrived in Mobile, Alabama on 10 January 1942. Coast Guard records indicated that *Empire Gem*'s visit to Mobile was for dry-docking and repairs (NARA, US Coast Guard RG 26 Box 50). Four days later, on 14 January 1942, the tanker departed Mobile with its 51-man British crew and headed for Port Arthur, Texas where it arrived on 16 January 1942.

While in Port Arthur, Lykes Brothers was *Empire Gem*'s local agent and in charge of securing and loading its cargo. *Empire Gem* left Port Arthur on 18 January 1942 with a cargo of approximately 10,000 tons of spirits/kerosene (NARA BT 389-38). While other (mostly secondary) sources provided contradictory reports on *Empire Gem*'s cargo (DIO 1945:34; Brechtelsbauer [1995-2013]; NARA, US Navy RG 38 Box 410; Gentile 1993:69), primary source merchant shipping records housed in the British National Archives provide the most reliable indication of the vessel's cargo.

While en route to Halifax to meet its cross-Atlantic convoy, U-*66* torpedoed the *Empire Gem* 28 miles off Cape Hatteras, North Carolina on 23 January 1942 at 1945 (Figure 7-160 and Figure 7-161). The tanker had been sailing in moderate seas with a westerly wind at 11.5 kts with a dimmed masthead light and side lights, as directed by the British Naval Control at Galveston, Texas. Just prior to the incident, *Empire Gem* passed the American merchant ship *Venore*, which was sailing from Chile to Baltimore with a cargo of 8,000 tons of iron ore. Upon reaching the Diamond Shoals Light ship *Empire Gem* changed heading to its next leg of its zigzag course. At 1945, when the tanker was 18 miles away from the lightship the U-*66* fired two torpedoes that hit *Empire Gem's* aft starboard tank, causing a large explosion and fire which is believed to have killed everyone in the engine room (DIO 1945:34; NARA, US Navy RG 38 Box 225;). The *Venore*'s third mate recalled the incident in the North Atlantic Naval Coastal Frontier War Diary from January 1942 (Mason 2015: Chapter 1:2).

> The Third Mate was waiting to relieve the watch when he was suddenly startled by the sound of a "terrific explosion" on the starboard quarter. Turning, he saw, about a mile away, the burning hull of the *Empire Gem* silhouetted against the darkness by a fire that climbed 500 feet into the night air. As he watched, the black hull of a submarine came round the stern of the sinking ship and moved into the circle of light.

Empire Gem's radio officer managed to send out an SOS for help that was picked up by the *Venore,* only 2 to 3 miles away. Another message was sent from a portable transmitter that was received by the Fifth Naval District shore stations. *Empire Gem's* crew tried to launch lifeboats, but were unsuccessful due to the intense heat onboard the burning vessel (Gentile 1993:70). Soon after the U-*66* torpedoed the *Empire Gem*, it turned its sights on the *Venore.* It fired several torpedoes, sinking *Venore* and killing 17 of its 41-man crew.

After the torpedoes struck, *Empire Gem* continued to motor in a westerly direction for three more hours at full speed before the engines finally stopped on 24 January. During this time the stern was enshrouded by a fireball. The tanker broke in half and the stern section sank. Onboard the still floating bow was *Empire Gem's* captain, Francis Reginald Broad and its radio operators Thomas Orrell (2nd radio officer) and Ernest McGraw (1st radio officer). The sailors managed to drop its two anchors and keep the bow in place while awaiting rescue, only Captain Broad and Officer Orrell survived (DIO 1945:34).

Empire Gem's bow remained afloat and right side up for several days after the incident. The Coast Guard placed a red flashing "C" buoy near the wreck to warn mariners of the hazard to navigation. Several days later the bow capsized but it stayed buoyant. The bow was anchored to the seafloor with its own anchors and never drifted from its original location. The Gentian survey suggests the bow was still afloat as late as 7 April 1942 (DIO 1945:35).

Newspapers did not report the *Empire Gem's* loss until June 1942 and the story's details were vague and unspecific. Similar text appeared on 4 June in various papers across the United States from the *Evening Recorder* in New York to *Statesville Daily Record* in North Carolina and the *Lanesville Signal* in Ohio. The *Evening Recorder* reported that:

> The German raiders bagged their biggest prize – the British tanker *Empire Gem*, carrying 10,600 tons of gasoline – five days after the [*City of*] *Atlanta* went down. The craft exploded in the night with a great flash visible from 50 miles and a roar heard along the Carolina coast.

The Statesville Daily Record wrote, "The light from the fires of the ship was visible for 50 miles. The roar of the explosion was heard 75 miles inshore." In July 1942, *Empire Gem*'s captain, Francis Reginald Broad, was honored with an award from the British Merchant Navy. The award stated that the captain, "displayed great courage and resources when his ship was torpedoed and set on fire" (*Manchester Guardian* 8 July 1942). Broad was honored for his courage and resource awarded the title of Officer of the Most Excellent Order of the British Empire (OBE).

> Captain Francis Reginald Broad, Master (Cadishead, Manchester): The ship was torpedoed and caught fire. The engines could not be stopped, and the master and two radio officers, who were forward of the fire and could nothing to stop the ship or help the crew, retreated to the forecastle head. The next morning, the ship broke in two and they had to jump into the sea, but only the master and one radio officer were picked up. That they survived the terrible ordeal was largely due to the master's courage and resource. By letting go both anchors when the engines stopped he kept the doomed ship head to wind, so that the fire was blown away from the forecastle (*Manchester Guardian* 8 July 1942).

The U-*66* led a very successful career that included not only the *Empire Gem* but 32 other vessels for over 200,000 gross tons sunk. It also damaged four more ships totalling 22,738 gross tons. The Type IXC submarine had been ordered on 7 August 1939 but was not launched until 10 October 1940 from the shipyard of AG Weser in Bremen, Germany. During the war, U-*66* participated in 10 patrols, covering 704 days, with captains Richard Zapp, Friedrich Markworth, and Gerhard Seehausen. It was on its fourth patrol with captain Zapp when it sank *Empire Gem* as part of Operation Drumbeat. It had left port on 25 December 1941 and headed to Cape Hatteras, where it began attacking merchant shipping of the U.S. coast on 15 January 1942. U-*66* first sank the American steam tanker *Allan Jackson*, then the Canadian passenger ship *Lady Hawkins*, followed by the Panamanian tanker *Olympic*. *Empire Gem* and *Venore* were its final two victims before it headed home to L'Orient, France. The U-*66* was ultimately sunk by American forces off the Cape Verde Islands on 6 May 1944 (Brechtelsbauer 1995-2013a, Marx and Delgado 2013b).

7.19.2 Archaeological Site Description

The team investigated *Empire Gem* in 2011 with a high-resolution blueview multibeam 1,350 kHz sonar mounted on an AUV. The multibeam sonar used high-frequency sound to image the shipwreck and produce digital point cloud images of the site. The images depicted a shipwreck broken in two with an inverted bow section (Figure 7-162 and Figure 7-163). The forward section of the vessel's hull appears to be structurally sound up to the breach.

Empire Gem rests at 160 ft, 12 miles south of Cape Hatteras, North Carolina. The wreck site measured 515 ft long by 210 ft wide with 30 ft of vertical relief above the seafloor (Figure 7-164). The vessel itself had large sections still intact and rested almost completely upside down. The site's main feature was the vessel's steel hull, which laid broken in two pieces. The bow section measured 262 ft long, while the stern section measured 140 ft long. Whereas the bow section was completely upside down, the stern section sat upright. However, the stern section was rotated 180 degrees from its original orientation, and the vessel's sternpost pointed directly at the broken end of the bow section. The shipwreck's longitudinal axis was oriented ENE by WSW, its bow points ENE - a disparity attributable to the circumstances of the sinking. The stern section broke off and sank first, while the bow section was at anchor and remained partially afloat for weeks (DIO 1945:35).

The inverted bow section was largely intact and potentially contained some remnants of *Empire Gem*'s cargo. Local divers and fisherman often report the strong smell of petroleum products when visiting the shipwreck, and the site is known as the 'smell wreck' or 'stink wreck' (Sommers 2008; Gentile 1993:71-72).

The team attempted to dive this site; however, the conditions were too poor on the bottom to accomplish any meaningful work. A combination of strong currents and near zero visibility prevented archaeological data acquisition. Overall, the site may be characterized as a large steel-hulled tanker broken in half just forward of the engineering space. The wreck's location matches historical accounts of *Empire Gem*'s loss off Cape Hatteras, North Carolina. Additionally, the shipwreck's size and construction features correspond to *Empire Gem*'s historically reported characteristics.

The stern section is upright and appears accessible, possibly allowing for access to smaller material culture finds. Documentation of the *Empire Gem*'s material culture could yield information about its crew and answer questions about ethnicity, social class, and shipboard life. *Empire Gem*'s crew was forced to quickly flee the sinking vessel, leaving their personal effects behind. The information gathered from analysis of the crew's effects would likely provide insight into life onboard an Allied merchant vessel operating in an active U-boat battlefield. *Empire Gem*'s crew consisted of 57 men from the UK whose nationalities were English, Scottish, Welsh, and Irish. The crew's length of individual service ranged from 32 years for the captain to an engineer on his first sea voyage. Crewmembers ranged in age from 57 years old for its donkeyman (boilerman or mechanic) to 16 for an apprentice. This site has been listed on the NRHP as results of this survey (Marx and Delgado 2013b).

Figure 7-160 *Empire Gem* attacked by U-*66*.
Source: NARA, 1939-1952

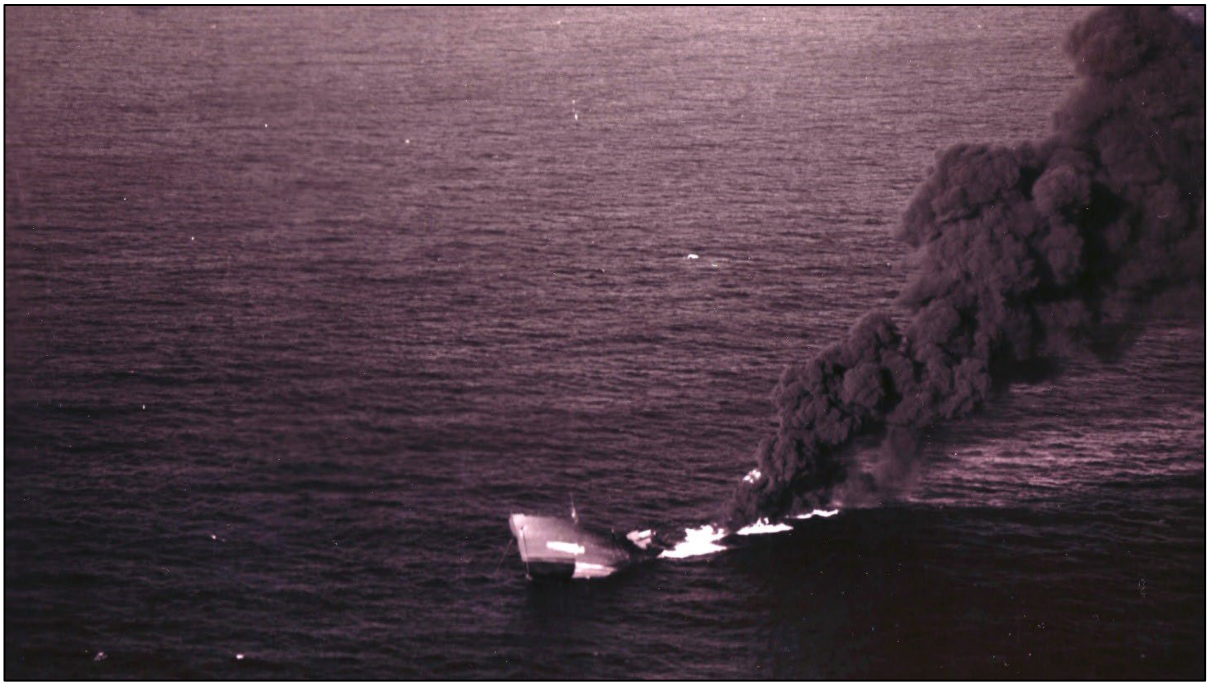


Figure 7-161 *Empire Gem* following the attack by U-*66*.
Source: NARA

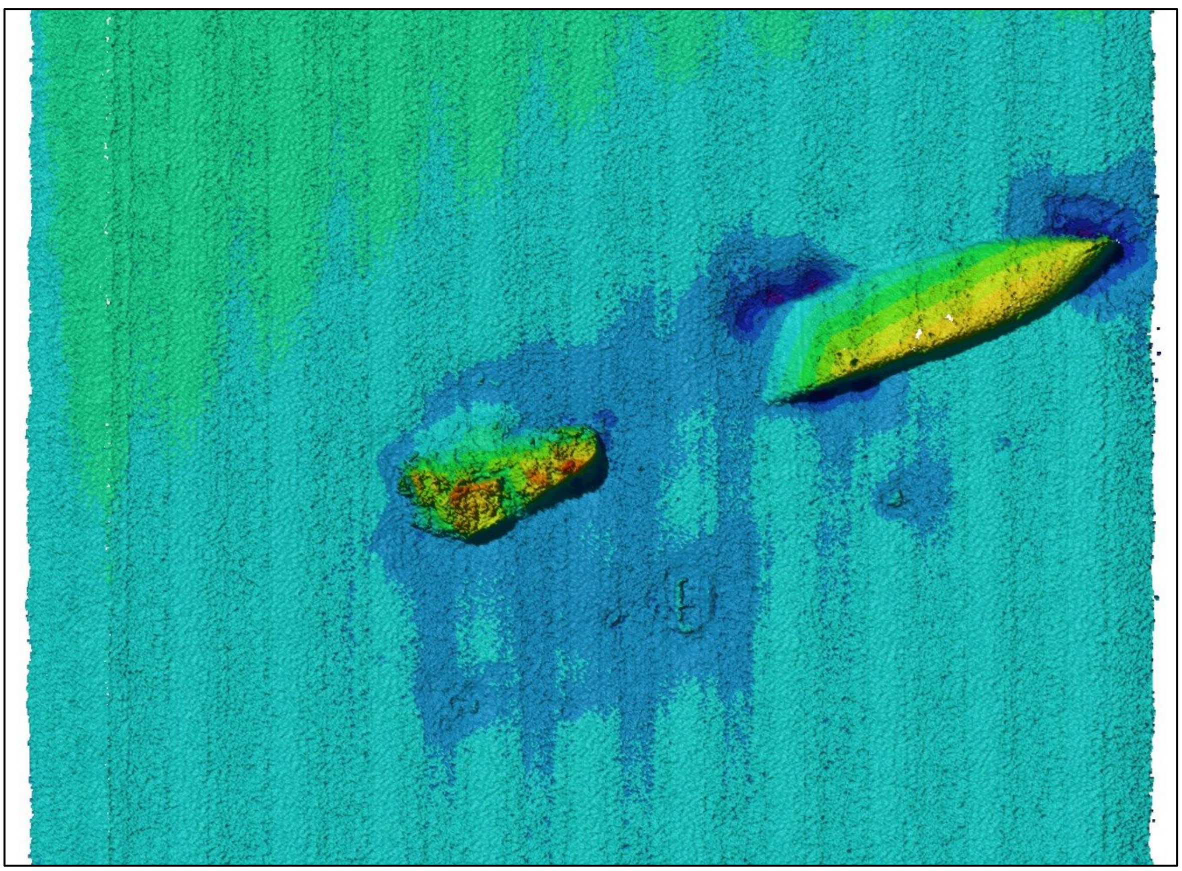


Figure 7-162 BlueView multibeam AUV survey of the *Empire Gem* wreck site.
Source: SRI/NOAA

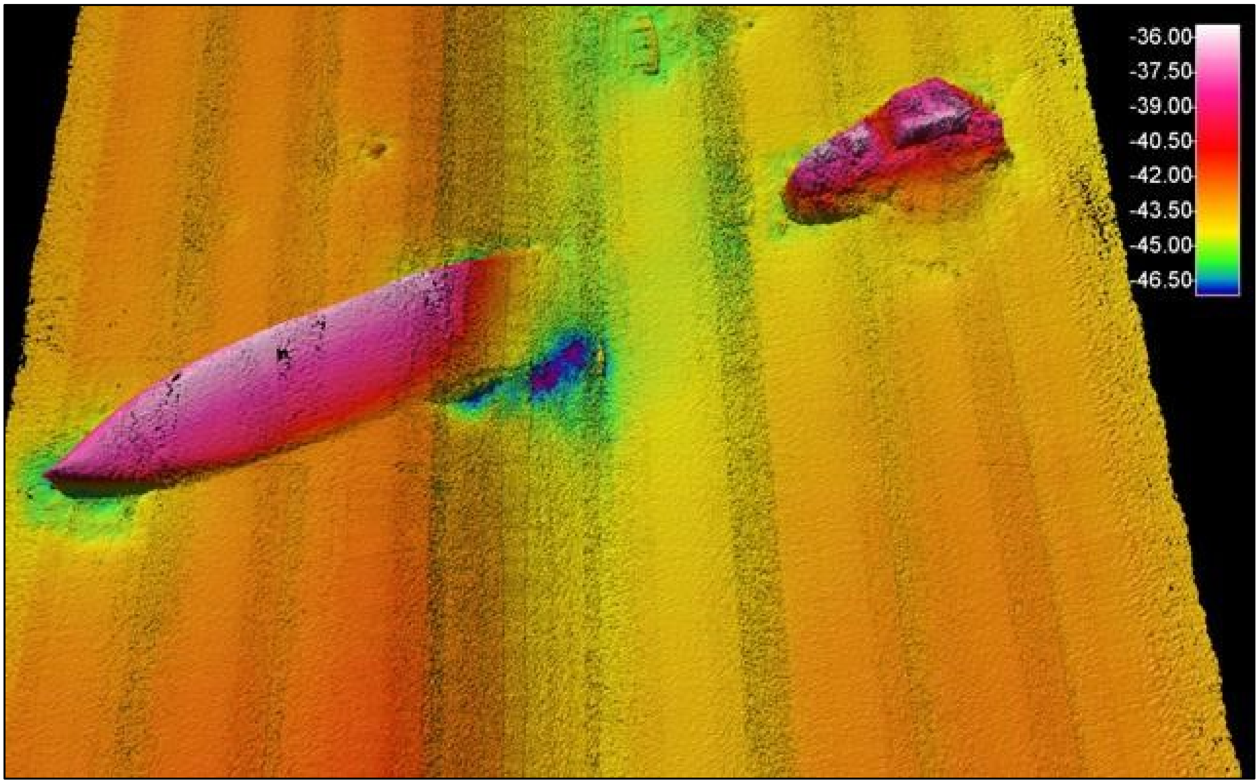


Figure 7-163 Detail view of *Empire Gem* wreck site from AUV survey.
Source: SRI/NOAA

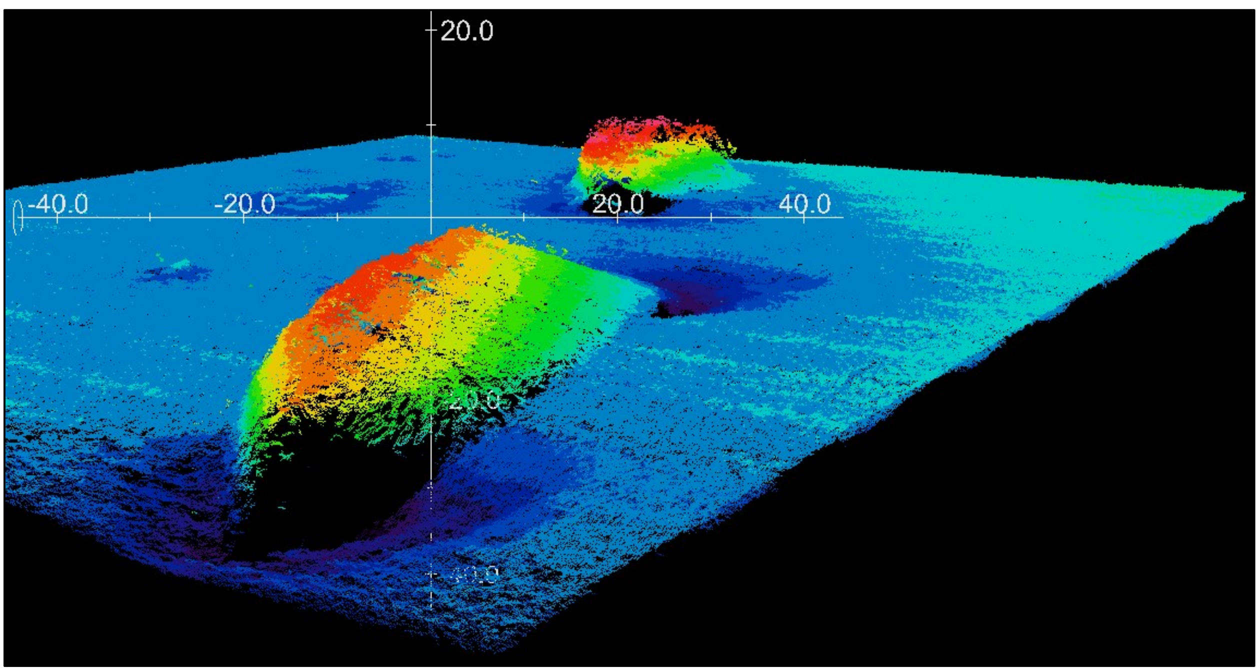


Figure 7-164 Isometric view of *Empire Gem* wreck site.
Source: SRI/NOAA

7.20 Empire Thrush

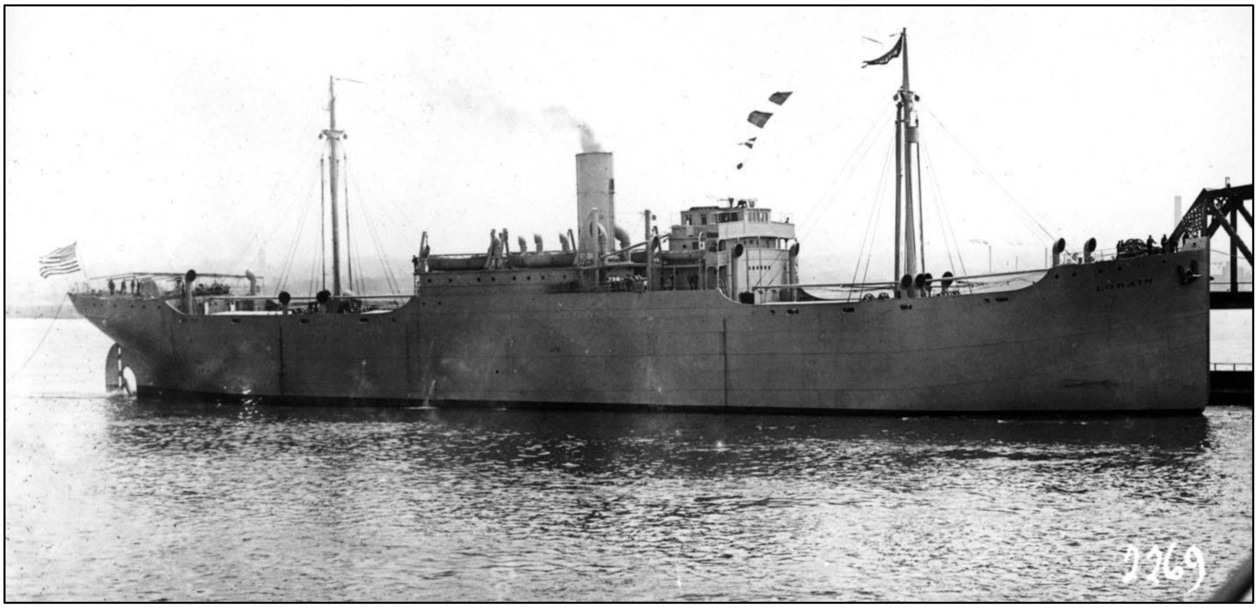


Figure 7-165 *Empire Thrush* (as *Lorain*) location and date unknown.
Source: Steamship Historical Society of America

Table 7-22 Characteristics of *Empire Thrush*

Characteristics	*Empire Thrush*
Year of Build/Type/Hull #	1919/Cargo/12
Date Lost	14 April 1942
Position & Depth	17 miles E of Cape Hatteras, NC 65 ft
Ship Characteristics	Length: 395.5'; Breadth: 53'; Depth: 31.4' Gross Tonnage: 6,160
Cargo	5,000 tons of rock phosphate, 740 tons of TNT and 2,800 tons of citrus pulp
Survivors	55 (55 Total on board)
Owner	Ministry of War Transport, UK
Builder	Federal Shipbuilding and Drydock Co., Kearny, NJ
Former Names	*Lorain* (US Shipping Board, 1919-1937)
Lloyd's Register Details	Steel (Stl) hull, one deck, one shelter deck, longitudinal framing, DR geared steam turbine, fitted for oil fuel, 3 Scotch boilers.
Port of Registry/Flag	London/UK
Sunk by	U-*203* (Rolf Mützelburg)
Data Collected on Site	R/V *Nancy Foster* multibeam 2016; diver investigation 2016.

7.20.1 History

Of all the vessels lost off the North Carolina coast during the war which the Navy and Coast Guard had to later survey and clear to ensure safe, navigable shipping lanes, *Empire Thrush* was by far the easiest ship to demolish (Table 7-22 and Figure 7-165, above). This process usually involved a coordinated Navy and Coast Guard effort to determine the highest point of relief on a vessel, then systematic setting of charges, demolition, followed by wire-dragging to ensure an adequate depth clearance. The British cargo vessel

Empire Thrush sank with a load of phosphate, pulp, TNT, and gunpowder. To clear the vessel from the shipping lanes the Navy simply countermined its cargo. USCGC Gentian reported the following (DIO 1945:26):

> Demolition was accomplished quickly by the Navy Salvage Service which set off the EMPIRE THRUSH'S cargo of explosives. When the GENTIAN revisited the scene on 24 July, all that could be found was a 30-ft hole where the wreck used to lie (and where the demolished wreck still lay, according to the Sonar gear and SMSD). The wire-drag cleared the area at a mean low water setting of 42 ft; deep drags were not attempted.

Thus, the vessel's remains came to rest in the waters east of Diamond Shoals and are perhaps the most diminished of any vessel lost during 1942 around Hatteras.

Though serving as a British merchant vessel during the WWII, the vessel was built as *Lorain* for the USSB in 1919 and remained in American service for 10 years, thereafter being mothballed for a period as part of the merchant reserve fleet. *Lorain* remained in this state until the 1941 passage of the Lend Lease Act transferred the vessel to British service, when its name changed to *Empire Thrush*. The ship was traveling to Halifax, Nova Scotia in April with a load of TNT, gunpowder, and phosphate when U-*203* attacked. All 50 members of the crew were rescued by merchant vessel *Evelyn* and were subsequently brought ashore. Parts of *Empire Thrush* remained above water for several months (Figure 7-166). The vessel's position was also referenced by the survivors of U-*701* who spotted the ship's mast and funnels after bailing out of their sunken U-boat (DIO 1987:223; Hickam, Jr. 1989:164; Gentile 1993:73-75).

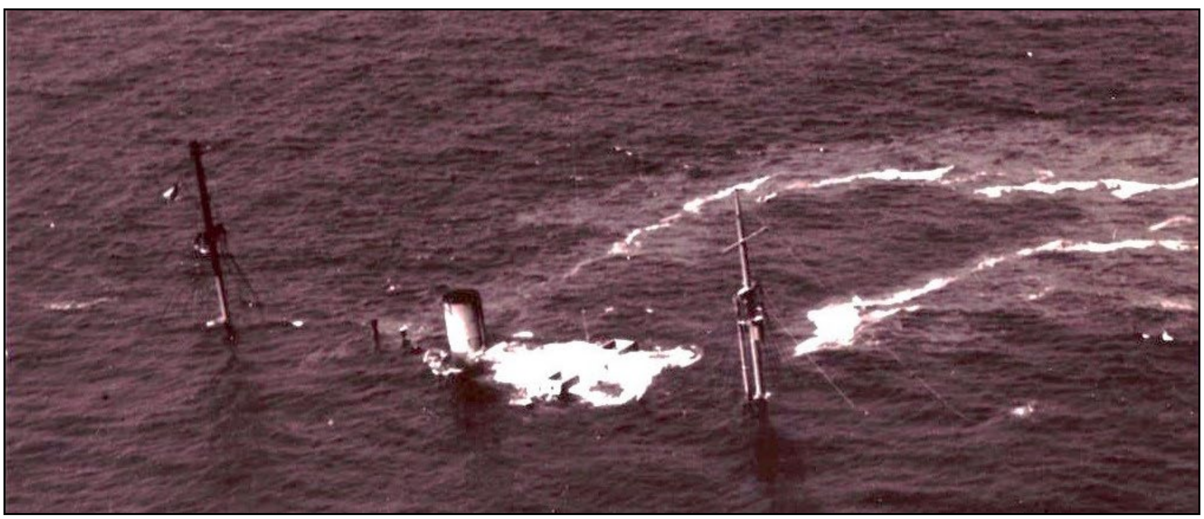


Figure 7-166 The visible funnel and masts of freighter *Empire Thrush*.
Source: NARA

7.20.2 Archaeological Site Description

The remains of *Empire Thrush* are almost completely obscured through a combination of the circumstances of its loss and dynamic sedimentation on the area where remains are located. Its location was reliably known, as the vessel remained visible above the water's surface for months following its loss. It was visited by aircraft, photographed, surveyed, and eventually demolished by the US Navy and Coast Guard. As a result, the vessel's location was plotted on nautical charts. Given the demolition which took place by means of detonating the vessel's explosive cargo, combined with the dynamic environment along the shoals, extremely limited observable material of the vessel's original structure remained above the seabed. The team investigated the site in 2016, at which time a multibeam survey was conducted followed by a series of dives. Only a single boiler could be seen in the data (Figure 7-167). Subsequent diving operations confirmed the object as a scotch boiler, consistent with what was known to be aboard *Empire Thrush*, and revealed very little surrounding debris (Figure 7-168 and Figure 7-169). It is reasonable to presume a great deal of disarticulated materials and hull structure is located beneath the sediment.

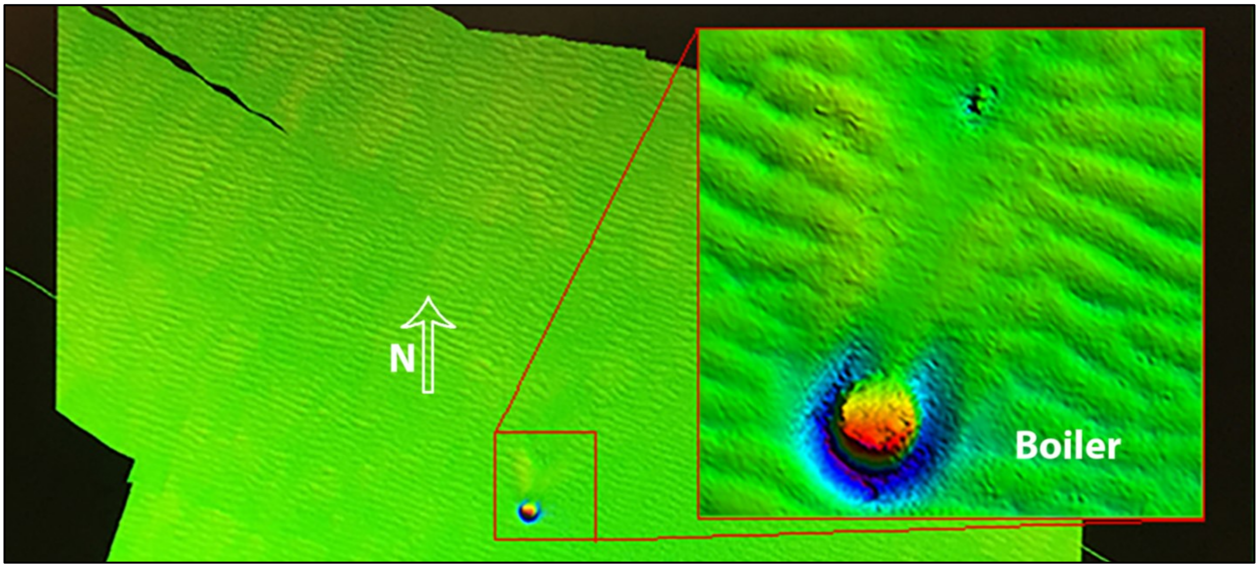


Figure 7-167 Reson 7125 400 kHz multibeam imagery of scotch boiler from *Empire Thrush*, detail inset.
Source: NOAA R/V *Nancy Foster*

Figure 7-168 Diver-collected imagery of scotch boiler from *Empire Thrush*.
Source: NOAA

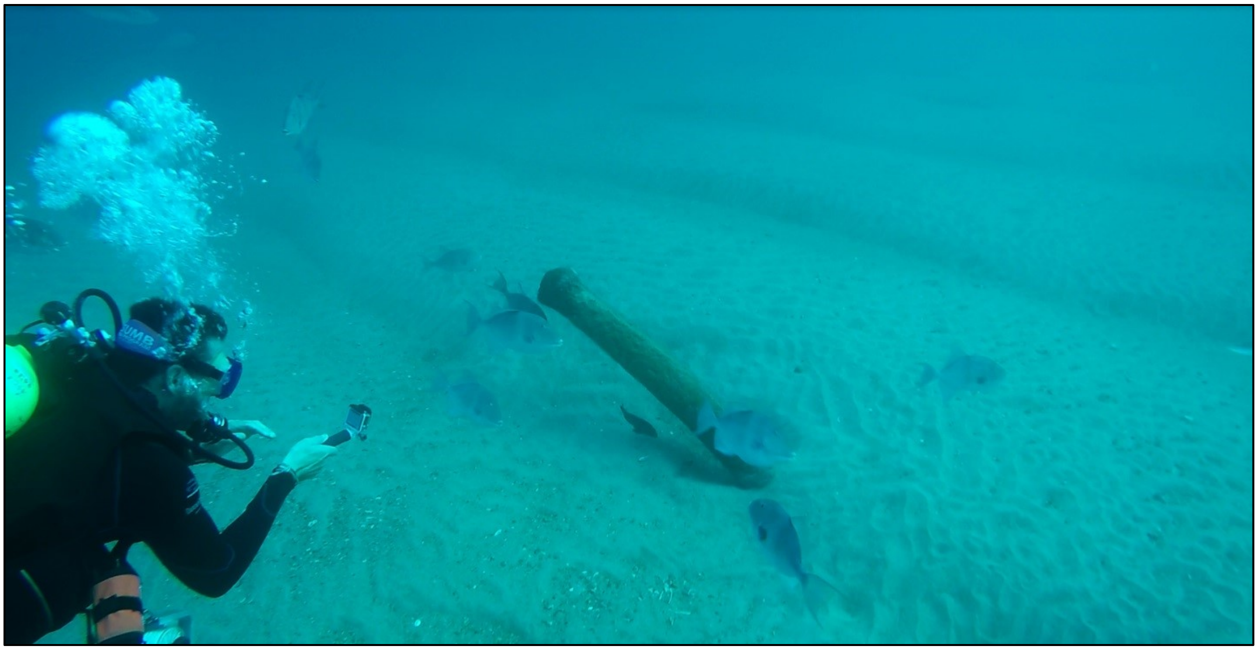


Figure 7-169 Only a few small pieces of debris such as this pipe are still visible on *Empire Thrush*.
Source: NOAA

7.21 Equipoise

Figure 7-170 Port profile of *Equipoise*.
Source: Mariners' Museum and Park

Table 7-23 Characteristics of *Equipoise*

Characteristics	*Equipoise*
Year of Build/Type/Hull #	1906/Cargo/unk.
Date Lost	26 March 1942
Position & Depth	Reported 65 miles SE of Cape Henry, VA 140 ft; site not identified during current study.
Ship Characteristics	Length: 430.2' Breadth: 54.3' Depth: 32' Gross Tonnage: 6,210
Cargo	8,000 tons of manganese ore
Survivors	13 (54 Total on board)
Owner	United States Maritime Commission
Builder	Barclay, Curle & Co, Glasgow, UK
Former Names	*Pietro Campanella* (Tito Campanella, 1925-1941) *Chanda* (British India Steam Co., 1906-1925).
Lloyd's Register Details	Steel (Stl) hull, two decks, deep framing, triple expansion steam engine
Port of Registry/Flag	Panama/Panama
Sunk by	U-*160* (Georg Lassen)
Data Collected on Site	n/a

7.21.1 History

The loss of Panamanian-flagged freighter *Equipoise* came at the climax of a spate of U-boat attacks in mid-March (Table 7-23 and Figure 7-170, above). In total, 27 ships were reported lost to the US Navy, three of them going down on 26 March: *Dixie Arrow*, *Equipoise,* and *Carolyn*. The sinking of these ships was also attended with a substantial loss of life.

Despite *Equipoise's* precautions, such as using Navy-issued routing instructions, traveling blacked out, maintaining radio silence, and being armed, U-*160* was able to locate and attack the vessel off the Northern Outer Banks of North Carolina. The torpedo hit the ship's starboard side and made a large hole below the water line. *Equipoise* was carrying a dense cargo of manganese ore, thus the ship went down very quickly following the torpedo strikes. Only 15 of the ship's 55 crew members were able to get off the ship. Of those, only 13 survived their two days adrift before being rescued; 9 required hospitalization, and one ultimately died (DIO 1987:156-158; Hickam, Jr. 1989:114; Gentile 1993:76-77).

7.21.2 Archaeological Site Description

USCGC *Gentian* surveyed the remains of a vessel it believed to be *Equipoise* in 1944. An underwater image (Figure 7-171) of a steam winch was included in their report.

Figure 7-171 Underwater image collected by the US Coast Guard, entitled "Steam winch believed to be on EQUIPOISE. Photographed from SC-664 in April 1943".
Source: DIO 1944

Based upon their deduction:

> The BUARQUE was observed to sink by the CGC CALYPSO at a reported position 17 miles south of the wreck located. This distance is greater than a reasonable navigation error would allow. It is therefore believed that the wreck can logically be identified as "Probably EQUIPOISE," which is known only to have sunk in the general area and which is believed to be the only vessel other than BUARQUE sunk in the area.

As was discussed in the Archaeological Site Description of *Buarque*, there was some discrepancy as to the actual identification of the site referenced in the USCGC *Gentian* survey. Additional research, therefore, is needed to clarify the various proposed identities for several vessel remains in the surrounding area.

7.22 Esso Nashville

Figure 7-172 Image of *Esso Nashville* following repairs after attack by U-*124*. Vessel refitted with armaments not available at the time of attack.
Source: Mariners' Museum and Park

Table 7-24 Charcteristics of *Esso Nashville*

Characteristics	*Esso Nashville*
Year of Build/Type/Hull #	1940/Tanker/4349
Date Lost	21 March 1942
Position & Depth	42 miles E of Cape Fear, NC 120 ft
Ship Characteristics	Length: 445.4' Breadth: 64.2' Depth: 34.9' Gross Tonnage: 7,943
Cargo	106,718 barrels of fuel oil
Survivors	38 (38 Total on board)
Owner	Standard Oil Company, NJ
Builder	Bethlehem Fairfield Shipbuilding Corp. Ltd., Sparrow's Point, MD
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, one deck, longitudinal framing, cruiser stern, fitted for carrying petroleum in bulk, two steam turbines geared to one screw shaft.
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	Simrad MB 2010

7.22.1 History

Standard Oil Company tanker *Esso Nashville* has the paradoxical distinction of having remains lost off North Carolina and also serving through the entirety of the WWII (Table 7-24 and Figure 7-172, above). The ship was launched on 15 June 1940 and was one of the largest, most modern tankers of its time. Completed at the Sparrow's Point yard of the Bethlehem Shipbuilding Company, *Esso Nashville* featured a powerful steam turbine engine, a carrying capacity of 106,718 barrels of oil, and an overall length of 463 ft (442 between parallels; Figure 7-173). The ship could pump 6,000 barrels per hour, and could make a maximum speed of 13 kts. In March 1942, the ship was en route from New York to Port Arthur, Texas. There, 78,000 barrels of oil were loaded and the tanker set off on a return journey to New Haven, Connecticut. Travelling unarmed and alone, the tanker's only defense was the Navy-issued routing instructions and nighttime blackout; *Esso Nashville* rounded the Frying Pan Shoals buoy an hour before midnight on 20 March (Standard Oil Company 1946:155-157).

Patrolling in the area was Johann Mohr's U-*124*. The abundance of ships off Hatteras resulted in very successful U-boat operations. U-*124* still had fuel and torpedoes, and was still finding targets. The night of 20-21 March was dark, rainy, and moonless. Nevertheless, Mohr spotted and attacked a large tanker, the *Esso Nashville*. The first launched an apparent dud, hitting the ship but not detonating. *Esso Nashville's* watch later recalled how the quizzical thump of the first torpedo sounded like the ship hitting a buoy or some other floating chunk of debris. Some suspected a torpedo; moments later suspicions were confirmed when the second torpedo slammed into the hull and exploded (Standard Oil Company 1946:157; Hickam, Jr. 1989:90-91).

Third Mate Kerves was on the bridge overlooking the starboard side of the ship and saw the torpedo wake that preceded the explosion. The tanker reportedly raised up and rolled to port so abruptly some feared it would capsize completely. Oil, smoke, and water sprayed over the entire ship, yet amid the chaos, the captain ordered the crew to abandon ship; the well-trained crew began an orderly effort to launch their lifeboats. The only individual who did not reach a lifeboat was Captain Edward Peters; he fell overboard where rough seas and pouring rain prevented him reaching the safety of a lifeboat. Instead, he yelled for his crew to stand off, and he navigated the sinking wreckage to climb back aboard the mangled tanker. Captain Peters managed this with a severely fractured leg. As the night wore on, the boats gathered and all the crew was safe. U-*124* did not come back to finish *Esso Nashville*, leaving instead to find more merchant ships to attack (Standard Oil Company 1946:157-159).

At dawn, the lifeboats remained in sight of the tanker; it was broken amidships and sinking by the same. Both bow and stern rose from the water, the tips of the masts almost touching. A short time after dawn, USS *McKean* and USCGCs *Agassiz* and *Tallapoosa* arrived, picking up lifeboats. Rescues were alerted to the presence of an additional survivor on the remains of the tanker: Captain Peters had raised the ship's flag upside down after taking refuge the night before; by mid-morning the entire 38-person crew was rescued without any loss of life and only minor injuries. Re-visiting the stricken tanker on 23 March, Navy tug USS *Umpqua* found the bow section broken and missing. With some difficulty, USS *Umpqua* and tug *Relief* got the ship's stern section, complete with intact engine room, into Morehead City (Figure 7-174 and Figure 7-175). There it was pumped out and secured. A second towing operation transported these remains back to the original shipbuilder in Baltimore, Maryland where a contract was established to re-build *Esso Nashville* (Figure 7-176; Standard Oil Company 1946:158-160). Standard Oil Company (1946:156) made the following statement regarding the tanker's salvage:

> Lest we forget or fail to appreciate just how important it was to salvage the after section of the *Esso Nashville* and to extend it into a complete ship, it should be recalled that in the same month of March 1942, the *Esso Bolivar* was seriously damaged and the *E.M. Clark*, *T.C. McCobb*, *Hanseat*, and *Penelope* were lost. Moreover, from the outbreak of the war in Europe until the

> torpedoing of the *Esso Nashville*, 14 Esso and Panamanian Transport Company tankers had been destroyed. By the time the *Esso Nashville* was rebuilt and returned to service in March 1943, the enemy had sunk 37 Esso and Panamanian Transport tankers and had damaged 8, a total of 45 ships lost or damaged during the critical phase of the Battle of the Atlantic.

The salvage and re-build operation was the first of its kind for the Baltimore yard of the Bethlehem Shipbuilding Company. For the entirety of the reconstruction, the tanker was dry-docked. Less than a year later, on 16 March 1943, *Esso Nashville* was re-christened and returned to service for Standard Oil Company, New Jersey (Figure 7-177 and Figure 7-178; Standard Oil Company 1946:156-161). *Esso Nashville* was fitted with armaments and returned to trans-Atlantic runs. In addition to petroleum cargoes, the ship was also outfitted to carry vehicles and machinery on deck, over the pumps and piping. By the conclusion of the Battle of the Atlantic in 1945, *Esso Nashville* delivered a total of 61 wartime cargoes for a total of 5,905,033 barrels of oil. The 1944 master of the tanker, Captain Alexander J. Zafiros, remarked on the vessel after taking it through particularly foul weather off Britain:

> It is noteworthy that all the machinery, and particularly that in the engine room, gave no trouble at any time. We never had to stop at sea. I think this is the most remarkable tanker I have ever been aboard. It is difficult to believe that a recommissioned ship could be as sound as this one.

In addition to the vessel's noteworthy performance, Captain Edward V. Peters was awarded an American Legion Medal for leadership and heroism in handling the safe evacuation of his crew and saving part of the ship, despite his injuries and at an apparent disregard for his own peril (Standard Oil Company 1946:161-162).

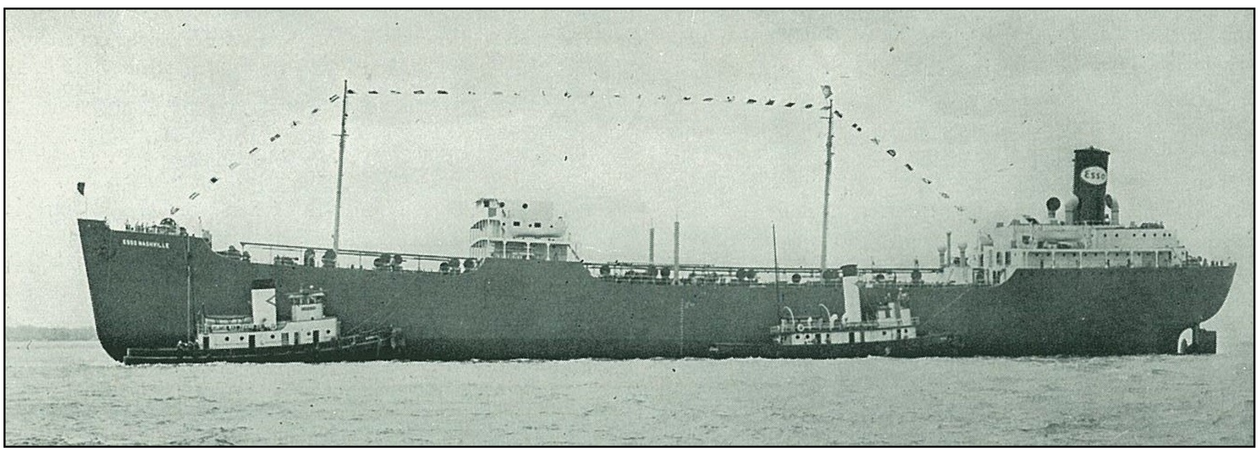


Figure 7-173 The launch of *Esso Nashville* from the Bethlehem Shipbuilding Company's Sparrows Point Yard.
Source: Standard Oil Company 1946:155

Figure 7-174 Stern section of *Esso Nashville* still afloat and under tow.
Source: Mariners' Museum and Park

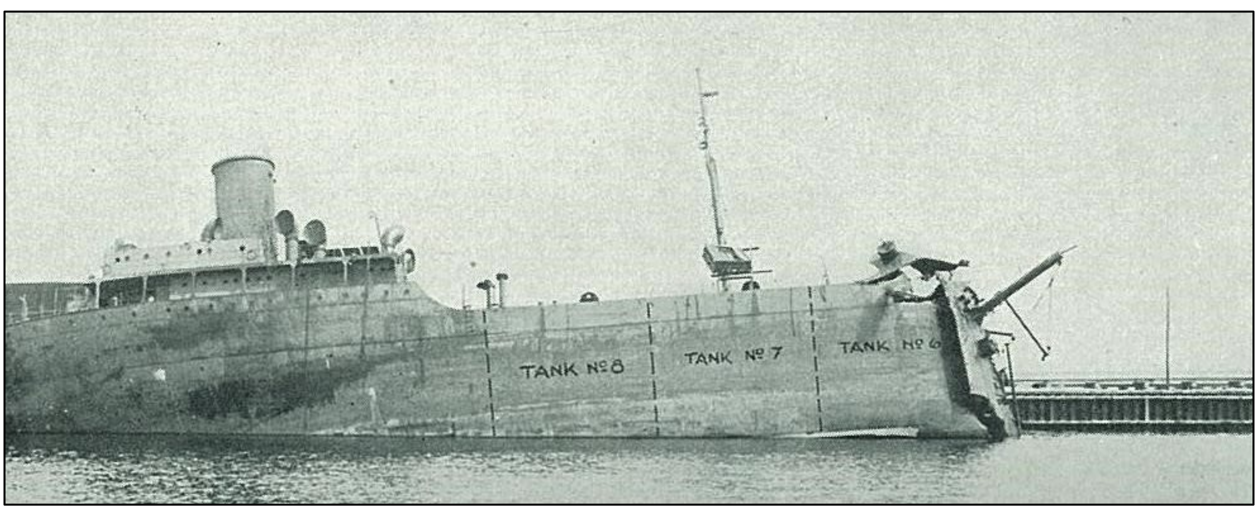


Figure 7-175 Stern section of *Esso Nashville* prior to entering dry-dock for reconstruction.
Source: Standard Oil Company 1946:160

Figure 7-176 Tanker *Esso Nashville* in dry-dock with new construction underway.
Source: Standard Oil Company 1946:161

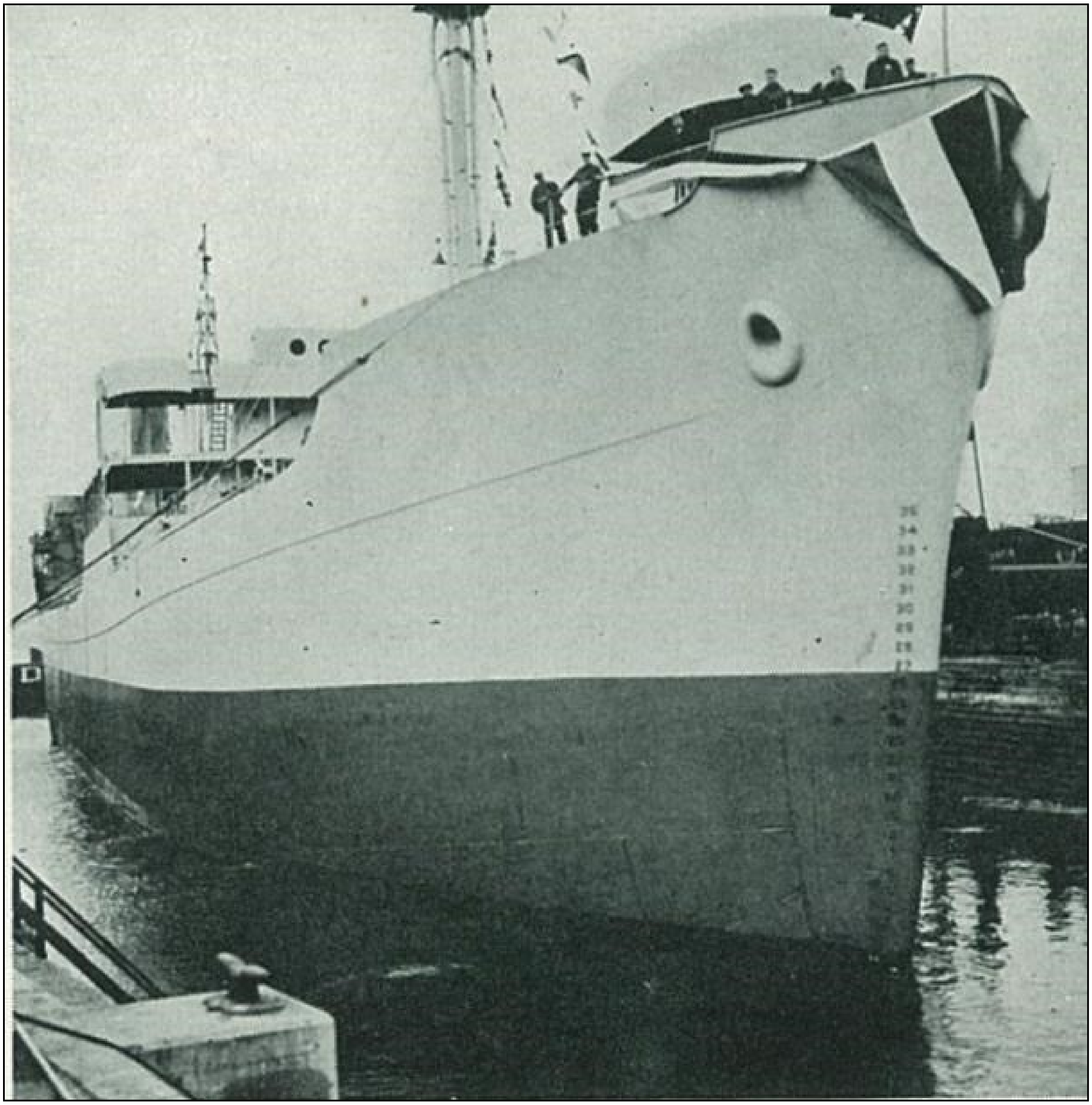


Figure 7-177 Re-christened *Esso Nashville* ready to leave the yard in Baltimore, Maryland.
Source: Standard Oil Company 1946:161

7.22.2 Archaeological Site Description

The remains of *Esso Nashville's* bow were re-located as early as 1984 (Farb 1985:242-243). Despite being relatively nearshore, it appeared that the Navy and Coast Guard did not attempt to survey the vessel's remains during 1944; no mention is made of the vessel in the USCGC *Gentian* survey, though its loss was documented in the ESF War Diary (DIO 1987:127-152).

Researchers investigated the site during in 2010. The NOAA R/V *Nancy Foster* (Cruise Number NF-10-10-LF from 3 -10 September) conducted targeted multibeam sonar surveys of several vessel sites, *Esso*

Nashville included. Mid-depth Simrad EM1002 System (95 kHz, 20 m-1,000 m) was utilized to provide a bathymetric scan of *Esso Nashville's* remains (Figure 7-179).

Figure 7-178 *Esso Nashville* at sea following repairs in April 1944.
Source: Standard Oil Company 1946:162

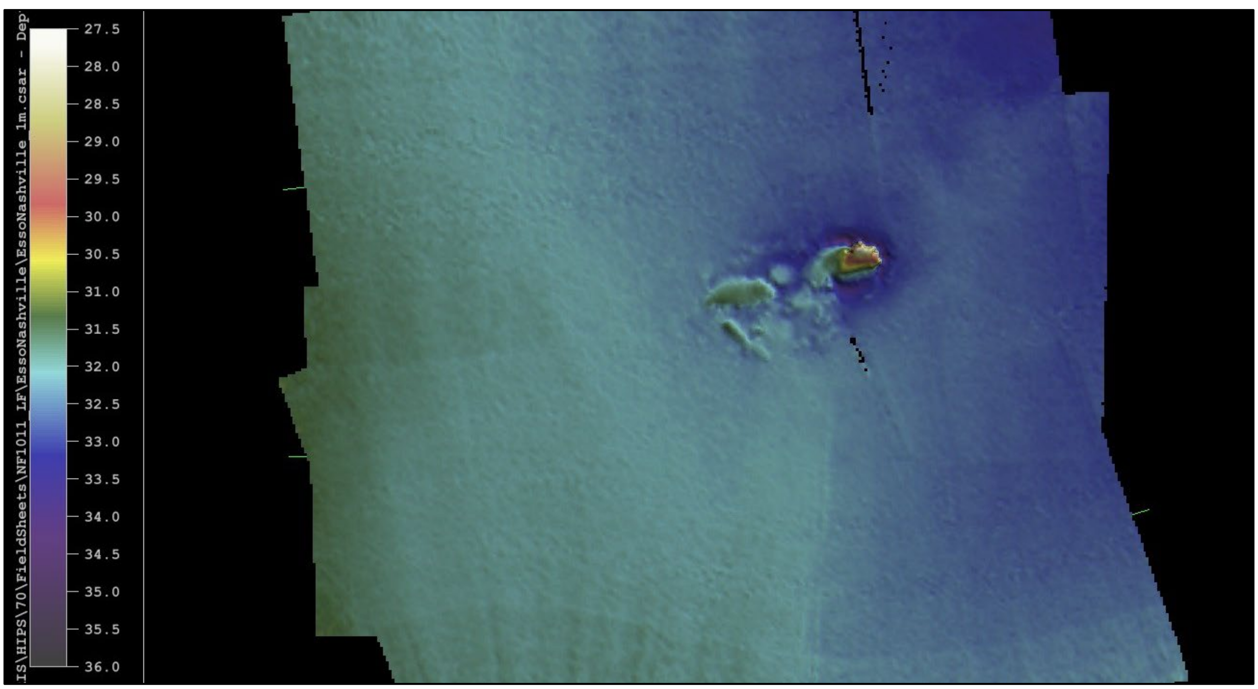


Figure 7-179 Exported multibeam sonar data from the survey of *Esso Nashville*'s remains.
Source: NOAA

The wreck site of *Esso Nashville* only contains the bow section of the vessel, as it broke approximately amidships during the torpedo attack and the stern section was refit. The remains on the seabed are upside down with a slight list to the starboard side. The forward most section of the bow, which contains the area of highest relief (15-20 ft), extends approximately 52 ft in overall length. Aft of this portion of the remains lies a section of disarticulated hull remains that have fallen in an area that extends approximately 163 ft and to a width of approximately 110 ft.

7.23 F.W. Abrams

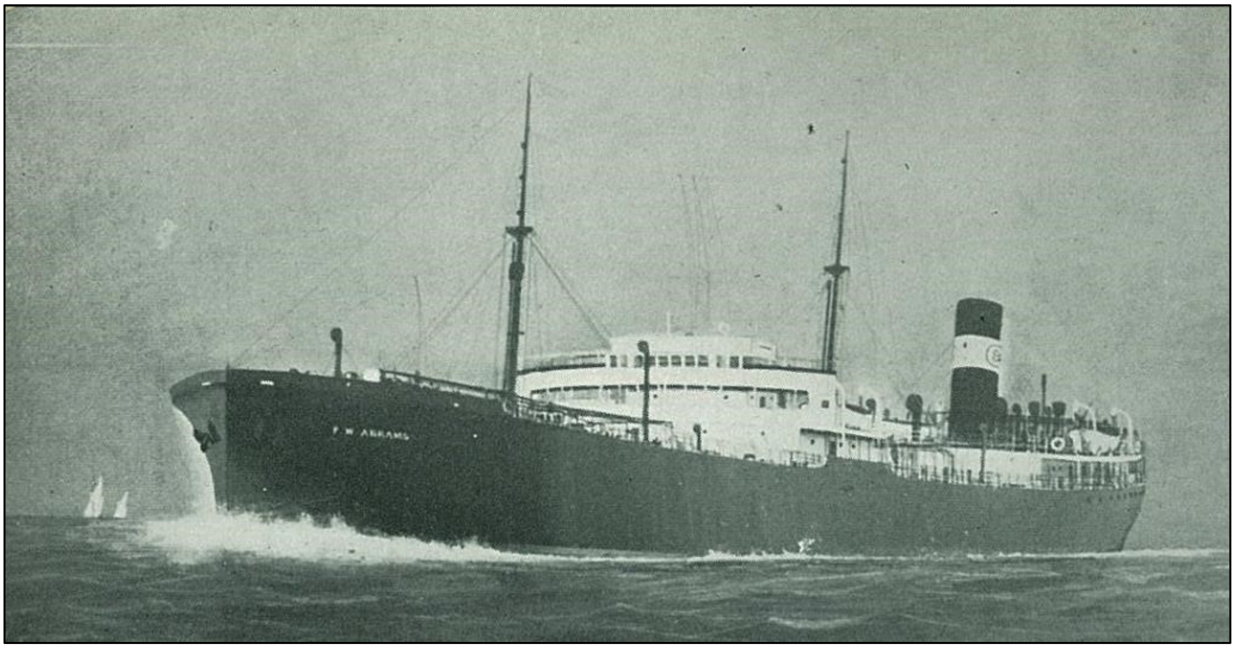


Figure 7-180 Esso tanker *F.W. Abrams* underway.
Source: Standard Oil Company 1946:288

Table 7-25 Characteristics of *F.W. Abrams*

Characteristics	*F.W. Abrams*
Year of Build/Type/Hull #	1920/Tanker/257
Date Lost	15 June 1942
Position & Depth	12 miles SW of Cape Hatteras, NC 70 ft
Ship Characteristics	Length: 467.6' Breadth: 62.7' Depth: 31.3' Gross Tonnage: 9,310
Cargo	90,000 barrels of crude oil
Survivors	36 (38 Total on board [0 dead and 36 survivors])
Owner	Standard Oil Company, NJ
Builder	New York Shipbuilding Corporation, Camden, NJ
Former Names	*Nora* (Grace Line Inc., NY, 1920-1932)
Lloyd's Register Details	Steel (Stl) hull, two decks, one shelter deck, longitudinal framing, fitted for carrying petroleum in bulk, fitted for oil fuel, quadruple expansion steam engine.
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	Mine (friendly)
Data Collected on Site	Side Scan Sonar 2013, Dive Assessment 2013; site plan 2016.

7.23.1 History

The loss of tanker *F.W. Abrams* happened under rare and unfortunate circumstances (Table 7-25, Figure 7-180, above and Figure 7-181). Unlike most casualties during the Battle of the Atlantic, the ship was not lost to hostile enemy action. It was also not lost to the usual hazards of maritime transport: storms, grounding, and collisions. Instead, *F.W. Abrams* fell victim to an uncommon type of naval friendly fire. The ship inadvertently strayed into an Allied minefield, struck a series of mines, and sank. The ship was, in fact, the first of four casualties of the minefield, all of which were Allied-affiliated vessels. Two more merchant ships would stray into the mines but were recovered. A tugboat sent to help clear them, *Keshena,* would also be lost to the minefield. The remains of *Keshena* and *F.W. Abrams* are the only remnants of this well-intentioned, but ultimately disastrous element of the naval battlefield off North Carolina.

Lacking the resources to institute a full convoy system in the spring of 1942, yet with merchant vessel losses mounting at an astonishing rate, the US Navy devised an intermediary solution to protect coast-wise shipping. To avoid the preponderance of nighttime U-boat attacks, vessels were advised to travel only during daylight hours, overnighting in the relative safety of coastal ports. Operating in this way, ships would essentially leapfrog down the Eastern Seaboard, yet in some areas there were no deepwater ports within a single-day's transit. To remedy this situation, the Navy established a series of anchorages fashioned from anti-submarine netting and mines. Since the area between Charleston and the Chesapeake lacked sufficient deepwater ports, an anchorage large enough to accommodate a 30-ship convoy was installed to the south west of Diamond Shoals (Figure 7-182). The installation took place between 20 and 25 May, with a total of 2,635 mines arrayed in two overlapping crescent-shaped legs (Bright 2012:141-143).

Working with the US Hydrographic Office, the Navy provided detailed plans and design information prior to the establishment of the minefield. Not wanting to publically reveal the presence and location of a defensive minefield, however, the Hydrographic Office made no specific mention of it; instead they issued a Notice to Mariners referencing a "danger area" off Hatteras with a geometry corresponding to that of the minefield. All Atlantic based warships, on the other hand, were notified of the minefield and a perimeter patrol was established specifically to keep merchants from traveling anywhere other than the swept channel in and out of the minefield. A break down in this system of communication was a contributing factor in all of the casualties that took place within the minefield (Cary 1942; DIO 1987:413-415; Bright 2012:146-147).

In June 1942, *F.W. Abrams* was completing a run from Aruba to New York, along the "Western Hemisphere supply line" that is serviced for Standard Oil Company, New Jersey, since the outbreak of war in Europe (Standard Oil Company 1946:288). Along these routes, the tanker completed 40 voyages between Gulf and Caribbean ports and destinations in the North US and Canada, carrying a total of 3,748,828 barrels of oil. As the ship proceeded along the coastal shipping route between Aruba and New York, it carried a cargo of 90,000 barrels, manned by a crew of 36 persons. *F.W. Abrams* reached the North Carolina coast in the evening of 10 June, where it rendezvoused with a patrol vessel (CG-*484*) for guidance into the protected anchorage. There, the ship overnighted—at the insistence of CG-*484*—and by first light was preparing to get underway. At 0545 hours, CG-*848* returned to *F.W. Abrams'* position to guide the ship out of the danger area (Standard Oil Company 1946:288-289; DIO 1987:345-384; Hickam, Jr. 1989:253-254).

Figure 7-181 *F.W. Abrams* (pictured as *Nora*) in New York.
Source: Steamship Historical Society of America

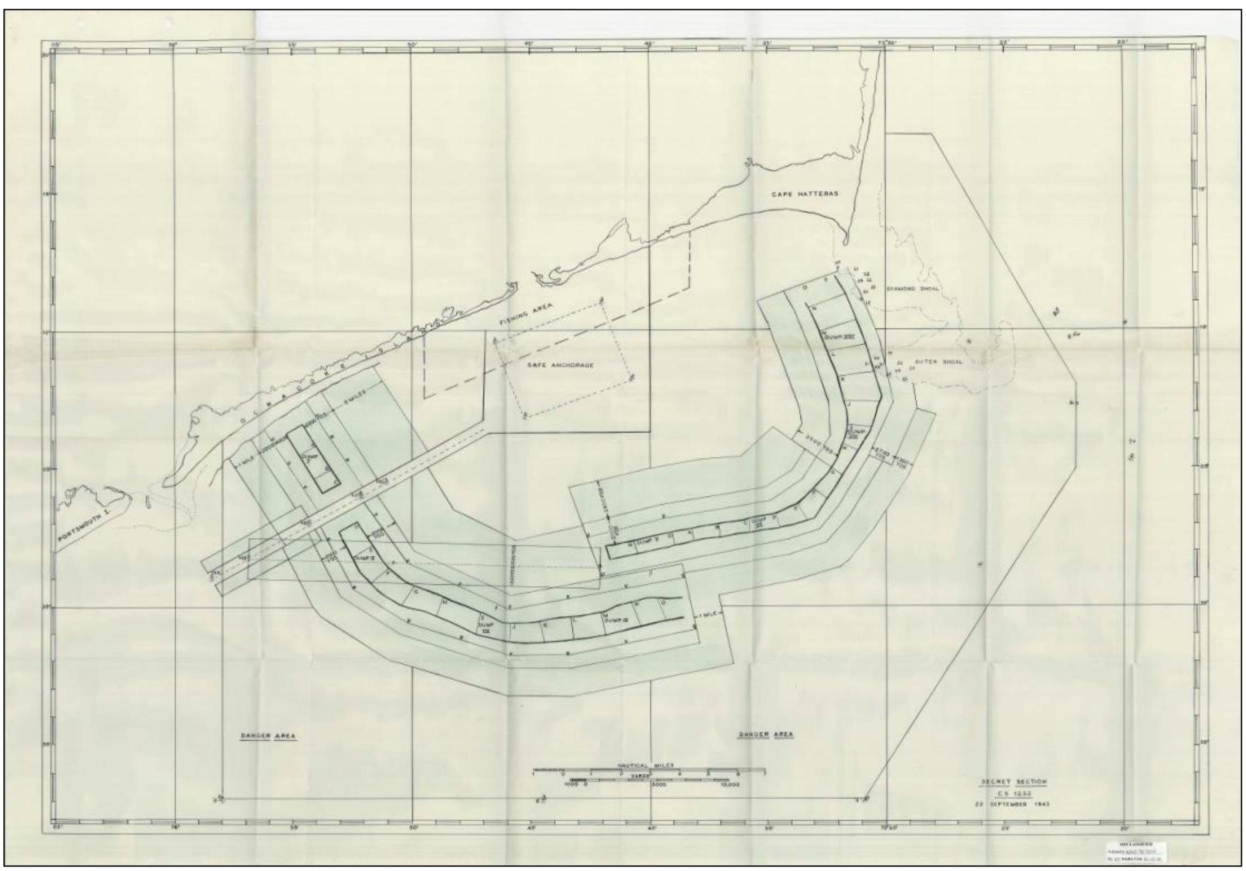


Figure 7-182 Cape Hatteras Minefield, including aids to navigation and 1942 location of Diamond Shoal.
Source: USN 1942a

Initially, a great deal of confusion surrounded the events which unfolded over the next two hours. When CG-*484* arrived in the morning, its commanding officer communicated to the master of the *F.W. Abrams* to follow the patrol vessel out of the danger area. The tanker obliged, and the two were underway together traveling for about an hour when the dreary morning's weather worsened. Fog, rain, and rough seas prevailed and the ships lost visual contact. As *F.W. Abrams* proceeded, CG-*484* searched in vain for the tanker. The Captain of *F.W. Abrams* reported that he believed his ship clear of the 'danger area,' but was also apparently completely ignorant of the large minefield surrounding the ship. Thus, at 0640 hours, an explosion rocked the tanker's starboard bow. Damaged, but under power, *F.W. Abrams* attempted to retreat to a nearby port. At approximately 0720 hours, another explosion rocked the ship, starboard amidships. Twenty minutes later, a third and final explosion tore through the port side of the ship between the bridge and bow. The order was given to abandon ship (COM5 1942c; Standard Oil Company 1946:289-290; DIO 1987:345-346).

Meanwhile, the Coast Guard patrol boat radioed back and forth with dispatch. As conditions worsened in the 0600 hour, the Coast Guard crew attempted to use blinker signals to stay in contact with *F.W. Abrams*. Being unable to find the ship, the boat searched for a couple of hours before returning to dock at 0930 hours; their reports to command as per the situation with *F.W. Abrams* were vague, contradictory, and "most unsatisfactory" (DIO 1987:346). The tanker's crew, meanwhile, believed they were under attack by a U-boat. Between the second and third explosion, one crew member sighted a "Submarine on the port quarter" (Standard Oil Company 1946:290). U-boat or no, the ship was sinking rapidly by the bow and conditions were not improving (Figure 7-183). The crew abandoned ship and made the short trip into Ocracoke Naval Station, all 36 arriving by 1240 hours (Standard Oil Company 1946:290).

All but two crew members, Captain Coumelis and Chief Engineer Larsen, departed Ocracoke for Morehead City, and thereafter on to New York City. The Captain and Chief Engineer, on the other hand, remained in Ocracoke to survey the remains of the tanker when weather conditions improved. This they did, along with naval authorities, on 14 June (Figure 7-184). During transit, they noticed several suspicious, low-lying items in the water. Upon further inspection, they were discovered to be mines (Hickam, Jr. 1989:254). Standard Oil Company (1946:288-290) maintained their tanker had been the victim of a U-boat after the war. Captain Coumelis also maintained that he had absolutely no knowledge of the large minefield in which his ship moored on the night of 10 June. Nevertheless, upon return to the ship several days later, it was clear that the remains of *F.W. Abrams* were no longer salvageable. Instead, they slowly settled, bow-first, into the sandy bottom.

7.23.2 Archaeological Site Description

The tanker's remains were visible for years after the ship's loss. The USCGC *Gentian* survey reported that the ship's masts were visible above the water until 1944. Pilots in training at nearby MCAS Cherry Point, North Carolina used the masts as bombing targets. Likewise, a patrol plane once mistook the remains of a single mast above the water for a periscope and commenced a depth charge attack on the site. In the summer of 1944, the Navy Salvage Service formally demolished *F.W. Abrams*, reporting a clearance greater than 40 ft. USCGC *Gentian* visited the tanker's remains in September of 1944 and confirmed its location and a clearance depth of approximately 34 ft mean low water (DIO 1945:35).

The destructive techniques applied to the vessel's remains left *F.W. Abrams* in a considerably more disarticulated state than vessels lost in deeper water. The team investigated the site in 2013, recording the 900 kHz side scan sonar image shown in Figure 7-185 and collecting photographs. The composite of the photographic and sonar imagery provided a fairly comprehensive overview of the vessel's remains.

The wreck of *F.W. Abrams* rests upright upon a flat, sandy bottom and is marked by a distinct separation of the bow and stern sections, with a 30-ft gap separating the two. The bow section is mostly disarticulated but contains a section of port side hull plating, approximately 144 ft in length, that exposes deck and framing features. The overall length of the bow section is approximately 195 ft in length with site scatter extending out approximately 68 ft. A small debris field was observed extant to the west, north, and south of the main bow area. Within this area, however, the stem post remains intact (Figure 7-186). The tanker's port side is more intact, extending several feet off the bottom.

Figure 7-183 Damaged and sinking tanker *F.W. Abrams*.
Source: Mariners' Museum and Park

Figure 7-184 Having submerged completely beneath the water, only the masts of *F.W. Abrams* were visible.
Source: Standard Oil Company 1946:291

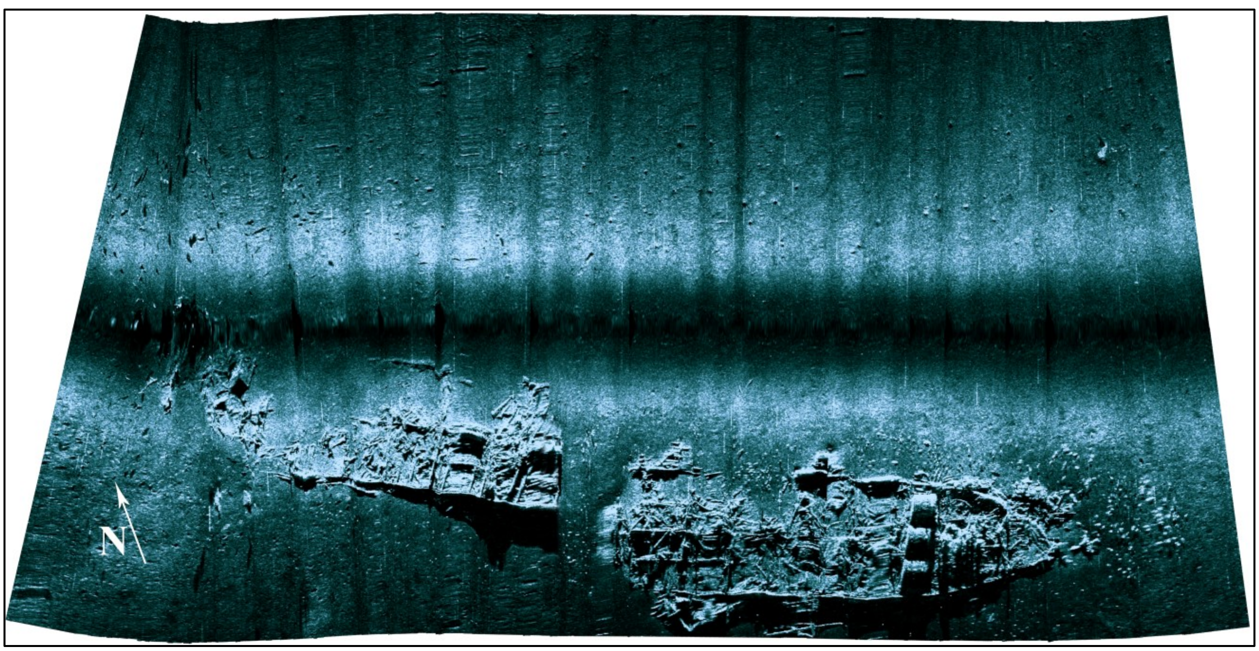


Figure 7-185 900 kHz side scan sonar image of the *F.W. Abrams*.
Source: NOAA

Figure 7-186 Stem post and associated bow structure of *F.W. Abrams*' remains.
Source: NOAA

The stern section is offset from the bow, slightly oriented at a different angle. The stern section was more contiguous than the bow section, revealing both port and starboard outer hull and comprising an overall length of approximately 235 ft and 62 ft abeam. Located in this section were three scotch boilers remaining *in situ*, with associated steam machinery intact abaft. The engine pistons were still evident but the structure surrounding was gone, though disarticulated components remained (Figure 7-187 and Figure 7-188). Like the bow section, a small area of debris was also observed radiating a short distance from the stern section. Nearly all structural remains present supported large amounts of biological growth, and the remains themselves were a haven for fish and other marine creatures.

The team returned to the site in partnership with BAREG in 2016 to collect more detailed data. Additional imagery and photogrammetric modeling was performed on the site to create an overall site map detailing the extent of the remains. Photogrammetric modeling was validated by updated multibeam imagery of the site also collected in 2016 (Figure 7-189 through Figure 7-191).

Figure 7-187 Cylinder head of engine piston of *F.W. Abrams*.
Source: NOAA

Figure 7-188 Engine and boiler assemblage looking forward. The majority of the engine housing was gone, revealing the cylinder head and pistons.
Source: NOAA

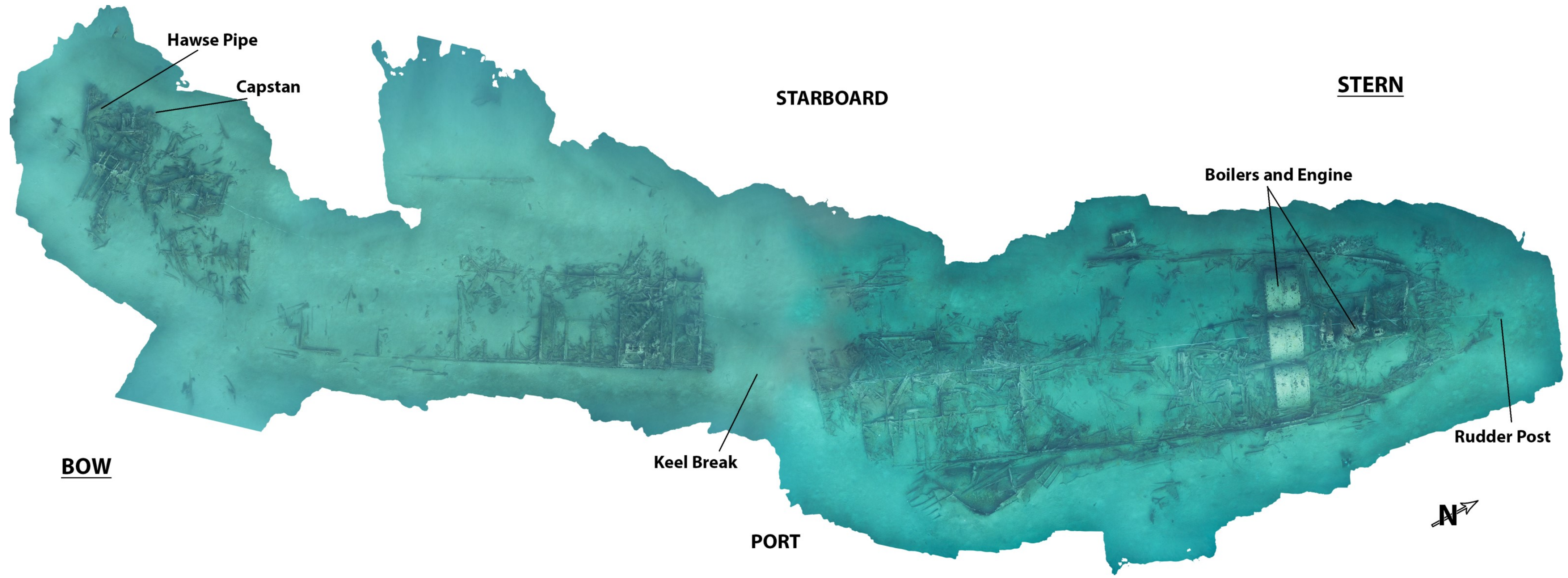


Figure 7-189 Orthomosaic compiled from photogrammetry of *F.W. Abrams* in 2016.
Source: NOAA

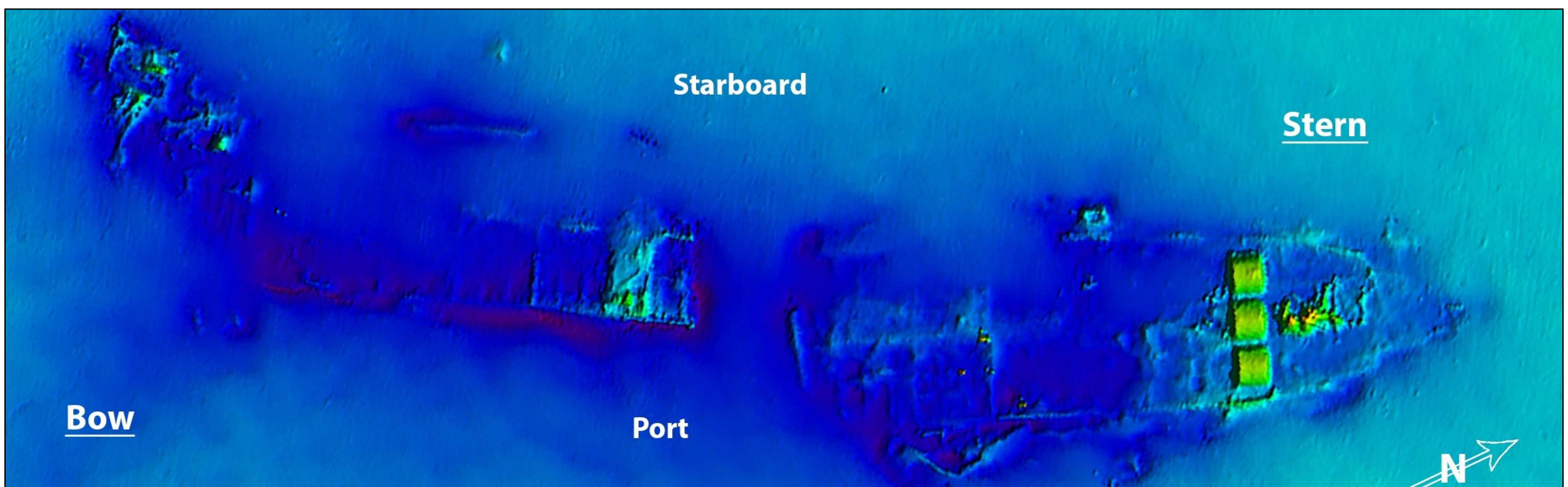


Figure 7-190 Reson 7125 400 kHz multibeam imagery of *F.W. Abrams*.
Source: NOAA R/V *Nancy Foster*

Figure 7-191 Final archaeological site plan of *F.W. Abrams*.
Source: NOAA and BAREG

7.24 John D. Gill

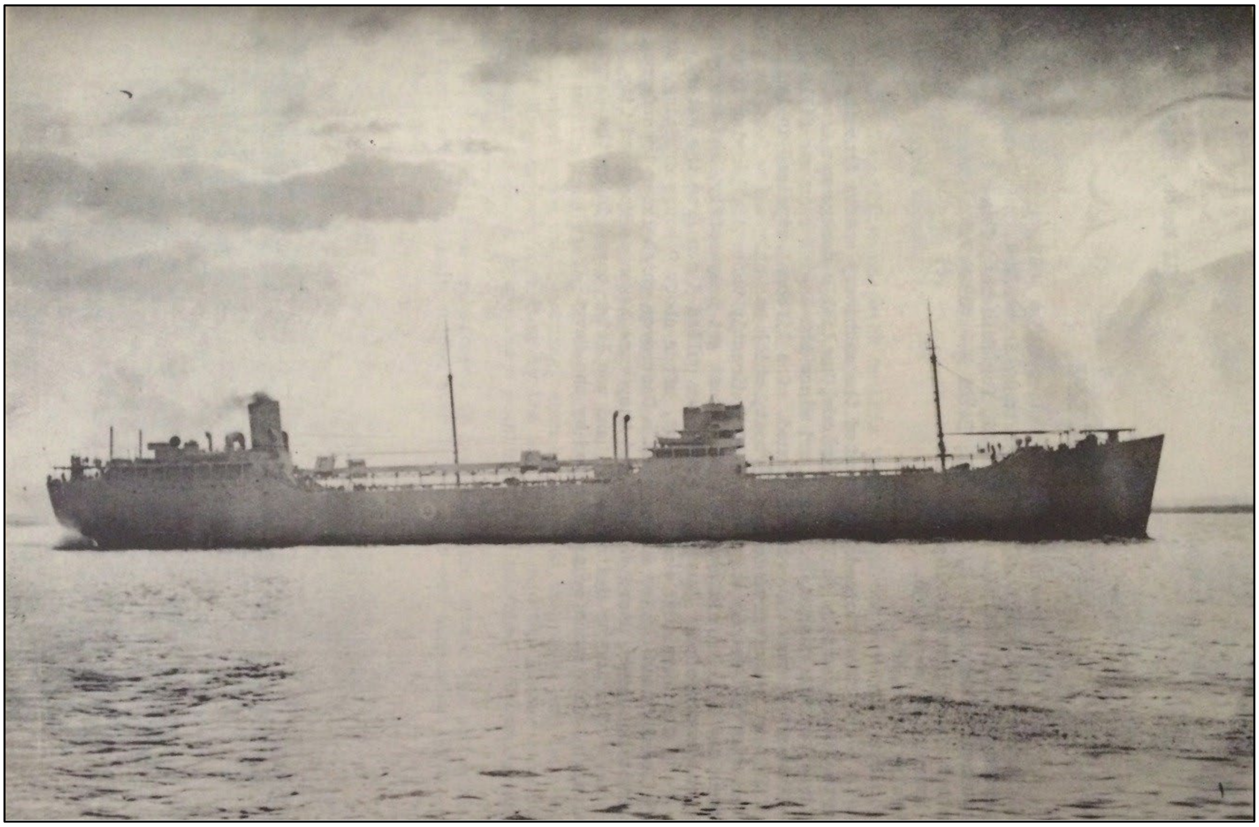


Figure 7-192 Starboard side of tanker *John D. Gill*.
Source: U.S. Coast Guard

Table 7-26 Characteristics of *John D. Gill*

Characteristics	*John D. Gill*
Year of Build/Type/Hull #	1942/Tanker/236
Date Lost	13 March 1942
Position & Depth	29 miles E of Cape Fear, NC 90 ft
Ship Characteristics	Length: 528.5';Breadth: 70.2'; Depth: 39.7' Gross Tonnage: 11,641
Cargo	141,000 barrels of crude oil
Survivors	26 (49 Total on board [23 dead])
Owner	Atlantic Refining Company, Philadelphia, PA
Builder	Sun Shipbuilding and Drydock Company, Chester, PA
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, one deck, longitudinal framing, fitted for carrying petroleum in bulk, cruiser stern, steam turbine connected to electric motor and screw shaft.
Port of Registry/Flag	Philadelphia, PA/USA
Sunk by	U-*158* (Erwin Rostin)
Data Collected on Site	R/V *Thomas Jefferson* multibeam

7.24.1 History

The tanker *John D. Gill* was completed in January 1942, just about the time the German U-boat campaign began to reach American waters (Table 7-26 and Figure 7-192, above). The vessel was built by the Sun Shipbuilding and Drydock Company of Chester, Pennsylvania and owned by the Atlantic Refining Company of Philadelphia, Pennsylvania. As a protective measure, the vessel was equipped with one 5-inch deck gun as well as two .50 caliber and two .30 caliber machine guns, that were manned by Naval Armed Guard crew. Including the Naval Armed Guard members, there was a total of 49 crewmembers aboard the vessel (Moore 1983:153; Farb 1985:255-256).

In mid-March 1942, *John D. Gill* was traveling north from Atreco, Texas to Philadelphia, Pennsylvania with a cargo of over 141,000 barrels of crude oil. This was the tanker's second voyage since its launch just three months prior. On its first cruise, as the vessel was passing the Wimble Shoals area, it rescued 25 survivors from torpedoed freighter *Marore.* On this cruise, *John D. Gill* put in at Charleston after a warning that enemy submarines were in the area. At 0045 hours EWT, *John D. Gill* departed Charleston and proceeded north with extreme caution. Late in the evening on 12 March 1942, a torpedo struck the starboard side at the #7 tank, near the area of the main mast. The vessel started to leak; however the oil did not ignite immediately. When a life ring with a self-igniting carbide lamp was thrown overboard by a crewmember, the lamp flare ignited and the oil was immediately set ablaze. As a consequence of the self-igniting flare, the US Coast Guard recommended that gun crews jettison ammunition before abandoning ship whenever possible, to avoid such a possibility (US Coast Guard 1945:26; Moore 1983:153; DIO 1987:91-139; Blair 1996:516; Wynn 1997:122;).

Explosions and fire wrecked the starboard lifeboats, but two on the port side were servicable. The No. 2 lifeboat was successfully launched with 15 crew members who were later picked up by *Robert H. Colley*, and taken to Charleston, South Carolina. The No. 4 lifeboat was jammed and capsized while being lowered and its occupants were dumped into the sea. Many were lost when sucked into the still turning propeller. Early in the morning of 13 March 1942, as *John D. Gill* sank beneath the waves, the Coast Guard found 11 survivors (8 crew members and 3 Naval Armed Guard) floating on a raft. The raft had been released by able seaman, Edwin F. Cheney, Jr., who then guided injured and burned shipmates to it. Cheney was later awarded the Merchant Marine Distinguished Service Medal for his bravery. Survivors were put onboard the US Coast Guard Cutter *Agassiz* (WSC-*126*) and taken to Southport, North Carolina. In total, 23 crewmembers were lost in the attack. US Coast Guard C-*4342* recovered 16 dead. (US Coast Guard 1945:26; Moore 1983:153; Farb 1985:255-256; DIO 1987:139; Blair 1996:516).

7.24.2 Archaeological Site Description

The team investigated the remains of *John D. Gill* using multibeam. Farb (1985:256-260) provides one of the most detailed published accounts on the disposition of the vessel's remains, indicating a nearly intact ship in relatively shallow, warm water. Numerous structural features remain, including evidence of the tanker's armament.

Observations based on the multibeam data showed the wreck site of *John D. Gill* is broken up into two sections with a gap of approximately 55 ft separating the two (Figure 7-193). The wreck site was oriented almost exactly east to west, bow to stern. The bow section, which provided the highest relief points on the entire site, was approximately 349.50 ft in total length, with an overall site scatter of approximately 191 ft at beam. Beam measurement was approximately 68.21 ft. Aft of the bow section was a gap of 55 ft that separated the stern section. The stern section was approximately 198.29 ft in total length, with a site scatter of over 162 ft at beam.

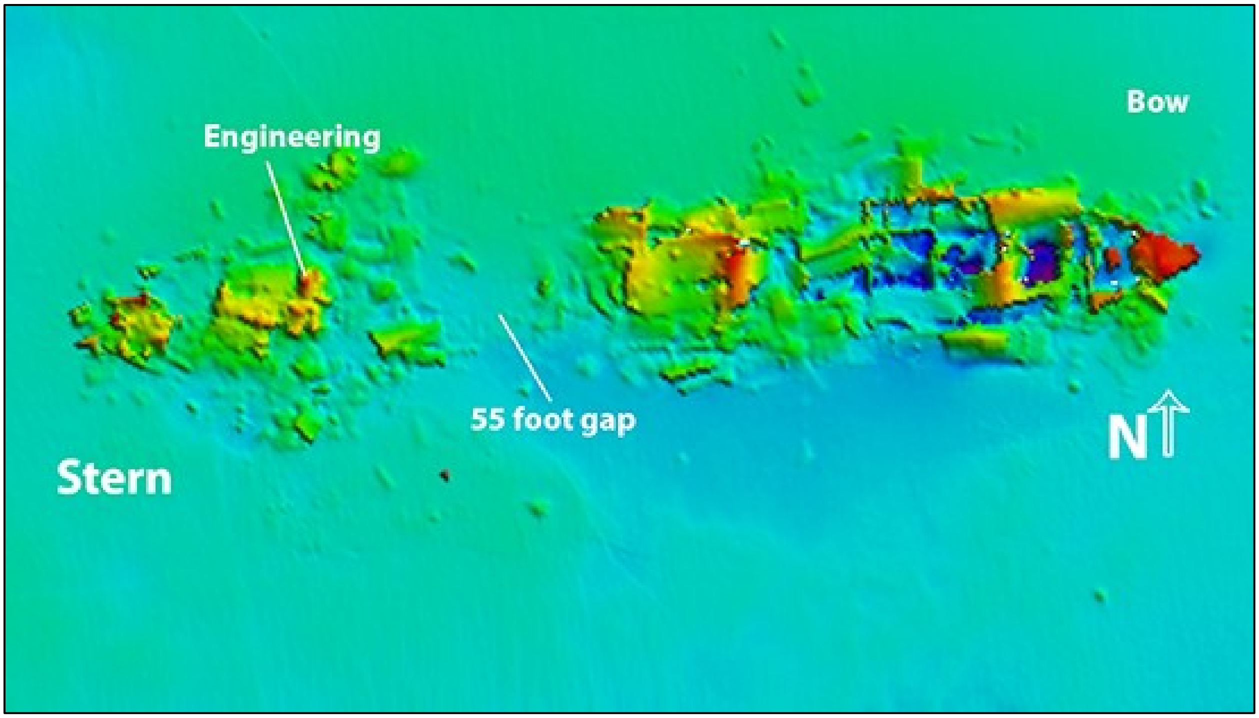


Figure 7-193 Multibeam survey of *John D. Gill* wreck site.
Source: NOAA R/V *Thomas Jefferson*

7.25 Kassandra Louloudis

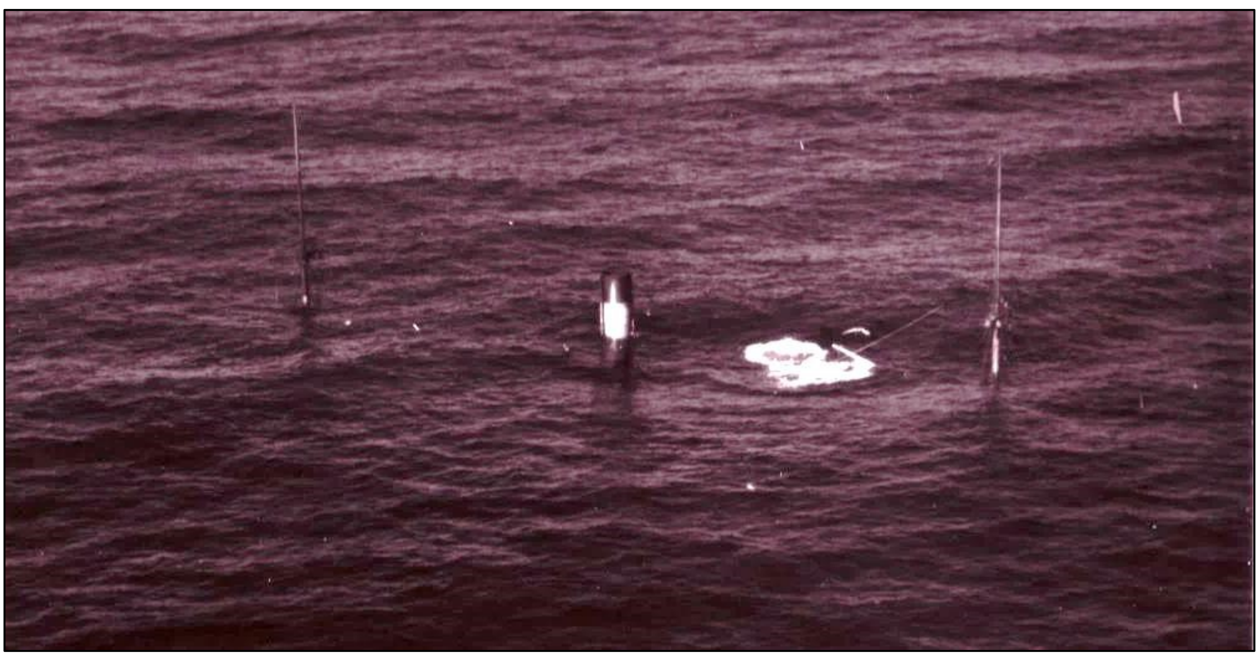


Figure 7-194 Funnel and masts of *Kassandra Louloudis* emerged from the water as the vessel came to rest in shallow water east of Diamond Shoals.
Source: NARA

Table 7-27 Characteristics of *Kassandra Louloudis*

Characteristics	*Kassandra Louloudis*
Year of Build/Type/Hull #	1919/ Freighter/unknown
Date Lost	18 March 1942
Position & Depth	10 miles SE of Cape Hatteras, NC 70 ft
Ship Characteristics	Length: 400.1'; Breadth: 52.3'; Depth: 28.5' Gross Tonnage: 5,106
Cargo	War material
Survivors	35 (35 Total on board)
Owner	Goulandris Bros, Piræus,Greece
Builder	W. Gray & Company Ltd, West Hartlepool, England, UK
Former Names	*Bondowoso* (Koninklijke, KRL, Ruys Willem & Co., Netherlands, 1919-1936)
Lloyd's Register Details	Steel (Stl) hull, two decks, triple expansion steam engine, three Scotch boilers.
Port of Registry/Flag	Andros/Greece
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	ADUS Survey 2011;photo and video 2011.

7.25.1 History

On 17 March 1942, Greek freighter *Kassandra Louloudis* was traveling south with an impromptu convoy of merchant vessels and tankers (Table 7-27 and Figure 7-194, above). The ship was traveling behind tankers *Acme* and *Gulf Dawn* just off Cape Hatteras, both under the protection of destroyer USS *Dickerson* and USCGC *Dione.* Despite this protective screen, U-*124* spent an hour maneuvering around the destroyers and launched a torpedo attack upon *Acme*, hitting the vessel at the stern. Seeing the explosion, the captain of *Kassandra Louloudis* made evasive maneuvers and tried to move away from the tanker (Hoyt 1978:75-76; DIO 1987:146; Hickam, Jr. 1989:76-78).

Tanker *Acme* was devastated by the attack, sinking by the stern and dead in the water. U-*124* deployed two more torpedoes, these aimed at the Greek vessel. One torpedo ran its course and connected with *Kassandra Louloudis*, quickly sinking the vessel. After witnessing *Acme's* attack, Captain Themistokles Mitlas of *Kassandra Louloudis* had ordered an evasive course; his zigzag caused U-*124's* first torpedo to miss, but the second hit an empty hold a few feet below the waterline. Meanwhile, the crew of the USCGC *Dione,* who had just finished recovering the survivors of *Acme*, brought their small cutter toward *Kassandra Louloudis* and picked up the entire crew of the Greek vessel. After recovering the 20 survivors of *Acme* and the 35 crewmembers of *Kassandra Louloudis,* the crowded USCGC *Dione* made its way towards Norfolk, Virginia to put them all ashore and the Greek freighter settled onto an even keel in shallow water (DIO 1987:146; Hickam, Jr. 1989:78-79; Wynn 1997:101).

7.25.2 Archaeological Site Description

The freighter's remains came to rest in water sufficiently shallow that the ship's masts and funnel were visible. Positive identification of the site was made by the US Navy in 1944, when divers were deployed and recovered items marked *Bondowoso*, the vessel's former name. US Navy divers noted:

> Disintegration was very rapid in the turbulent Cape Hatteras waters. The wreck had disappeared below the surface within a few months, and in the summer of 1944 when demolition operations

> were commenced, divers found the hull itself ripped apart with the cargo and wreckage spread over a considerable area (DIO 1945:27).

The US Navy also reported the vessel's remains, even after demolition, produced a very easily detectable sound target. In fact, it attacked *Kassandra Louloudis's* remains in June of 1942, mistaking it for an enemy submarine (DIO 1945:27-28).

In 2011, multibeam sonar data were collected and processed into a georectified high-resolution acoustic image and 3D point cloud models (Figure 7-195 through Figure 7-197). Divers deployed at the site verified the site's location and orientation, and also collected photographic imagery (Figure 7-198). The freighter's remains were found nearly intact from bow to stern, despite the Navy's report of a considerable debris field. Overall, the observable length of the wreck from the stem post forward was 389.5 ft and measured 62 ft wide. Much of the assorted cargo appeared to remain *in situ*, with heavy encrustation providing a cohesive force. The most prominent features of the site were the three Scotch boilers arrayed amidships, the highest point of vertical relief, rising 15.7 ft off the bottom. Just aft, the triple expansion steam engine was still in place, but had been knocked down. At the stern, the sternpost, rudder, and propeller were intact and visible, though the propeller was partially buried.

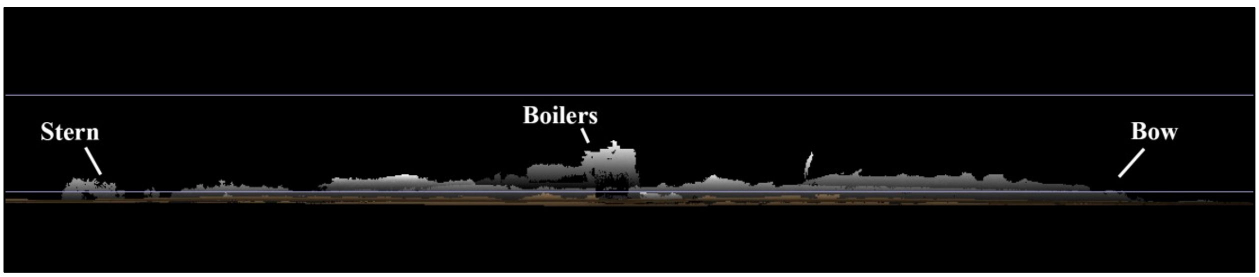


Figure 7-195 Profile view of *Kassandra Louloudis*.
Source: ADUS/NOAA

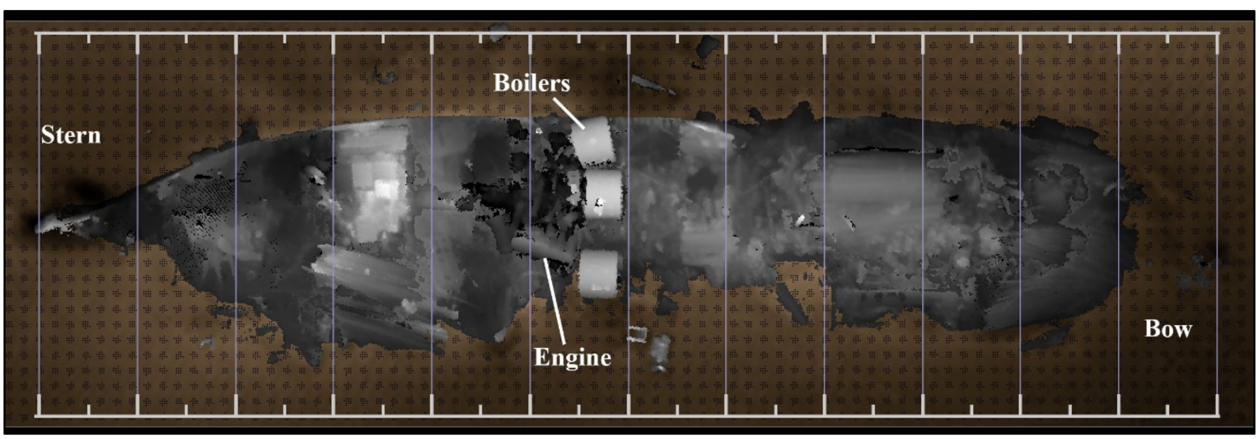


Figure 7-196 3D visualization of ADUS *Kassandra Louloudis* multibeam data in profile (top) and plan views (bottom).
Source: ADUS

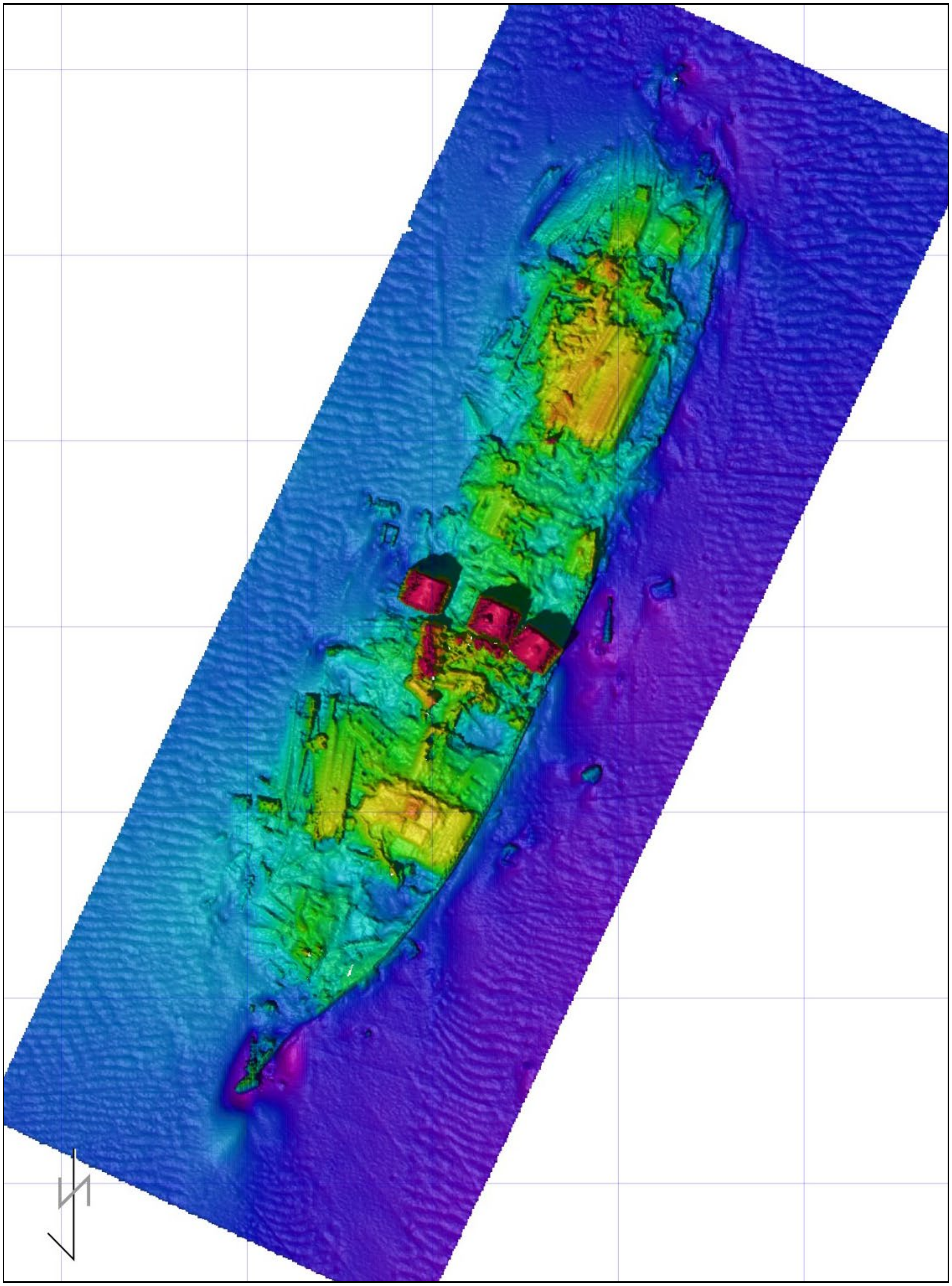


Figure 7-197 6-mm resolution 455 kHz multibeam survey of *Kassandra Louloudis*.
Source: ADUS/NOAA

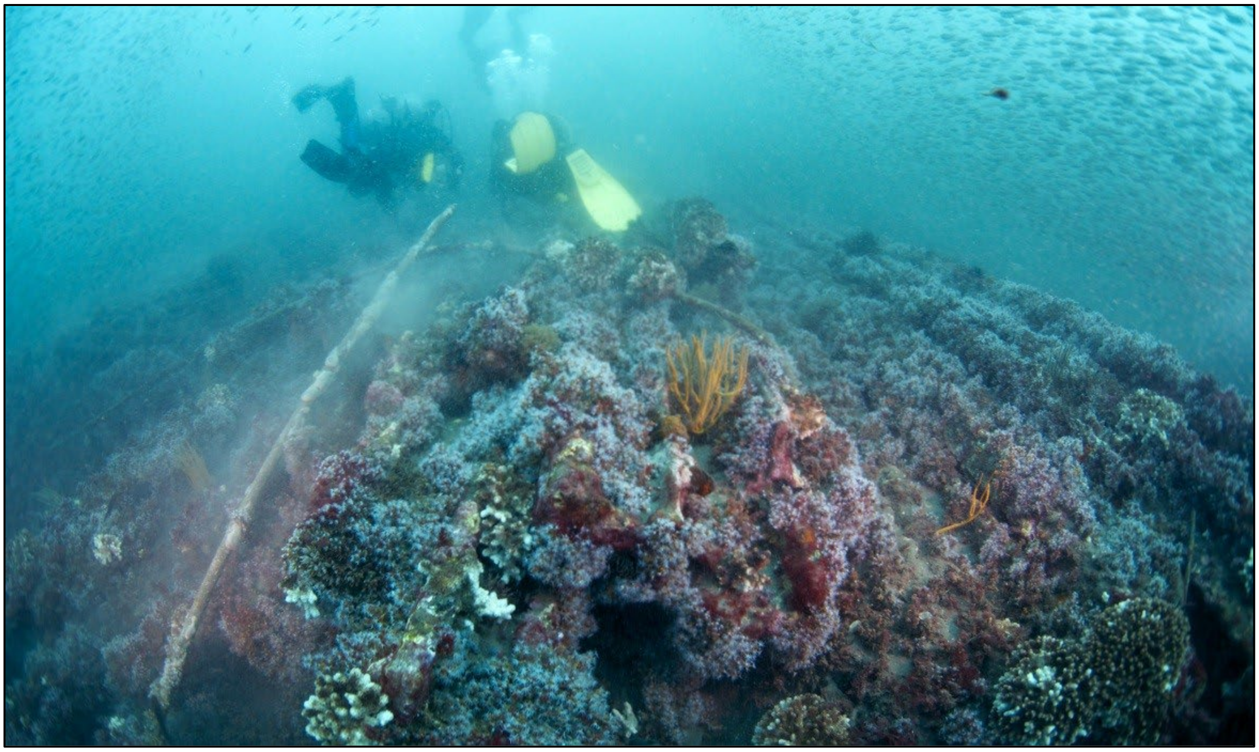


Figure 7-198 Amidships image of encrusted cargo remains at *Kassandra Louloudis*.
Source: John McCord, UNC-CSI

7.26 Lancing

Figure 7-199 *Lancing* in 1942, starboard side profile view.
Source: NARA

Table 7-28 Characteristics of *Lancing*

Characteristics	*Lancing*
Year of Build/Type/Hull #	1897/Tanker-Whale Factory Ship/240
Date Lost	7 April 1942
Position & Depth	14 miles SE of Cape Hatteras, NC: 160 Ft
Ship Characteristics	Length: 470.0';Breadth: 57.2';Depth: 31.9' Gross Tonnage: 7,866
Cargo	8,800 tons of fuel
Survivors	49 (50 total on board [1 dead and 49 survivors])
Owner	Melsom & Melsom, Larvik, Norway
Builder	Charles Connell & Company, UK
Former Names	*Flackwell* (Flack D. & Son, 1922-1925) *Calanda* (Foreign Trading Corp., 1920-1922) *Omsk* (Russian Volunteer Fleet, 1916-1918, The Shipping Controller, UK, 1918-1920) *Rio Tiete* (Peterson & Co., 1914-1916) *Knight Errant* (Knight Steamship Co., 1897-1914)
Lloyd's Register Details	Steel (Stl) hull, steam screw, single screw, two decks, triple expansion steam engine.
Port of Registry/Flag	Lavik/Norway
Sunk by	U-*552* (Erich Topp)
Data Collected on Site	ADUS 2011; Sreening Level Risk Assessment (NOAA 2013b)

7.26.1 History

Lancing is the oldest vessel assessed in this study and possibly the most independently significant in terms of vessel design and use (Table 7-28 and Figure 7-199, above). Originally built as *Knight Errant*, *Lancin* was built in Glasgow, Scotland by Charles Connell and Company and launched in December 1897. It measured 470 ft long, over 57 ft wide, and had a depth of over 34 ft. It was a steel-hulled, four-masted, long bridge deck steamship with two steel decks and web frames built under a Lloyd's special survey. It had a cellular double bottom right fore and aft, having transverse divisions, forming six separate compartments, with asphalted bulkheads for water ballast. Cellular construction made the vessel very strong by providing increased longitudinal support and protection if the vessel grounded (Lloyd's Register of Shipping 1901; Lloyd's Register of Shipping 1906:407; *Marine Engineer and Naval Architect* 1898a:408). Part of the *Knight Errant's* interior steel, such as in the tanks and bilge, was coated with Wailes and Doves Bitumastic enamel to prevent corrosion. Lastly, it was built with electric lights and classified as an A1 vessel meaning it was fit to carry dry and perishable goods (Pollock 1884:15).

Dunsmuir and Jackson of Glasgow, Scotland constructed the *Knight Errant's* direct action triple expansion steam engine in early 1898. Its cylinder diameters were 27 inches for the high-pressure cylinder, 46 inches for the intermediate pressure cylinder, and 76 inches for the low-pressure cylinder with a 51-inch stroke. Its three single-ended forced draught boilers, with 9 total corrugated furnaces, produced 200 pounds of pressure and a nominal horse power of 549. Each boiler measured 14 ft, 3 inches in diameter and 11 ft, 6 inches in length. They had a grate surface area of 142 square ft and a heating surface area of 7,567 square ft. It was also equipped with an auxiliary boiler for supplying steam power to the steamship's deck winches. (Lloyd's Register of Shipping 1901:KNI-KOH; *Marine Engineer and Naval Architect* 1898a:408).

Following completion, the steamship was named *Knight Errant* upon its christening in 1897 by Mrs. J. Ernest Muir. It was built for Greenshields, Cowie and Company's Knight Line (also known as the Knight Steamship Company) of Liverpool, England (*Marine Engineer and Naval Architect* 1898a:408).

Knight Errant operated under the control of the Knight Steamship Company and was predominantly engaged in the trans-Atlantic coal trade until around 1900, but also occasionally carried other bulk cargoes such as wheat (*Virginia Pilot* 1900). From around 1901 through its sale in 1913, *Knight Errant* operated as a tramp steamer sailing all over the globe carrying various cargoes of nickel ore, grain, coal, sugar, and kerosene (*New York Times* 1901, 1903; *Advertiser* 1901, 1902; *Sydney Morning Herald* 1901, 1908; *Brooklyn Daily Star* 1903; *Syren and Shipping* 1904; *San Francisco Call* 1904, 1905 (16 May and 28 Sept.); *Argus* 1908).

In 1913, the European and Brazilian Shipping Company bought the *Knight Errant* for 46,000 pounds and renamed the steamship *Rio Tiete* (named after a Brazilian river in the state of São Paulo). The Toronto, Canada based European and Brazilian Steamship Company, LTD was formed in 1912 to operate lines of steamers and other vessels and carry on a general ship-owning and shipping business throughout the Dominion and elsewhere (*Railway and Marine World* 1912:259). Shortly after the *Rio Tiete* was acquired the company was bought out by the London based London-American Maritime Trading Company (managed by Petersen & Co., LTD) in June 1914. They assumed ownership of the European and Brazilian Steamship Company's fleet of 9 steamships due to debt (*Financial Review of Reviews* 1914:1085).

WWI (July 1914 through November 1918) was chaotic for shipping companies. In late 1915, the Russian Volunteer Fleet Association of Petrograd, Russia purchased *Rio Tiete* for 100,000 pounds and renamed it *Omsk*, after the Siberian city Omsk. The Russian Volunteer Fleet Association was established in 1878 by a group of Russians at the request of Tsar Alexander III to fund the purchase of auxiliary steamships for the Russian navy. During WWI, the fleet helped supply Allied forces, many of which came from American ports.

Omsk was scheduled to participate in American efforts to supply Russia during WWI. Tsarist Russians and American capitalists worked together in 1916 and 1917 to supply Russians with locomotives built by the American Locomotive Company. The Russians were heavily dependent on its railway due to the country's vast size, especially during times of conflict. The Russian military ordered 70 engines from the American Locomotive Company. The contract also included delivery of the engines "free alongside a steamer provided by the Union" (Rielage 2002:75-81). After the locomotives reached the steamship, it was the buyer's responsibility for shipment. By September 1916, 28 engines were completed and shipped onboard the Russian Volunteer Association freighter *Turgat*. "The freighter *Omsk* was scheduled to ship another 30 in the near future" (Rielage 2002:82). The *Omsk* never ended up shipping the cargo due to a failure of payment and breach of contract by the Russian government (Rielage 2002:83-86).

In November 1919, the *Omsk* was loaded in New York, as referenced in the *San Francisco Chronicle* in October 1919, with "candy, chewing gum, and tooth paste... by the ton into the steamer *Omsk*, Christmas ship of the Y.M.C.A. for American troops in Siberia... Nearly 71,000 pounds of yuletide gifts valued at close to $60,000 make up the shipment" (*The Baltimore Sun* 19 November 1919). "Aside from the individual soldier bundles, 'Y' huts will receive for distribution hundreds of thousands of cigarettes, more than 67,000 bars of chocolates, 271 soccer footballs, 670 stereopticon lamps, 15 bass drums and a miscellaneous collection of other musical instruments, postcards, and books. Books to teach English to the Czechoslovakian soldiers billeted with Americans are also in the shipment" (*Philadelphia Inquirer* 1919).

After the signing of the treaty of Brest Litovsk, which ended Russia's involvement in WWI, in March 1918, many of the Russian Volunteer Fleet Association's vessels were seized by the Allies. Eventually Britain took control of 11 ships, including the *Omsk*. The 1919-1920 Lloyd's Register listed that the *Omsk* was under the ownership of The [British] Shipping Controller and managed by Royal Mail Steam Packet Company.

Following the war between 1920 and 1924, the steamship underwent several changes of ownership and subsequent name changes. In 1921 *Omsk* was sold to the London Steamship and Foreign Trading Corporation, LTD and renamed *Calanda*. The British Corporation ran the steamship as an "ordinary cargo vessel" (*Marine Engineer and Naval Architect* 1921:380). Then in 1922, *Calanda* was sold to another British company, D.L. and Flack and Son, LTD, and renamed *Flackwell*. D.L. Flack and Son specialized in the coal, wood, and ice trade with a focus on bunker coal. They had offices in New York and London (*Marine Review* 1922:269). The vessel would be sold and renamed again in 1925.

Hvaefanger A/S Globus (Globus Whaling Company) of Norway purchased *Flackwell* in 1925 and renamed it *Lancing*. Its management responsibilities fell under Melsom and Melsom of Larvik, Norway. Immediately after its purchase, it was sent to the shipyard of Framnæs Mek.Værksted in Sandefjord, Norway for outfitting as a whaling factory ship. *Lancing* was retrofitted with the very first stern slipway, one of the most important developments in whaling that ushered into the period of modern pelagic whaling. Prior to the development of a practical factory ship, whalers towed their catch back to shore stations for processing. Norwegians Christian Fred Christensen and Captain H.G. Melsom invented this new technological advancement and chose *Lancing* to be their test ship. "The revolutionary proceeding of cutting away part of the rudder stock and stern frame-post to provide room for the slipway proved highly successful. In fact, it made factory ships possible... Thanks to the stern slipway, the whales are cut up without the difficulties that attended operations when carcasses had to be fleshed alongside" (*Montreal Gazette* 1934). *Lancing*'s conversion called for a straight slipway that required removing 11 ft of rudder stock, the stern frame post, and rudder. Shipbuilders added a sunk quarter portion to the hull to provide additional space between the deck and slipway surface and the slipway slide for the steering compartment. This arrangement allowed a permanent slipway all the way down to the waterline (Basberg 1998:26).

A cut out in the *Lancing's* stern allowed whale carcasses to be brought up onboard to the aft deck for fleshing and processing. "The slipway put an end to ship side fleshing, which could be safely undertaken only in calm sea. Formerly factory ships had often been compelled to anchor along the Antarctic ice barrier to cut up the whales. Now they could remain in open water at all times" (*Milwaukee Journal* 25 November 1955). "It was not obvious at the time that the *Lancing's* slipway would become the standard design" (Basberg 1998:28). "It is difficult to overestimate the importance of this innovation to whaling or contribution to the destruction of whale populations in the Antarctic" (Clapham and Baker 2002).

At the outbreak of WWII, *Lancing* and the other Norwegian floating factory ships were ordered to the nearest Allied or neutral port. "From here they were directed to America, where the oil was discharged in Curacao and New Orleans, with a view to subsequent transport in smaller consignments to Britain" (Tonnessen and Johnsen 1982:480). *Lancing*'s owner remained Hvaefanger A/S Globus throughout the war and during 1940 and most of 1941, historical records indicate that *Lancing* was still active sailing to and from the whaling grounds transporting whale oil. *Lancing* still supported the Allied war effort even though its home country of Norway was invaded and under German occupation from 9 April 1940 until 8 May 1945.

Since the beginning of 1941 *Lancing* had been outfitted with defensive weapons to combat the U-boat threat in the Atlantic. At first it only carried a 4-inch naval gun mounted on a special raised platform on its stern above the poop deck as well as a number of small arms such as rifles and a revolver. Its gun crew, at that time, consisted of 8 men that it drew from its existing crew. As war dragged on, *Lancing*'s armament would change and adapt to the increased U-boat threat and its participation in convoys. By November/December 1941 *Lancing*, in addition to the 4-inch naval gun at the stern, carried two machine guns located at the aft end of the boat deck, two machine guns located at the forward end of the fore deck, forward of the main mast, and one additional machine gun that was not in use. It also carried rifles, revolvers, and shotguns. Its personnel consisted of one gun layer, 4 merchant seamen gunners, 2 merchant navy defense officers, and 2 British soldiers. If needed, *Lancing*'s regular crew helped the gunners. Additional supplies now onboard included 15 steel helmets, 55 gas masks, 4 rockets, 4 fouling cables, a zigzag clock, a convoy light and buoys, and degaussing gear. Lastly, it had concrete slabs or armor plating placed around the bridge and radio room for additional protection (Figure 7-200; NARA 1939-1952).

On 28 March 1942, *Lancing* departed Curacao for New York with 8,802 tons (approximately 60,000 barrels) of pool marine fuel oil for the British Ministry of Shipping. It sailed independently from Curacao, not in a convoy, which was not unusual for a sailing between those two ports at the time. As the vessel moved northward approaching Cape Hatteras, *Lancing*'s crew was unaware that they were being followed by the German submarine U-*552* whose captain, Erich Topp, would soon order an attack.

On 7 April 1942, *Lancing* had six lookouts posted while it passed Cape Hatteras, North Carolina. It was holding its course and not zigzagging with no lights on and no radio communications (NARA 1941 - 1945, US Navy RG 38, Box 235). *Lancing* was traveling on a course of north 15 degrees at 9 kts when it was torpedoed at 0435 hours EWT without warning, 14 miles off Cape Hatteras, by U-*552*. The torpedo hit the hull's starboard side amidships, 1 fathom below the waterline. It blew up a portion of the deck and created a large hole in the side that immediately flooded the engine room and drowned stoker Emil Hansen, the only fatality of the sinking. The radio equipment was fatally damaged so no distress signals were sent out. Fortunately for the crew, there was no fire as a result of the torpedo's explosion. Even though the tanker was equipped with defensive weapons it did not try to fire its guns because the submarine was never seen. *Lancing*'s crew recollects that the U-boat might have been on the surface when it launched its attack due to hearing an automobile engine sound 10 minutes before the torpedo hit (NARA, US Navy RG 36, Box 235).

The 49 survivors fled into lifeboats and rafts at 0450 hours EWT. They stayed near the sinking vessel until it slipped beneath the waves, stern first, an hour and a half after impact. Another hour and a half later, the American tanker *Pan Rhode Island* picked up 28 survivors and the British patrol vessel HMT *Hertfordshire* picked up 21 survivors off Diamond Shoals, North Carolina and took them to Norfolk, Virginia (NARA, US Navy RG 36, Box 235; Hickam, Jr. 1989:125).

Lancing would rest on the seabed little more than a week before seeing further action. On 16 April 1942 while running routine convoy support around Cape Hatteras, USCGC *Dione* picked up a hard sonar contact and began a depth charge attack. It was not uncommon for sunken vessels to be mistaken for enemy submarines, and it was learned that in this case, *Dione* had indeed depth charged the recently sunk *Lancing* when wreckage from the vessel came to the surface (Hickam, Jr. 1989:167; Marx and Delgado 2013a))

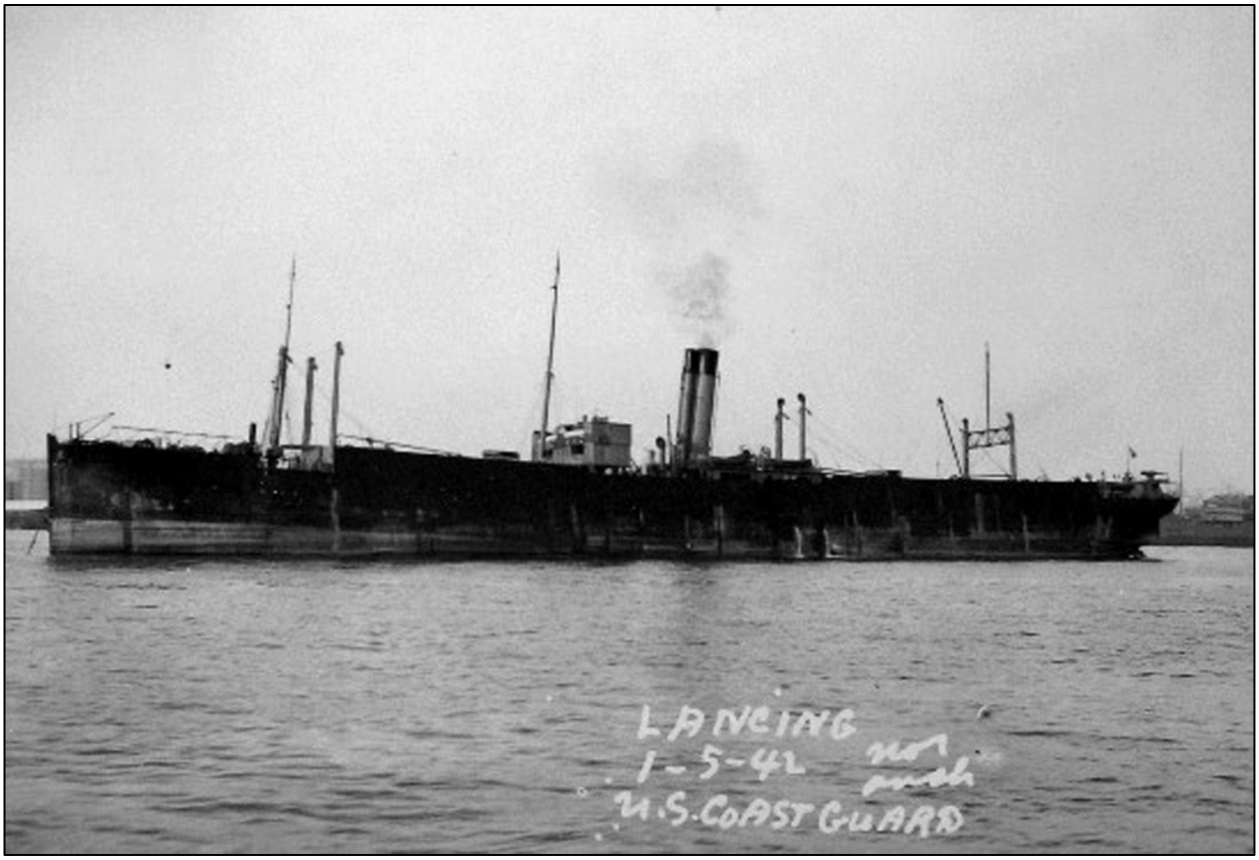


Figure 7-200 *Lancing* in 1942, port side profile view.
Source: NARA

7.26.2 Archaeological Site Description

Dive operations were conducted on this site; however, poor visibility prevented any photographic imagery from being collected. During 2011, the team collected high-resolution multibeam sonar data of *Lancing*. From these data, the team generated extremely detailed 3D point cloud models of the site and rendered them in a visualization program that allowed for three-dimensional viewing and manipulation utilizing a pole-mounted Reson SeaBat 8125 (6-mm depth resolution). The images clearly reveal *Lancing*'s extant remains sitting nearly upside down on the seafloor with the starboard side slightly more embedded in the sediment, and the portside slightly elevated (Figure 7-201 through Figure 7-204). The vessel was broken amidships and the two sections rested at slight different angles; the bow section measured at the stem-post rested at 70 degrees, while the stern section measured at the rudderpost rested at 75 degrees.

Despite being positioned upside down there remained a number of observable features related to the historical record. First, the vessel itself had an observed length based on acoustic modeling of approximately 472 ft between perpendiculars (in keeping with historical record of 470 ft). The breach in the hull amidships was located 237 ft from the bow. The torpedo that sunk *Lancing* was reported to have struck starboard side amidships. Heavy sediment deposition and acoustic shadowing in the starboard amidships area obscured detailed observation of the purported location of torpedo impact. While the very bottom of the hull was visible, significant portions of the hull that would have been below the waterline were not. Likewise, it is possible the torpedo detonated below the hull, thus snapping the keel but leaving no discernable 'hole' or observable ballistic damage, but instead created a near uniform breach of the hull. Both victim and aggressor reported the strike amidships and this breach is consistent with those reports, despite no discernible impact point.

Moving towards the stern on the starboard side just forward of the propeller, was a large, wide-open damaged area. This circular area had an average diameter of 19.5 ft. The damage observed in this area was most likely related to the subsequent depth charge event that took place on 16 April 1942. This is the only historical reference that would account for this level of structural damage on this portion of the vessel (Hickam, Jr. 1989). Potential depth charge damage at the stern and the torpedo damage and amidships breach both offer locations of potential interior penetration. At the very stern of the vessel, the 4-bladed propeller and rudder were still in their original, albeit inverted positions. Directly below the top of the rudder post, the whale slipway was clearly evident. This opening was square in shape and measured 15 ft per side.

In addition to these prominent features, there was a large disarticulated debris field amidships on the portside. While some debris was observable the length of the vessel on the portside, the area amidships had a higher concentration of material. This area corresponds with the main deck house on *Lancing*. On the port quarter, lying perpendicular to the hull, two long cylindrical features laid on the seabed. These features likely corresponded to forward king-posts/derricks observable in historic photographs.

Despite being inverted, the features that have historical and archaeological significance were still prominent. These were the signatures of damage during the Battle of the Atlantic as seen in both the amidships break and the stern depth charge damage, as well as the whaling slipway. The slipway itself lends a great deal of significance, as this vessel represents a significant development in factory whale ships and the whaling industry in general in the twentieth century.

Being positioned upside down has had some implications for the preservation of the site. Due to the water depth and the fact that no superstructure presented high relief in the water column, this site was never deliberately wire-dragged or blasted as a navigation hazard (despite having been accidentally depth charged during the war). Consequently, the hull, with the exception of the break amidships and the damage at the stern, is quite intact. At the time of its loss, the vessel was carrying 8,800 tons of fuel oil and some of this cargo is likely still present on site. Boaters and divers know the vessel as the 'slick' wreck on account of surfacing sheening that is occasionally observed on site. No internal investigations of the hull took place on this survey and as such, the extent of remnants of the cargo remains unknown at this time (NOAA 2013b).

The historical significance and extant archaeological remains observed during the course of this survey were used to successfully list the *Lancing*'s remains on the NRHP (Marx and Delgado 2013a). The National Register boundaries of the *Lancing* shipwreck encompass the footprint of its articulated remains within a square (500 m per side) to capture debris and artifacts that are separated from the main structure. The 61.77635 acre site includes the main hull structure and debris field surrounding the tanker.

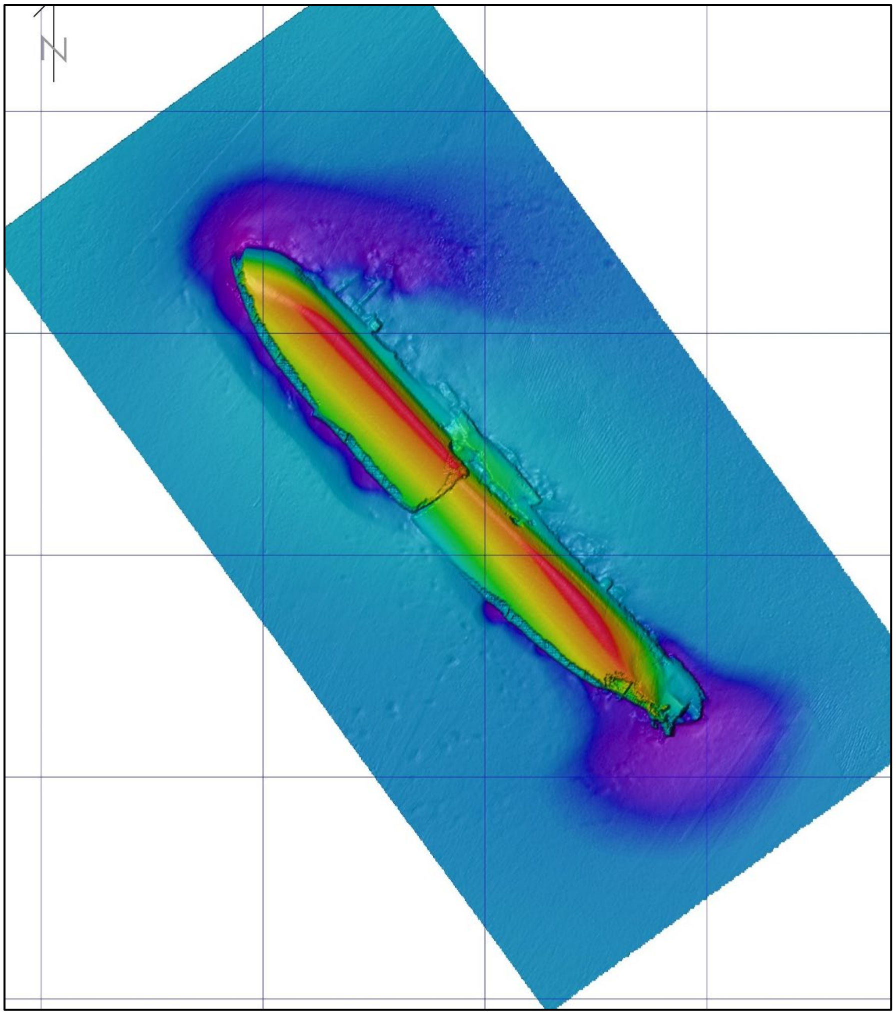


Figure 7-201 Reson 8125 scaled 6-mm resolution 455 kHz multibeam survey of *Lancing* wreck site.
Source: ADUS

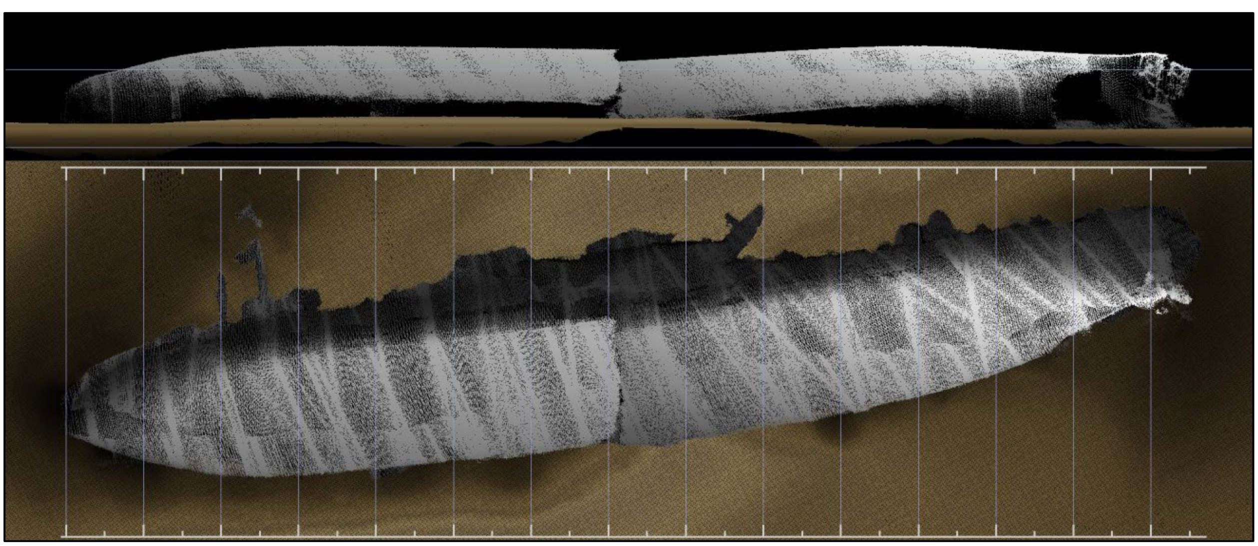


Figure 7-202 Multibeam SONAR plan and profile visualization of the *Lancing* wreck site scaled in 10-m grid.
Source: ADUS

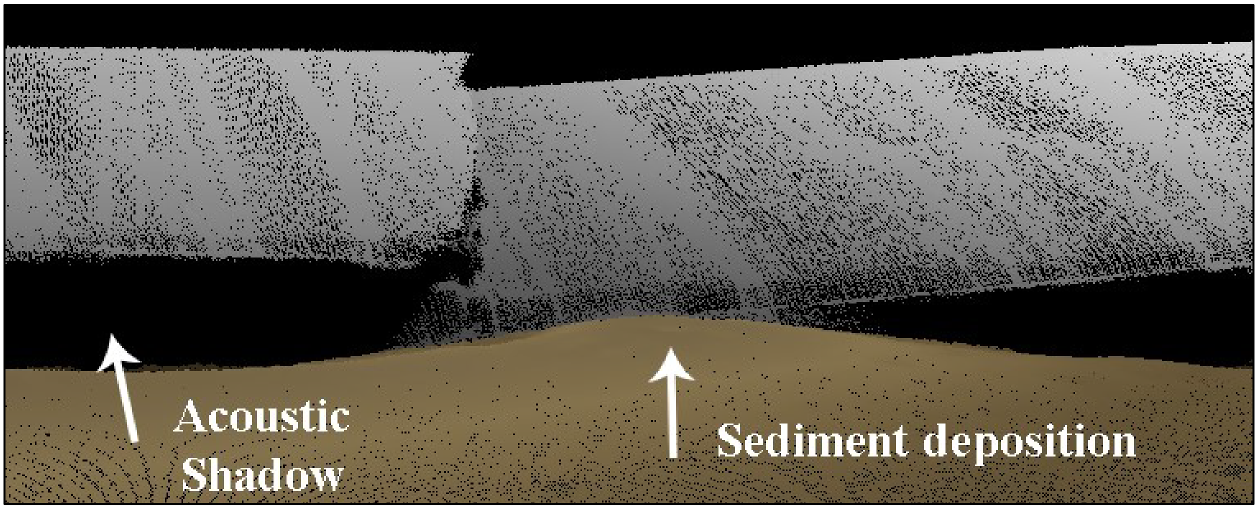


Figure 7-203 Starboard amidships area showing obscured areas where torpedo impact was reported.
Source: ADUS

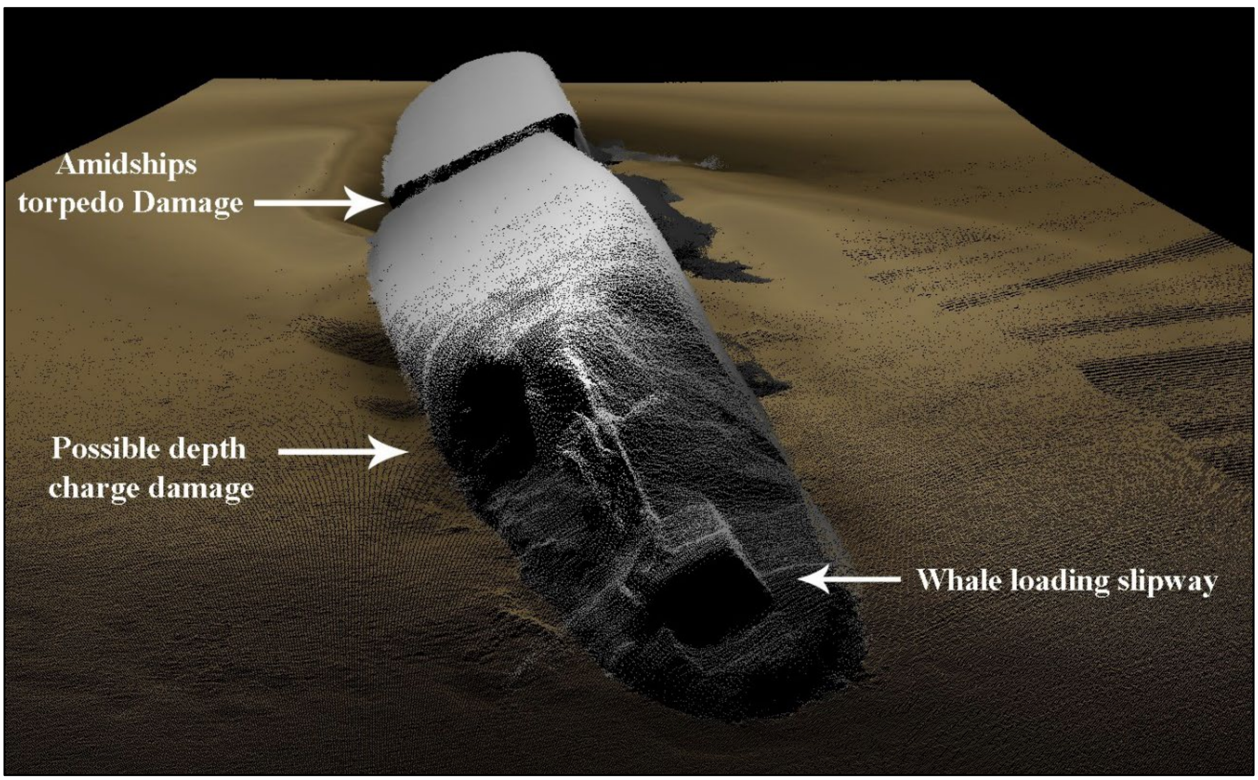


Figure 7-204 Isometric SONAR visualization of the *Lancing* wreck site clearly depicting the starboard side torpedo damage, depth charge damage, and the whale-loading slipway.
Source: ADUS

7.27 Liberator

Figure 7-205 USS *Liberator* at St. Nazaire, France while employed as a troop transport in 1919.
Source: US Naval Historical Center

Table 7-29 Characteristics of USS *Liberator*

Characteristics	USS *Liberator*
Year of Build/Type/Hull #	1918/Cargo/151
Date Lost	19 March 1942
Position & Depth	12 miles SE of Cape Hatteras, NC: 120 ft
Ship Characteristics	Length: 410.0' Breadth: 56.0' Depth: 29.0' Gross Tonnage: 7,720
Cargo	11,000 tons of sulfur
Survivors	31 (36 Total on board [5 dead])
Owner	Lykes Brothers Steamship Company, Tampa, FL
Builder	Bethlehem Fairfield Shipbuilding Corp., San Francisco, CA
Former Names	USS *Liberator* (1918-1919, US Navy)
Lloyd's Register Details	Steel (Stl) hull, web frames, longitudinal framing, two decks, fitted for oil fuel, triple expansion steam engine, three Scotch boilers.
Port of Registry/Flag	Galveston, TX/USA
Sunk by	U-*332* (Johannes Liebe)
Data Collected on Site	*Pisces* multibeam 2012; photo and video 2013.

7.27.1 History

Liberator was constructed by the Bethlehem Steamship Company of San Francisco, California at their Union Ironworks plant (Table 7-29 and Figure 7-205, above). The vessel was 410 ft long, 56 ft abeam, and had a depth of 29 ft. Two sister ships, *Challenger* and *Volunteer*, were built there as well, all destined for Naval duty during WWI. *Liberator* was launched on 24 March 1918 and commissioned by the US Navy as USS *Liberator* on 2 July 1918 (Figure 7-206 and Figure 7-207). USS *Liberator* operated in the Naval Overseas Transportation Service and was based in St. Nazaire, France running transatlantic resupply missions. The Naval Overseas Patrol Service is an ancestral agency to the modern Military Sealift Command (Figure 7-208 and Figure 7-209). It operated under US Navy control until 1919 when it was then decommissioned, but remained the property of the USSB until 1933, at which time it was sold to Lykes Brothers Steamship company and home ported in Galveston, Texas (Silverstone 2006:159).

In mid-March 1942 *Liberator* would find itself off the U-boat infested waters of Cape Hatteras. Following U-*124*'s attack on *Papoose* and *W.E. Hutton*, US Navy destroyer USS *Dickerson* (DD-*157*) was dispatched to the area to provide assistance. Meanwhile, rounding Cape Lookout under the cover of darkness on 18 March 1942 was the 7,720-ton freighter *Liberator* with a cargo of sulfur. As the steamer passed Lookout, the vessel came upon the burning hulk of a large tanker (Hickam, Jr. 1989:86-88).

The naval gun crew onboard the cargo ship was immediately put on full alert. As *Liberator* intercepted radio traffic that the U-boat responsible for the attacks might still be in the area, the Captain ordered the vessel to accelerate to full speed. Miles away in the inky dark of night, USS *Dickerson*'s radar crew established a fast-moving surface contact in the vicinity of the burning tanker. It appeared to be a U-boat fleeing on the surface. USS *Dickerson* closed the distance to investigate, but the vessel in question actually was *Liberator*. Unbeknownst to *Liberator*, however, was the fact that this friendly escort vessel was in the area to assist the damaged tankers. Already on edge, the crew onboard *Liberator* spotted a vessel in the shadowy fringes of the burning tanker and opened fire. The watch onboard USS *Dickerson* noted several flashes before two rounds came pouring into the destroyer. *Liberator* scored a direct hit on USS *Dickerson*'s bridge, killing several sailors including the Captain, who died shortly before making port the following day. As he lay wounded on the bridge, the Captain ordered the vessel to make full speed away from the attacking freighter and back to Norfolk (Hoyt 1978:75; Hickam, Jr. 1989:87-89).

Meanwhile, the commotion of all these vessels on the surface attracted the attention of another lurking U-boat, U-*332*. The violent explosions onboard *Papoose* and *W.E. Hutton*, the racing propellers of USS *Dickerson* and *Liberator*, and the barrage of *Liberator*'s gunfire attracted the U-boat. The gun crew onboard *Liberator* believed they had just driven away a belligerent U-boat when in fact they had attacked their best hope for protection. As *Liberator* sped into the darkness, U-*332* exploited their folly and lined up for an attack. Hours after *Liberator* fired on USS *Dickerson*, on 19 March 1942, two torpedoes struck the freighter, setting the cargo of sulfur afire, and forcing the crew to abandon ship. Five crewmembers were lost in the explosion, and U-*332* crept off undeterred. Thirty-one crewmembers were later rescued by Navy tugboat USS *Umpqua* (ATO-*25)* and taken to Morehead City, North Carolina (Hickam, Jr. 1989:87-89; Blair 1996:518; Wynn 1997:172;).

7.27.2 Archaeological Site Description

They US Navy and Coast Guard surveyed the remains of a vessel initially believed to be *Liberator* in 1944; further investigation, however, revealed this site was actually Greek freighter *Kassandra Louloudis*. Instead, another position investigated by USCGC *Gentian* was not officially identified, but was suspected to be the *Liberator*. Here, the vessel was noted as resting next to breaking waves along the outer stretch of Diamond Shoals. Several eyewitness accounts collected by the Navy and Coast Guard corroborated this position, but more thorough investigations were not made (DIO 1945:27-29).

The position occupied by *Liberator's* remains exposed it to a highly dynamic environment. Divers visiting the site since at least the 1990s have noted dramatic scouring and shifting of sediments, resulting in varying degrees of burial and relief; loose sulphur has also been observed (see Gentile 1993:112). The team investigated *Liberator* for the first time in 2012 and again in 2016. NOAA R/V *Pisces* collected multibeam data (Figure 7-210 through Figure 7-212).

Figure 7-206 *Liberator* on 21 June 1918 while fitting out at the Bethlehem Shipbuilding Corporation, Union Plant at Alameda, California.

Source: NARA

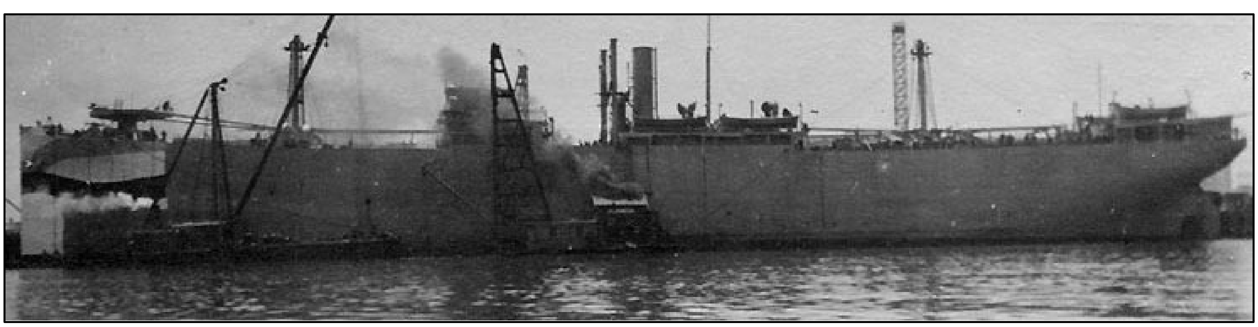


Figure 7-207 *Liberator* fitting out at Bethlehem Shipbuilding Corporation's Union Plant at Alameda, California, with two derrick barges alongside.

Source: NARA

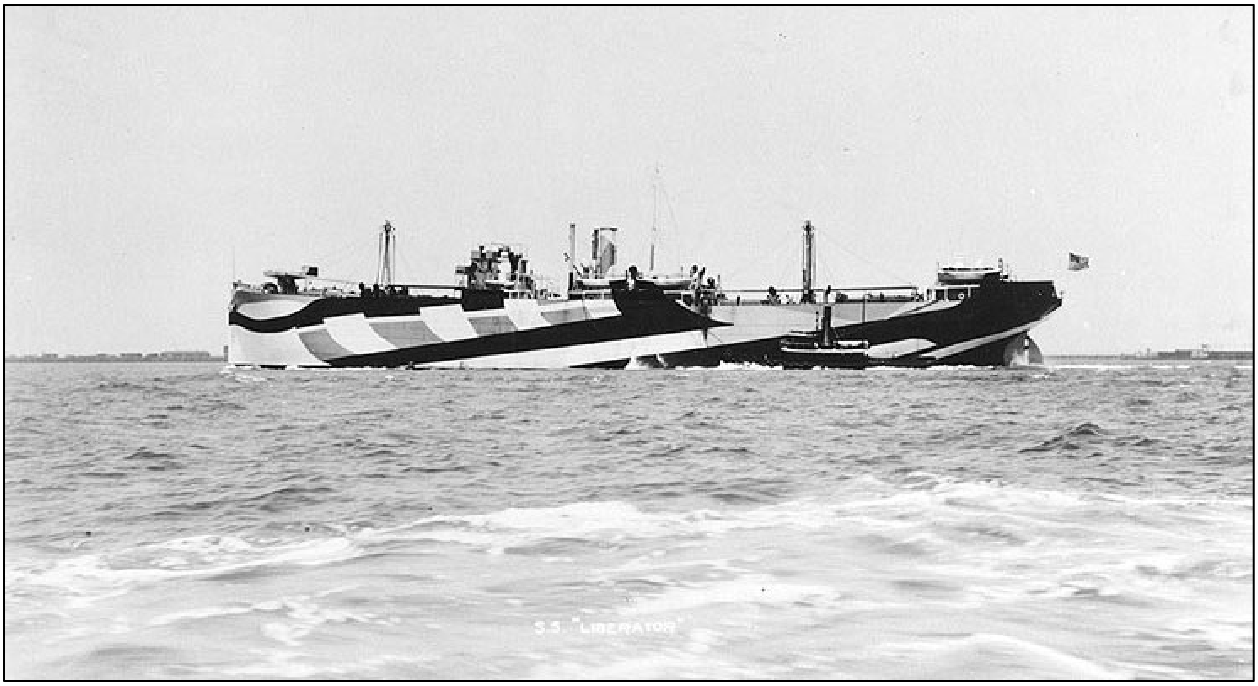


Figure 7-208 *Liberator* with WWI "dazzle" camouflage.
Source: NARA

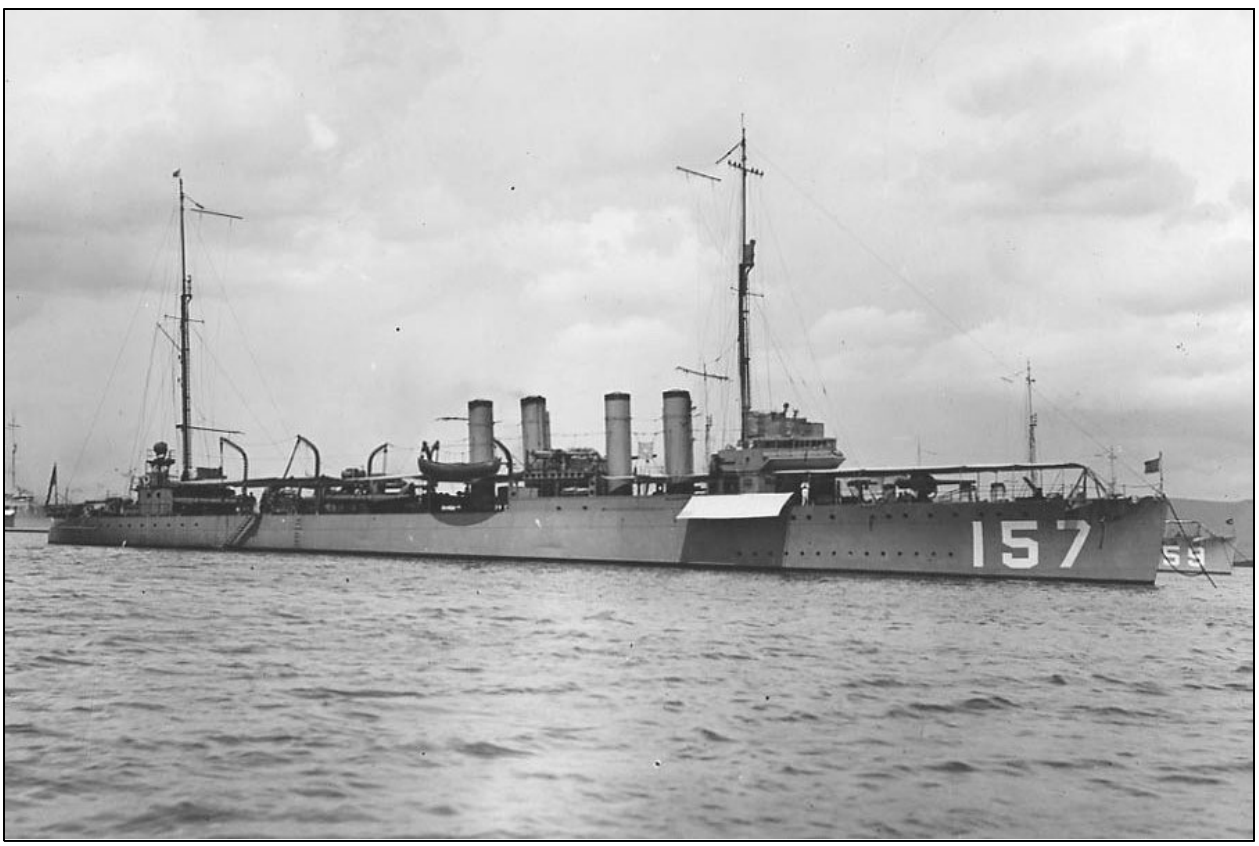


Figure 7-209 USS *Dickerson* (DD-*157*) during WWI.
Source: U.S. Naval History and Heritage Command

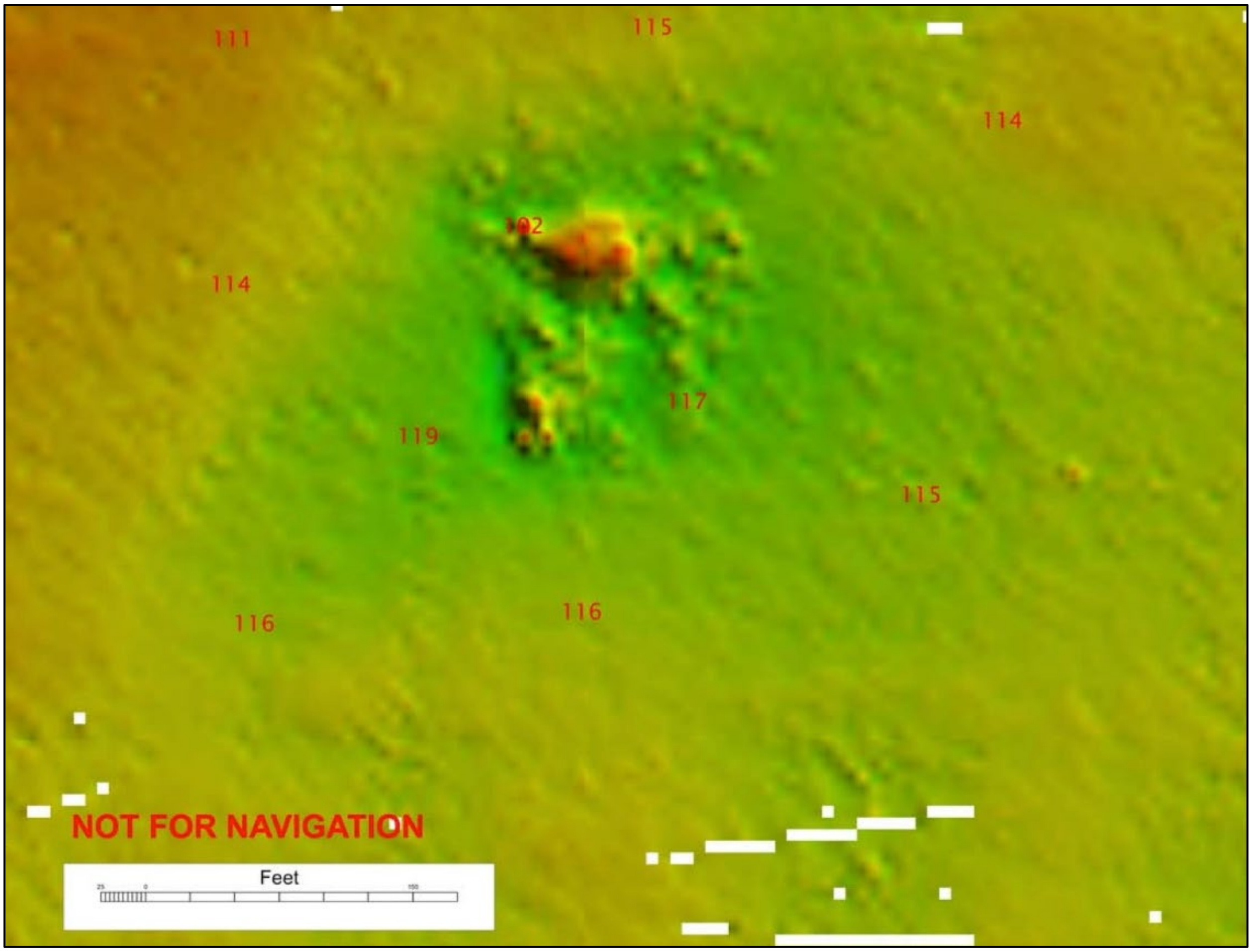


Figure 7-210 Detail survey data of the *Liberator* wreck site.
Source: NOAA

The wreck of *Liberator* is located in approximately 120 ft of water. As built, the vessel was 410 ft long and 56 ft abeam. Much of the site remained extant with a large degree of relief. The layout of the site made it difficult to obtain a comprehensive sonar image, as there were some components that were lower relief obscured in shadows. Diving operations were similarly limited, yielding only enough information to determine the orientation of the site (Figure 7-213).

The vessel was broken into three distinct sections, with the bow section oriented parallel to the rest of the hull. The orientation of the wreck was complicated by the fact that multiple pieces of the bow section were facing aft. The largest section was a portion of the hull, which laid starboard side down and rose 30 ft off the bottom. The site was generally oriented WNW to ESE, stern toward amidships. This section has a total overall site scatter length and beam of approximately 113.45 ft and 35.38 ft, respectively. Due south of this section is a smaller set of site remains, that are oriented in a WSW to ENE fashion. It was approximately 23 ft south of the stern section and most likely part of the amidships hull. It measured approximately 42.65 ft in length and 5.78 ft at beam. Directly SW of this section, following a gap of approximately 12 ft, was the third section, the bow. The bow section was oriented NNW to SSE, bow toward amidships (Figure 7-214). It had an overall length of approximately 59 ft, with a site scatter width of 26.79 ft. The bow rested on its starboard side and was broken-up just aft of where the port anchor was still visible in its hawse pipe (Figure 7-215). There was some evidence of recent salvage attempts on components of deck machinery. Modern fire hose had been wrapped around a winch and dislodged some of the deck machinery, yet failed to recover the material (Figure 7-216).

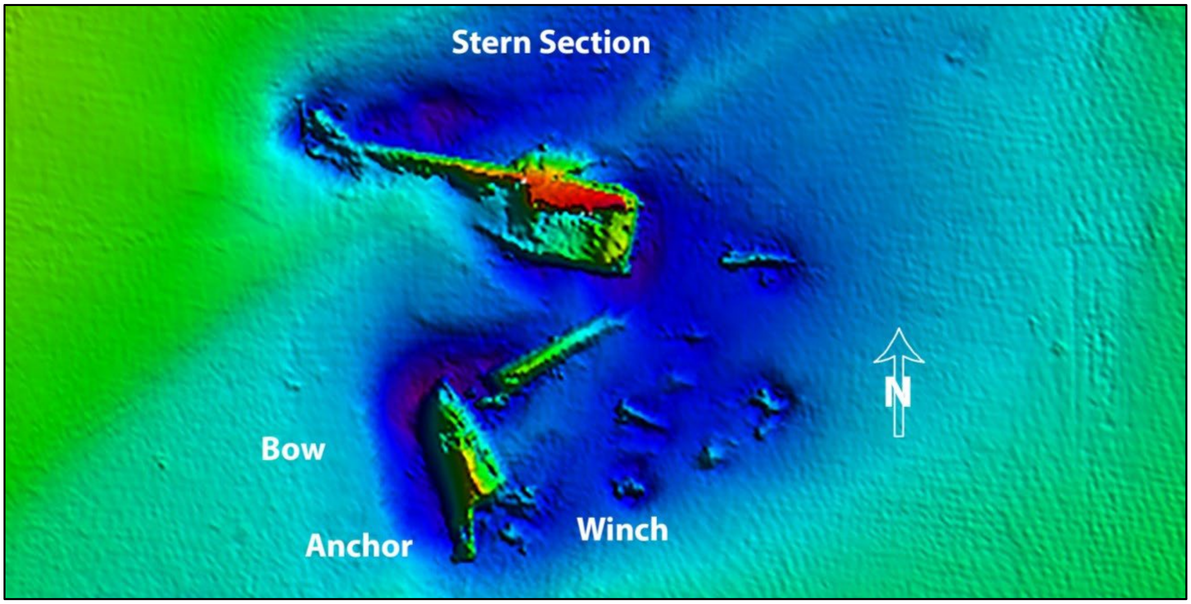


Figure 7-211 Reson 7125 400 kHz multibeam survey of *Liberator* wreck site, 2016.
Source: NOAA R/V *Nancy Foster*

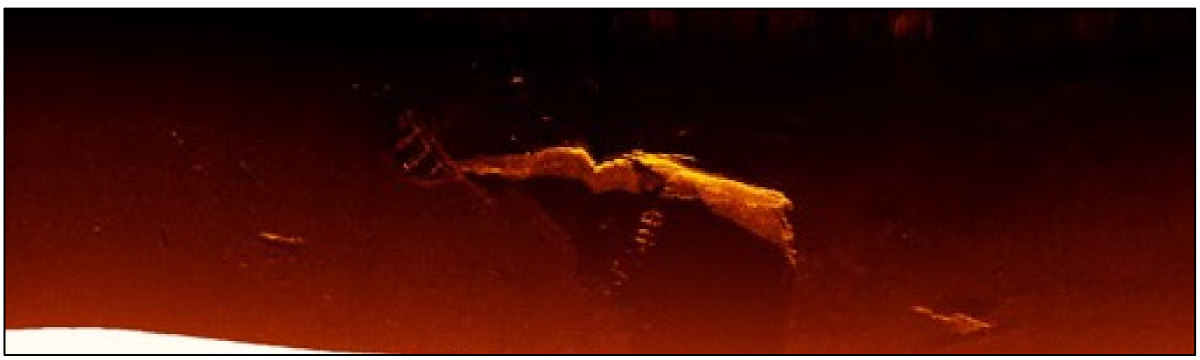


Figure 7-212 Attempted high-frequency side scan sonar image of the *Liberator* wreck site.
Source: NOAA

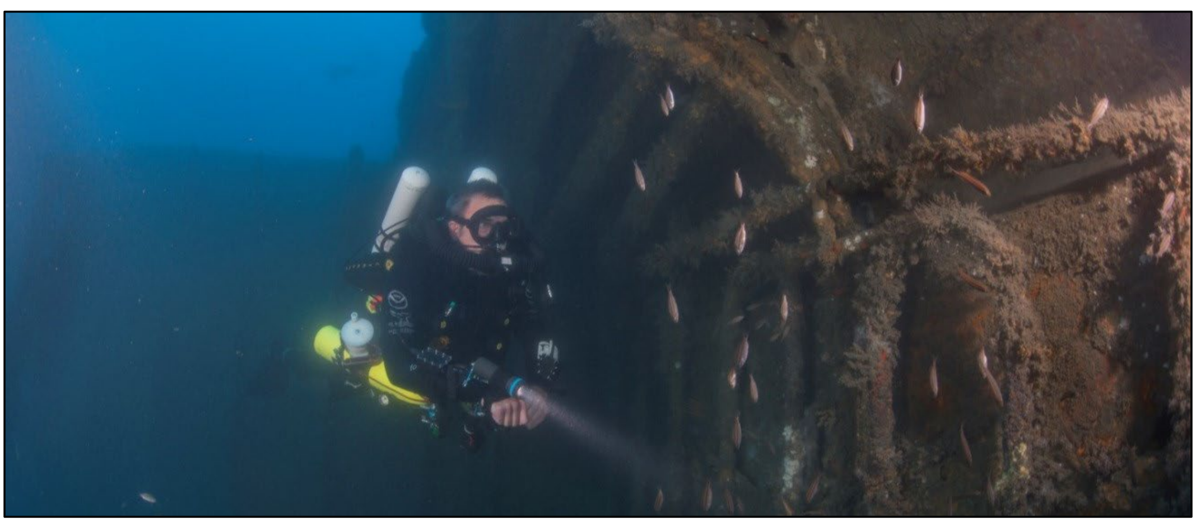


Figure 7-213 Diver investigating the *Liberator* wreck site.
Source: NOAA

Figure 7-214 Bow remains of *Liberator*.
Source: NOAA

Figure 7-215 One of the anchors of *Liberator*.
Source: NOAA

Figure 7-216 Remains of fire hose wrapped around the winch in a suspected salvage attempt.
Source: NOAA

7.28 Ljubica Matkovic

Figure 7-217 *Chetopa* still under construction at Newark Bay Shipyard on 27 September 1918.
Source: NARA, Courtesy of Rod Mather

Table 7-30 Characteristics of *Ljubica Latkovic*

Characteristics	*Ljubica Latkovic*
Year of Build/Type/Hull #	1919/Freighter/6
Date Lost	24 June 1942
Position & Depth	Unknown, presumed SE of Hatters Estimated 400-500 ft
Ship Characteristics	Length: 324.0' Breadth: 46.2' Depth: 25.0' Gross Tonnage: 3,289
Cargo	Sugar, diesel oil, timber
Survivors	27 (27 total onboard)
Owner	E. Matkovic
Builder	Submarine Boat Works, Newark, NJ
Former Names	*Phyllis Soto* (owner unknown 1937-1938) *Chetopa* (Charles Nelson Co, San Francisco, CA, 1920-1937)
Lloyd's Register Details	1 Deck, 2 tiers of beams in the fore and aft holds, fitted for fuel oil, double reduction gearing (DR) steam turbine engine.
Port of Registry/Flag	Split, Yugoslavia
Sunk by	U-*404* (Otto von Bülow)
Data Collected on Site	NOAA R/V *Nancy Foster* multibeam and ROV 2018.

7.28.1 History

Ljubica Matkovic was an American-built freighter (Table 7-30 and Figure 7-217 above) that operated in the Pacific via San Francisco running cargo to the Far East. In this service, one aspect of the history of *Matkovic* highlights the context of the onset of World War II through the experiences recorded of a young boy that sailed aboard the vessel.

Richard Harris Chambers was born in 1924 and grew up near Detroit, Michigan. His father was a Baptist missionary to China who died when Richard was just 8 years old. His mother, Christine Chambers, was an English professor at the University of Shanghai, where she stayed with Richard and his two sisters, Christine and Lois (*Lansing State Journal* 2 November 1937).

The Chambers family was in China during the summer of 1937. Christine and her daughters left for a vacation trip up the Yangtze River and Richard went to spend the summer at a YMCA camp in Tsingtao, 400 miles from Shanghai. They parted ways on 7 July and planned to reunite at the end of summer. Coincidently, 7 July 1937 marked the beginning of the Sino-Japanese War, with conflict breaking out at what is now known as the Marco-Polo Bridge Incident. The Sino-Japanese war would eventually be absorbed into the broader conflict of WWII (*Oakland Tribune* 1937).

As hostilities grew it became unsafe for the Chambers family to remain in China. The YMCA camp closed in mid-August due to war conditions after it was learned that one of the boys' fathers was killed by a bomb in Shanghai. By this time, Mrs. Chambers and her daughters had made it to Kuling, where she wrote to Richard in the hopes that he might be reunited with her. However, war conditions were such that railroads and shipping were disrupted by troop movements and Richard was unable to reach his mother before she was moved (*Oakland Tribune* 1937).

This left Richard, a 13-year old boy alone in a country that had just begun a war. He made his way to the American consulate in Tsingtao where he arrived with just one dollar. He was told that all American women were being evacuated to the Philippines or the United States for safety and that his mother and sisters were likely already en route home. The consulate made arrangements for Richard's evacuation aboard a tramp steamer in port at Tsingtao preparing to sail for Honolulu. That vessel was *Phyllis Soto* (*Honolulu Star-Bulletin* 1937).

Richard was the only passenger aboard *Phyllis Soto*, and worked in the kitchen as *Soto* crossed the Pacific, "I gave the captain my dollar to make it legal, but I peeled potatoes and washed dishes so the crew wouldn't think I wasn't one of them." Richard had said later to a reporter. Unbeknownst to Richard, his mother was able to later get in touch with the consulate and cabled money for his transport before sailing for Japan (*Oakland Tribune* 1937).

Shortly after departure *Phyllis Soto* encountered a typhoon in the Tsushima straits that battered the ship, forcing the captain to stop at Yokohama, Japan for repairs. Coincidently, Richard's mother was in Yokohama at the time *Phillis Soto* came to port, but neither she nor Richard knew the other was there. As a consequence she booked passage to Vancouver and Richard remained in Yokohama for 21 days while *Phyllis Soto* prepared for passage to Honolulu (Oakland Tribune 1937).

The voyage from Japan to Hawaii presented further trouble for *Phyllis Soto*. The ship was caught in an additional typhoon. When they were still more than a thousand miles from shore, Captain Kaufhold was forced to radio a distress call to the US Coast Guard. US Coast Guard Patrol Boat *Reliance* was dispatched to assist and days later *Phyllis Soto* limped into Honolulu with rapidly diminishing supplies and approximately 8 ft of water in the No. 1 hold. By then, the crew of *Soto* began to see Richard as the source of their bad luck, with one mariner aboard *Soto* remarking to a reporter in Hawaii, "What can you expect from a sky pilot's kid? He's a jinx if there ever was one." (*Honolulu Star-Bulletin* 1937).

Once in Honolulu Richard was able to transfer to the Matson Liner *Lurline* bound for San Francisco. He had radioed ahead to a family friend, Dr. Charles Shepherd, located in San Francisco that he hoped would be there upon his arrival. *Lurline* finally landed in San Francisco on 28 October 1937, more than two months after Richard was evacuated from the YMCA camp in China. The duration of the passage allowed Dr. Shepherd time to correspond with Mrs. Chambers, who had safely made it back to Detroit and awaited word of her sons' whereabouts. When Richard got off *Lurline*, Dr. Shepherd greeted him with a radiogram:

> "Richard could not believe his eyes when Dr. Shepherd proffered the letter from his mother. 'Why it's from Detroit,' he exclaimed. 'Is my mother there?' His joy was unrestrained when he opened the letter and found instructions for the reunion with his family in Detroit." (*Oakland Tribune*, 1937).

Richard returned home but he would later return to the Pacific as an adult, having risen to the rank of Lieutenant in the United States Army. Unfortunately, although he survived to see the war end, Richard Harris was killed in a plane crash at Manila, Philippine Islands on 28 September 1945, just weeks after cessation of hostilities He was 21 years old (*The Michigan Alumnus*, 1946).

Phyllis Soto was later sold to Yugoslavian interests shortly before hostilities broke out in Europe and renamed *Ljubica Matkovic*. During the war, *Matkovic*, like many other merchant ships, filled the critical role of moving bulk goods needed by Allied powers to continue the war effort. With a cargo full of sugar, diesel, and timber, *Matkovic* was sailing from Trujillo, Dominican Republic to New York. As the vessel was traveling off the North Carolina coast on the morning of 24 June 1942, a series of three torpedo strikes hammered the freighter. Quickly, the crew abandoned the ship and set off in two lifeboats. Six hours later, a blimp from Elizabeth City spotted the 27 survivors that were later picked up by a patrol boat out of Ocracoke; survivors were landed at Morehead City that same day. Not a single life was lost (DIO 1987:398-400; Hickam, Jr. 1989:270).

7.28.2 Archaeological Site Description

The location and identification of *Ljubica Matkovic* has long been a mystery. Due to the confusion of reporting during wartime and the contemporaneous assessment of wreck sites conducted by Woods Hole Oceanographic Institute aboard USCGC *Gentian* in the summer of 1943, the identity of many wrecks off North Carolina have been jumbled (see descriptions of *W.E. Hutton* and *Papoose*). A similar mix-up appears to have occurred here.

The confusion begins with positions reported in the Eastern Sea Frontier War Diary. On 24 June 1932 at 0300 hours EWT *Ljubica Matkovic* was struck by a torpedo fired from U-*404*. The position recorded in the war diary was 34-30N, 75-40W (DIO 1987:398). Later that same day, at 1919 hours EWT, U-*404* launched another attack sinking both *Nordal* and *Manuela*. The position recorded for *Nordal* is identical to the position reported for *Matkovic*: 34-30N, 75-40W (DIO 1987:399).

With the positions and circumstances of the loss of *Nordal* and *Matkovic* being so similar it is not surprising that further research into these targets was complicated. In the summer of 1943, USCGC *Gentian* conducted a survey of several recently sunken vessels. In many cases there was visual evidence of these wrecks at the surface, whether structural in the form of deckhouses or masts, or by heavy oil slicks coming from the wreckage. Such was the case with a site described in the report as *Nordal*. The *Gentian* team based their assertion on the attack position provided (from PC-*465*) and came upon an oil slick that was followed until they located the wreck via fathometer in 67 fathoms of water (402 feet) in the position 34-41.5N, 75-35.1W, approximately 1.5 miles from the location of the attack as reported (USONI 1943:Box 413–24). Why the team concluded the vessel was *Nordal* instead of *Matkovic* is uncertain. It is possible they were referencing data from PC-*465* without the benefit of the broader War Diary that showed how proximate the two attacks actually were. Irrespective of why, *Gentian* recorded a single image of a wreck lying on the seabed, which at the time was the deepest underwater wreck photo ever taken (Figure 7-218). Their final report suggests the remains are that of *Nordal*. There is no record of anyone ever returning to this site.

During the course of this survey an unidentified target was recorded in 2011 via an AUV-based sonar search conducted in collaboration with the University of Texas's Applied Research Lab (ARL:UT). At the time, the focus of the search was to locate the remains of the KS-520 convoy battle and this target did not appear to be associated. A follow-up survey with SRI International confirmed the target observed was likely a shipwreck (Figure 7-219). The wreck lies in 400 ft of water in the position 34.744406N - 75.570695W.

In 2018 while aboard the NOAA R/V *Nancy Foster* an effort was made to relocate the site described in the *Gentian* report. At first, the unknown target located in 2011 was not considered a possibility due to its location. The position is approximately 14.5 nautical miles away from the historically reported sinking location in the ESF War Diary and the target was observed as being too small to be *Nordal*. However, upon further investigation several elements aligned to suggest that the wreck located in 2011 is indeed the same wreck imaged by Woods Hole in 1943.

Figure 7-218 USCGC *Gentian* photograph taken by means of a pressure sensitive drop camera. The survey team identified this site in 400 feet of water as *Nordal*.
Source: USONI 1943:Box 413–24

The positions recorded by the *Gentian* in 1943 for the location observed plot out approximately 3 nautical miles SSW of the location identified in 2011. This is well within an expected margin of error between 1943 position accuracy and 2018 position accuracy. This is further affirmed by the fact the locations they reported, when converted to modern accurate coordinates, are in an area with water depth over 100 fathoms, or 600 ft deep. The water depth reported for the target photographed in 1943 is identical to the water depth of the target observed in 2011 – 400 ft. *Gentian's* ability to accurately determine water depth is considered far more reliable than technology for determining position in 1943.

The site was then subsequently resurveyed by NOAA R/V *Nancy Foster* in 2018 to produce a slightly higher resolution multibeam sonar survey (Figure 7-220). The wreck site is located in an area with a maximum water depth of approximately 440 ft, with the vessel sitting mostly upright on its keel. There is discernable evidence to identify the bow and stern, with the remains oriented SSE to NNW, bow to stern.

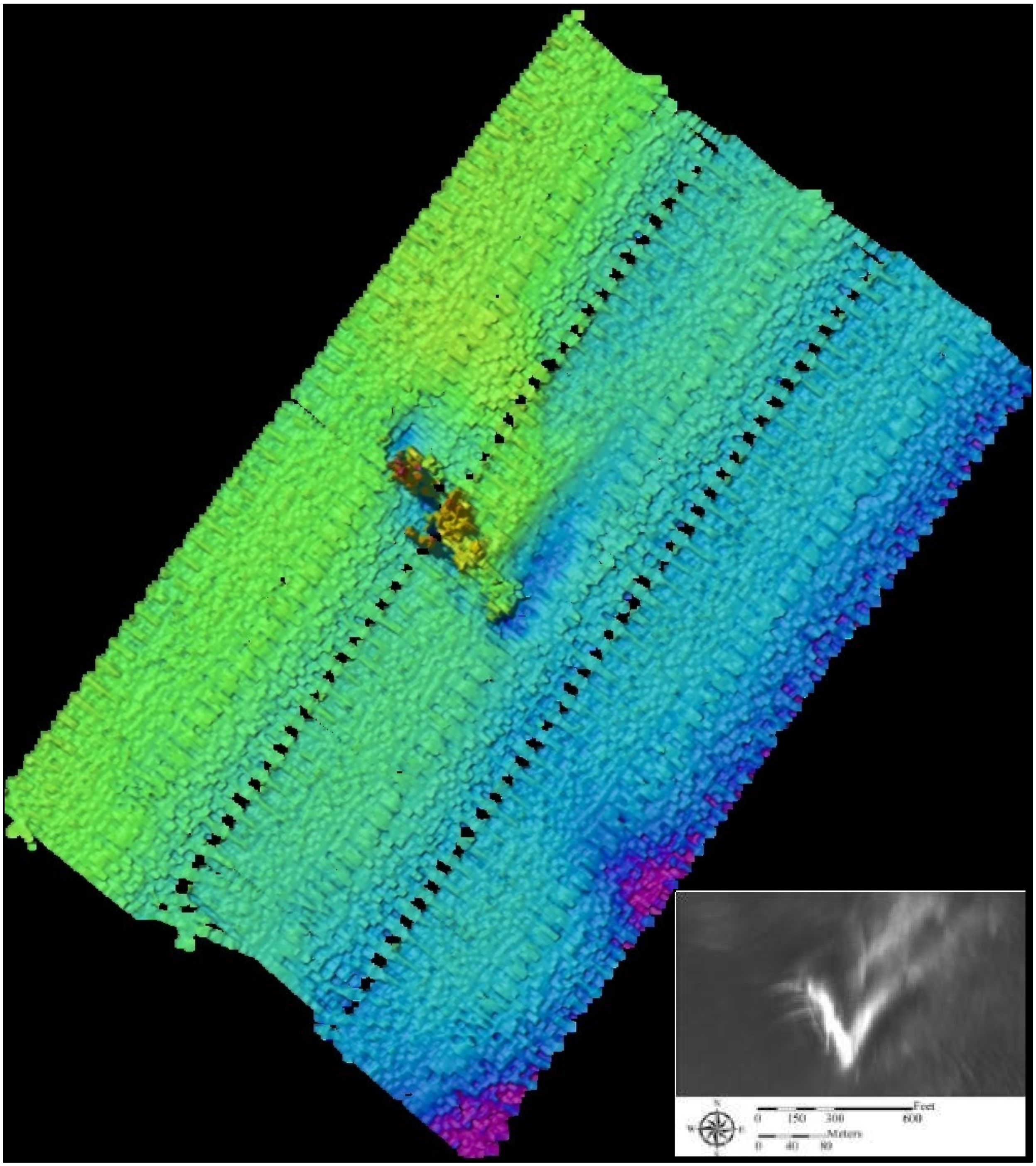


Figure 7-219 Anomaly recorded in 2011 of a suspected shipwreck site.
Source: SRI – ARL:UT – NOAA

Following sonar data acquisition, an ROV system was deployed to collected imagery on the site. PIXEL ROV, a system developed by Marine Imaging Technologies, was utilized for this follow-up survey. Video documentation of the site verified the mid-section aft toward the stern and propeller is considerably intact, totaling approximately 207 ft of largely intact structure, particularly at the main deck level. A bulkhead is observable as well as hull framing, providing substantial relief to the site of approximately 30 ft. Additional deck features are observable, including a winch and loading/unloading equipment. Aft of the bulkhead area is the fantail section. This section is broken away from the rest of the upright structure and is resting on its starboard side. The deck level of the fantail is therefore nearly vertical (Figure 7-219). Both the rudder and propeller are visible as well. The forward bow area constitutes approximately 109 ft of the entire wreck site and is much more disarticulated and indistinguishable in features. Relief is lowest in this portion. The maximum observed length is 318 ft and the maximum observed beam is 44 ft (Figure 7-220).

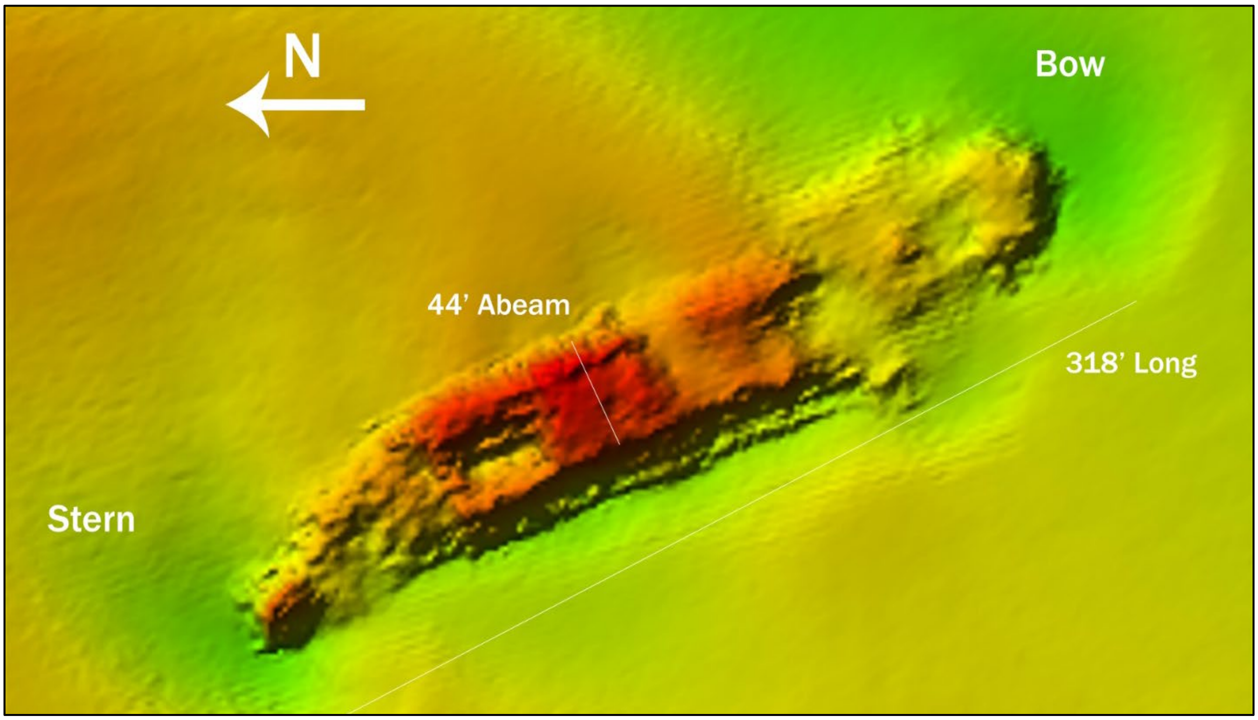


Figure 7-220 Multibeam sonar image of *Ljubica Matkovic* wreck site.
Source: NOAA R/V *Nancy Foster*

The observed dimensions suggest that this site, although the same visited in 1943, is actually *Ljubica Matkovic* and not *Nordal*. *Matkovic's* dimensions as built were 324 ft x 46.2 ft, almost identical to the acoustically derived observations from the wreckage of 318 ft x 44 ft. *Nordal* on the other hand is substantially larger at 365 ft x 57 ft. Even accounting for some margin of error this site is simply too small to be *Nordal*.

Additionally, visual observation of the vessel and its configuration align well with historic imagery of the ship. Although the dive was insufficient to complete a systematic survey or comprehensive model of the site, several hours of video and photography were recorded and some partial models obtained. When compared to historic photographs the general layout between historic images and photos of the wreckage are consistent. The main loading hatches in particular have a striking resemblance including the placement of derrick mounts and winches as well as athwartship beams and distinctive diagonal supports on the hatch combing. (Figure 7-221).

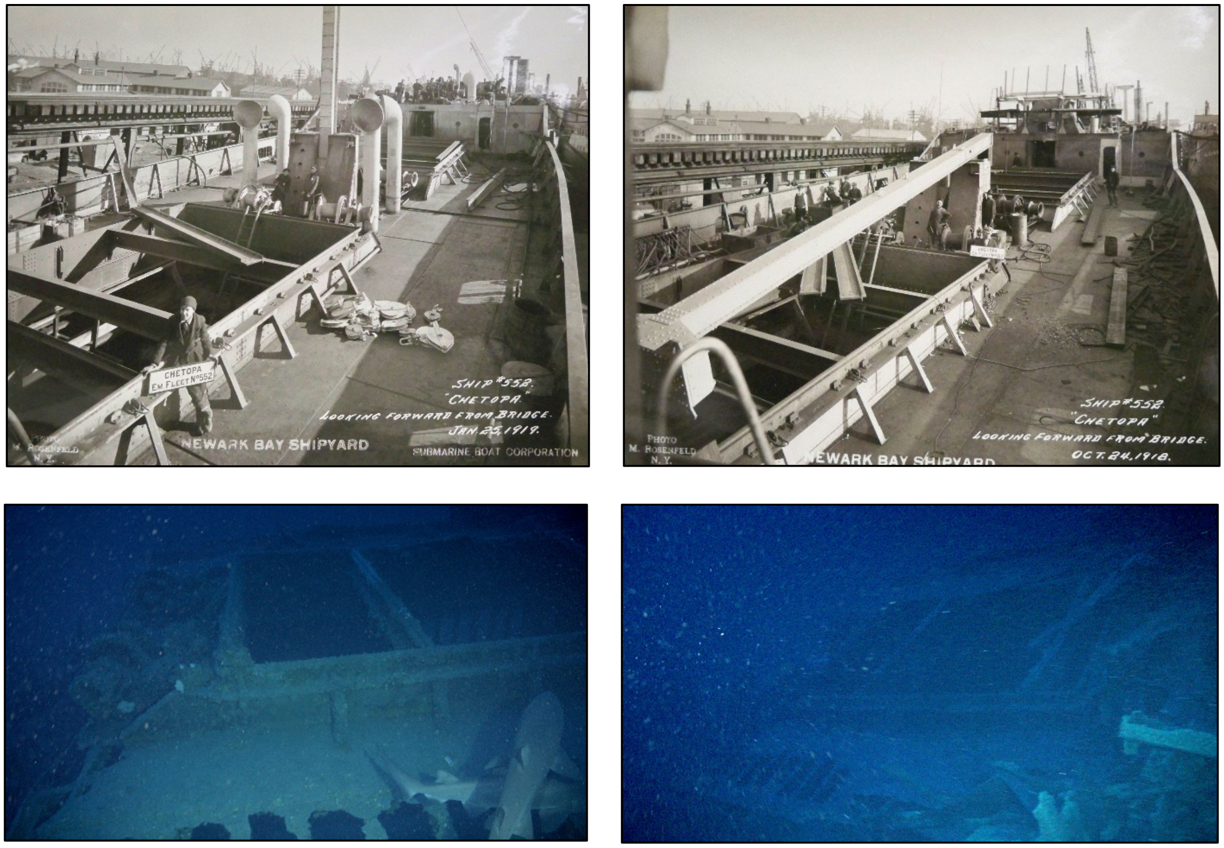


Figure 7-221 Historic Images of *Chetopa* (top) compared to images of the wreck site observed in 2018 (bottom).
Source: NARA via Rod Mather (top), NOAA photos (bottom)

There remains one prominent feature of the wreck that both firmly places this site into the context of war but also illuminates some deficits in the available historic record. On the fantail a large deck gun is still mounted in place pointing astern. A partial photogrammetric survey was completed in this area that provides a view of the fantail and armament arrangement (Figure 7-222). The presence of this feature allows for some certainty that this cargo ship was lost during wartime. However, there is a lack of historic evidence that *Ljubica Matkovic* was fitted with any defensive armament. This is not to say there is any evidence that suggests it was not fitted with a gun, rather there simply is not any reference that the researchers have found on this matter. A historical source that definitively states both the existence and type of armament would add even further evidence that this site is *Matkovic*. However, the lack of this is not unexpected. These vessels were routinely fitted with guns and tracking down a specific record of it can be difficult, particularly given that this was a Yugoslavian registered vessel at the time of loss.

The gun itself appears to be a Mark 12 4-inch 50-caliber deck gen, a type commonly affixed on merchant ships (USN, 1945:118). This is an American built weapon installed on a Yugoslavian ship. Again, while no specific record of the weapon installation has been found, there is some historical evidence to explain how and when this might have ended up on Ljubica Matkovic. When Axis powers invaded Yugoslavia on 6 April 1942, *Ljubica Matkovic* and 8 other Yugoslavian ships were moored in U.S. ports. They had all been tied up there for some time as they waited to see how the war in the Balkans would unfold (*The Baltimore Sun* 1941).

Secretary of State Cordell Hull was deeply concerned by the news of the invasion of Yugoslavian territory making the following statement with the full backing of Roosevelt:

> The barbaric invasion of Jugoslavia and the attempt to annihilate that country by brute force is but another chapter in the present planned movement of attempted world conquest and domination… Another small nation has been assaulted by the forces of aggression and is further proof that there are no geographical limitations or bounds of any kind to their movement for world conquest. The American people have the greatest sympathy for the nation which has been thus so outrageously attacked and we follow closely the valiant struggle the Jugoslav people are making to protect their homes and preserve their liberty. (*The Philadelphia Inquirer* 1941).

Secretary Hull went on to state that, "This Government with its policy of helping those who are defending themselves against would-be conquerors is now proceeding as speedily as possible to send military and other supplies to Jugoslavia." (*The Philadelphia Inquirer* 1941). The purpose of this statement was to apply the Lend-Lease bill to Yugoslavia to supply aid as was being done with Great Britain, albeit on a small scale. This was a statement following a meeting between Secretary Hull and Yugoslavian Ambassador Constantin Fotitch. After this meeting it was reported that the first shipment of military supplies would be transported by the 9 Yugoslavian ships in U.S. ports, among which was *Ljubica Matkovic* (*The Philadelphia Inquirer* 1941).

While not explicit evidence of a Mark 12 4-inch gun (Figure 7-223) being installed on *Matkovic*, this situation would account for a U.S. military weapon finding its way onto a Yugoslavian ship.

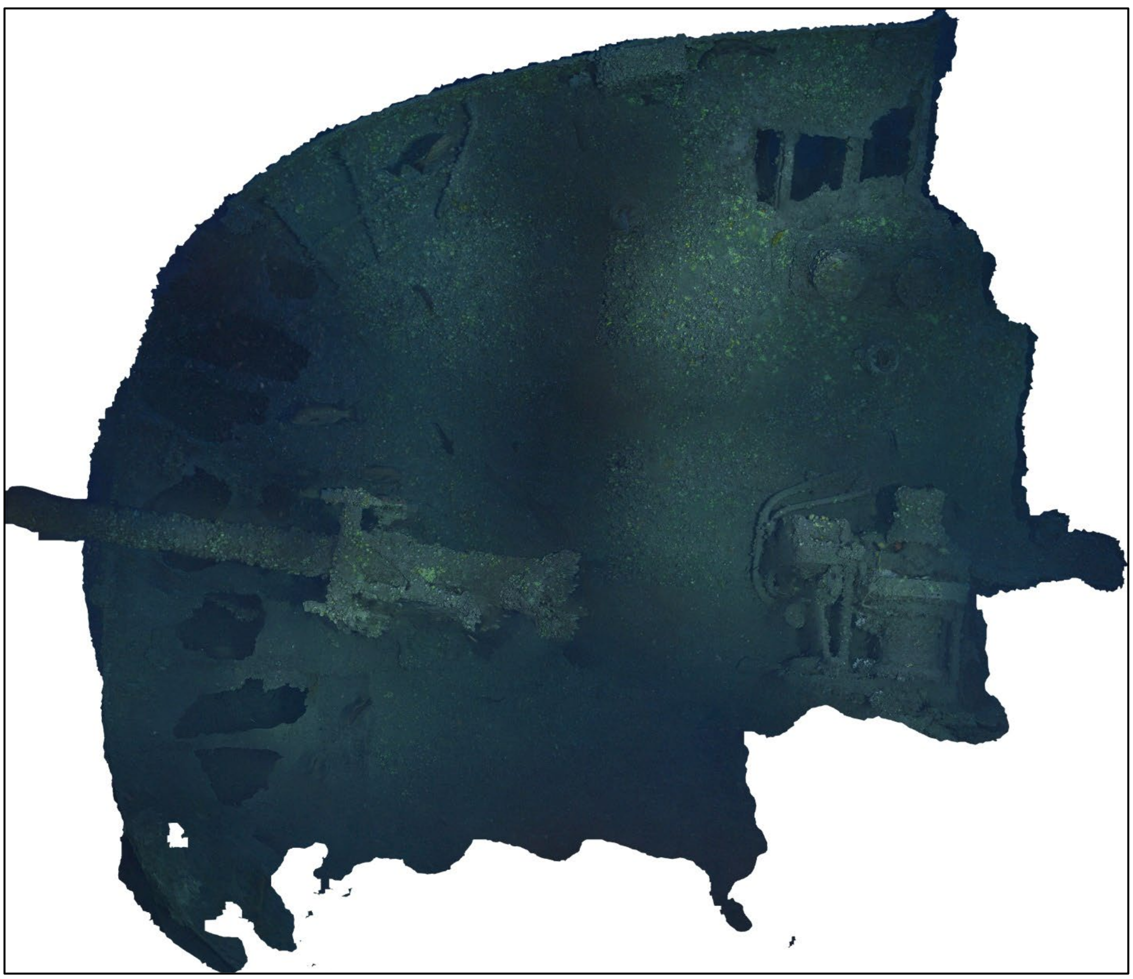


Figure 7-222 Partial orthomosaic of the stern section of suspected *Ljubica Matkovic* wreck site.
Source: Marine Imaging Technology – NOAA

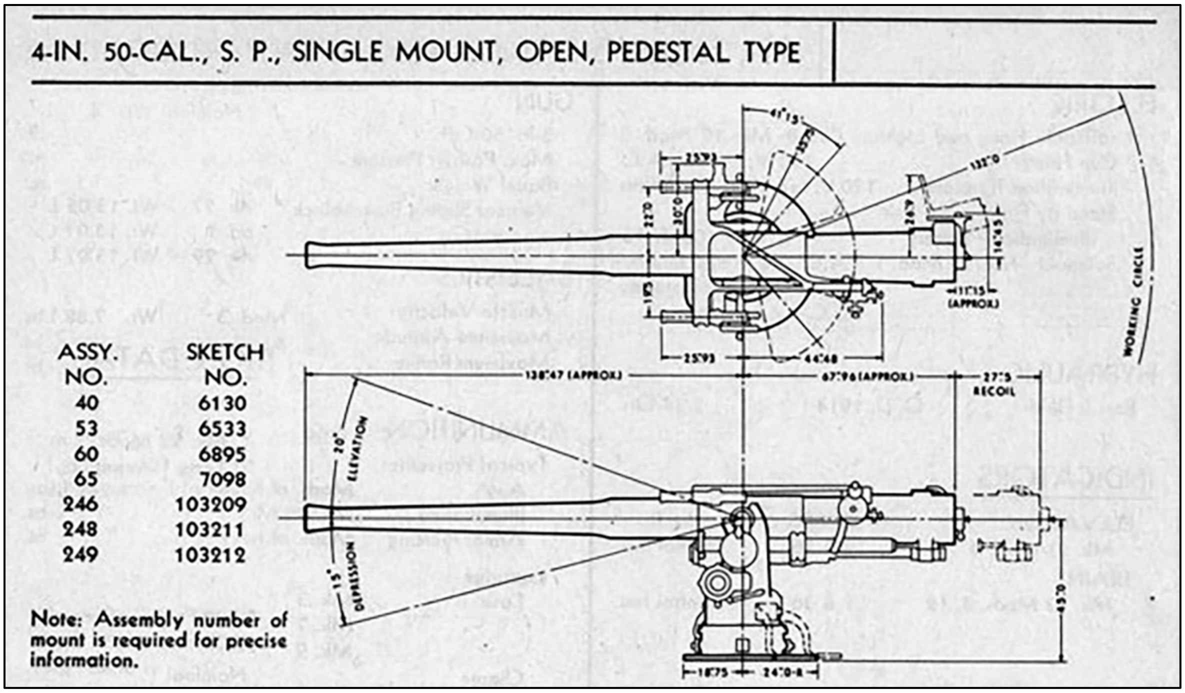


Figure 7-223 Plan and profile view of a Mark 12 4-inch 50-caliber deck gun.
Source: US Navy, 1945:118

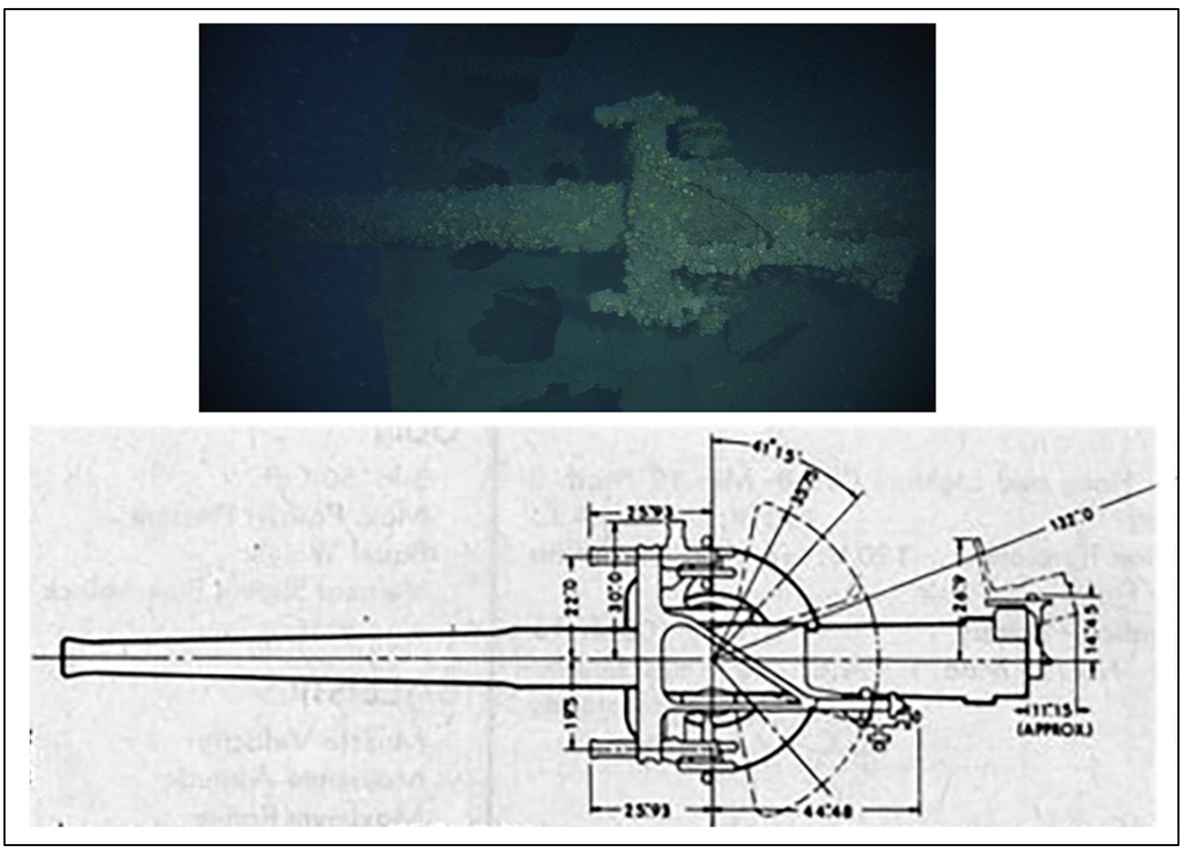


Figure 7-224 Comparison of the deck gun observed on the stern of the suspected *Ljubica Matkovic* and technical drawings of a Mark 12 4-inch 50-caliber deck gun.
Source: NOAA and US Navy, 1945:118

7.29 Malchace

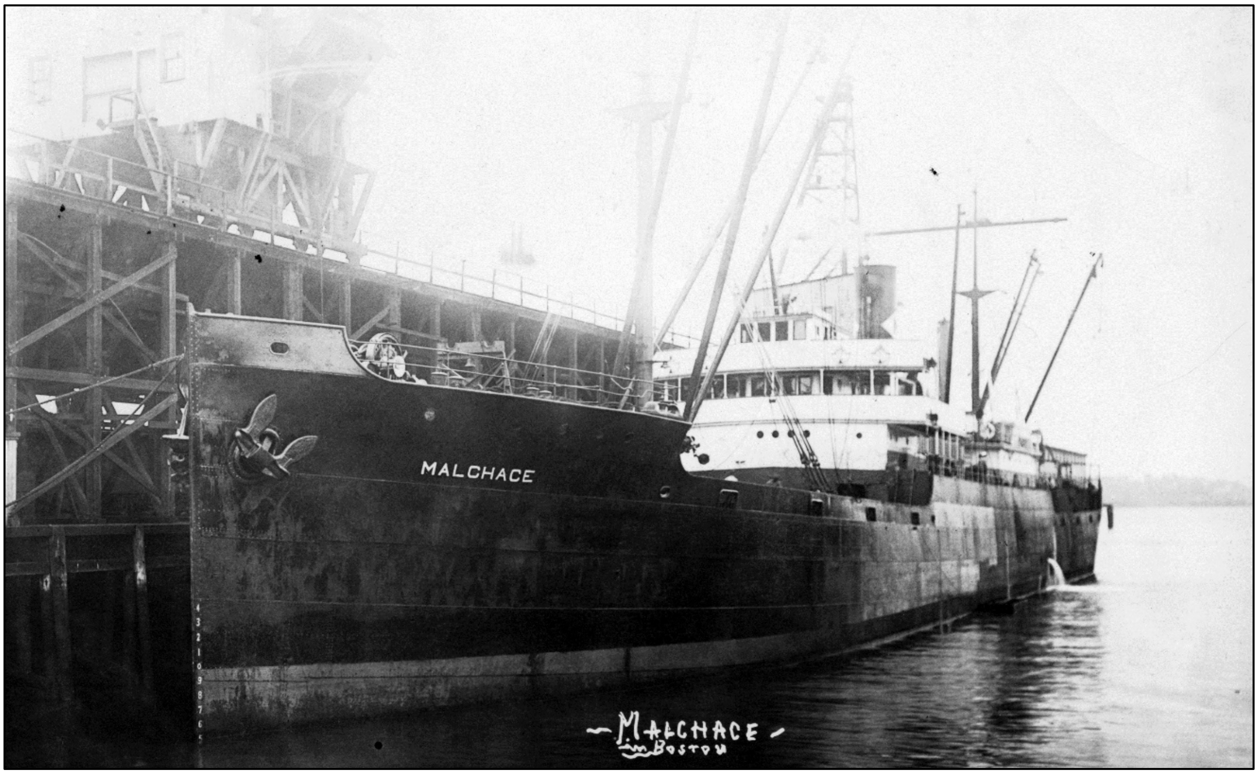


Figure 7-225 *Malchace* in port at Boston, Massachusetts.
Source: Mariners' Museum and Park

Table 7-31 Characteristics of *Malchace*

Characteristics	*Malchace*
Year of Build/Type/Hull #	1920/Cargo/106
Date Lost	9 April 1942
Position & Depth	44 miles E of Cape Hatteras, NC 200 ft
Ship Characteristics	Length: 333.8'; Breadth: 48.0' Depth: 24.9' Gross Tonnage: 3,516
Cargo	3,628 tons of soda ash
Survivors	28 (29 Total on board [1 dead])
Owner	Solvay Process Company, NY
Builder	Merrill-Stevens Ship Building Corp., Jacksonville, FL
Former Names	*Chickamauga* (1920-1929, USSB)
Lloyd's Register Details	Steel (Stl) hull, fitted for oil fuel, longitudinal framing, one deck, triple expansion steam engine.
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*160* (Georg Lassen)
Data Collected on Site	*Pisces* multibeam 2012; Side Scan 2013; R/V *Thomas Jefferson* multibeam 2016..

7.29.1 History

Malchace, built in 1920 by Merrill-Stevens Ship Building Corporation in Jacksonville, Florida, was originally named *Chickamauga* (Table 7-28 and Figure 7-225, above). The vessel was under the control of the USSB until it was sold in 1929 to C.D. Mallory & Co of New York. It was renamed *Malchace* and operated out of Wilmington, Delaware (Figure 7-226). In 1941, the vessel was again transferred, this time to the Solvay Process Company of New York, but remained registered in Delaware (Lloyds Register of Shipping 1930-1942; Farb 1985:87).

In early April, 1942, *Malchace* was transiting alone from Baton Rouge, Louisiana to Hopewell, New Jersey with a cargo of soda ash. In the early morning hours, U-*160* attacked the unarmed freighter. *Malchace* was struck by a torpedo on the port side, just forward of the No. 4 hold. The captain, Henry F. Magnusdal, stopped the engines. U-*160*, under the command of Georg Lassen, surfaced and circled the ship before sending second torpedo into the port side of *Malchace*. The explosion tore a hole through the engine room bulkhead, and the space quickly flooded. Magnusdal ordered the crew to abandon ship, and all but one of the 29 crewmembers made it safely to the lifeboats. *Malchace* sank a few hours later. The lifeboats were spotted later that morning by passing Mexican tanker *Faja de Oro* and the survivors were taken to Norfolk, Virginia (Moore 1983:181; Farb 1985:87-89; DIO 1987:201-216; Hickam, Jr. 1989:127-128; Blair 1996:520; Wynn 1997:123).

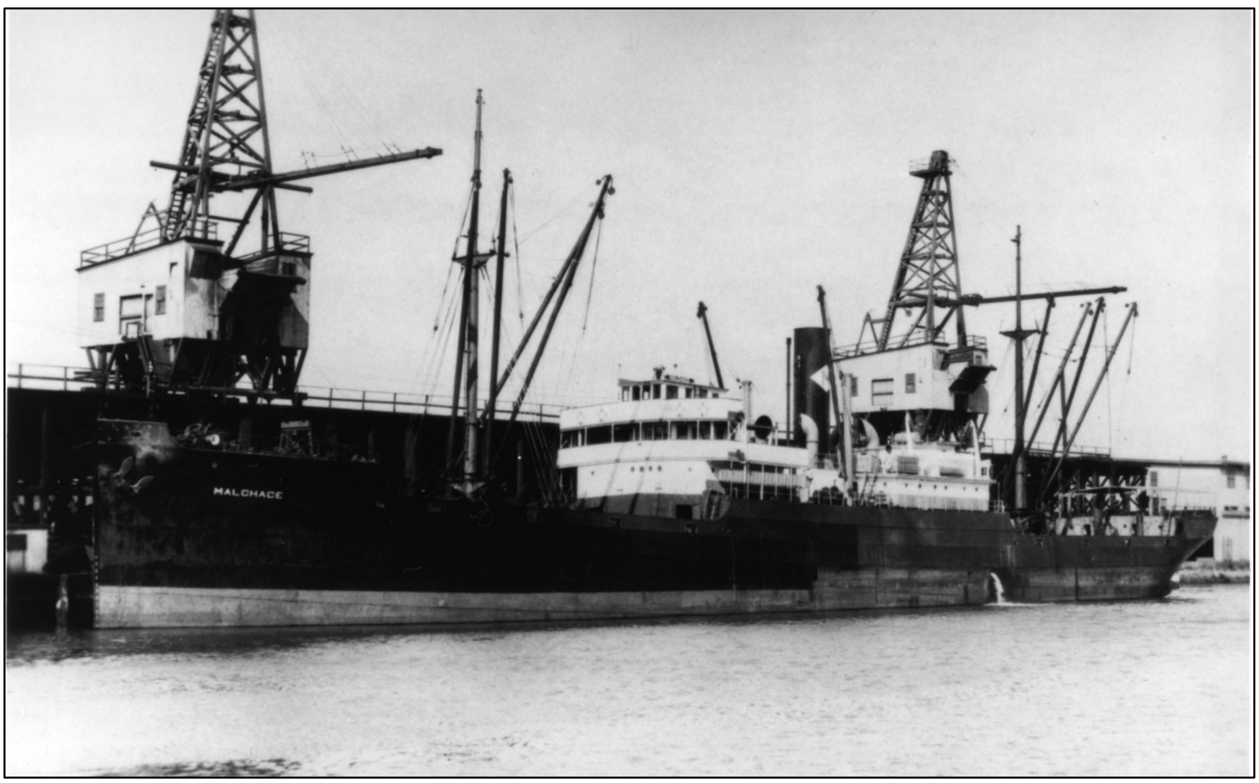


Figure 7-226 *Malchace* at dock.
Source: Steamship Historical Society of America

7.29.2 Archaeological Site Description

Based upon *Faja de Oro's* reported position of *Malchace's* single lifeboat, the US Coast Guard and Navy felt the vessel may have sunk in shallow enough water to pose a hazard to navigation. The area off Hatteras was searched, and a target was located which was later determined to be the remains of

Tamaulipas. Thus, the US Navy and Coast Guard were unable to locate the remains of *Malchace* in shallow water following the war (DIO 1944:26-27). Nonetheless, the vessel's location was well known by at least 1985, as it was well described in Roderick M. Farb's survey of vessels visited by North Carolina sport divers.

In 2013, the team collected high-resolution remote sensing data (Figure 7-227). The water depth and orientation of the site, however, made it very difficult to scan with a towed sonar array, resting as it was in over 200 ft of water in the Gulf Stream. As a result, only the lower frequency (500 kHz) band of the Klein 3000H sonar was effective at imaging the entire vessel. Due to logistical and operational constraints, diving operations were not conducted at *Malchace*. The measured dimensions (including observed debris fields) were 362.1 ft long and 54.7 wide.

NOAA R/V *Thomas Jefferson* surveyed the site with multibeam in 2016 (Figure 7-228). This imagery functioned as an effective ground-truthing of the vessel's location, and demonstrated that there were no large areas of associated debris beyond the linearly-arranged main site area.

The *Malchace* wreck site is mostly contiguous and oriented SE to NW, bow to stern. The wreck is lying on its extreme port side and is almost upside down with the hull mostly intact. The boilers and machinery are visible amidships. The stern and amidships area, including the boilers, provide the highest forms of relief on the wreck site. The site has an overall length of 359.43 ft, with an overall site scatter of approximately 80.49 ft at beam. Observed beam measurement is approximately 35.59 ft.

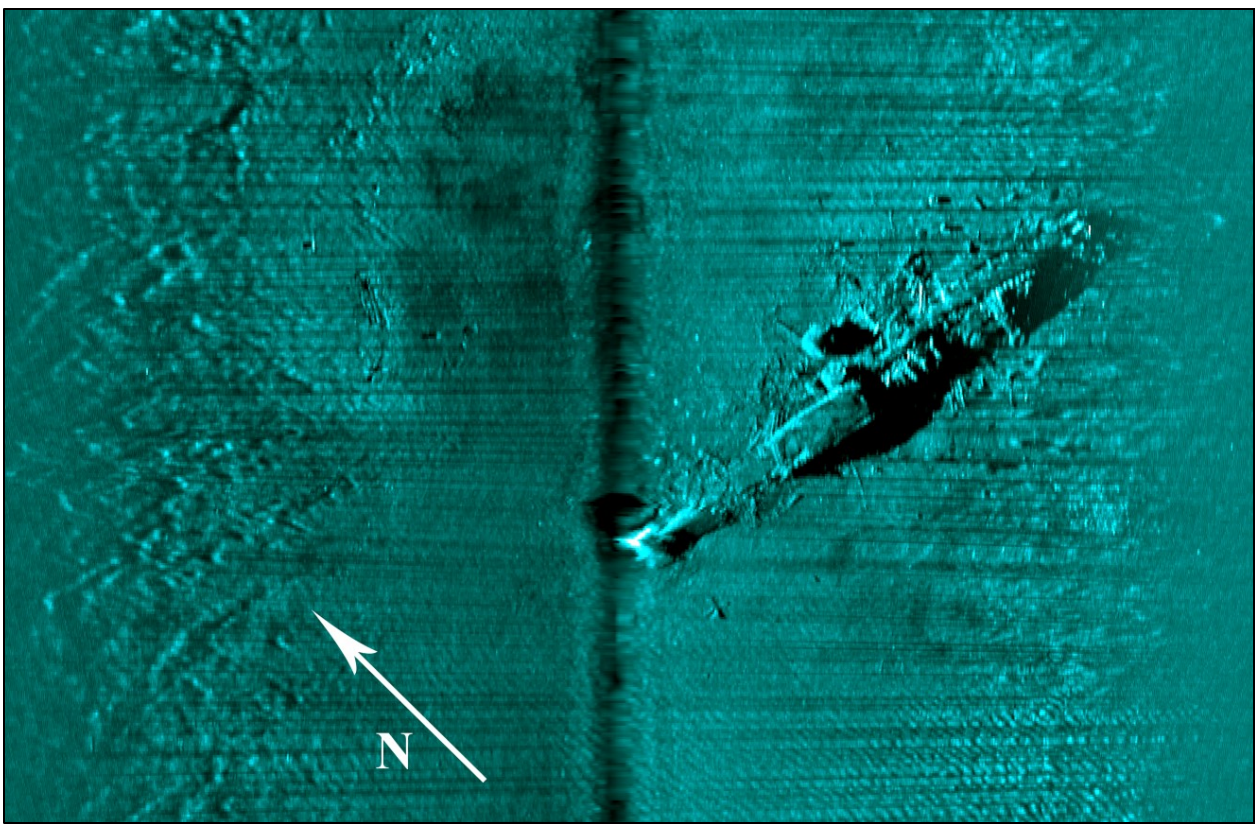


Figure 7-227 Low frequency (500 kHz) side scan sonar image of *Malchace*.
Source: NOAA

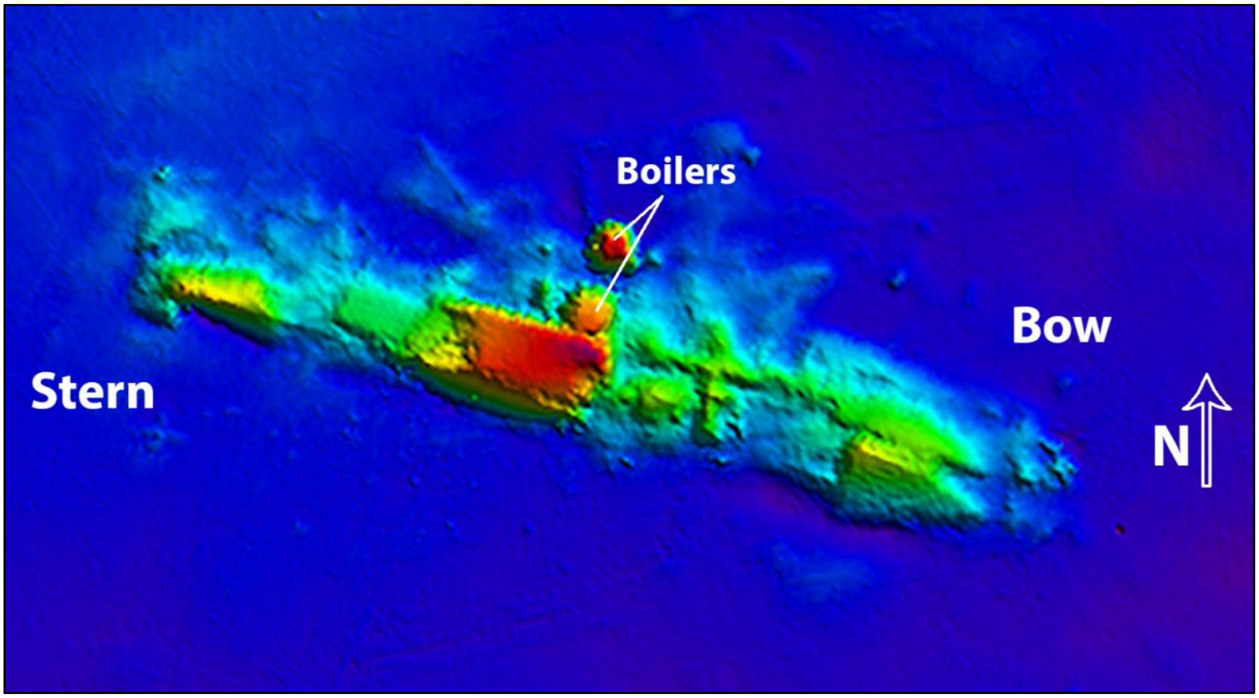


Figure 7-228 Multibeam survey of the site of *Malchace* from NOAA R/V *Thomas Jefferson* 2016.
Source: NOAA

7.30 Manuela

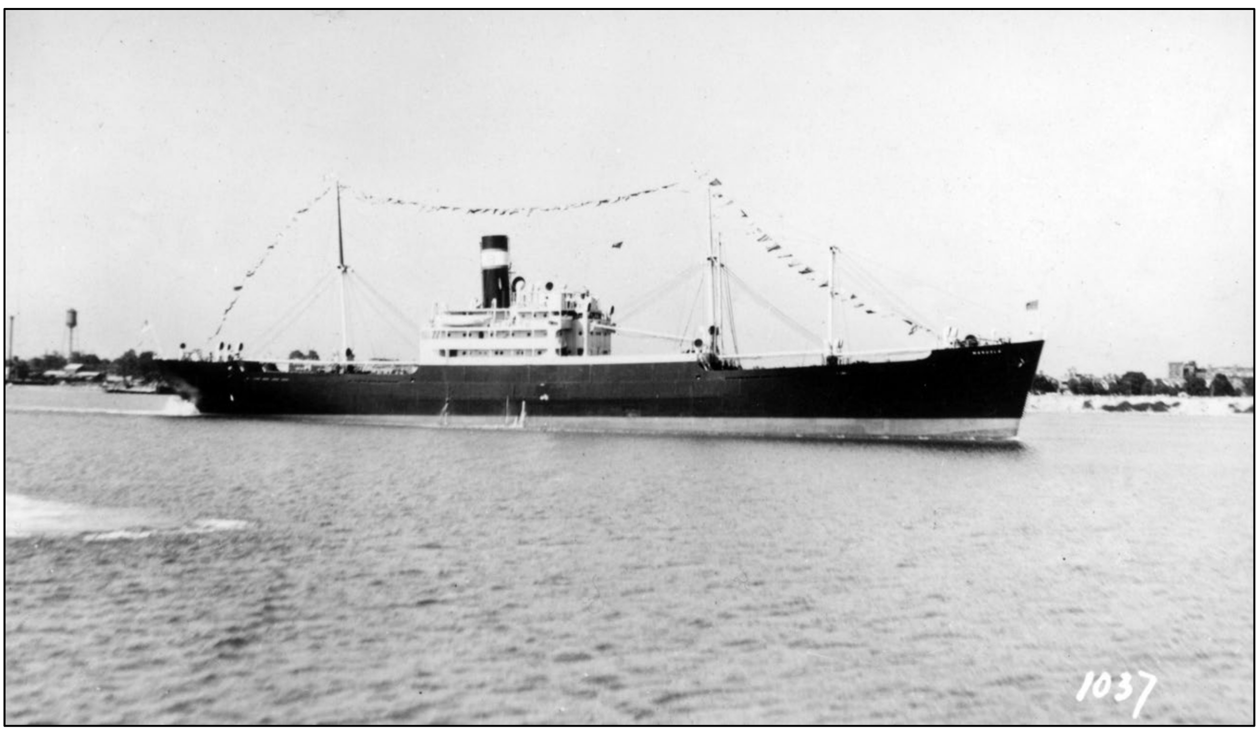


Figure 7-229 *Manuela* in port.
Source: Steamship Historical Society of America

Table 7-32 Characteristics of *Manuela*

Characteristics	*Manuela*
Year of Build/Type/Hull #	1934/Freighter/358
Date Lost	25 June 1942 (attacked on 24 June and sunk the following day).
Position & Depth	44 miles E of Cape Hatteras, NC 160 ft
Ship Characteristics	Length: 393.8';Breadth: 55.3';Depth: 28.1' Gross Tonnage: 4,772
Cargo	6,500 tons of sugar
Survivors	41 (43 Total on board [2 dead])
Owner	A.H. Bull Steamship Company Inc., New York, USA
Builder	Newport News Ship Building and Dry Dock Company, Newport News, VA, USA
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, steam screw, solid bronze propeller, two decks, fitted for oil fuel, two steam turbines.
Port of Registry/Flag	New York, NY/USA
Sunk by	U-*404* (Otto von Bülow)
Data Collected on Site	ADUS 2011; photo and video 2013.

7.30.1 History

Manuela was built in 1934 by Newport News Ship Building and Dry Dock Company in Newport News, Virginia (Table 7-32 and Figure 7-229, above). *Manuela* was delivered to A.H. Bull Steamship Company, Inc. on 2 June 1934 who operated it out of New York, New York. This was the second ship delivered to A.H. Bull in 1932. The first was an identical sister ship, *Angelina*, also built by Newport News Shipbuilding. Since the cessation of WWI shipbuilding programs, few vessels were being built in the United States. At the time of their construction, these two ships were the first large freighters built in an American Yard in 12 years. *Manuela* was 393.8 ft in length, 55.3 ft abeam, with a depth of 28.1 ft, and had a single screw, with oil-fired steam turbines. A.H. Bull Steamship Company ran a regular route between New York and Puerto Rico, and it was this service that *Manuela* was engaged in for the entirety of its career (The Log, 1934:11).

In late June 1942, *Manuela* was northbound from San Juan, Puerto Rico to New York, New York carrying a cargo of 101,000 bags of raw and refined sugar (Figure 7-230). On 24 June 1942, *Manuela* was awaiting escort support from Beaufort, North Carolina with a convoy of 11 ships. The escort compliment consisted of the USCGC *Dione*, along with HMT *Norwich City* and two small Coast Guard patrol craft CG #*408* and CG#*252*. Once assembled the convoy headed north toward the treacherous waters off Cape Hatteras. However, just after rounding Cape Lookout, North Carolina, the convoy was spotted by U-*404*, captained by Otto von Bülow.

U-*404* under von Bülow's command had just sunk *Ljubica Matkovic* the previous day and were searching for more prey. USCGC *Dione* picked up U-*404* on sonar and executed a depth charge attack, which was evaded by von Bülow. U-*404* maneuvered into position and fired a single torpedo, striking the vessel *Nordal*. While HMT *Norwich City* moved in to assist survivors of the *Nordal* attack, another torpedo was launched, striking the starboard side amidships of *Manuela*. The torpedo exploded and 2 men were killed in the blast while the other crewmembers were saved. Further attempts on the convoy were made by U-*404*, but von Bülow ultimately decidedly to flee without further success given the effectiveness of

Dione's countermeasures and patrolling aircraft. Surviving crew from *Nordal* and *Manuela* were delivered to Morehead City (DIO 1944:14; DIO 1987:399; Moore 1983:183; Hickam, Jr. 1989:270; Blair 1996:607; Wynn 1997:266).

Twenty-three crewmen were able to launch the No. 2 lifeboat while 17 others jumped overboard swimming to life rafts. After 30 minutes, the men in the lifeboat were towed by USCGC-*408* to the armed trawler HMS *Norwich City* and taken to Morehead City, North Carolina. The 17 men on the life rafts were recovered by US Coast Guard vessel USCGC-*483* and taken to the Naval Operating Base in Norfolk, Virginia. The following day, while being taken in tow, a seriously injured crewman was found still aboard *Manuela*. He was delivered safely to Morehead City (Moore 1983:183).

Nordal sunk quickly, but for a time it appeared as though *Manuela* might be saved. Once survivors were accounted for, *Manuela* was taken undertow for a time before ultimately sinking. There are some conflicting historical accounts concerning towing of the vessel. The US Coast Guard Cutter *Gentian* survey reports that *Manuela* was taken in tow by *Norwich City* and ultimately sunk at 1940 hours EWT. Whereas, the Eastern Sea Frontier War Diary (DIO 1942) states that the aircraft apparently observed tugboat *P.F. Martin* with *Manuela* in tow as late as 1600 hours EWT on 25 June 1942. In this instance, the ESF war diary is the more reliable source (DIO 1944:14; Moore 1983:400).

Figure 7-230 *Manuela* 22 January 1942.
Source: Steamship Historical Society of America

7.30.2 Archaeological Site Description

Manuela rests at 160 ft, southeast of Ocracoke, North Carolina. The team investigated *Manuela* in 2010, 2011, and 2013. A 455 kHz 6-mm resolution multibeam survey was conducted in 2011; the multibeam data generated a georectified image for GIS and diagnostic purposes and provided detailed positioning of the wreck and its features (Figure 7-231 through Figure 7-234). The wreck presented several intact sections with high relief, but the majority was disarticulated. In-water documentation at this site consisted primarily of photo/video documentation (Figure 7-235 through Figure 7-240).

The wreck was lying on it starboard side and was broken into three main sections of high relief, the bow, a large amidships hull section, and stern. The bow was broken up and lying hard on its starboard side and the anchor windlass and port side anchor were also visible. The amidships and bow sections were nearly turtled, but not entirely. The stern section was also tilted on its starboard side with the rudder partially buried and propeller blades sticking up from the wreckage. The remains of the engine and condensers were present at the aft end of the amidships break area and were scattered.

The site remains were distributed on the seabed over an area 401 ft long by 163 ft at the wide point of the debris field amidships. The amidships and stern sections were generally in alignment but they were separated and twisted. The bow section extended aft 130 ft. The bow section was offset from the amidships section by 37 ft to the north. The intact amidships section was 111.5 ft long and a broken down component extended a further 61 ft. There was then a 23-ft gap where the vessel was very broken up around the engineering area, before the stern section that extended for 95.5 ft. The highest points of relief were at the bow: 18 ft, stern: 25.5 ft, and aft-most portion of the amidships section: 21 ft.

A static temperature logger also was placed on site. A number of sites in the study area had data loggers placed on them in 2010 (*Manuela*, *E.M Clark*, *Dixie Arrow*, U-*701* and *Keshena*). Long-term temperature data on such sites will aid in associated biological- or ecosystem-based assessments, as well as providing a valuable parameter for ferrous metal corrosion potential analysis. The only data logger that was recovered was the one placed on *Manuela*. The remaining data loggers were not relocated on subsequent trips to the wrecks. The data logger placed on *Manuela* recorded temperature every 30 minutes from 20 June 2010 through 11 December 2012 (Figure 7-241).

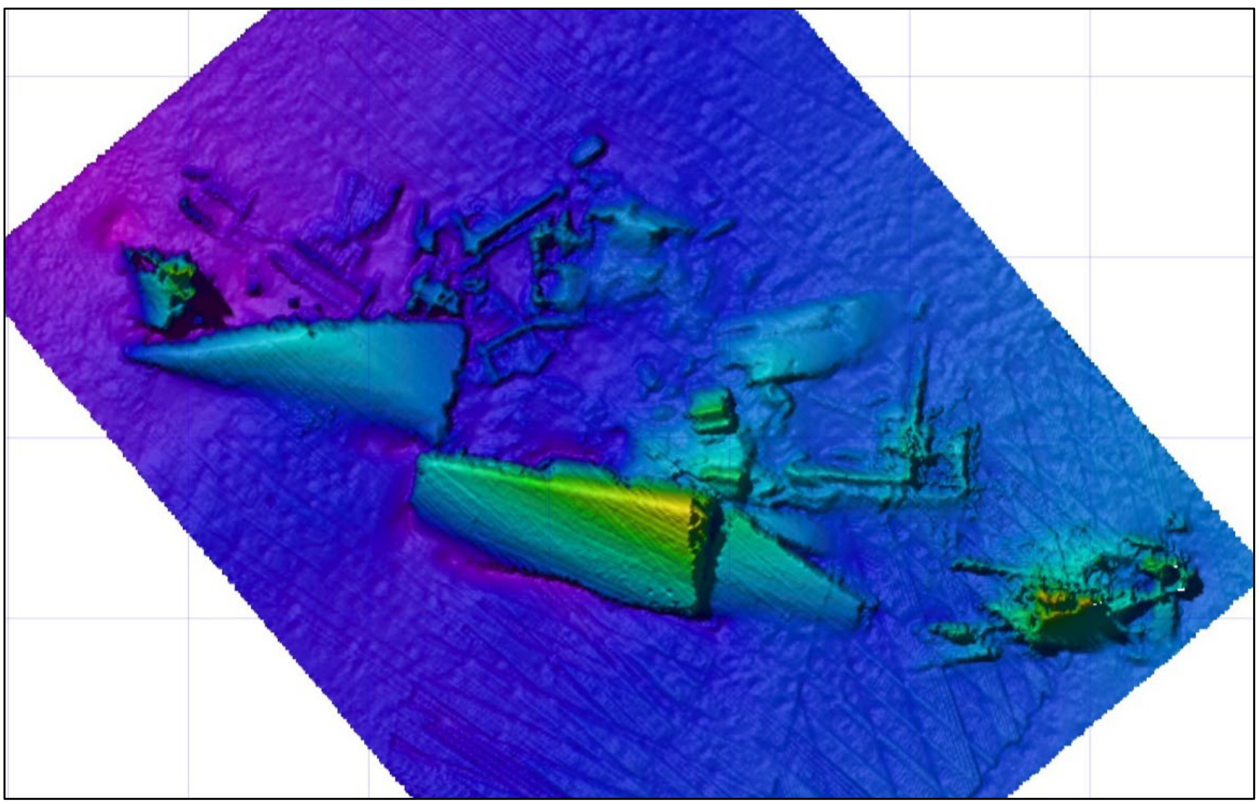


Figure 7-231 Multibeam survey of *Manuela* wreck site.
Source: ADUS

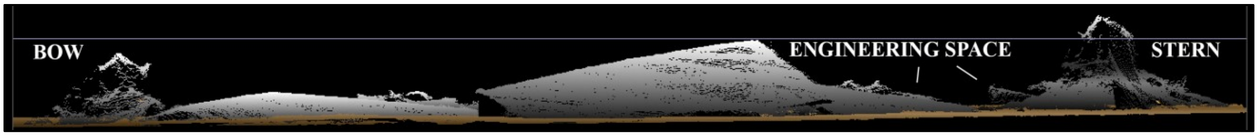


Figure 7-232 Profile view from the port side of *Manuela*.
Source: NOAA/ADUS

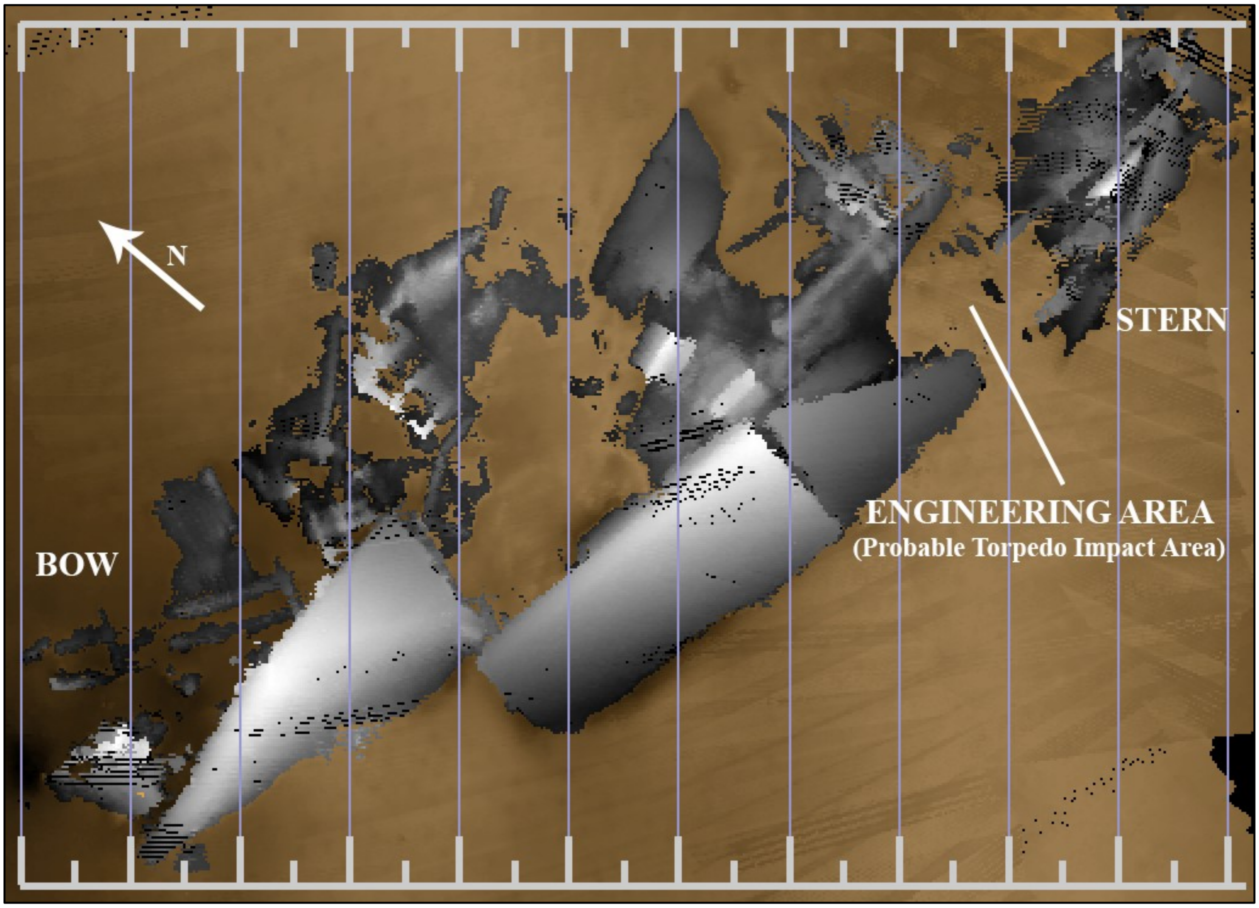


Figure 7-233 Plan view of *Manuela* wreck site; grid lines are spaced at 10 m.
Source: NOAA/ADUS

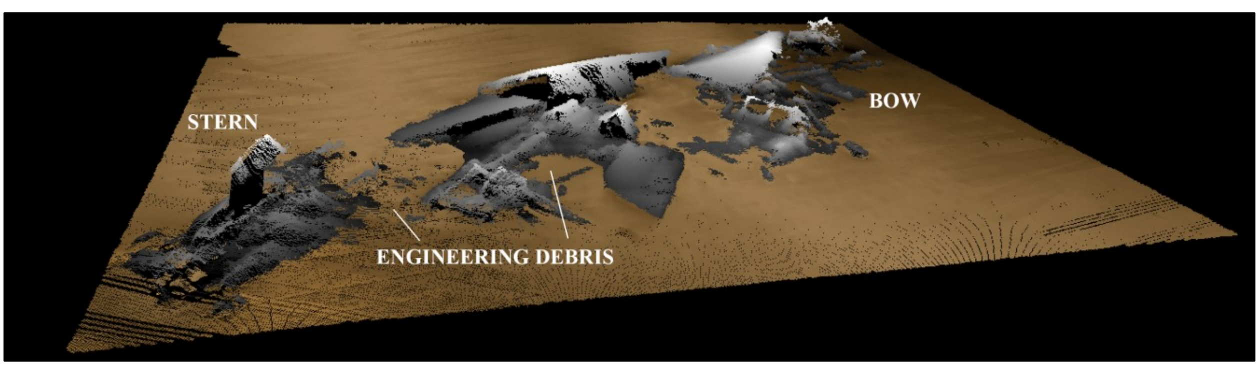


Figure 7-234 Isometric view of *Manuela* wreck site.
Source: NOAA/ADUS

Figure 7-235 Diver collecting video on *Manuela* around engineering wreckage.
Source: NOAA

Figure 7-236 Stern section of *Manuela*.
Source: NOAA

Figure 7-237 Propeller and stern section of *Manuela*.
Source: NOAA

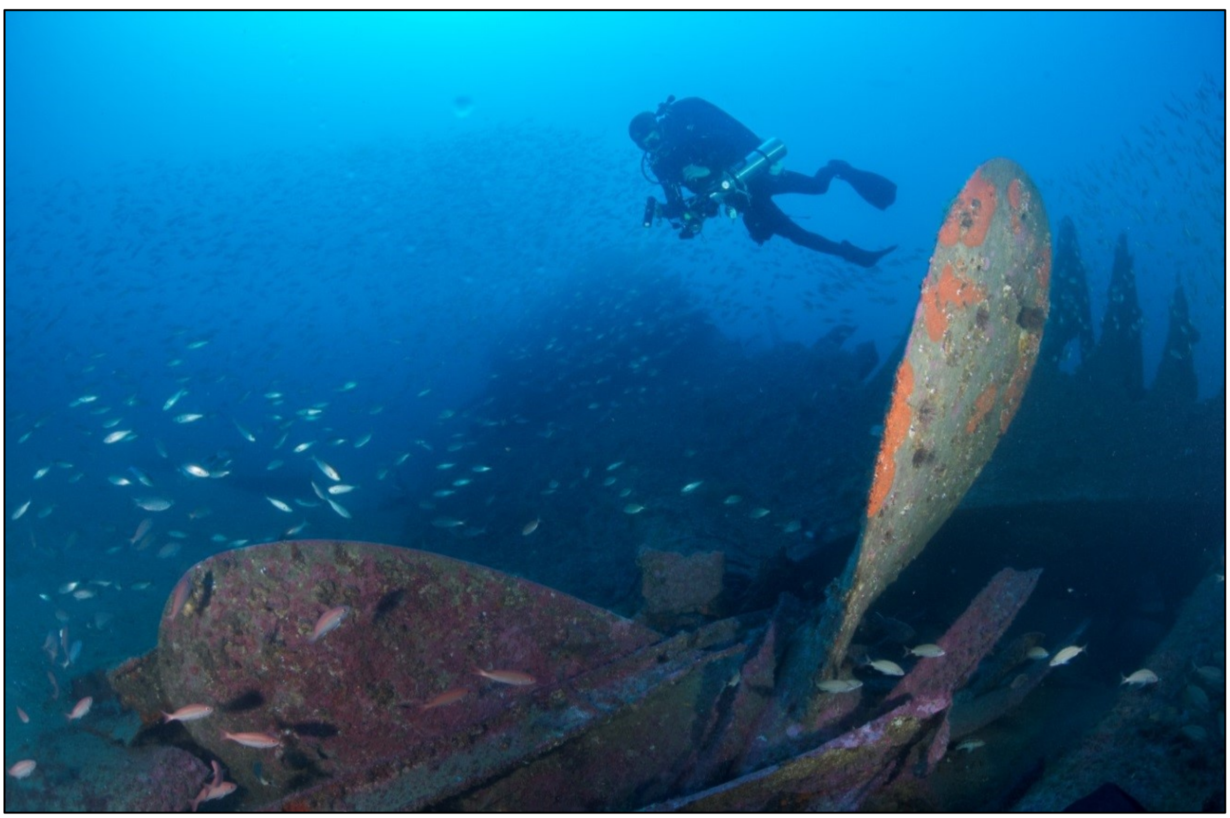


Figure 7-238 Diver inspecting the propeller on *Manuela*.
Source: NOAA

Figure 7-239 Divers examining the wreck of *Manuela* amidships.
Source: NOAA

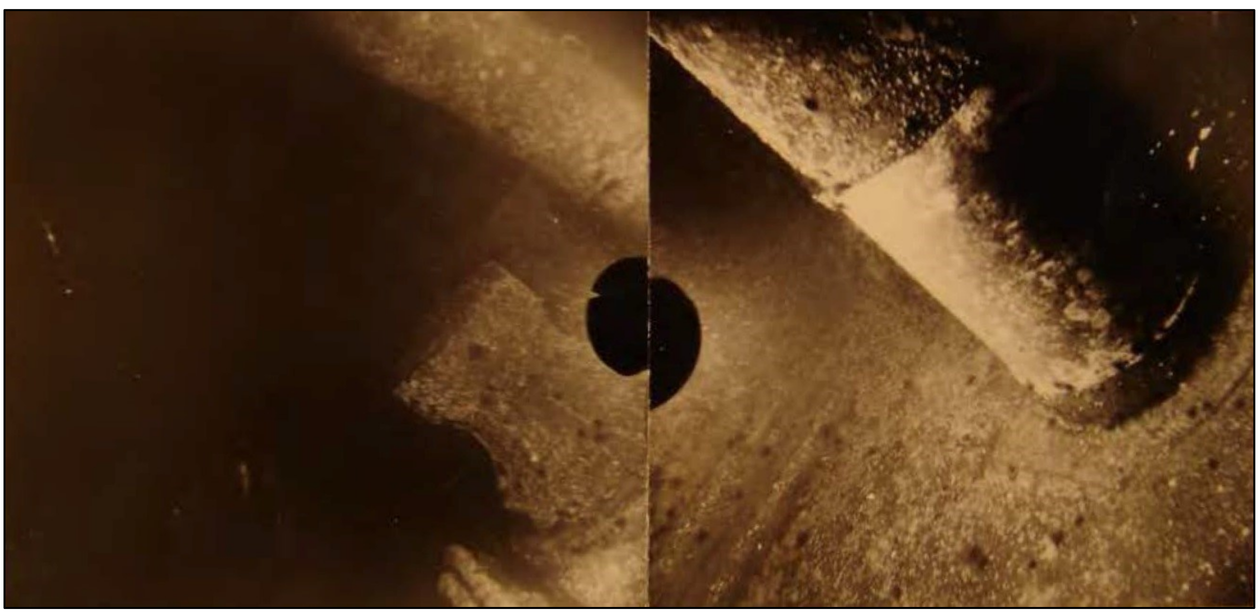


Figure 7-240 Capstan on the poop deck of *Manuela* collected during USCGC *Gentian* survey.
Source: DIO 1944

Figure 7-241 Temperature data on *Manuela* from 20 June 2010 – 11 December 2012.
Source: NOAA

7.31 Marore

Figure 7-242 *Marore* in port, date and location unknown.
Source: The Mariners' Museum and Park

Table 7-33 Characteristics of *Marore*

Characteristics	*Marore*
Year of Build/Type/Hull #	1922/Freighter/
Date Lost	27 February 1942
Position & Depth	39 miles NE of Cape Hatteras, NC 130 ft
Ship Characteristics	Length: 550.3' Breadth: 72.2' Depth: 43.9' Gross Tonnage: 8,215
Cargo	23,000 tons of iron ore
Survivors	39 (39 Total on board [0 dead and 39 survivors])
Owner	Ore Steam Ship Corporation, New York, NY
Builder	Bethlehem Ship Building Corporation Ltd., Sparrow's Point, MD
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, twin screw, longitudinal framing, fitted for oil fuel, two steam turbines.
Port of Registry/Flag	New York, NY/USA
Sunk by	U-*432* (Heinz-Otto Schultze)
Data Collected on Site	Side Scan Sonar 2013.

7.31.1 History

Marore was built in 1922 by Bethlehem Shipbuilding Corporation of Sparrow's Point, Maryland, for Guaranty Trust Company of New York but was sold to the Ore Steamship Corporation (Table 7-33 and

Figure 7-242, above). The ship was part of a fleet of near sister ships built by Bethlehem Shipbuilding that included several other ships lost as a result of WWII activity off North Carolina and Virginia, including: *Venore*, *Chilore* and *Santore. Marore* was a notable in that it was constructed as a combination ore carrying and oil carrying design, allowing it to carry a range of cargoes. According to Lloyd's Register, the vessel measured 550.3 ft in length, was 72.2 ft wide with a depth of 43.9 ft (other historical sources list the vessel as having been 571.5 ft long). The ship was equipped with twin screws, and had two oil-fired steam turbines. At the time *Marore* was constructed the vessel was outfitted with the latest in marine technology, including superheated boilers and new radio equipment (Figure 7-243) (DOC 1922:45; The Marine Journal 1922:21).

Marore made headlines in its first year of service. On 19 July 1942, *Marore* set a new record for the largest individual cargo to transit the Panama Canal by carrying 20,000 tons of iron ore from Cruz Grande, Chile to New York (Figure 7-244). This record stripped a sister ship, *Bethore*, of the title and would stand for nearly 6 months until it was reset by Standard Oil Tanker *William Rockefeller* with 22,000 tons of crude on 27 October 1922 (*Nautical Gazette* 1922:244; *Weekly Commercial News* 1922:9).

For 20 years, *Marore* engaged in the same trade, alternately carrying oil or ore between New York and South American ports. Like any working ship, *Marore* had an occasional allision; navigation of the Panama canal proved particularly hazardous. On 9 July 1928, with an overloaded cargo and poor steering, *Marore* struck the east bank of the Empire reach cut in the Panama Canal doing $6,000 in damage. Just a few months later on 29 September 1928, *Marore* again ran aground on the west bank of the canal causing $10,500 in damage. Finally, on 10 May 1936, near Balboa, Panama *Marore* was slightly damaged in a collision with the USS *Minneapolis* (Annual Report of the Governor of the Panama Canal (GPC) 1928:30; *New York Times* 1936).

Northbound, Captain Charles E. Nash was carrying a cargo of 23,000 tons of iron ore from Chile to Baltimore, Maryland. Nearing the end of a long voyage, Nash and *Marore* had just passed Cape Hatteras and were off Wimble Shoals on 27 February 1942. It was still early in the Battle of the Atlantic along America's coast and effective convoys had not yet been established. Consequently, *Marore* was traveling alone. Meanwhile U-*432*, commanded by Heinz-Otto Schultze, was in the area seeking targets. Just after midnight, without warning, a torpedo struck on the portside amidships resulting in a violent explosion, knocking 3rd assistant engineer E.B. Stahl off his feet and waking the crew, all but 9 of whom were asleep. Within 10 minutes the entire crew had awoken, launched lifeboats and had abandoned the vessel. After clearing the sinking hulk, the survivors watched as the U-boat began shelling the sinking remains of *Marore*. Captain Nash estimated that nearly 90 percent of the rounds struck *Marore* and the radio operator, Christopher Core, said the tracer rounds resembled a "beautiful display of fireworks" (*New York Times* 1942e:1,8). All 39 crew made it safely away from the sinking freighter. Two lifeboats containing 25 survivors drifted for 12 hours before they were spotted and rescued by passing tanker *John D. Gill* and taken to Norfolk, Virginia. The other 14 survivors rigged a sail and set out for shore. After 14 hours they were picked up by the Coast Guard and ferried ashore in surfboats by the Coast Guard Station at Big Kinnakeet, North Carolina (Figure 7-245; *New York Times* 1942f:1,8; Moore 1983:185; Wynn 1997:285).

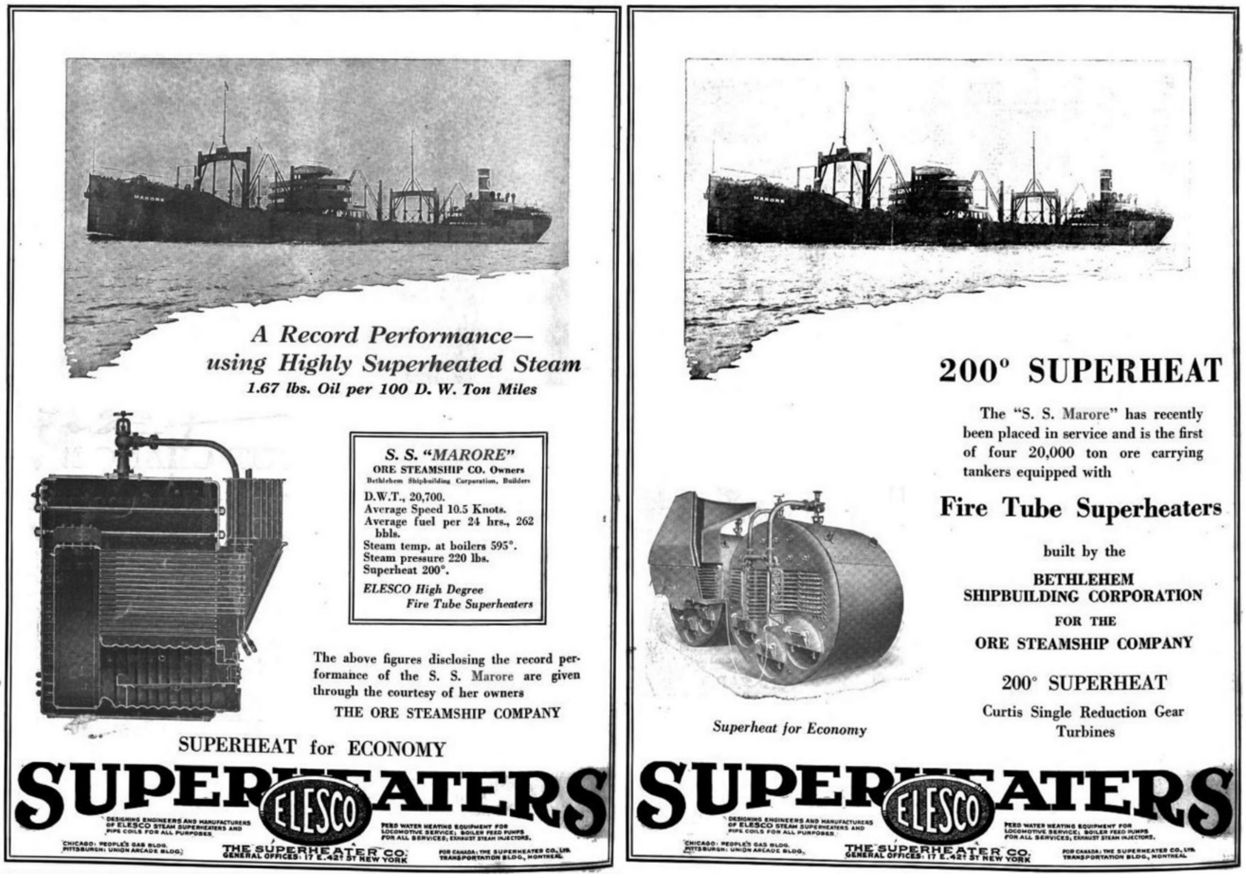


Figure 7-243 Advertisements showcasing the state of the art technology installed aboard *Marore*.
Source: Marine Engineering, 1922

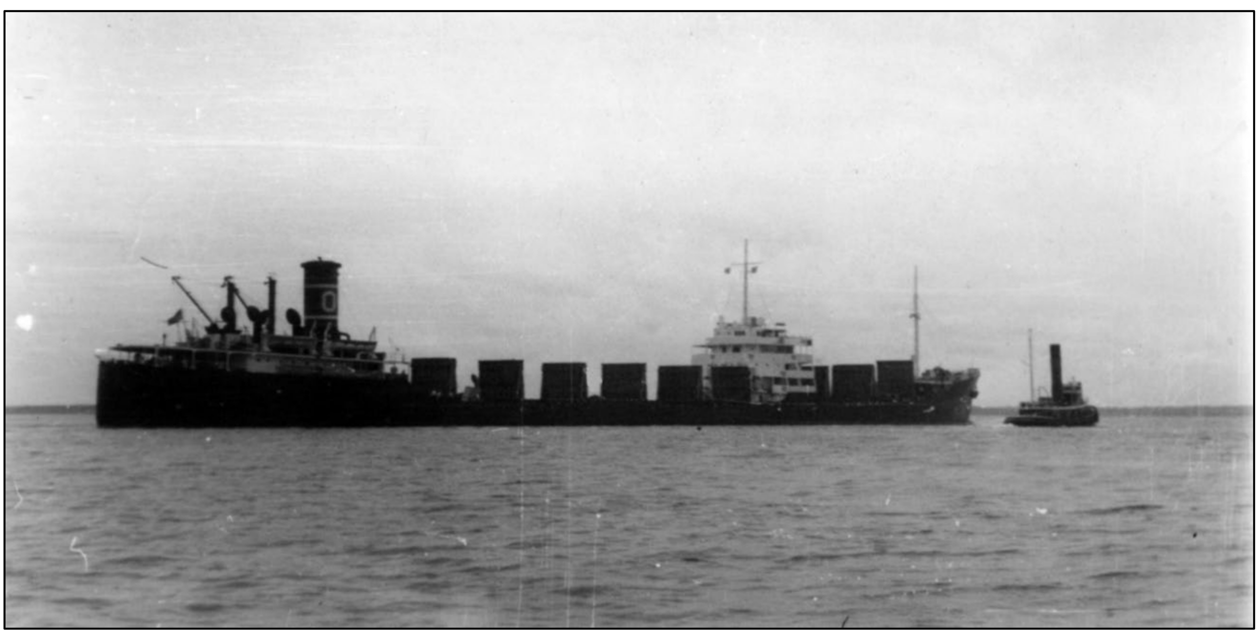


Figure 7-244 *Marore* starboard side.
Source: Steamship Historical Society of America

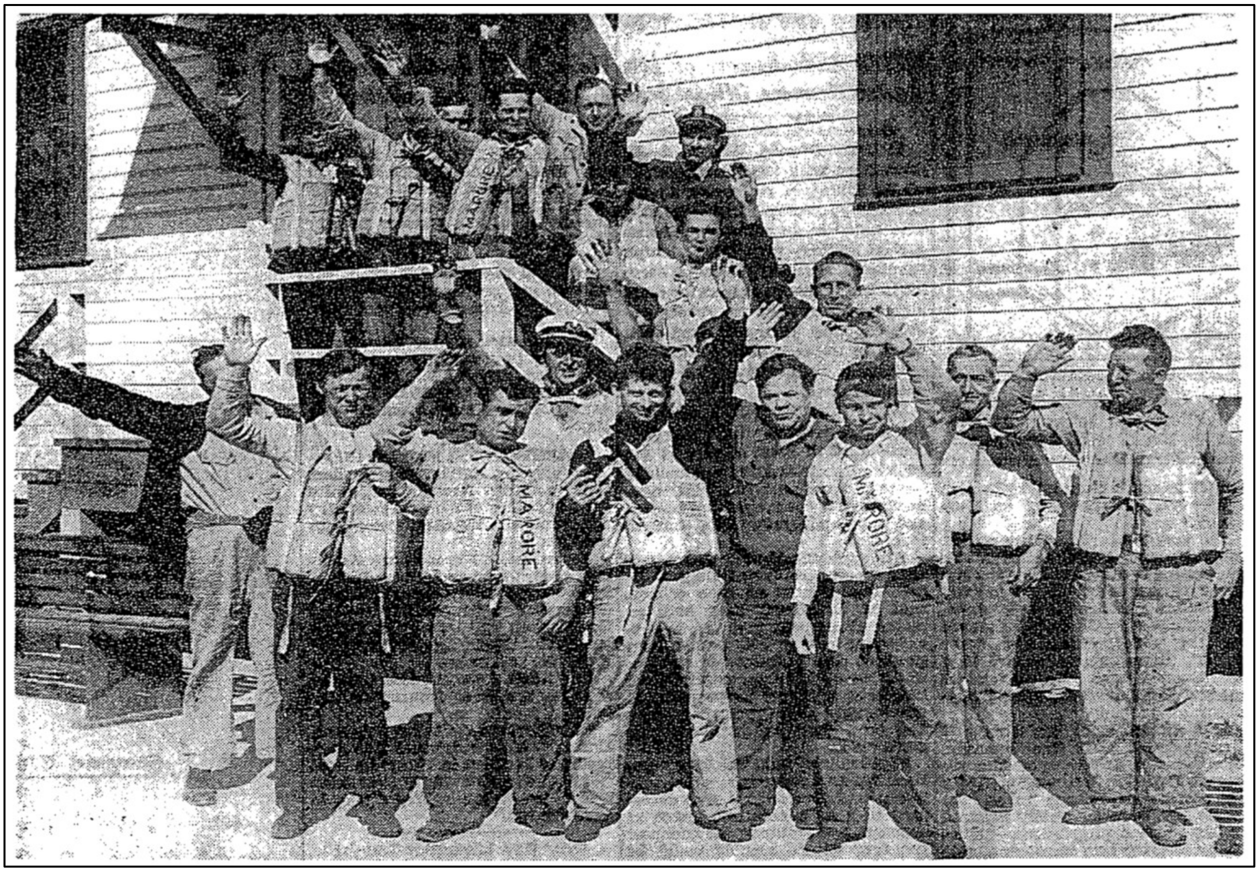


Figure 7-245 Survivors from the sinking of *Marore* safe in port.
Source: *New York Times* 1942f

7.31.2 Archaeological Site Description

The wreck site of *Marore* has been known since its loss. In the 1960s, Florida-based salvage outfit Stefanich Shipping Company planned to salvage the Chilean based ore from *Marore* and *Venore*, which they estimated to be valued at $700,000. The success of this effort, if any, is unclear. Additionally, the propellers were blown off and salvaged (*New York Times* 1962; Gentile 1993:119).

Due to time limitations and site conditions, only sonar data was collected at the site of the *Marore* during the 2013 field season. According to historical accounts, the vessel sunk slowly rolling over as it went to the bottom. Sonar imagery (Figure 7-246 and Figure 7-247) is consistent with accounts of the vessel's dimensions and loss. There were two main sections, bow and stern. The bow section, approximately 185 ft in length, appeared to be largely intact and inverted. The other main section, however, was heavily broken up revealing large machinery near the stern, presumably the propulsion system. The stern section was approximately 315 ft in length. From amidships forward the hull appeared to be largely intact and inverted. Moving aft, the ship was heavily broken up, revealing large machinery near the stern, presumably the propulsion system. Photographic and video survey of this site would reveal greater detail and is recommended in future research. Diving at the site is suspected to have poor visibility conditions due to its location on Wimble Shoals.

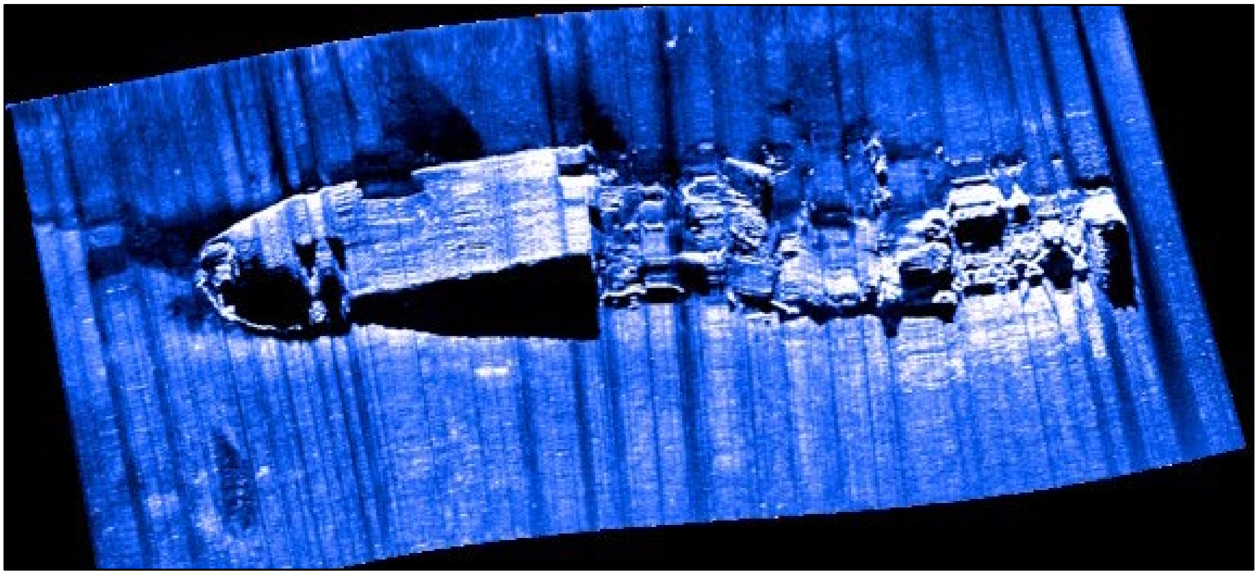


Figure 7-246 Low frequency sonar image of the *Marore* wreck site.
Source: NOAA

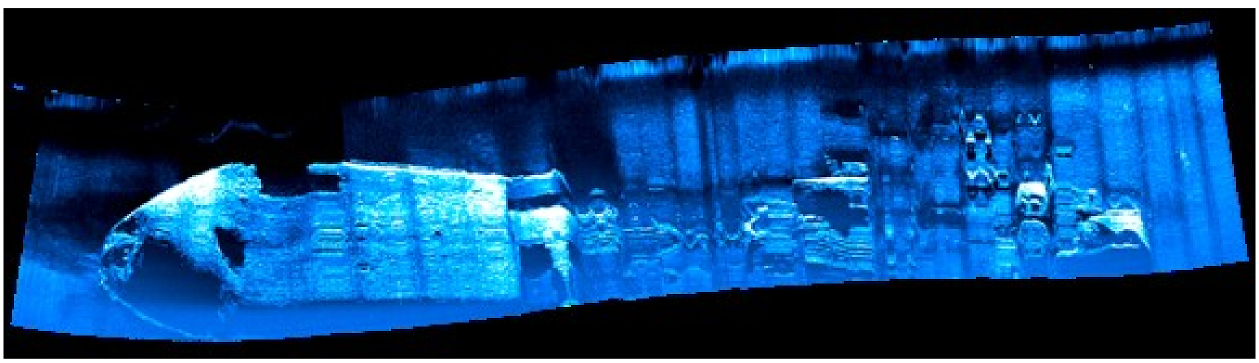


Figure 7-247 High frequency sonar image of the *Marore* wreck site.
Source: NOAA

7.32 Naeco

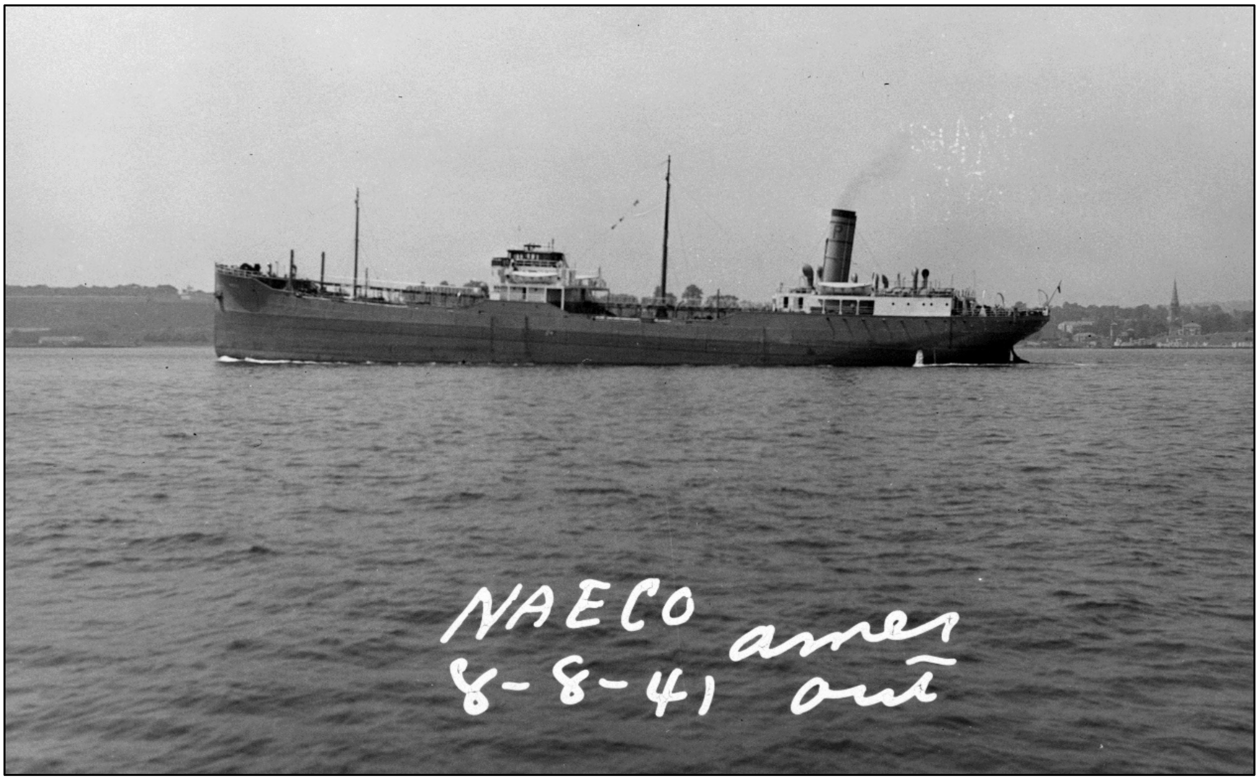


Figure 7-248 *Naeco* on 8 August 1941, location unknown.
Source: Mariners' Museum and Park

Table 7-34 Characteristics of *Naeco*

Characteristics	*Naeco*
Year of Build/Type/Hull #	1918/Tanker/449
Date Lost	23 March 1942
Position & Depth	41 miles S of Cape Hatteras, NC 145 ft
Ship Characteristics	Length: 411.6'; Breadth: 53.4'; Depth: 31.2' Gross Tonnage: 5,373
Cargo	72,000 barrels of kerosene and 25,000 barrels of heating oil
Survivors	14 (38 Total on board [24 dead and 14 survivors])
Owner	Pennsylvania Shipping Co., Philadelphia, PA
Builder	Bethlehem Ship Building Corporation Ltd., Wilmington, DE
Former Names	*Charles M. Everest* (Standard Vacuum Transportation Co., Socony-Vacuum Oil Co., USSB, 1918-1933)
Lloyd's Register Details	Steel (Stl) hull, longitudinal framing, fitted for oil fuel, three decks, triple expansion engine.
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	Simrad MB 2010; photo and video 2013.

7.32.1 History

Naeco was built in the Harlan Plant by the Bethlehem Ship Building Corporation in Wilmington, Delaware (Table 7-34 and Figure 7-248, above). It was built for the USSB to support shipping during WWI, and originally christened *Charles M. Everest.* With WWI ended, the USSB sold *Everest* to the Socony-Vacuum Oil Company in 1919, where it operated under the same name until 1933. *Charles M. Everest* was sold once more in 1933 to the Pennsylvania Shipping Company of Philadelphia, Pennsylvania, and renamed *Naec*o, which is the word 'ocean' spelled backwards. *Naeco* was home ported in Wilmington, Delaware through the beginning on WWII (Figure 7-249; Aldridge 1918:468; Lloyd's Register of Shipping 1919-1942).

The vessel had a relatively uneventful service life with the exception of one deadly incident in 1920. While laid up for repairs at the Robins Dry Dock on Dwight Street in Brooklyn, New York, sparks from burners used to loosen rivets near a gas tank caused an enormous explosion. The blast was so extreme a nearby office building was shaken so hard a woman working inside was knocked down the stairs and broke her leg. At the same time, a 250-pound metal beam was launched skyward and came crashing down on John Keupp, a fireman tending to a small blaze on a nearby ship. The beam crushed his skull, killing him instantly. This tragic event would pale in comparison to the circumstances of *Naeco's* loss 22 years later (*New York Times* 1920).

In late March 1942, *Naeco* was traveling from Houston, Texas with 97,000 barrels kerosene and #2 fuel oil bound for Seawaren, New Jersey. By 23 March 1942, *Naeco*, under the command of Emil Engelbrecht, was about 5 hours past Frying Pan Shoals and approaching Cape Lookout when a massive explosion erupted. *Naeco* had been struck with a torpedo from U-*124*. Captained by Johann Mohr, U-*124* had been hunting in North Carolina for 9 days on a particular devastating patrol. Mohr had already sunk 6 other ships and damaged 3 more. With only 2 torpedoes remaining in his Type IXB, Mohr had one last chance to increase his tonnage. Having been plagued by malfunctioning torpedoes, Mohr prepped his remaining munitions. The first torpedo loosed was a dud. With only one shot left, the final torpedo was fired. It struck amidships and ignited the cargo in an enormous fireball, instantly engulfing the deckhouse and bridge in flames. Burning oil was pouring outward and spreading over the surface of the water. All hands in the bridge area and forward were killed in the explosion or by the resulting flames. The Chief Engineer shut down the engines several minutes after the blast and turned on the steam smothering system to try and stop the burning fuel. The remaining crew scrambled to abandon ship as it was apparent that the vessel was going to sink. The explosions also destroyed all the forward lifeboats but 10 crewmembers made it safely into the No. 3 boat. The No. 4 lifeboat was also lowered but since *Naeco* was still making considerable way it was swamped. The remaining men had no choice but to swim. By 0730 hours, USCGC *Dione* arrived and picked up the survivors from Lifeboat No. 3 and two more survivors from the water. Rescue tugs USS *Umpqua* (ATO-*25* and USS *Osprey* (AM-*56*)) also assisted. USS *Umpqua* found one survivor had swum back and clung to the wreckage of *Naeco*, while USS *Osprey* found one more survivor clinging to remnants of a life raft (US Coast Guard 1945:38; Moore 1983:199; DIO 1987:151; Hickam, Jr. 1989:95; Blair 1996:519; Wynn 1997:101).

The burning tanker broke in two, sinking bow first. The stern continued to float and burn awhile, and the ESF war diary reports that the wreckage had sunk by 0830 hours EWT, approximately one mile from the bow section. In all, 24 crewmembers of *Naeco* lost their lives in the attack. With the sinking of the *Naeco*, Mohr and U-*124* headed back across the Atlantic with the most successful cruise in American waters up to that point (Moore 1983:199; DIO 1987:151; Hickam, Jr. 1989:95; Blair 1996:519; Wynn 1997:101).

Figure 7-249 *Naeco* underway.
Source: The Mariners' Museum and Park

7.32.2 Archaeological Site Description

Multibeam survey of *Naeco* was conducted aboard the NOAA R/V *Nancy Foster* on Cruise Number NF-10-10-LF in 2010 using a mid-depth Simrad EM1002 System (95 kHz, 20 m-1,000 m). The data revealed a wreck site that had two large, disparate, intact sections. The two sections rested nearly a mile away from each other (Figure 7-250 and Figure 7-251).

Diver-based assessment of the stern of *Naeco* was completed in 2013. The site of *Naeco* presented some recoding challenges. First, the site was broken in two pieces at the time it was torpedoed. This of course is not uncommon; however, in this instance the two pieces are approximately one mile apart. Similar to the *Tamaulipas*, only the stern section of *Naeco* was photo- and video-documented during this survey. The stern section rested in an area where the seabed is approximately 150 ft deep. This allowed divers to record portions of the stern section, which included the engine and boilers around the areas of high relief (Figure 7-252 through Figure 7-254). Deck hatches and the steering quadrant were easily discernable. The engine and boiler assembly were also visibly intact and upright with the surrounding hull fallen away.

The stern section of *Naeco* is divided into two main parts. The forward section of the stern area measured approximately 75 ft in length and 62 ft at its widest point. This section includes and intact section of the hold. Aft of this section, the engine and boilers were exposed, the hull structure surrounding them having largely fallen away. This section measureed approximately 126 ft in length and 65 at the widest point. Aft of the engine and boilers, the steering quadrant was visible. Overall, this second section of *Naeco's* stern area provided the highest relief, at approximately 20 ft.

The bow section, located about one mile from the stern section, was not assessed by divers during this survey. Some intact structure was visible in the multibeam data on the east side of that portion of the site, but it is largely a debris field extending 382 ft in length 294 ft wide. The overall debris field extended over 87,550 square ft, a considerable site for future dive investigations.

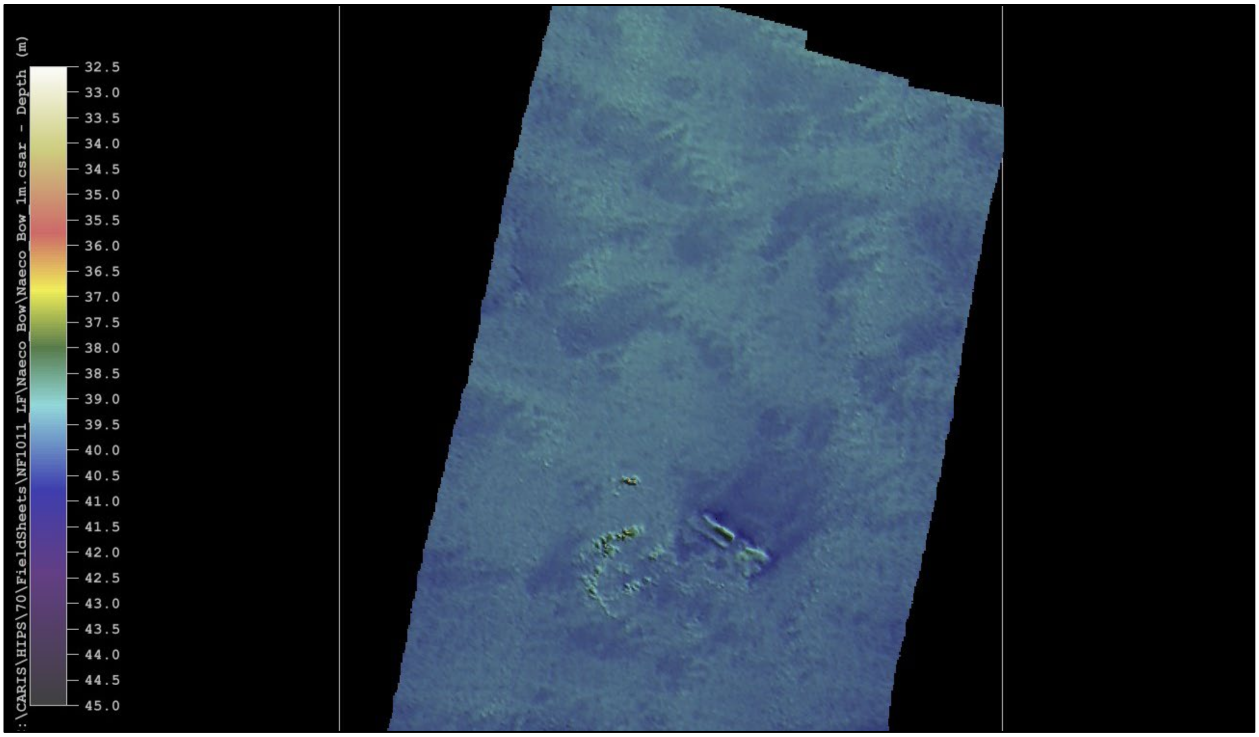


Figure 7-250 Multibeam survey of the wreck of the bow section of *Naeco*.
Source: NOAA

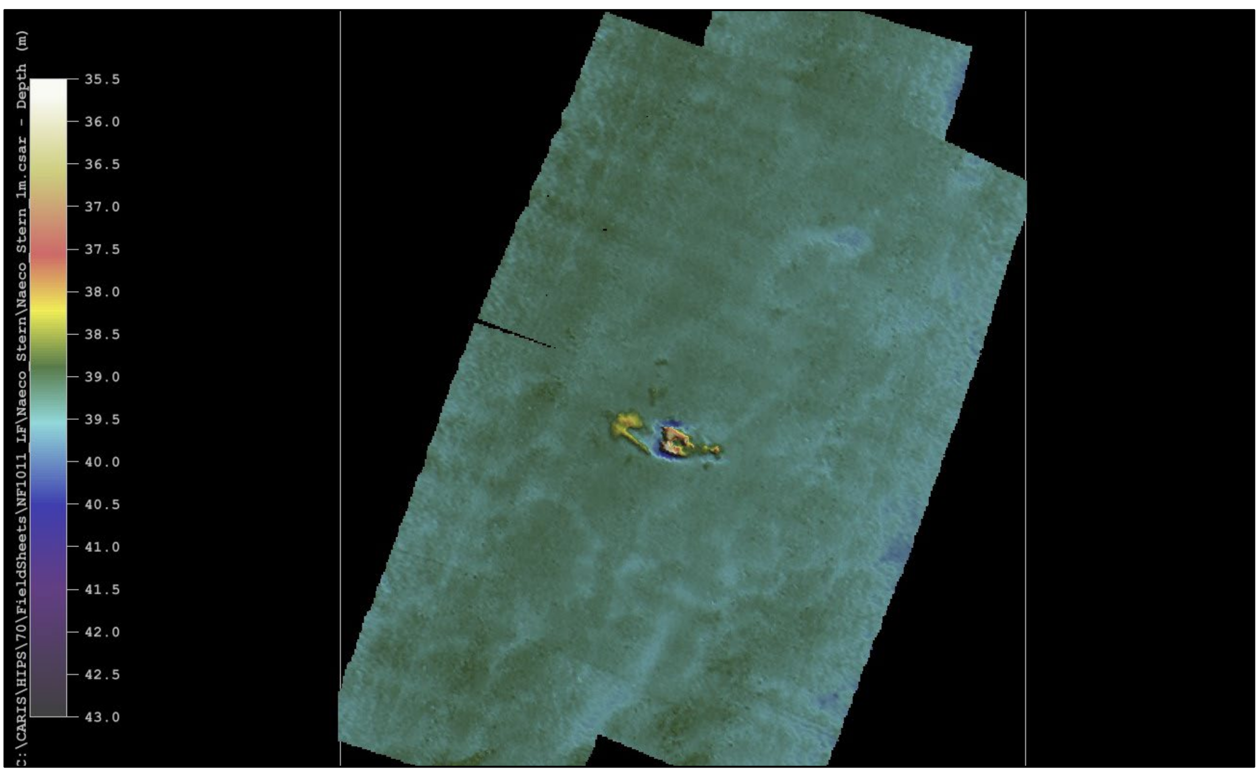


Figure 7-251 Multibeam survey of the wreck of the stern section of *Naeco*.
Source: NOAA

Figure 7-252 Intact deck hatch on stern of *Naeco*.
Source: NOAA

Figure 7-253 Steering quadrant located at stern of *Naeco* wreck site.
Source: John McCord, UNC-CSI

Figure 7-254 Steam engine and boiler assembly at the stern of *Naeco*.
Source: NOAA

7.33 Nordal

Figure 7-255 Photograph of *Nordal*, 28 December 1941.
Source: Steamship Historical Society of America

Table 7-35 Characteristics of *Nordal*

Characteristics	*Nordal*
Year of Build/Type/Hull #	1939/Freighter/5613980
Date Lost	23 June 1942
Position & Depth	Unlocated
Ship Characteristics	Length: 365.2'; Breadth: 57.3'; Depth: 20.2' Gross Tonnage: 3,845
Cargo	6,675 tons of manganese ore, burlap, gunny bales, hides, coffee, and castor seeds
Survivors	32 (0 dead and 32 survivors)
Owner	Viking Corporation, Panama City
Builder	Fredriksstad Mekaniske Verksted, Norway
Former Names	None
Lloyd's Register Details	Steel hulled freighter with riveted hull fastenings and an oil-fired steam engine; strengthened for navigation in ice.
Port of Registry/Flag	Panama
Sunk by	U-*404*
Data Collected on Site	NOAA Screening Level Assessment 2013 (NOAA 2013f).

7.33.1 History

Nordal was a steamship freighter that was built by the Norwegian shipyard Fredriksstad Mekaniske for Viking Tanker Corporation, Panama (Table 7-35 and Figure 7-255, above). The freighter was launched on 17 June 1939, and was delivered by August 1939. It was a steel built freighter with welded hull fastenings and one operational full-length deck, including a shelter deck. The ship was strengthened for navigation in ice with supplemental welding on the butts of the keel and bottom plating. The vessel was driven by a 4-cylinder compound oil-fired engine and two single-ended boilers (Figure 7-256; Lloyd's Register of Shipping 1940).

On 2 June 1942, *Nordal* departed from Bahia, Brazil, bound for Baltimore, Maryland with 6,675 tons of manganese ore, burlap, gunny bales, hides, coffee, and castor seeds. The freighter was proceeding in a convoy with 11 other ships. The escort compliment consisted of the USCGC *Dione*, along with HMT *Norwich City*, and two small Coast Guard patrol craft CG #*408* and CG#*252*. Amongst this convoy was another fated ship; *Manuela* (DIO 1987:399; Hickam, Jr. 1989:270; NOAA 2013f:4).

On 24 June, at approximately 1923 EWT, the freighter, *Nordal,* was torpedoed by U-*404* without warning. It was later reported that an explosion took place on the aft starboard side proximate to the #6 hatch. The explosion caused a large spout of water to go up as high as the mast top, approximately 100 ft. The gaping hole in the ship's side was below the surface. The No. 3 hold, where the hides were being stored, flooded immediately causing the ship to list severely to starboard, with the stern down in the water. Following the explosion, *Nordal*'s engines were shut off and all hands except one abandoned ship in three lifeboats. Moments later, another ship in the convoy, *Manuela*, was rocked by another explosion. The escort vessels began ASW procedures and effectively prevented U-*404* from inflicting damage on the remaining convoy. Before the *Nordal* had actually sunk, the crew was picked up by British trawler *Norwich City* and taken to Morehead City, North Carolina. *Manuela* remained afloat until the following day and was observed by aircraft and reported in the ESF war diary. At the time *Manuela* was seen, it was noted that *Nordal* could not be seen and was probably sunk. The exact time of sinking is therefore unknown (Hickam, Jr. 1989:270; Office of the Chief of Naval Operations 1942; NOAA 2013f:5).

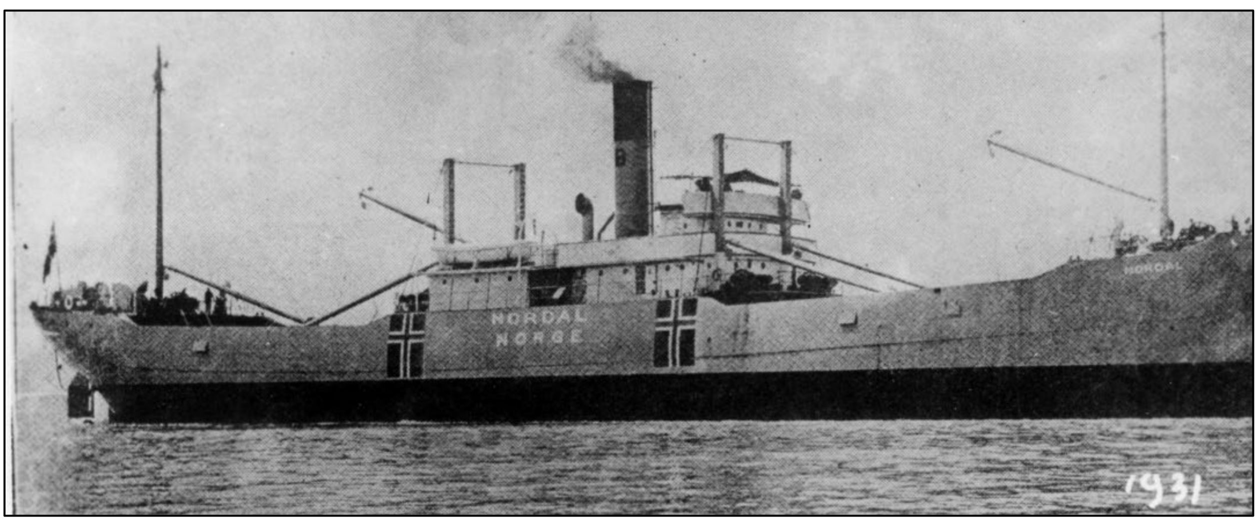


Figure 7-256 Starboard side of *Nordal*.
Source: Steamship Historical Society of America

7.33.2 Archaeological Site Description

The Captain estimated that the ship would sink within a few hours after it was abandoned, but no witnesses were present when the vessel finally did sink. The approximate sinking location suggests the vessel is in an area of just over 400 ft of water. This location is very close to the edge of the continental shelf and it is possible that the ship sank in much deeper water. Currently, the location of the wreck site is unknown, however it was reported by the US Coast Guard Cutter *Gentian* survey that a site they identified as *Nordal* was visited in 1944. The report describes a wreck that had as much as 72 ft of relief in 402 ft of water. The vessel is described as upright and intact and within 2 miles of the reported position of *Nordal*. Light marine growth seemed to indicate a recent wreck. The site was imaged with a drop camera and observed a heavy spar with bricks and heavy timber which may represent some of *Nordal'*s cargo (Figure 7-257). At the time this image was collected it was the deepest underwater wreck photograph ever taken (DIO 1944:24; NOAA 2013f:6). Follow on surveys conducted by NOAA in 2018 determined that the wreck photographed in 1944 by *Gentian* is likely not the *Nordal* but rather the *Ljubica Matkovic* (see Section 7.28). The final resting place of *Nordal* remains unknown.

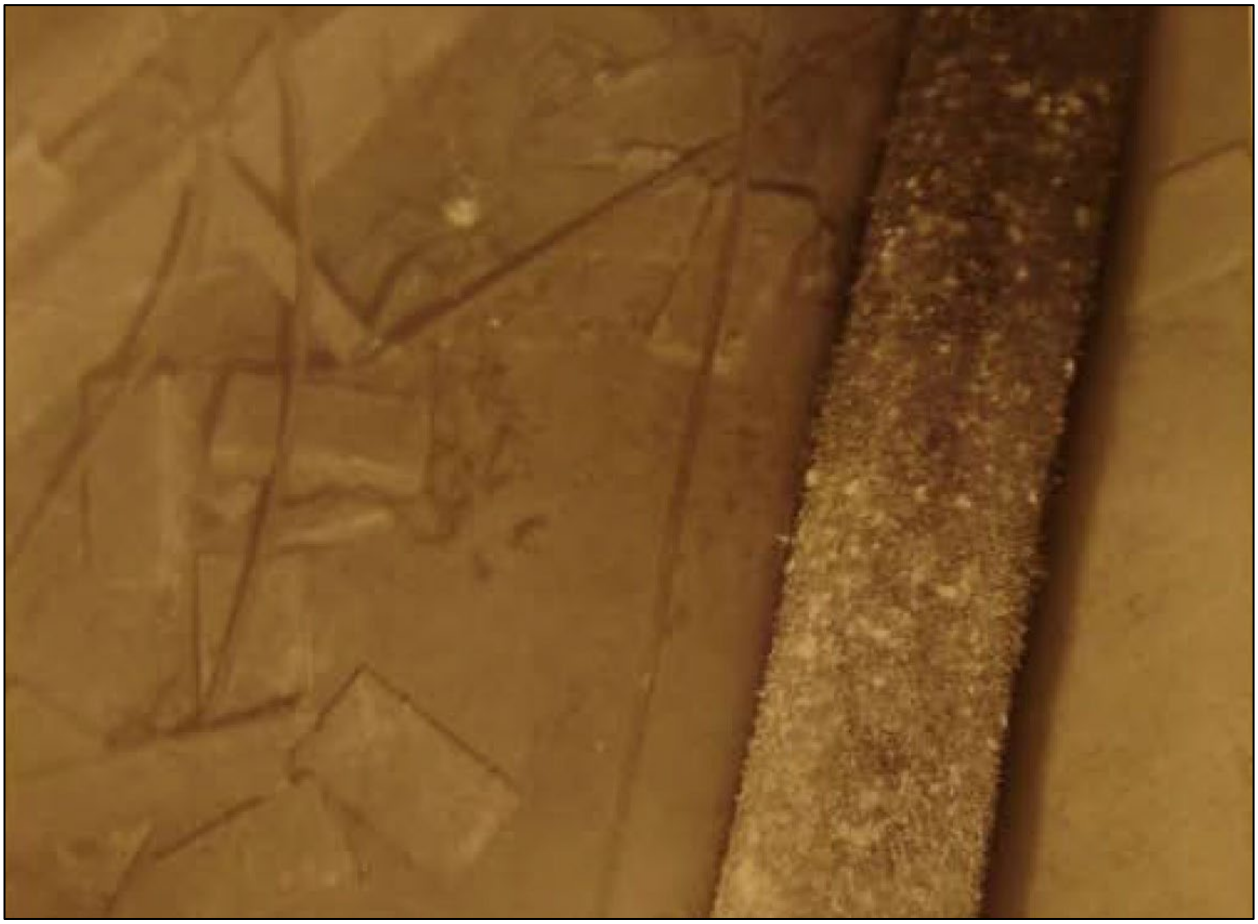


Figure 7-257 Suspected to be *Nordal* taken during USCGC *Gentian* Survey.
Source: DIO 1944

7.34 Norvana

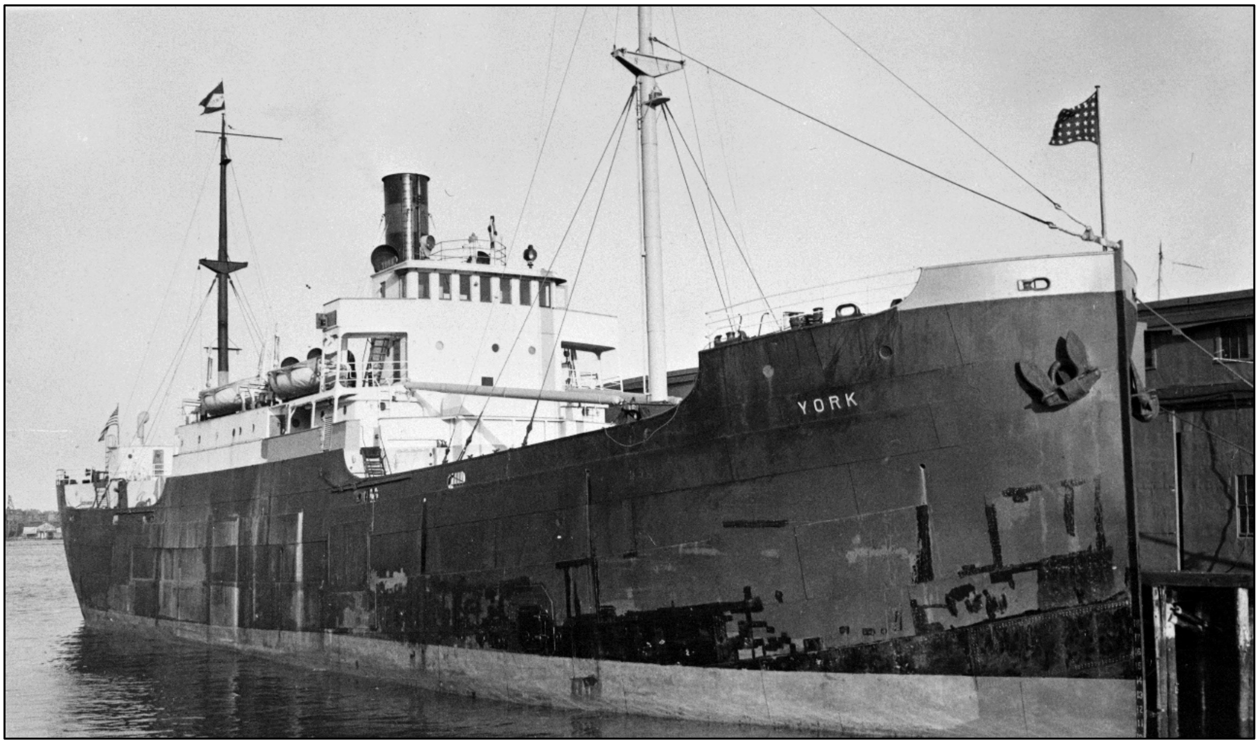


Figure 7-258 *Norvana* under former name, *York*; date and location unknown.
Source: Mariners' Museum and Park

Table 7-36 Characteristics of *Norvana*

Characteristics	*Norvana*
Year of Build/Type/Hull #	1920/Freighter/146
Date Lost	22 January 1942
Position & Depth	25 miles E of Kill Devil Hills, NC 110 ft
Ship Characteristics	Length: 253.4';Breadth: 43.8';Depth: 26.2' Gross Tonnage: 2,677
Cargo	Cuban Sugar
Survivors	0 (29 Total on board [29 dead and 0 survivors])
Owner	North Atlantic and Gulf Steam Ship Company, New York, NY
Builder	Saginaw Ship Building Company, Saginaw, MI
Former Names	*York* (Merchants and Miners Transportation Co., 1927-1941) *Lake Gatun* (USSB, 1920-1927)
Lloyd's Register Details	Steel (Stl) hull, single screw, three decks, fitted for oil fuel, triple expansion steam engine.
Port of Registry/Flag	Baltimore, MD/USA
Sunk by	U-*66* (Richard Zapp) or U-*123* (Reinhard Hardegen)
Data Collected on Site	Side Scan Sonar and Photo 2014.

7.34.1 History

Norvana was launched on 1 November 1920 by the Saginaw Ship Building Company of Saginaw, Michigan and delivered to the Emergency Fleet Corporation on 21 November 1942 (Table 7-36 and Figure 7-258, above, and Figure 7-259). The vessel had an overall length of 253.4 ft, was 43.8 ft wide, and grossed 2,677 tons. There is some indication the name of the vessel fluctuated during construction, having been laid down as *Lake Eaglerock*, launched as *Lake Gara,* and delivered as *Lake Gatun*. Ultimately the name *Lake Gatun* was selected, in honor of a small lake by that same name in the Panama Canal. Like many other ships built at this time, it had been intended to support shipping needs during WWI, but was delivered after the cessation of war. *Lake Gatun* was controlled by the USSB and operated under its auspices until being sold to Stanley Hillier Inc., of San Francisco, California in 1926. Hillier only had possession of *Lake Gatun* for one year before transferring ownership back to the USSB. *Lake Gatun* was subsequently laid up for a number of years and fell into disrepair until Merchants and Miners Transportation Company acquired it for $40,000 and subsequently renamed the vessel *York*. It operated under this capacity for over a decade until October 1941 when *York* was again transferred back to the United States Government, operating under the North Atlantic and Gulf Steam Ship Company of New York, New York and renamed *Norvana* (*American Shipping* 1920:66; Annual Report of the GPC 1921:650; Traffic World 1926:1129; Nautical Gazette 1929:610; *Fairplay Weekly Shipping* 1929:583).

Figure 7-259 *Norvana* on 28 November 1941, location unknown.
Source: Mariners' Museum and Park

Norvana operated along the East Coast and into the Caribbean through the beginning of WWII. Just a few days after the opening salvo of the Battle of the Atlantic in late January 1942, *Norvana* left Cuba bound for Philadelphia, Pennsylvania with a cargo of sugar and 29 crew. The vessel was travelling alone northbound past Cape Hatteras, North Carolina when it was attacked by a German U-boat U-*66* on 22 January 1942. U-*66* fired two stern torpedoes at the vessel and the U-boat commander Richard Zapp noted that the vessel "breaks apart amidships and sinks within one minute" (Hickam, Jr. 1989:20). The ship never sent a distress signal and was lost with all 29 crew. *Norvana* was simply reported as 'overdue' until it became clear it had been lost. The only physical evidence of the loss was a battered and empty lifeboat that was discovered (*New York Times* 1942e; Moore 1983:205; Hickam, Jr. 1989:20; Wynn 1997:47).

The sinking of *Norvana* was a part of the first wave of five boats sunk in Operation Paukenschlag (Drumbeat). During this same patrol, Zapp in U-*66* also sank *Allan Jackson*, passenger vessel *Lady Hawkins*, *Olympic* (probably), *Empire Gem,* and *Venore*. This was the single most devastating patrol off North Carolina during the Battle of the Atlantic with a total loss of 374 people (Döenitz 1959:203; Moore 1983:205; Wynn 1997:47).

7.34.2 Archaeological Site Description

The wreck site of *Norvana* was visited by the Navy Salvage Service in 1944 in order to mitigate the navigation hazard posed by the remains. During this operation, the ship's bell was recovered, which was marked *Lake Gatun*, positively identifying the wreck site as *Norvana* (Gentile 1993:158). In 2014, the team investigated the site using a side scan sonar survey and brief diver based assessments. A low-frequency sonar image depicting the overall site distribution was collected (Figure 7-260) as well as an inventory of still images of major artifact and component features (Figure 7-261 through Figure 7-265).

The wreck site of *Norvana* was largely contiguous, oriented almost directly N to S, bow to stern. The bow of *Norvana* was broken off from the remainder of the vessel, however it was quite intact; there were anchors still attached in their hawse pipes. The bow section presented the highest area of relief at this site. The broken bow section measured approximately 31 ft in length and 37 ft at beam. A section of approximately 18 ft of sand separated the bow area from the next section, moving aft. This amidships section contained machinery pieces, a windlass, and broken deck plating, and extended approximately 101 ft, with site scatter approximately 59 ft at the widest point. The amidships section contained the remains of the vessel's engineering space. There were two boilers along with the triple expansion engine, which was intact albeit dislodged and lying on its side. Aft of the boilers, the site remains extended approximately 100 ft with deck structure and disarticulated beams scattered throughout. At the stern, the steering quadrant and propeller were visible, along with a portion of the fantail stern itself, laying on its port side. This area, at the stern, provided an area of high relief as well. A considerable amount of remaining structure was still visible of *Norvana* with areas of high relief at the bow and stern, as well as large sections of deck structure throughout the site.

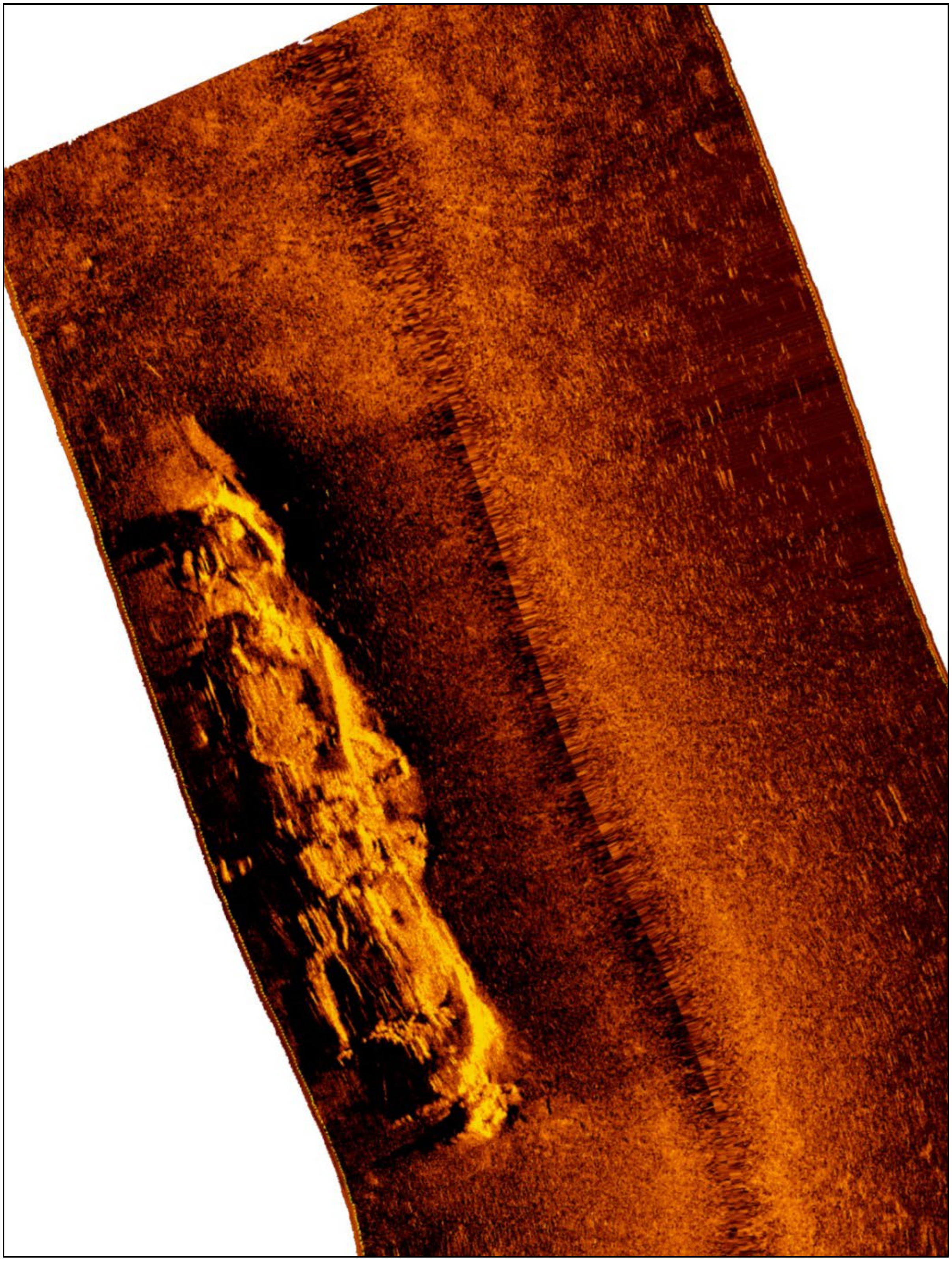


Figure 7-260 North-up low-frequency side scan sonar image of *Norvana* wreck site.
Source: NOAA

Figure 7-261 Anchor at the bow of *Norvana*.
Source: NOAA

Figure 7-262 Hawse pipes and chain at the bow of *Norvana*.
Source: NOAA

Figure 7-263 Steering quadrant of *Norvana*.
Source: NOAA

Figure 7-264 Fantail stern and propeller of *Norvana*.
Source: NOAA

Figure 7-265 Engine remains of *Norvana*.
Source: NOAA

7.35 Olympic

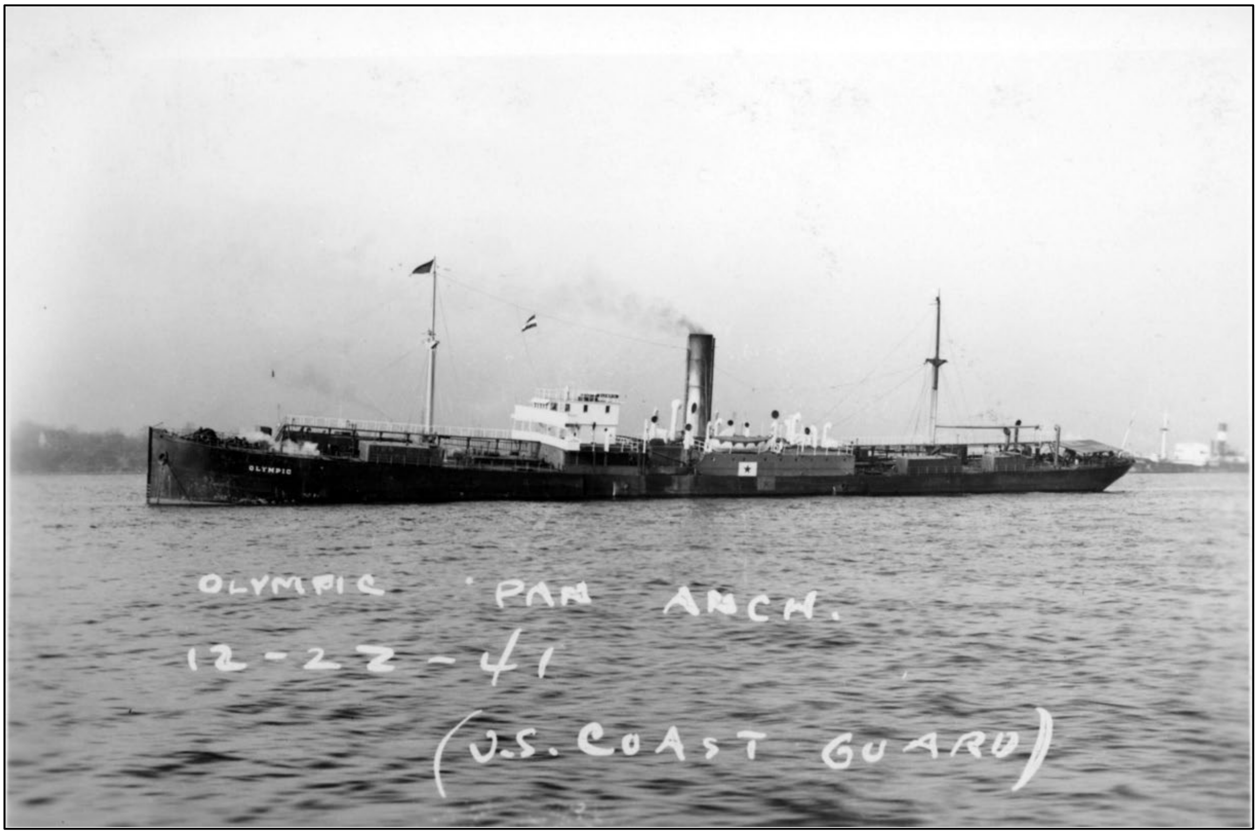


Figure 7-266 *Olympic* pictured on 22 December 1941.
Source: Steamship Historical Society of America

Table 7-37 Characteristics of *Olympic*

Characteristics	*Olympic*
Year of Build/Type/Hull #	1907/Freighter/404
Date Lost	22 January 1942
Position & Depth	E of Cape Hatteras, NC Not officially located/identified
Ship Characteristics	Length: 370'; Breadth: 50.1'; Depth: 32.1' Gross Tonnage: 5,335
Cargo	Crude oil
Owner	Cia International de Vapores, Ltda
Survivors	0 (35 crew, all hands lost)
Builder	J. Readhead & Sons Ltd., South Shields, UK
Former Names	*Dayton* (Standard Oil Co., 1914-1925; J.M. Botts 1923-1925) *Harport* (Harrison J.& C. Ltd., 1907-1912; Deutsch-Amerikanische Petroleum Ges 1912-1914)
Lloyd's Register Details	Steel (Stl) hull, two decks, fitted for oil fuel, single screw, triple expansion engine, two boilers.
Port of Registry/Flag	Panama/Panamanian
Sunk by	U-*66* (Richard Zapp) or U-*130* (Ernst Kals)
Data Collected on Site (determined not *Olympic*)	Side Scan Sonar 2012; photo and video 2013, 2015.

7.35.1 History

Olympic was originally built as a cargo vessel by J. Readhead & Sons Ltd., of South Shields, United Kingdom (Table 7-37 and Figure 7-266, above). Completed in 1907 it was christened *Harport*, and operated for Harrison J & C Ltd. of London, United Kingdom. In 1912, *Harport* was sold to the Deutsch American Petroleum Company and converted to a tanker (Figure 7-267 and Figure 7-268). In 1914, the *Harport* was sold again, this time to the Standard Oil Company of New Jersey and renamed *Dayton*. As a tanker, the vessel continued to work with the Standard Oil Company until being sold in 1925 to the Olympic Steam Ship Company of San Francisco, California, having it's name finally changed to *Olympic*. Olympic Steamship Company dissolved in 1931 and reorganized in Nevada, though this is not reflected in Lloyd's. *Olympic* was under control of the Olympic Steamship Company until 1940 when it was sold briefly to Petroleum Heat & Power Company of Los Angeles. Just prior to America's entry into the war *Olympic* changed ownership one final time, coming under the auspices of Cia International de Vapores, Ltda in 1941 and registered in Panama (Lloyd's Register of Shipping 1907; 1941; *New York Times* 1942e; Williams 2014:269).

Olympic measured 370.0 ft in length, 50.1 ft abeam, and had a depth of 32.1 ft. The vessel was built with a cellular double bottom and had its machinery amidships. Most contemporary purpose-built tanks had machinery towards the stern, but *Olympic*, having been built initially as a freighter, had both the engineering space and pilot-house located amidships. The cylinder heads on the triple expansion steam engine were 26 inches, 42 inches, and 70 inches with two 10-ft long scotch boilers (Lloyd's Register of Shipping 1941).

The exact circumstances of *Olympic's* loss are dubious. It left Curacao and was never heard from again, leaving a blank puzzle piece many historians have tried to fill in with an accounting of post-war records. On 22 January 1942, *Olympic* was traveling northbound from Curacao to Baltimore, Maryland and based on its departure time it would have been off North Carolina. The U-boat menace in American waters had just begun a few days before and it was long before the institution of convoys. Consequently, *Olympic* was traveling alone and unarmed, a perfect target for a German U-boat. It is unclear which U-boat actually is responsible for the attack on *Olympic*. The sinking is variously attributed to U-*66* or U-*130*, both of which were operating in the same area at that time and reported sinking similarly sized vessels. On 22 January 1942, Richard Zapp of U-*66* reported two torpedoes were launched at an unidentified vessel, both of which struck, resulting in the vessel breaking in two and sinking within one minute. This vessel could have been *Olympic*. Likewise, Ernst Kals in U-*130* reported sinking a ship East of Hatteras on 22 January 1942 that also fits the description of *Olympic*. Without either commander's knowledge of the vessel's exact identity and with no survivors, a definitive historical account of the loss is not possible. (Lloyd's Register of Shipping 1941; *New York Times* 1942e; Hickam, Jr. 1989:296; Gannon 1990:270; Blair 1996:469, 473; Wynn 1997:106).

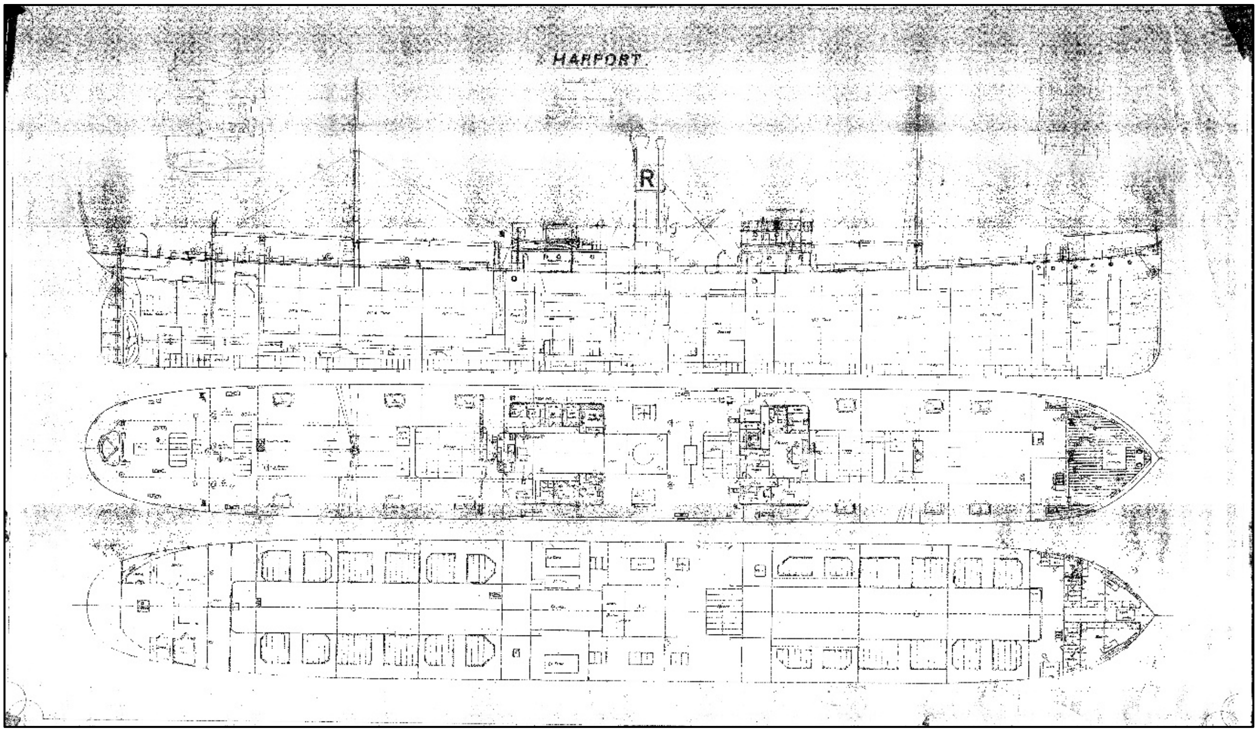


Figure 7-267 Deck arrangement drawing of *Harport*, the original name for *Olympic*.
Source: National Maritime Museum, 1941

7.35.2 Archaeological Site Description

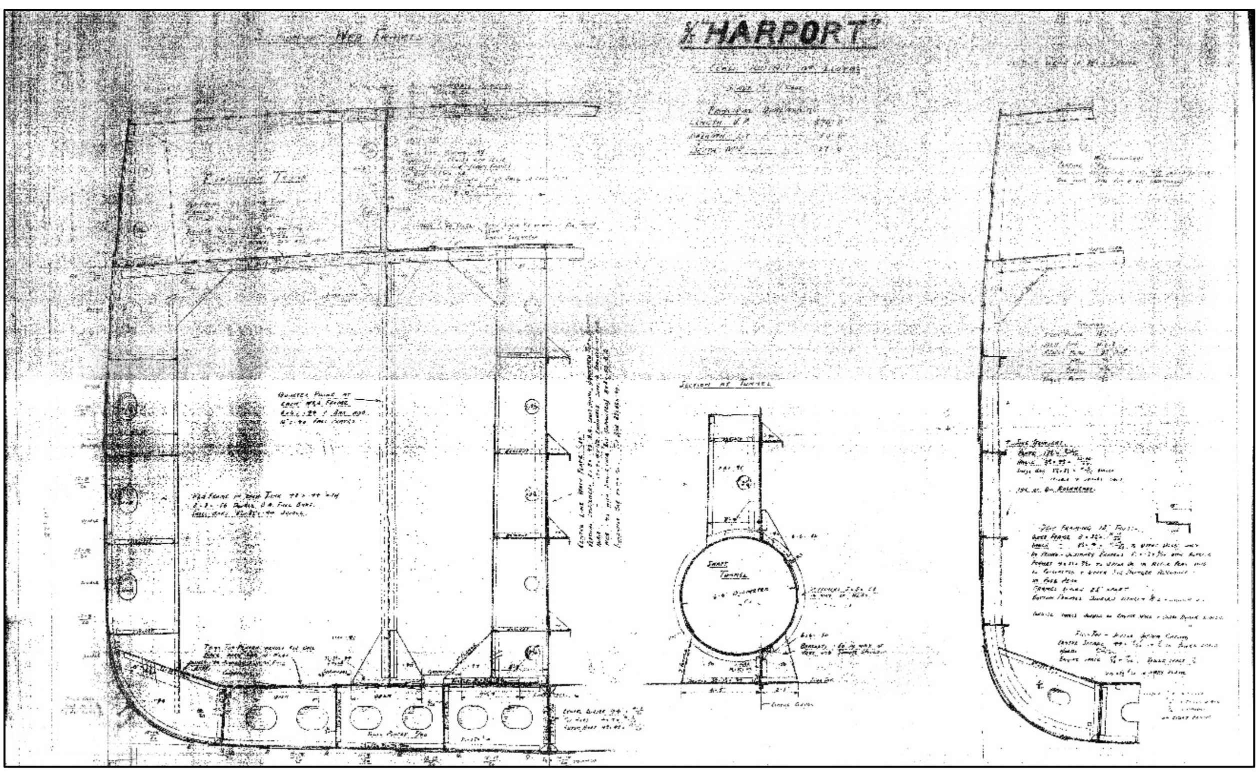


Figure 7-268 Cross-section drawing of *Harport*, the original name for *Olympic*.
Source: National Maritime Museum, 1941

The location for an action reported by U-*66* on 22 January 1942 is consistent with the location of a site located in 2012, but also consistent with the reported position of *Merak*. U-*66* asserts that two torpedoes were fired at an unidentified vessel, both of which struck, resulting in the vessel breaking in two and sinking within one minute. The archaeological evidence on the seabed is consistent with such a report, as the vessel is broken in two and appears to have sunk quite rapidly. There is significant amidships damage as well as damage at the bow, which may be evidence of a second torpedo strike. Post-war analysis suggested that due to the timing and route of *Olympic*, the loss referred to in the war diary of U-*66* could potentially be that of *Olympic* (Blair 1996:469). The methods of deduction that suggest *Olympic* was sunk by U-*66* off North Carolina are hardly conclusive. It is possible *Olympic* is not in these waters at all and U-*66* sunk another unidentified vessel. Such was the fog of war.

Due consideration was given that the site discovered in 2012 was a possible candidate for *Olympic*, however, diving operations conducted in 2015 produced evidence that reveal the positioning and number of gudgeons located on the rudderpost seem to rule out *Olympic*. With *Merak* as the best candidate for this site's identity, it leaves the final positive location of *Olympic* still in question.

7.36 Panam

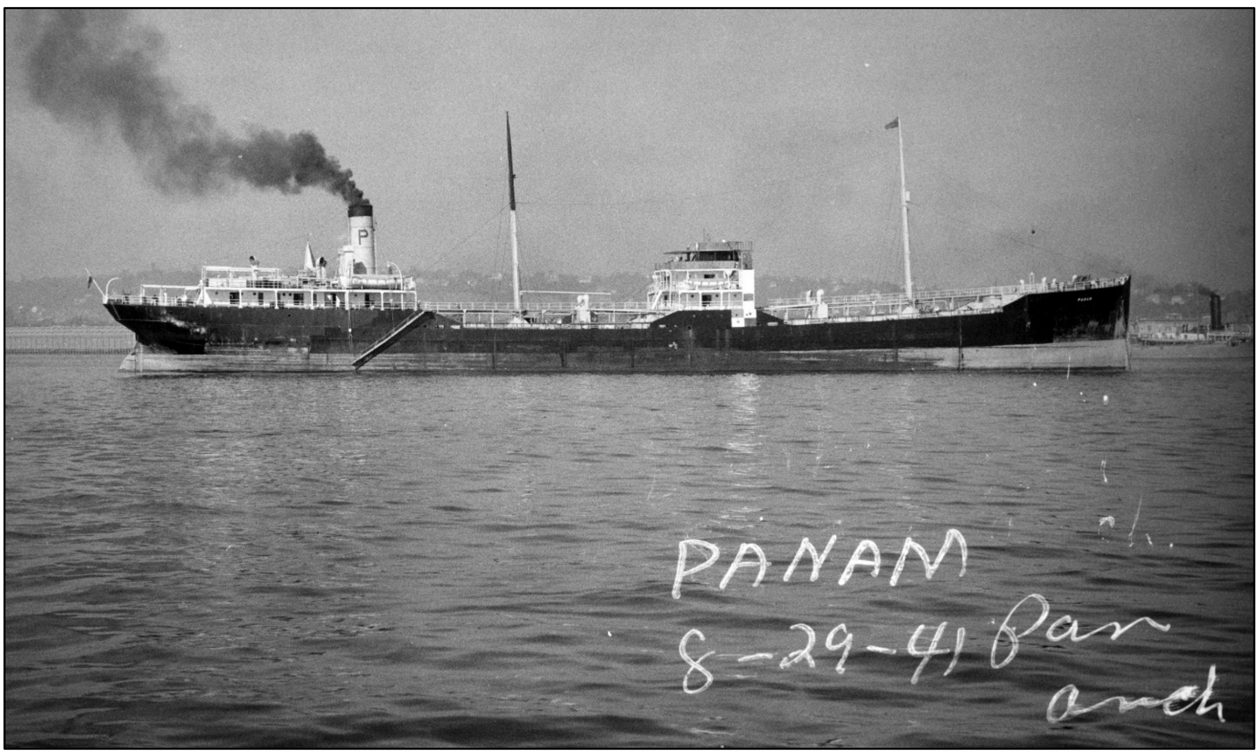


Figure 7-269 *Panam*, dated 29 August 1941, location unknown.
Source: Mariners' Museum and Park

Table 7-38 Characteristics of *Panam*

Characteristics	*Panam*
Year of Build/Type/Hull #	1925/Tanker/198
Date Lost	4 May 1943
Position & Depth	38 miles SE of Cape Lookout, NC 480 ft
Ship Characteristics	Length: 438.7';Breadth: 57.2'; Depth: 33.5' Gross Tonnage: 7,277
Cargo	Water ballast
Survivors	49 (51 Total on board [2 dead and 49 survivors])
Owner	Panamanian Government United States War Shipping Administration, Chartered to Marine Transport Lines, Inc.
Builder	Livingstone & Cooper Ltd, Hessle, UK
Former Names	*Onokia* (Union Steam Ship Co. of NZ, 1925-1937)
Lloyd's Register Details	Steel (Stl) hull, two decks, fitted for oil fuel, longitudinal framing, 2 two stroke cycle single acting oil engines.
Port of Registry/Flag	Panama /Panamanian
Sunk by	U-*129* (Hans-Ludwig Witt)
Data Collected on Site	Side Scan Sonar 2013. Screening Level Risk Assessement (NOAA 2013c)

7.36.1 History

Panam was launched in 1925 for the Union Steam Ship Company of New Zealand, built by Livingstone and Cooper Ltd. in Hessle, United Kingdom (Table 7-38 and Figure 7-269, above). Originally named *Otokia*, and operating under Union Steam Ship Company, the vessel was principally engaged in transporting oil between Californian ports and Wellington, New Zealand (Figure 7-270 and Figure 7-271). It continued in this routine capacity until being sold to Edward Allan Summers of London, whom operated a Messrs. Summers and Company based in Kobe, Japan for £55,000 *Onokia* operated for two years under these auspices running oil between Japan and the Far East and Californian ports. This investment turned out well for Mr. Summers as a sharp rise in the value of used tonnage was experienced, and he was able to sell *Onokia* in 1937 for £120,000 to a Panamanian company, Cia Maritima Istmenia Ltda. Upon being sold, the vessel was renamed *Panam,* beginning service between the Caribbean and New York (*Daily Commercial News and Shipping List* 1936, 1937).

In this service, *Panam* came under some legal scrutiny when significant amounts of oil were discharged from the vessel into New York Harbor, a violation of the Oil Pollution Act of 1927. Travelling northbound to New York from Curacao, *Panam* claimed to have encountered severe weather, straining the rivets in the hull, resulting in the leaks. Ultimately, it was determined that *Panam* pay a fine of $2,500. The vessel continued to operate for this company until 1942 when its official ownership was taken over by the Panamanian government. *Panam* was later seized by the United States War Shipping Administration and operated under charter with Marine Transport Lines, Inc. (The Pan-Am 1945:148 F.2d 925; Lloyd's Register of Shipping 1926-1944; NOAA 2013c:5).

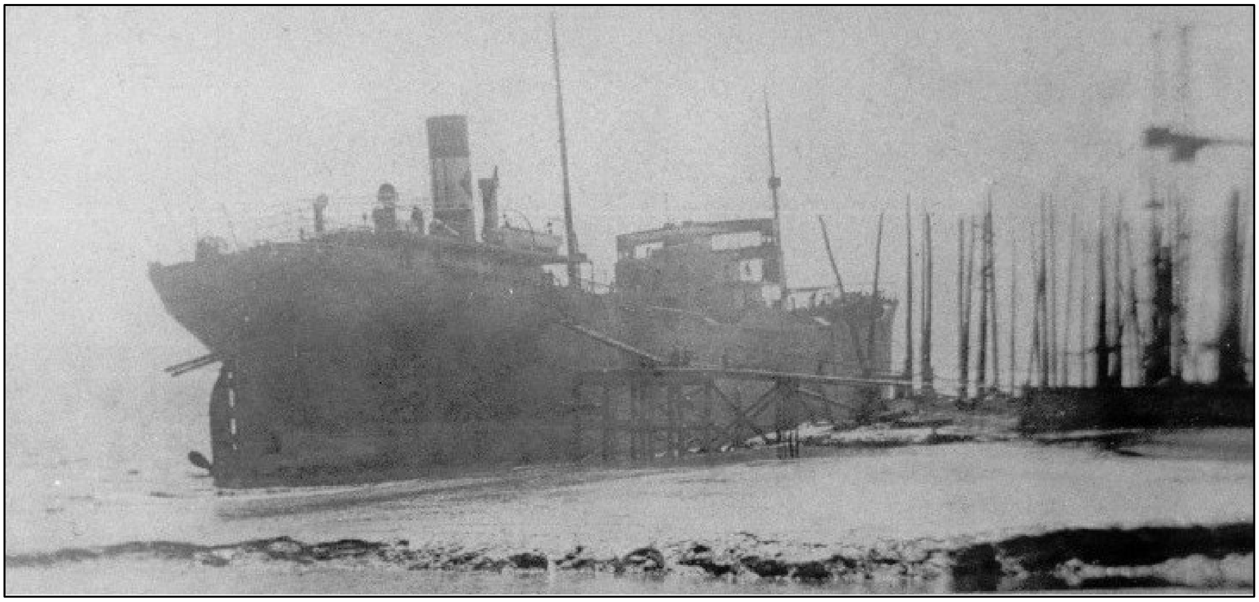


Figure 7-270 Stern view of *Onokia* in 1925 fitting out on the River Humber at Livingstone & Cooper Shipyard in Hessle, UK.
Source: Collection of North East Maritime, UK

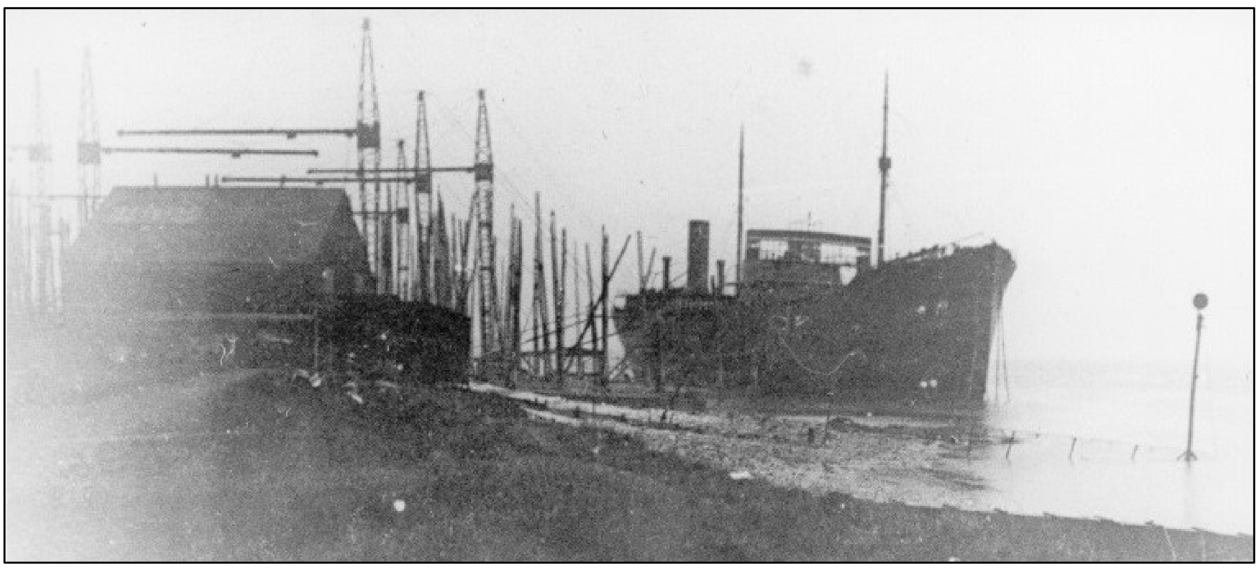


Figure 7-271 Bow view of Onokia in 1925 fitting out on the River Humber at Livingstone & Cooper Shipyard in Hessle, UK.
Source: Collection of North East Maritime, UK

7.36.2 Archaeological Site Description

Panam was first evaluated during the US Coast Guard Cutter *Gentian* survey. It was within a few miles of survivors' accounts and a 60 square mile survey in the vicinity determined no other wrecks were in the area. The shallowest depth of the wreck was recorded at 65 fathoms (District Intellignece Office 1945:43) off Cape Lookout, North Carolina. Coming to rest in such deep water ensured the site would be spared post depositional alteration due to blasting and wire-dragging, as well as more dynamic natural forces found in shallower waters. As a result, the remains were nearly completely intact from bow to stern when surveyed by the team (Figure 7-272). The vessel was upright on its keel with much of the superstructure, particularly king posts, still erect on the deck fore, aft, and amidships. This site was located in the approximate historic location where *Panam* was known to have sunk.

The historical record indicates the vessel was 438 ft with a 57-ft beam as built. The observed dimensions based off sonar for this site were 438 ft with a 60-ft beam. This, coupled with the apparent deck superstructure, and proximity to historically reported position, makes the identification of the site as *Panam* very probable.

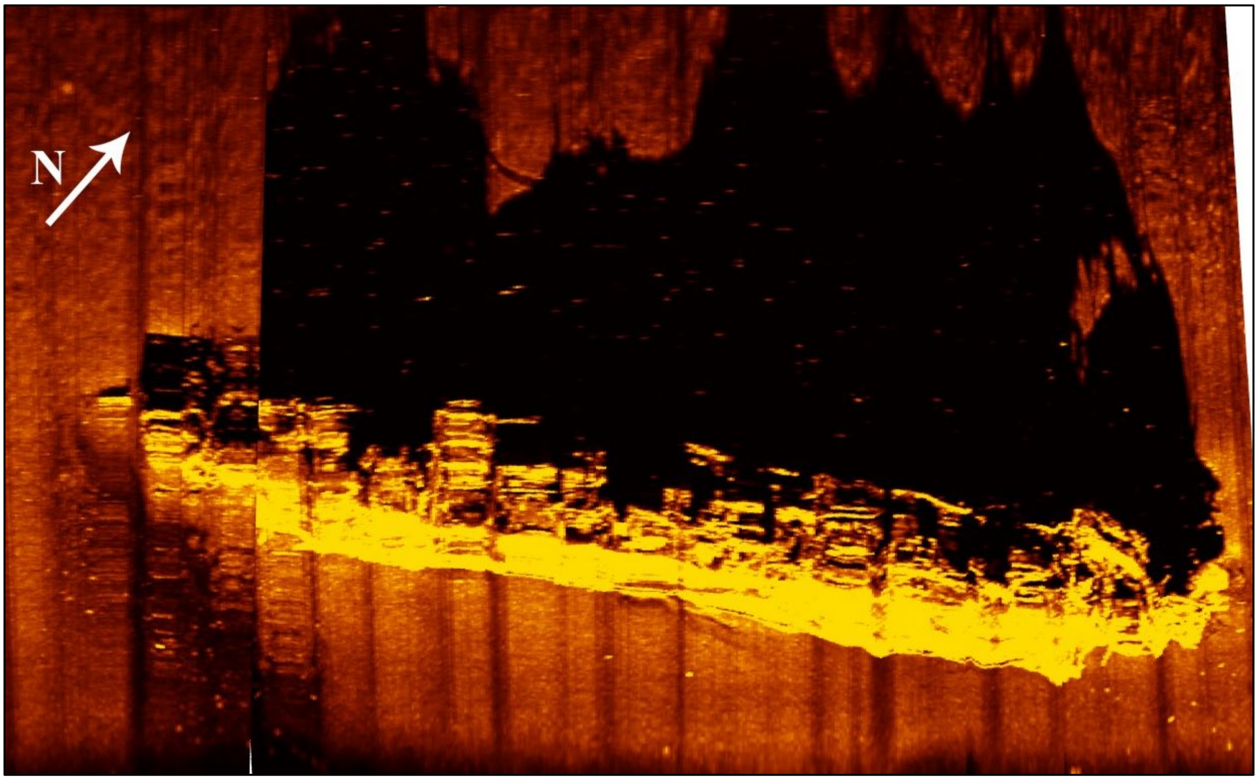


Figure 7-272 Low frequency sonar image of the *Panam* wreck site.
Source: NOAA

7.37 Papoose

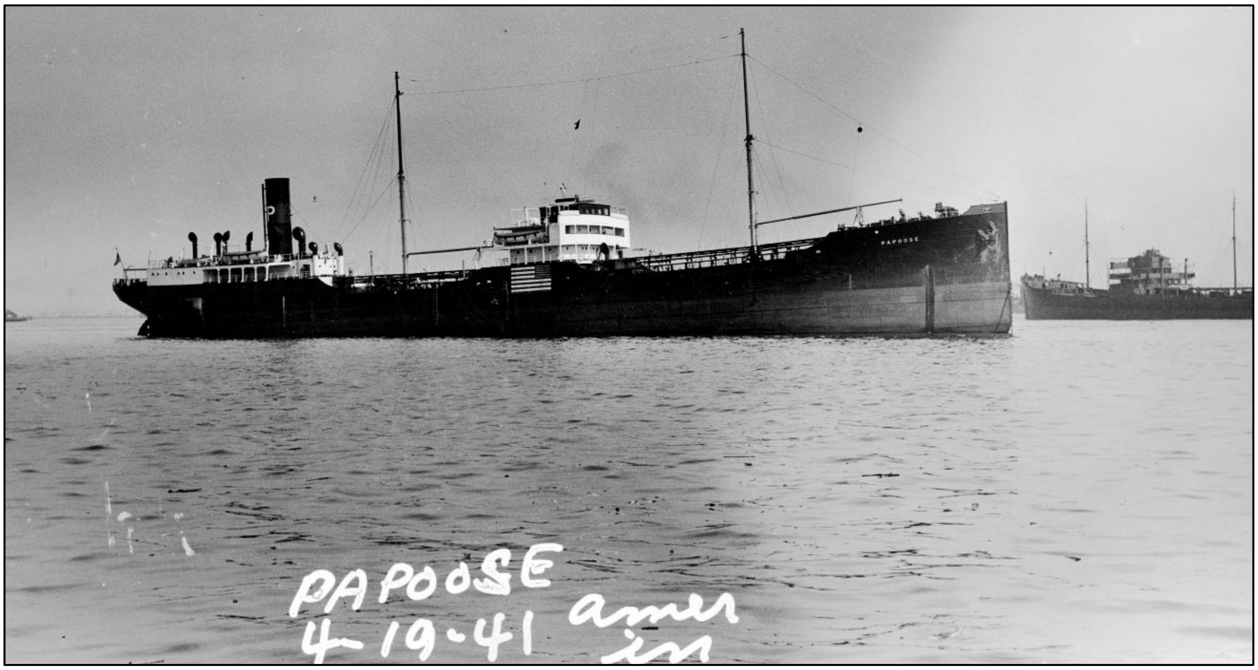


Figure 7-273 *Papoose*, dated 19 April 1941, location unknown.
Source: Courtesy of Mariners' Museum and Park

Table 7-39 Characteristics of *Papoose*

Characteristics	*Papoose*
Year of Build/Type/Hull #	1921/Tanker/25
Date Lost	18 March 1942 (attacked) Date of Sinking Uncertain
Position & Depth	25 miles NE of Cape Hatteras, NC 200 ft
Ship Characteristics	Length: 412' Breadth: 53.3' Depth: 31' Gross Tonnage: 5,939
Cargo	Water ballast
Survivors	32 (2 lost and 32 survivors)
Owner	Petroleum Navigation Company, Houston, TX
Builder	Southwestern Ship Building Company, San Pedro, CA
Former Names	*Silvanus* (Dutch-Indies Steam Tanker Co., 1921-1926)
Lloyd's Register Details	Steel (Stl) hull, two decks, fitted for oil fuel, longitudinal framing, triple expansion engine.
Port of Registry/Flag	Wilmington, Delaware/USA
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	Side Scan Sonar 2013.

7.37.1 History

Papoose was built in 1921 by the South Western Ship Building Company of San Pedro, California (Table 7-39 and Figure 7-273, above). Originally named *Silvanus*, the vessel was launched on 8 July 1921 for the Dutch owned Anglo-Saxon Petroleum company and delivered to its subsidiary, the Dutch-Indies Steam

Tanker Company (Nederlandsch-Indische Tanstoomboot Maatschappij). The ship measured 427 ft long overall and 412 ft in length between perpendiculars, was 53.3 ft abeam, and grossed over 5,900 tons (*Nautical Gazette* 1921b:47; *The Oil Weekly* 1921:46; Campo 2002:300)

Commercial ships, particularly in peacetime, had a fairly routine service life carrying cargo from port to port, and unloading and reloading. However, accidents do tend to punctuate this routine, but few vessels have had as troubled a past as *Silvanus/Papoose*. On 8 April 1926, *Silvanus* was downbound on the Mississippi River carrying a full load of Venezuelan naphtha and casinghead gasoline. About 40 miles south of New Orleans, Louisiana near Favret Light, another ship, Standard Oil Tanker *Thomas H Wheeler*, was upbound with a full cargo. Both ships' Masters had given over command to local pilots and were sailing in a heavy fog. The *Thomas H Wheeler*, concerned about the fog, slowed the vessel to a near standstill and gave the order to drop anchor. Meanwhile, Captain Visser of *Silvanus* had advised his pilot to change course and slow its speed. This was ignored by the pilot who was running *Silvanus* at over 13 kts and veering off course in the river. Consequently, *Silvanus* collided with the near stationary *Thomas H Wheeler*. The *Thomas H Wheeler* connected with the port side of *Silvanus* at the #9 tank. Crushed and twisting metal caused sparks igniting the volatile cargo in a terrible explosion. In addition to collision damage, the fire swept the decks completely burning away the superstructure killing 26 plus the pilot, all lost in the flames (Figure 7-274). The Burning hulk of *Silvanus* bounced between river banks before finally running aground (*Galveston Daily News* 1926; *New York Times* 1926; Woodhead 1927:21; The Silvanus 1932:56 F.2d 257; Nederlandsch Indische Tanstoomboot Maatschappij et al. v. Standard Oil Co 1933:66 F.2d 113).

Silvanus was nearly declared a total loss and turned over to its underwriters. The remains were put up for bid and it was purchased by the Petroleum Navigation Company of Houston, Texas. On 29 October 1921 *Silvanus* was towed up the Neches River to Pennsylvania Shipyard where it underwent extensive rebuild (Figure 7-275). Three hundred workers were assigned to rehabilitate the vessel at a cost of over $500,000. Crew quarters were lavishly appointed and the vessel was outfitted with the most modern equipment. When the work was finally complete the vessel was re-christened as *Papoose*, launched on 31 March 1927 and began service for Petroleum Navigation Company (Figure 7-276; Woodhead 1927:22).

Papoose was involved in further incidents in the coming years. In 1928, *Papoose* rescued crewmembers from a barge and tugboat *Princess* after they sunk in a gale. In 1930, en route from Trinidad to New York with 58,000 barrels of gasoline, *Papoose* was caught in a violent storm and lost its propeller. US Coast Guard Cutter *Champlain* towed *Papoose* 170 miles to safety. A year later, on 2 May 1931, *Papoose* had yet another collision in a heavy fog. Running at full steam just outside of Hampton Roads, Virginia, *Papoose* collided with USS *Wright* - a 500-ft long airplane tender. The port bow of *Papoose* struck the starboard bow of *Wright*, mashing in the bow of *Papoose* and causing the *Wright* to keel over, damaging two aircraft. No serious injuries or further damage occurred, but the circumstances were otherwise quite similar to the *Thomas H Wheeler* incident (*New York Times* 1928, 1930, 1931; *The Papoose* 1935:12 F.Supp. 743).

Further controversy surrounded *Papoose* in 1934 when it was accused of transporting 'hot' (contraband) oil. *Papoose* made attempts to unload 3,000,000 gallons of gasoline in West Coast United States ports but was blocked by Oil Administrator, Secretary Ickes, on suspicion that some portion of the cargo was produced in excess of pre-determined volumes. California state official and federal agents prevented *Papoose* from delivering the cargo inciting a public debate between Ickes and T.E. Buchanan, president of Petroleum Navigation Company, who insisted the cargo was collected in accordance with the law (*New York Times* 1934a, 1934b).

On 15 March 1942, *Papoose*, under the command of Captian Roger Zalnick, departed from Providence, Rhode Island bound for Port Arthur, Texas (Figure 7-277 and Figure 7-278). The ship was sailing alone, unarmed and was carrying no cargo sailing in water ballast. By 18 March 1942, *Papoose* was 16 miles SSE of Cape Lookout, North Carolina when it was spotted by U-*124*, captained by Johann Mohr. The night was clear and the seas were rough with a fresh NW wind. Mohr fired the first torpedo at 2135 hours EWT striking the tanker aft on the portside. The explosion knocked out the engines and destroyed the No. 4 lifeboat. The blast sent water rushing in and flooded the engine room, killing a fireman and an oiler - the only two crewmembers lost in this action. A distress signal was sent, and approximately 5 minutes following the initial torpedo strike, the order was given to abandon ship. Lifeboat No. 3 was the first to launch (USCoast Guard 1945:34; Moore 1983:215; DIO 1987:146; Hickam, Jr. 1989:85; Wynn 1997:101).

Just after Lifeboat No. 3 was away, the survivors observed the wake of a torpedo that narrowly missed the lifeboat itself and struck the starboard side of *Papoose*. A massive explosion erupted amidships shattering the amidships deckhouse and radio station and causing an additional secondary explosion. Falling debris from this eruption fouled the afterfall on the No. 1 lifeboat, which was still being lowered and stuck 15 ft from the water. The Captain was able to lower the bow to the water and cut the stern lines loose to get it launched. The No. 1 lifeboat cleared the stricken tanker 5 minutes after the second torpedo struck. The two lifeboats carrying 32 survivors rowed in a northeasterly direction towards shore. Hardly an hour later the crew could see the burning flames from U-*124*'s next victim, tanker *W.E. Hutton*. At 0730 hours EWT the next morning, *Papoose's* survivors were picked up by USS *Stringham* and taken to Norfolk, Virginia. At that time *Papoose* was still afloat (Figure 7-279; USCG 1945:34; Moore 1983:215; DIO 1987:146; Hickam, Jr. 1989:85; Wynn 1997:101).

Captain Zalnick believed, based on the condition of the vessel and the fact that it was still afloat, that it might be possible to be saved. The salvage tug *Kewaydin* was dispatched to locate the hull and determine the feasibility of salvage. It was not relocated at that time. US Coast Guard reports on 21 March 1942 stated a hull marked *Papoose* was observed north of Cape Hatteras at 35-23N. 75-07W. These reports were later dismissed by US Coast Guard surveyors recording positions of the wrecks. The actual day the vessel sunk is uncertain, but it likely occurred on 21 March (USCG 1945:34; Moore 1983:215; DIO 1987:146; Hickam, Jr. 1989:85; Wynn 1997:101).

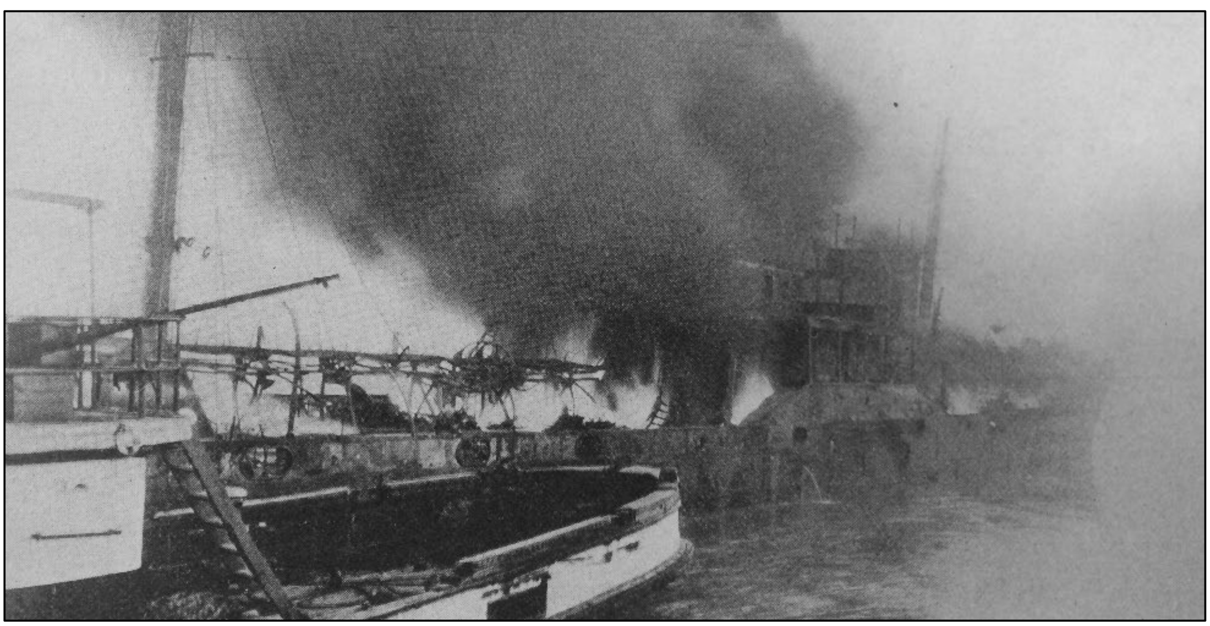


Figure 7-274 *Silvanus* on fire after a deadly collision with *Thomas M. Wheeler* on the Mississippi River on 8 April 1926.

Source: Woodhead 1927:21

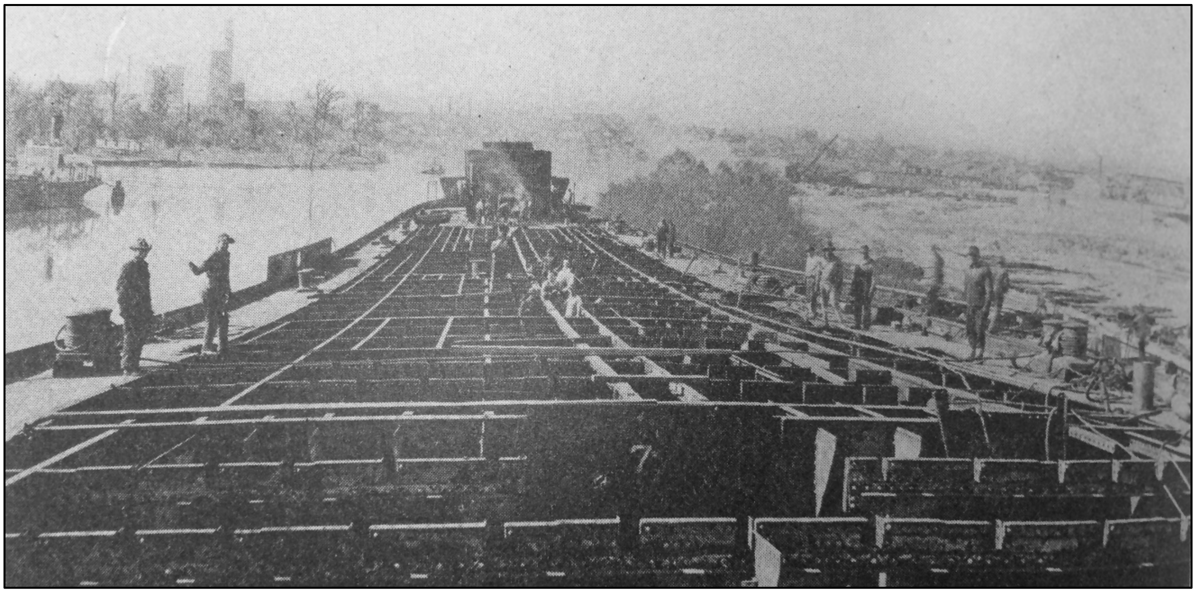


Figure 7-275 Following the devastating fire, *Silvanus* is being rebuilt at the Pennsylvania Shipyard in Beaumont, Texas, pictured on 3 January 1927.
Source: Woodhead 1927:21

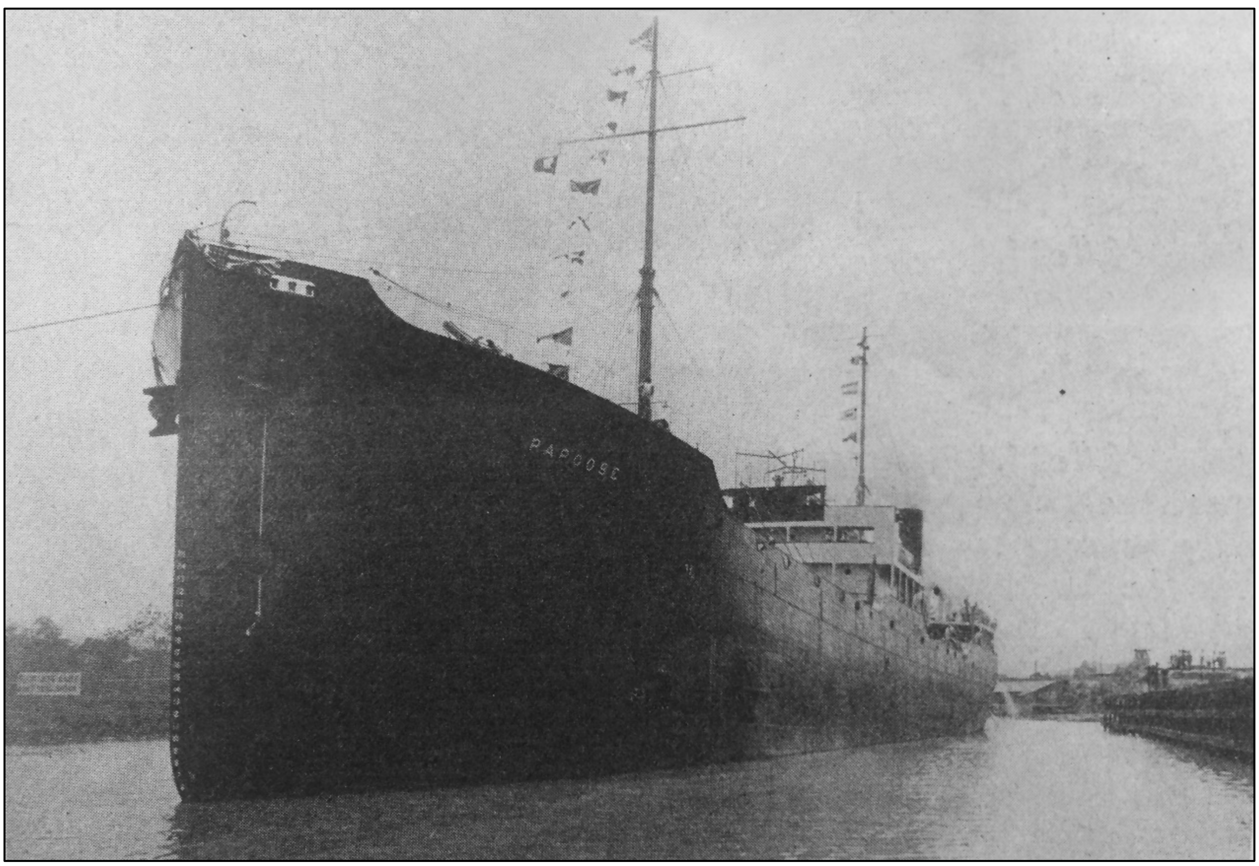


Figure 7-276 *Silvanus* re-christened as *Papoose*, leaving the repair yard on 3 May 1927.
Source: Woodhead 1927:21

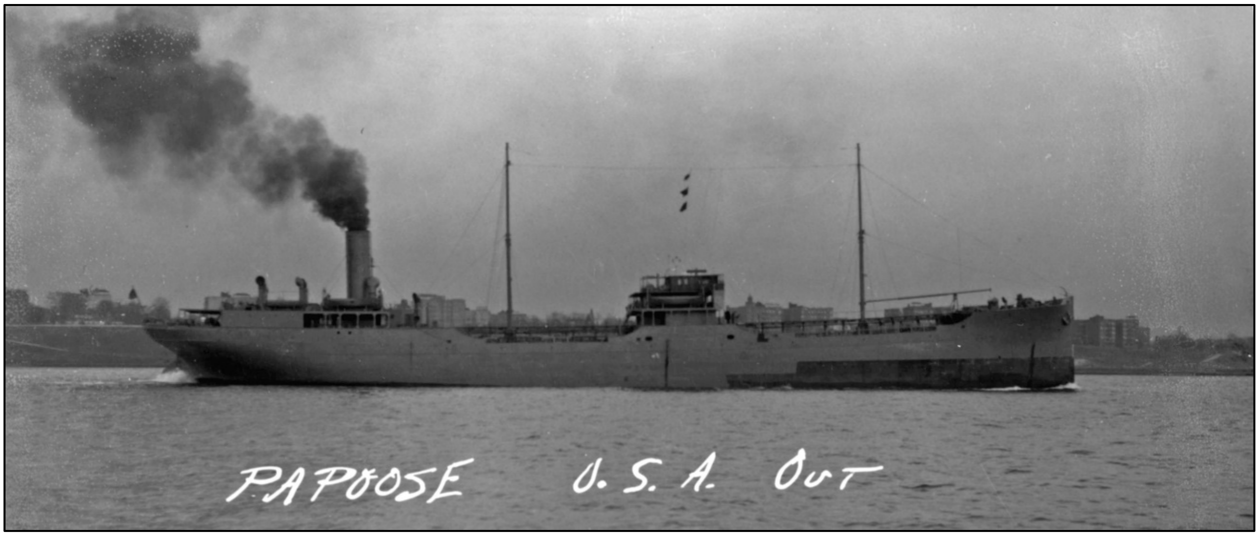


Figure 7-277 ***Papoose*** **on 17 December 1941.**
Source: Steamship Historical Society of America

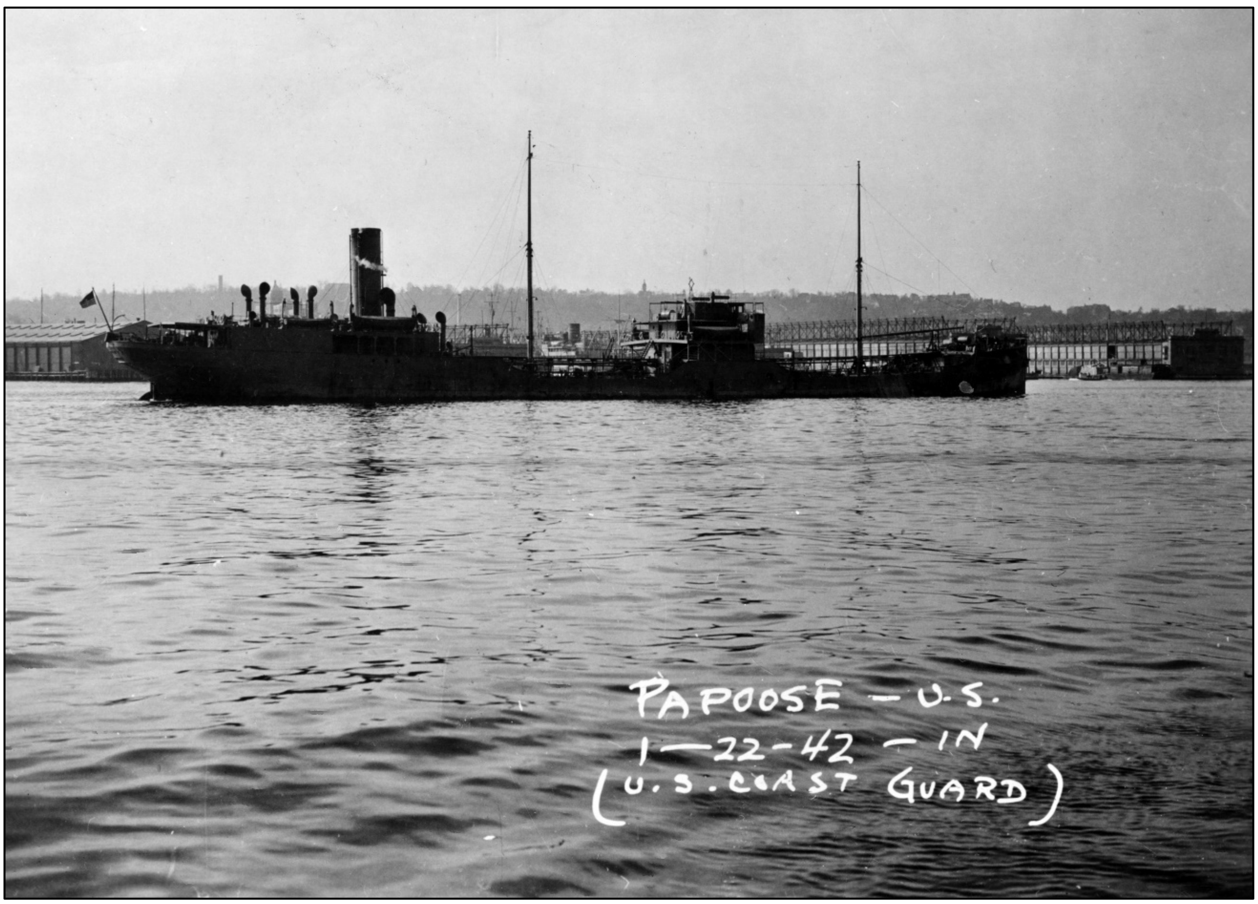


Figure 7-278 ***Papoose*** **on 22 January 1942.**
Source: Mariners' Museum and Park

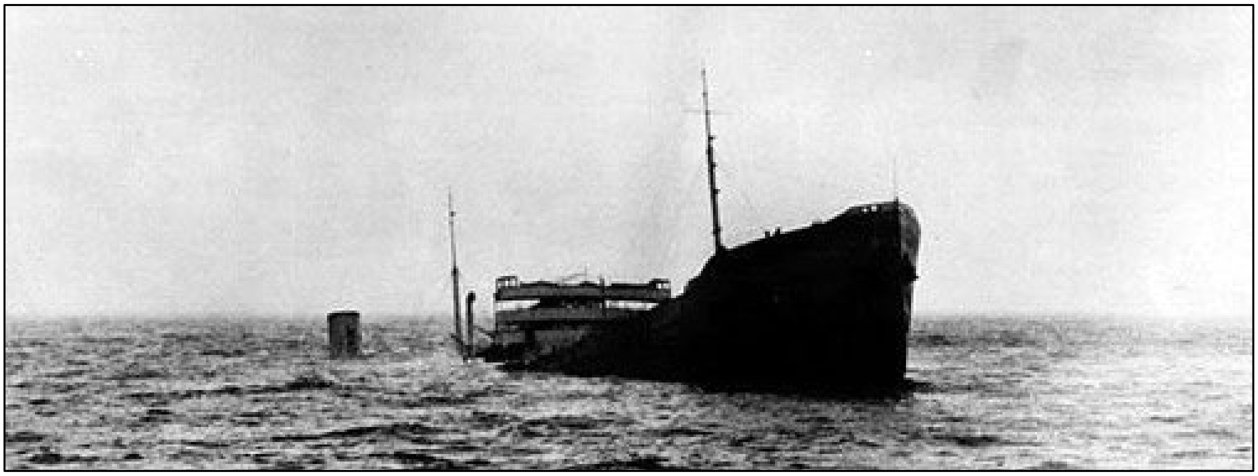


Figure 7-279 *Papoose* adrift and half submerged prior to sinking; date and location unknown.
Source: Courtesy of Association of Underwater Explorers/Dale Hansen.

7.37.2 Archaeological Site Description

There has been some debate over the identity of many of the WWII wrecks located off North Carolina. Much of the initial confusion stems from the US Coast Guard Cutter *Gentian* survey, which assumes a wreck near the reported attack position near Cape Lookout is *Papoose* and dismisses US Coast Guard reports that remains of *Papoose* were reported off Cape Hatteras two days later. This type of confusion is understandable amongst collections of shipwrecks in close proximity and in the fog of war, and is one reason close scrutiny is necessary. Over many years, local divers and avocational researchers were able to successfully present a compelling case for the identity of *Papoose* and other mislabeled sites off North Carolina. The site of what is now accepted to be *Ario*, was incorrectly identified as the remains of *W.E. Hutton*, and the site previously identified as *Papoose* is now known to be *W.E. Hutton*. Likewise, the site now known to be *Papoose* had previously been identified as *San Delfino* (DIO 1944:15-16; Barnette 2006:74-81).

The *Papoose* wreck site is located in just over 200 ft of water, northeast of Cape Hatteras, North Carolina. The wreck was large, intact, and upright on its keel. The shadow observed in a low-frequency sonar pass suggests there remained a high degree of relief and consequently remains of the deck and superstructure (Figure 7-280). The observed length was 396.5 ft and the beam was 56 ft. Historic dimensions were reported as 412 ft long and 53 ft abeam. Diving operations were attempted on this site but visibility was not conducive to useful data acquisition.

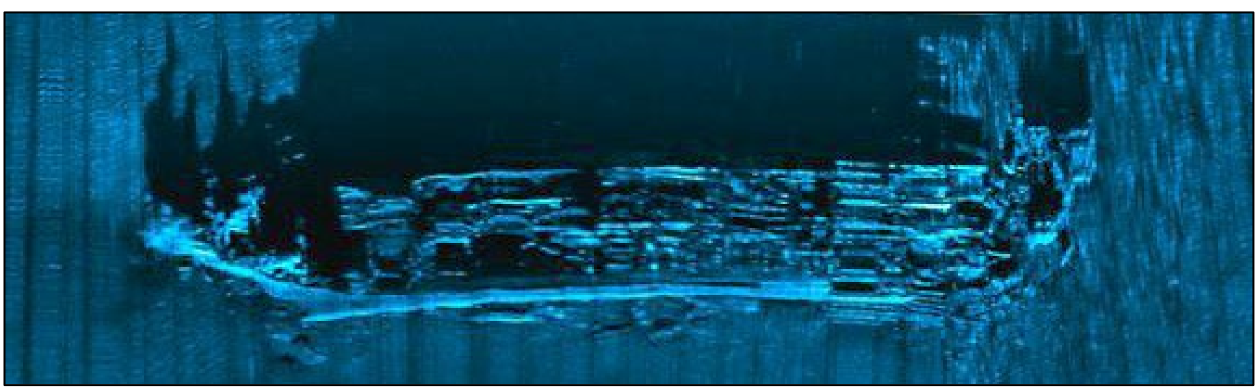


Figure 7-280 Low frequency sonar image of the *Papoose* wreck site.
Source: NOAA

7.38 Rio Blanco

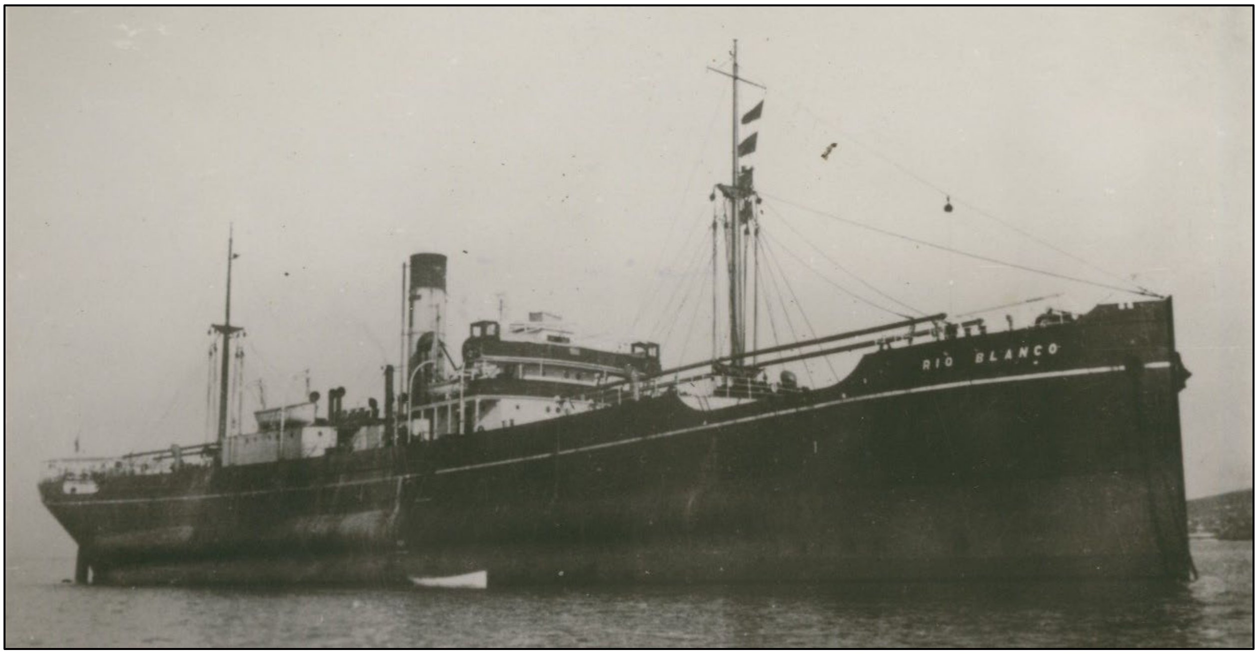


Figure 7-281 *Rio Blanco*, date and location unknown.
Source: Courtesy of Library of Contemporary History, Stuttgart, Germany – From the Raul Maya Collection, Uruguay

Table 7-40 Characteristics of *Rio Blanco*

Characteristics	*Rio Blanco*
Year of Build/Type/Hull #	1922/Cargo/220
Date Lost	1 April 1942
Position & Depth	70 miles E of Cape Hatteras, NC Not officially Located
Ship Characteristics	Length: 363.1' Breadth: 53.2' Depth: 26.3' Gross Tonnage: 4,086
Cargo	6,440 tons of iron ore
Survivors	21 (40 on board 19 lost)
Owner	Thompson Steam Shipping Co., Ltd., UK
Builder	Blyth Ship Building & Drydock Co., Ltd. Blyth, UK
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, one deck, web frames, corrugated sides, three boilers, triple expansion steam engine.
Port of Registry/Flag	London /UK
Sunk by	U-*160* (Georg Lassen)
Data Collected on Site	Historical documentation 2015.

7.38.1 History

Rio Blanco was built in 1922 by the Blyth Ship Building and Drydock Company of Blyth, United Kingdom (Table 7-40 and Figure 7-281, above). The vessel was built with web frames and had corrugated sides. Grossing 4,086 tons, *Rio Blanco* had an overall length of 363.1 ft, was 53.2 ft abeam, and had a depth of 26.3 ft (Lloyd's Register of Shipping 1942/43).

On 1 April 1942, *Rio Blanco* was on route from St. Thomas, Virgin Islands, bound for Norfolk, Virginia. The cargo vessel, traveling alone, was carrying a freight of 6,440 tons of iron ore when it was spotted by U-*160* approximately 60 miles due east of Cape Hatteras. Captained by Georg Lassen, U-*160* moved into attack position and fired one torpedo at the unsuspecting *Rio Blanco*. In the early afternoon of 1 April 1942, the torpedo crashed into the amidships section, causing the vessel to sink rapidly. In the attack, 19 of the crewmembers, including one Armed Guard, were lost. After being adrift nearly two weeks, 9 crew plus the Captain and 2 Naval Armed Guard crew were picked up by HMS *Hertfordshire* (FY-*176*) and landed at Norfolk, Virginia. The remaining 9 crew members were picked up by HMCS *Niagara* (I-*57*) and landed in Halifax, Nova Scotia (Mooney 1981:120; DIO 1987:225; Hickam, Jr. 1989:119; Wynn 1997:123).

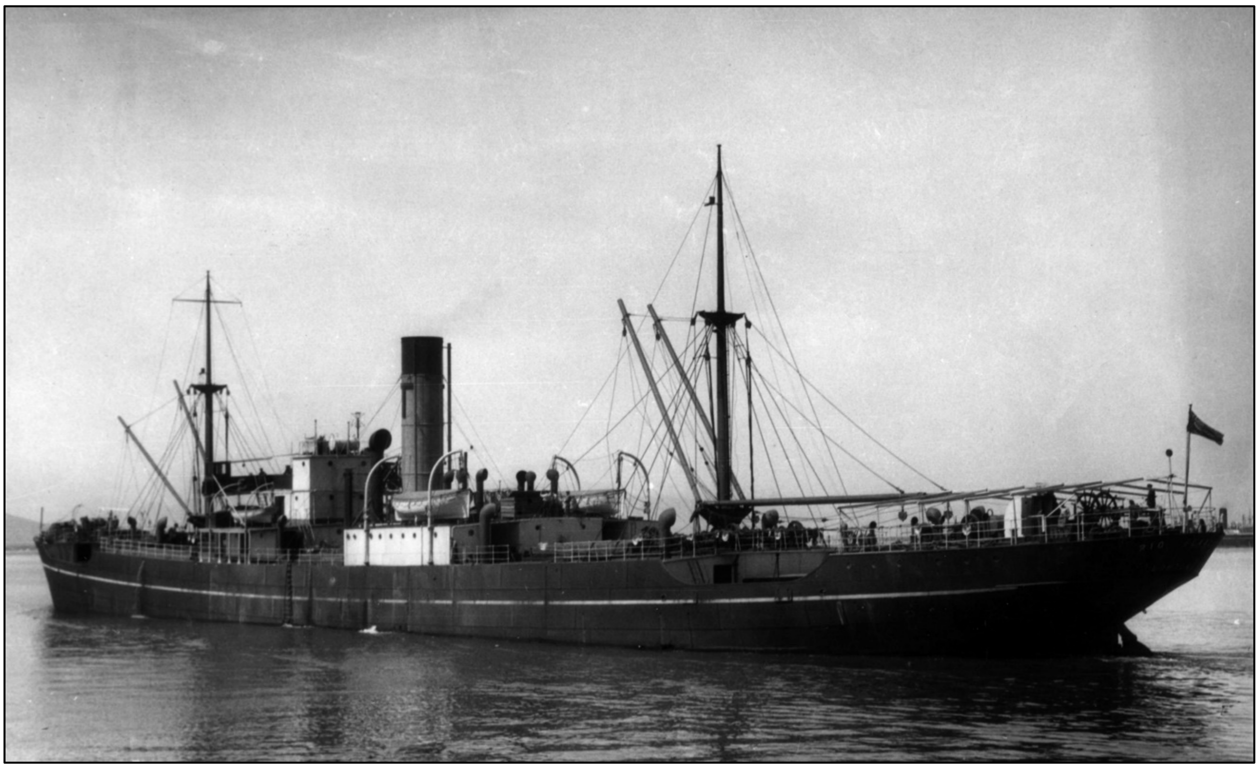


Figure 7-282 *Rio Blanco*, date and location unknown.
Source: Steamship Historical Society of America

7.38.2 Archaeological Site Description

The site of *Rio Blanco* has not been located in any official capacity. The location, according to reports, suggests the vessel likely sunk in deeper water, making it difficult to locate and provide information for assessment, though it is possible the remains are in accessible depths.

7.39 San Delfino

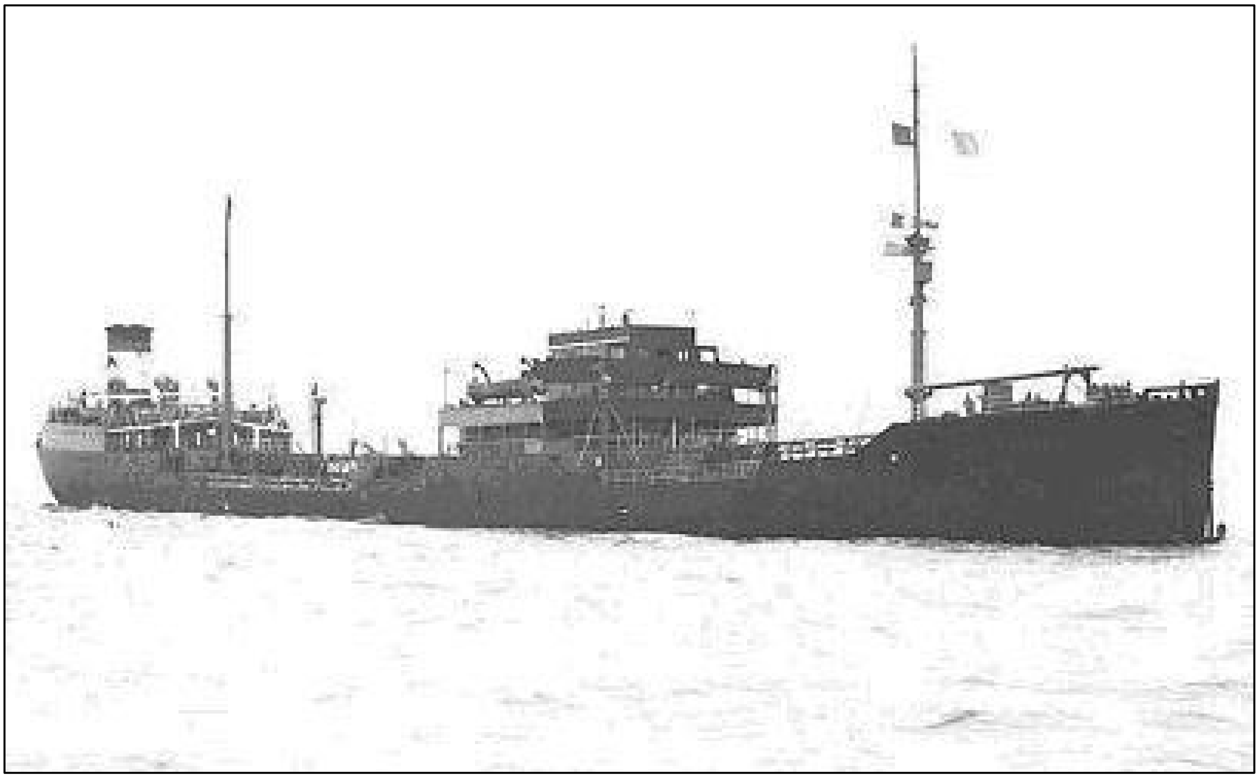


Figure 7-283 Starboard side of *San Cirilo*, the sister ship of *San Delfino;* date and location unknown.
Source: Royal Fleet Auxiliary Historical Society 2015

Table 7-41 Characteristics of *San Delfino*

Characteristics	*San Delfino*
Year of Build/Type/Hull #	1938/Tanker/283
Date Lost	10 April 1942
Position & Depth	41 miles NE of Cape Hatteras, NC 110 ft
Ship Characteristics	Length: 463' Breadth: 61.2' Depth: 33.1' Gross Tonnage: 8,072
Cargo	11,000 tons aviation fuel, ammunition
Survivors	22 (50 Total on board [28 dead])
Owner	Eagle Oil & Shipping Co., Ltd., London, UK
Builder	Furness Ship Building Co., Ltd. Middlesborough, UK
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, two decks, cruiser stern, fitted for oil fuel, longitudinal framing at bottom and at deck, machinery aft, twin screw, 4 two stroke cycle single acting oil engines.
Port of Registry/Flag	London /UK
Sunk by	U-*203* (Rolf Mützelburg)
Data Collected on Site	Side Scan Sonar, photo and video 2013.

7.39.1 History

San Delfino was built by the Furness Ship Building Company at Haverton Hill-on-Tees, for Eagle Oil and Shipping Company of London (Table 7-41 and Figure 7-283, above). Eagle Oil Company was a subsidiary of Royal Dutch Shell. The ship was 463 ft long, 61.2 ft abeam, and had a depth of 33.1 ft. San Delfino was designed to carry 12,000 tons deadweight and could make 12.5 kts (Figure 7-284; Fairplay Weekly Shipping 1938:62; Lloyd's Register of Shipping 1938).

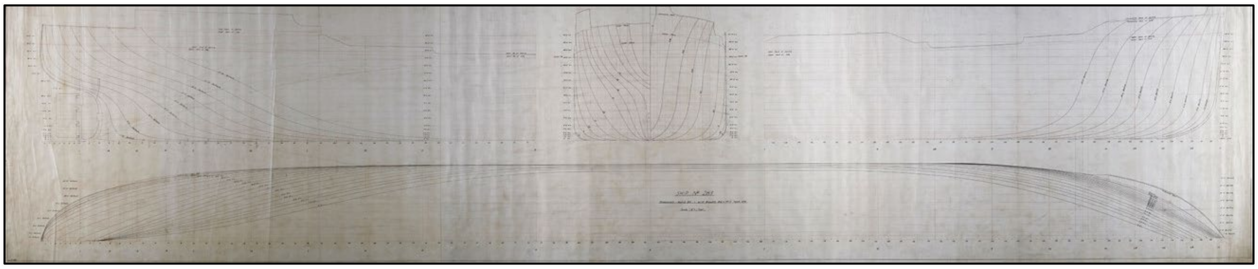


Figure 7-284 Hull plans for *San Delfino*.
Source: Teesside Archives, Middlesborough, UK

Although ultimately lost off North Carolina, the action that sunk San Delfino was not the first attack sustained by the ship during the war. On New Year's Day, 1 January 1940, San Delfino struck a mine off the River Humber in the UK while waiting to unload a full cargo of kerosene and vaporizing oil. At 0200 hours a massive explosion occurred that shattered two after tanks and blew a hole in the engine room. The keel was broken and the ship was nearly torn in two. Captain Perry was able to beach the ship and there were no casualties. Over the next few days the cargo was safely removed with lighters and by the end of January was berthed at Hull. The reason the ship did not sink outright was attributed to a newly developed compressed air device. San Delfino was equipped with air pipe that ran the entire length of the hull. If a breach occurred in a particular hold, the top hatch could be secured and compressed air could be pumped in to float the vessel (Sydney Morning Herald 1940; Shell Oil 1948:25).

On 10 April 1942, San Delfino was northbound from Houston, Texas to Halifax, Nova Scotia and had just passed Cape Hatteras. The ship was spotted by U-203, captained by Rolf Mützelburg. U-*203* was part of the fourth wave of U-boats to come to the American coast during Operation Paukenschlag (Drumbeat). U-*203* had just reached its destination after a fuel stop in the Azores, and over the course of the next 5 days U-*203* would torpedo 4 ships, of which *San Delfino* would be the first (Wynn 1997:150)

After U-*203* fired one torpedo into the starboard side of *San Delfino*, the Captian ordered the lowering of life rafts and the crew began to abandon ship. Two boats were filled with survivors; however, one boat could not overcome the strong current and was pushed into the massive flames of the burning oil. These 28 crewmembers were swallowed by the flames and never seen again. The master, 19 crew members, and 2 gunners in the other lifeboat could hear the screams of their shipmates, but could not help them. The survivors were picked up by HMS *Norwich City* and delivered to Morehead City (Stick 1952:237; DIO 1987:216; Hickam, Jr. 1989:128; Blair 1996:539).

Two sailors from the lost crew washed ashore in Buxton North Carolina near the Cape Hatteras Light. One of the bodies was identified by Aycock Brown, a civilian Naval Intelligence Officer. The bodies were subsequently buried on site as there was no way to preserve them for transport. This site, along with the British Cemetery on Ocracoke are still marked and maintained today (Stick 1998:143).

7.39.2 Archaeological Site Description

As discussed in the entries for *Papoose*, *Ario,* and *Hutton*, there has been persistent confusion over the identity of some wreck sites, including *San Delfino*. One such site known locally as the 'green buoy wreck'. Locally, the site was long believed to be WWI casualty *Mirlo*. This was later proven incorrect through research conducted by the recreational and avocational diving community. Though not proven conclusively, the most probable candidate for the identity of the so-called green buoy site is *San Delfino*. The site remains are similar in size and lost in close geographical proximity. The machinery onboard *San Delfino* was diesel powered, matching the remains observed on the bottom.

Sonar data collected in 2013 provided a general baseline and layout of the wreck site. From the sonar imagery, it was not possible to conclusively determine distinguishing characteristics beyond general size parameters. However, most vessels of this size located within this region in a comparable water depth have discernable boilers in sonar imagery (Figure 7-285). The absence of the boilers was confirmed by subsequent diving operations (Barnette 2006).

The presumed wreck site of *San Delfino* was mostly intact, though angled over to the starboard side. The site had overall observed site dimensions of approximately 450 ft in length and 60 ft at beam. The site had often been suspected as being that of *Mirlo*, a vessel of similar size and dimensions also lost in the same geographical area as *San Delfino*, but sunk during WWI. The two vessels were dissimilar in engine features, however, and from the sonar imagery, this aspect of the subject wreck was not conclusively determined. The engineering spaces were disarticulated with various areas of high relief obscuring the identification of individual features.

Diving operations conducted in 2013 confirmed the lack of primary boilers and the presence of large diesel engines. The wreck was mostly intact, though still angled over to starboard. Other sections that were observed and recorded were located at the stern. A large propeller (Figure 7-286) was identified as well as a large deck gun, a feature known to be on *San Delfino* (Figure 7-287 and Figure 7-288).

Given the size and position of the site along with wartime characteristics, such as the stern deck gun, the best candidate for this site is *San Delfino,* though further research and diving operations are needed before this can be conclusively determined. Other armament features were not immediately identified. This site would benefit from comprehensive survey, as diving operations were limited due to time and poor visibility conditions.

A compelling account of identifying this wreck along with several others in the study area was published by recreational and avocational historians. This account adds clarity to the tangled and confusing web of identifications and misidentifications of tankers *Mirlo*, *San Delfino*, *Papoose*, *W.E. Hutton,* and *Ario*, all war casualties off Cape Hatteras, North Carolina. This article, however, provides less than certain evidence that the so-called green buoy site is actually *San Delfino*, although it is a likely candidate (Barnette 2006:74-81).

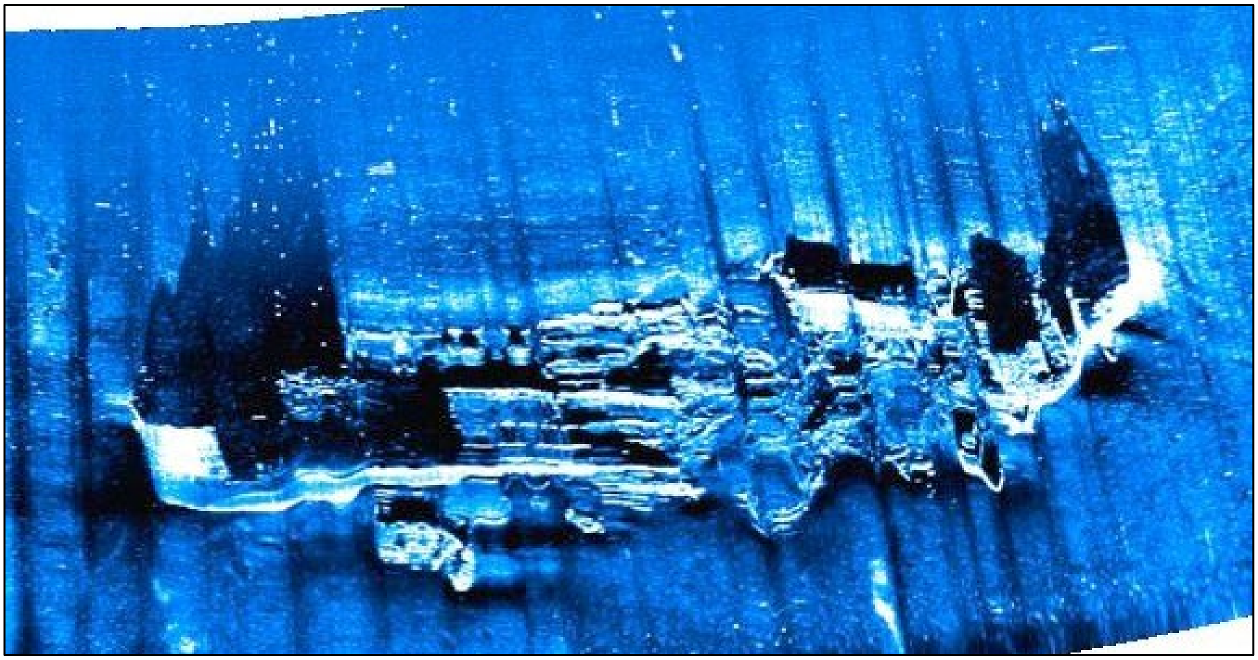


Figure 7-285 Sonar image of the presumed wreck site of *San Delfino*.
Source: NOAA

Figure 7-286 Propeller at the stern of *San Delfino* wreck site.
Source: NOAA

Figure 7-287 Fantail stern with deck gun visible at the *San Delfino* wreck site.
Source: NOAA

Figure 7-288 Deck gun at the stern of *San Delfino* wreck site.
Source: NOAA

7.40 Suloide

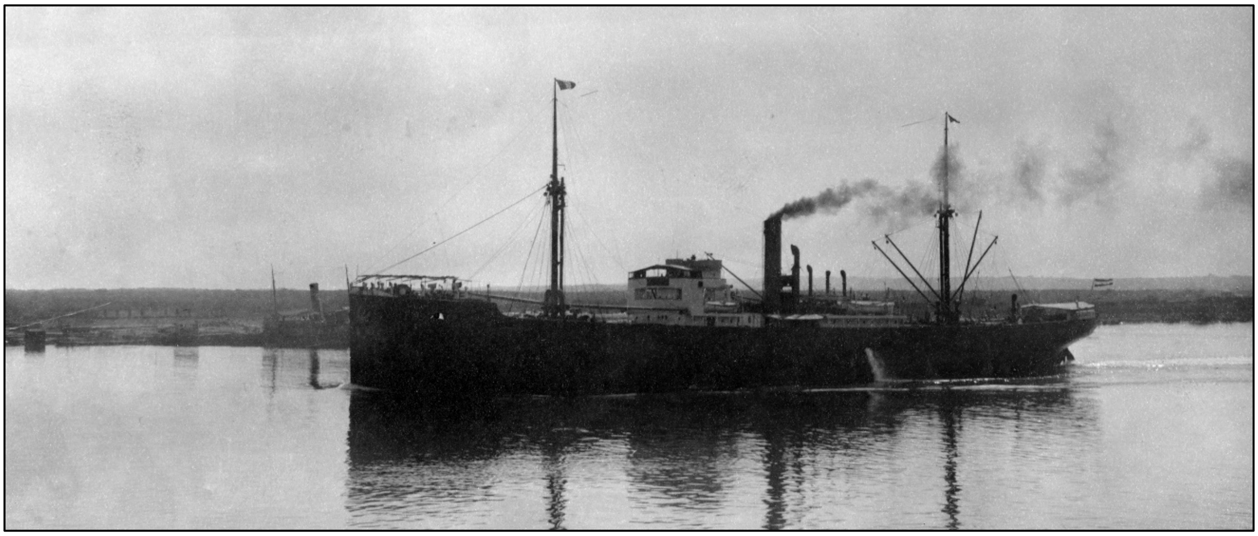


Figure 7-289 Port side view of *Suloide* (as *Amassia*).
Source: Mariners' Museum and Park

Table 7-42 Characteristics of *Suloide*

Characteristics	*Suloide*
Year of Build/Type/Hull #	1920/Cargo/357
Date Lost	26 March 1943
Position & Depth	20 miles W of Cape Lookout, NC 65 ft
Ship Characteristics	Length: 338.1' Breadth: 48.2' Depth: 21.0' Gross Tonnage: 3,235
Cargo	Manganese ore
Survivors	No loss reported
Owner	Lloyd Brasileiro (Companhia De Navegação), Rio de Janeiro, Brazil
Builder	Neptun Werft A.G., Rostock, Germany
Former Names	*Maceio* (Hamburg-Sudanmerikanische Steamboat Co., 1937-1941) *Amassia* (Hamburg – America Line, 1921-1937)
Lloyd's Register Details	Steel (Stl) hull, two decks, triple expansion steam engine, one screw.
Port of Registry/Flag	Rio de Janeiro /Brazil
Sunk by	Collision with wreckage of *W.E Hutton*
Data Collected on Site	Simrad Survey 2010.

7.40.1 History

Suloide was a Brazilian cargo ship of 3,235 tons built in 1920 by Neptun Werft A.G., Rostock, Germany (Table 7-42 and Figure 7-289, above). Originally named *Amassia*, the vessel operated under German controlled Hamburg-Amerika Lien throughout the 1920s and 1930s (Figure 7-290). It had an overall length of 338.1 ft and was powered by a triple expansion engine. The vessel was sold from the Hamburg-American Line Co. (Hamburg-Amerika Linie) in 1937 to the Hamburg-Sudanmerikanische Steamboat Co. and renamed *Maceio*. The vessel was sold again in 1941 to Lloyd Brasileiro of Brazil. When the vessel was acquired, it was renamed *Suloide* and would carry freight along the East Coast (Lloyd's Shipping Register 1942/43).

In March 1943, *Suloide* was loaded with a cargo of manganese ore from Trinidad and was bound for New York, New York. As *Suloide* was making its way along the coast, it suffered a broken rudder chain and although the wreckage was marked, *Suloide* could not steer away and struck the wreck of *W.E. Hutton*. The No. 1 hold quickly filled with water and the vessel began to sink. *Suloide* drifted about a mile toward shore before sinking at a depth of 65 ft. There were casualities due to the collision but the US Coast Guard was dispatched to blast the remains of *Suloide* due to it being a navigational hazard. The Naval Salvage Service began demolition of both *Suloide* and *W.E. Hutton* in the spring of 1944. A wire-drag party from United States Coast and Geodetic Survey visited the wreck on 31 May 1944 and reported a least depth of 39 ft at mean low water (DIO 1944:8,40).

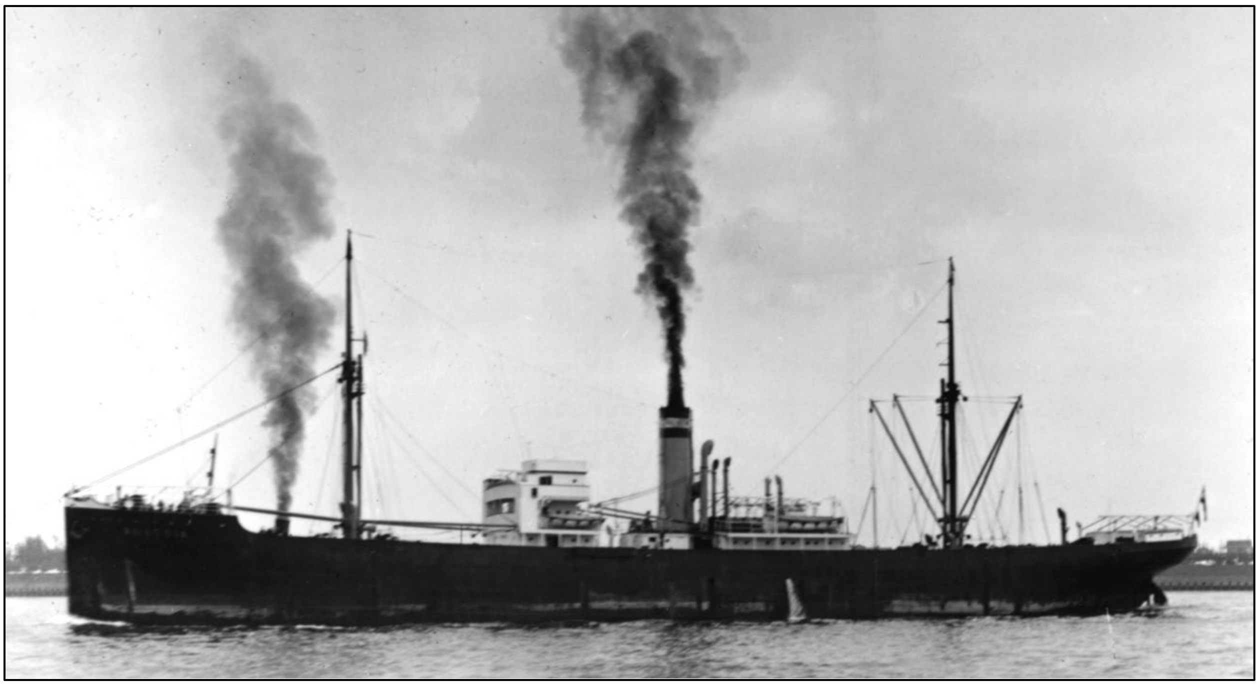


Figure 7-290 *Suloide* pictured as *Amassia*, date and location unknown.
Source: Steamship Historical Society of America

7.40.2 Archaeological Site Description

A series of multibeam surveys were completed during 2010 and 2016 aboard NOAA R/V *Nancy Foster* on Cruise Numbers NF-10-10-LF and NF-16-09. The surveys focused on known wreck sites using a mid-depth Simrad EM1002 System (95 kHz, 20 m-1,000 m) and a Reson 7125 at 400 kHz. The level of resolution acquired was designed to provide detailed and extremely accurate positioning, as well as insight into site distribution (Figure 7-291). Although *Suloide* was leveled after its loss, a distinctive outline to the wreck site remains.

The wreck site of *Suloide* is largely contiguous, however, there is very little that remained of the upper structure. The remains were oriented N to S, bow to stern, with only the boilers remaining as any substantial feature of relief. The remains can be divided into 2 main sections, the bow section forward of the amidships boilers, and the second section aft of the boilers towards the stern. The forward bow section measured approximately 158 ft in length, with the widest beam measured at approximately 57 ft. The stern section, including the boilers, measured approximately 161 ft in length, and approximately 45 ft at beam. Remains of hatch combings and masts were evident in the forward section. The wreck site of *Suloide* was not investigated by divers during this survey.

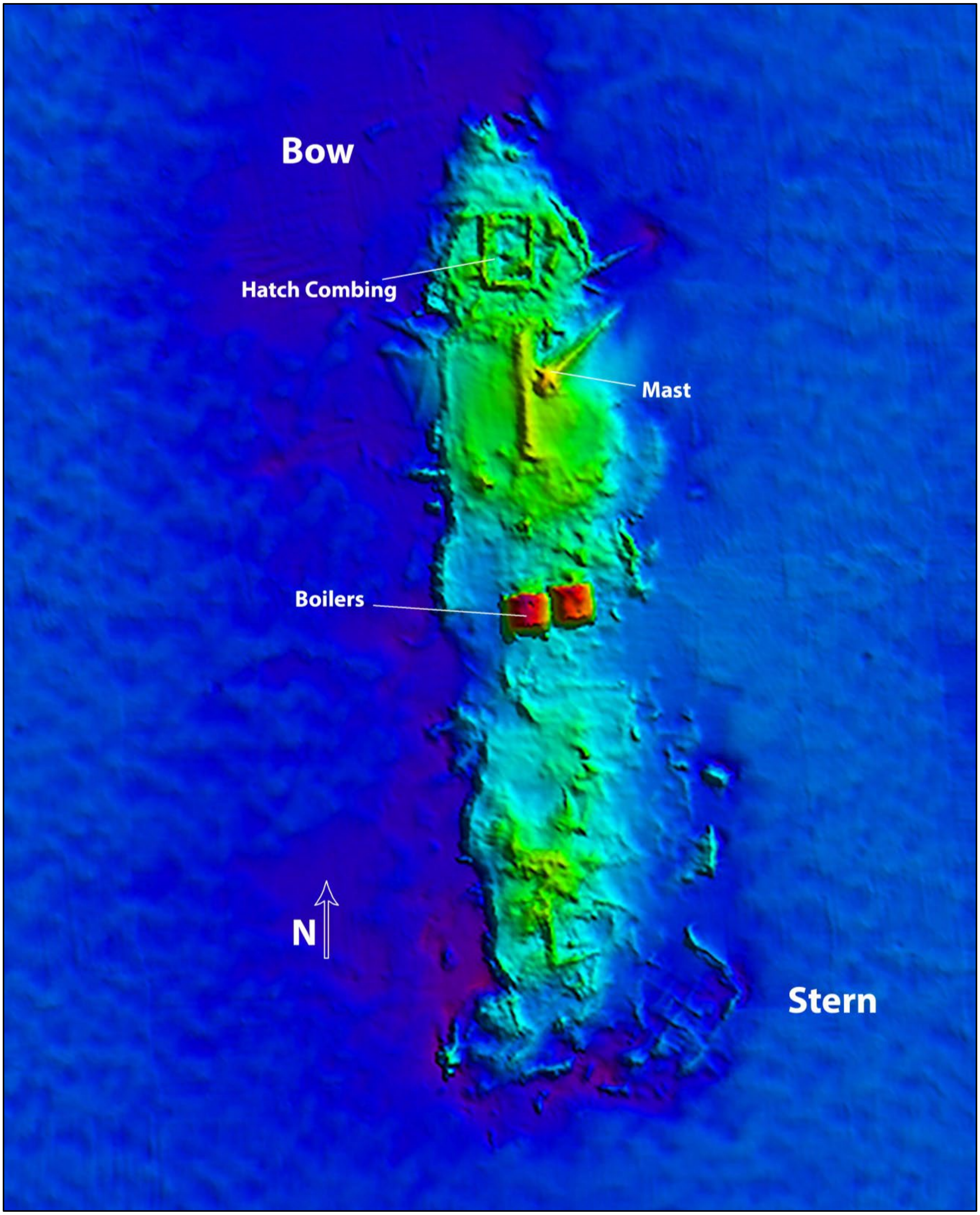


Figure 7-291 Reson 7125 multibeam at 400 kHz of *Suloide* collected in 2016.
Source: NOAA R/V *Nancy Foster*

7.41 Tamaulipas

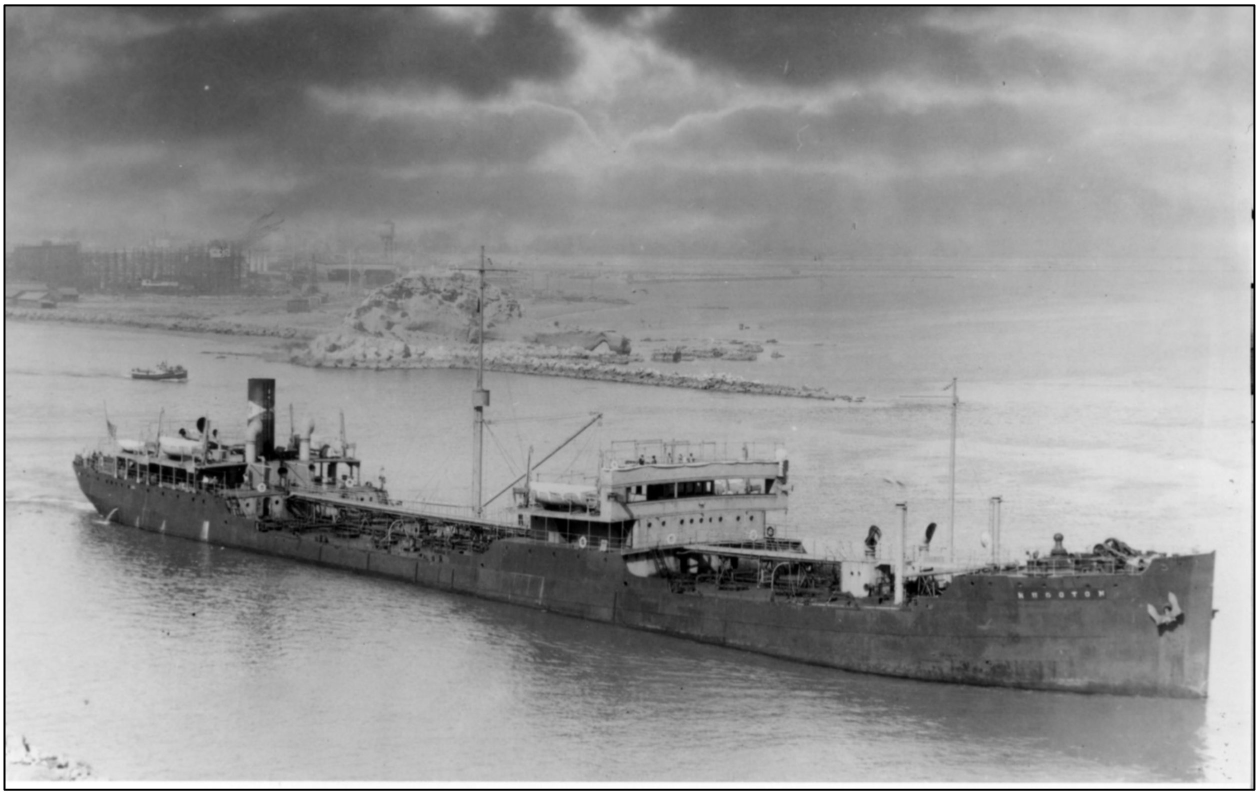


Figure 7-292 *Tamaulipas* under the former name of *Hugoton*.
Source: Steamship Historical Society of America

Table 7-43 Characteristics of *Tamaulipas*

Characteristics	*Tamaulipas*
Year of Build/Type/Hull #	1919/Tanker/4185
Date Lost	10 April 1942
Position & Depth	30 miles E of Cape Lookout, NC 155 ft
Ship Characteristics	Length: 434.8'; Breadth: 56.2'; Depth: 31.7' Gross Tonnage: 6,943
Cargo	70,000 barrels gas oil
Survivors	35 (37 Total on board [2 dead and 35 survivors])
Owner	Mexican Trading & Shipping Co., New York, NY
Builder	Bethlehem Fairfield Ship Building Corp., Sparrow's Point, MD
Former Names	*Hugoton* (Mallory & Co., New York, NY 1919-1941)
Lloyd's Register Details	Steel (Stl) hull, two decks, fitted for oil fuel, longitudinal framing, triple expansion engine.
Port of Registry/Flag	Wilmington, DE/USA
Sunk by	U-*552* (Erich Topp)
Data Collected on Site	ADUS Survey 2011; photo and video 2013.

7.41.1 History

Tamaulipas was completed by the Bethlehem Fairfield Ship Building Company for the USSB but delivered following the cessation of WWI in 1919 (Table 7-43 and Figure 7-292, above). Originally named *Hugoton*, the vessel was assigned to Columbus Shipping Company and operated under charter to the Standard Oil Company. It was then contracted out to the Malston Company, Inc., and managed by Mallory & Co., of New York, New York, operating from Mexico to the United States. The vessel grossed close to 7,000 tons and had an overall length of 434.8 ft. In 1941, the vessel was sold to the Mexican Trading and Shipping Company and renamed *Tamaulipas*. The vessel continued to operate on a route from Mexico to the United States, carrying petroleum products to refineries on the East Coast from Tampico, Mexico (USSB 1920:2490; Lloyd's Register of Shipping 1942/43).

On 9 April 1942, *Tamaulipas* was traveling from Tampico, Mexico to New York, New York with a full cargo of 70,000 barrels of furnace oil. The vessel was traveling alone and unarmed with a crew of 37 men. As they approached Cape Lookout, an area known for U-boat attacks, the crew was on high alert. One of the lookouts reported that a sound like a motor was heard astern of them and later spotted the streak of a torpedo cross the tanker's wake. It is unclear if this truly was a near miss torpedo or simply a fish. Nevertheless, Captain, A. Falkenberg, quickly made an adjustment to zigzag the *Tamaulipas* course. At 2320 hours EWT, a torpedo crashed into the starboard side, aft the midship house, near the #5 tank. The torpedo caused an enormous explosion breaking the ship's back and setting the cargo ablaze. The torpedo had been fired from U-*552*, captained by Erich Topp, one of the most successful U-boat commanders of the war (US Coast Guard, War Action Casualties 1945:55; Moore 1983:275; DIO 1987:216; DIO 1944:20-21; Blair 1996:539; Wynn 1998:28).

Within minutes Falkenberg realized the ship was lost, ordered the crew to abandon ship, and the survivors crew made it into the #1 and #3 lifeboats. With burning oil all around them, the lifeboats escaped the tanker. A few hours later, 35 of surviving crew were picked up by HMS *Norwich City*, where they joined the surviving crew from *Atlas,* another tanker sunk by Topp earlier that day. They survivors were taken to Morehead City, NC. Two crewmembers of *Tamaulipas* died in the attack (USCG 1945:55; Moore 1983:275; DIO 1987:216; Blair 1996:539; Wynn 1998:28).

7.41.2 Archaeological Site Description

The team investigated *Tamaulipas* in 2011 and again in 2013. A high-resolution multibeam survey was conducted of the site in 2011. Multibeam data generated georectified images of the sites for GIS and interpretive purposes (Figure 7-293 through Figure 7-297). The wreck of *Tamaulipas* was broken into two sections, with the forward section turtled and the outer hull pointing toward the surface. Located approximately one-half mile further north, the aft section of *Tamaulipas* was sitting upright on the seabed. The vessel had broken in two after the attack, but only after floating for some time in the current. There was a distinct break in the hull structure, delineating the point where the vessel broke in half, associated with the torpedo strike. The overall length of the forward bow section was approximately 193 ft, from the bow to amidships breaking point, oriented NE to SW from the bow.

The northern stern section sat upright on the seafloor and had an overall site scatter length of approximately 248 ft. The site itself was relatively contiguous and was oriented SW to NE, forward section to stern. There were three main areas of this stern section. The forward cargo area, which was forward of the engine and boilers, contained disarticulated hull and deck plating. This section extended a length of approximately 85 ft. Aft of this section was the engine machinery area, with two boilers and the engine visible. This section extended a length of approximately 116 ft and was also the area of highest relief. Aft of this section was the distinct fantail stern that was laying to its starboard side, with part of the steering quadrant located adjacent to this structure. This section extended a length of approximately 40 ft and was offset slightly from the other two sections, oriented in a more N to S direction.

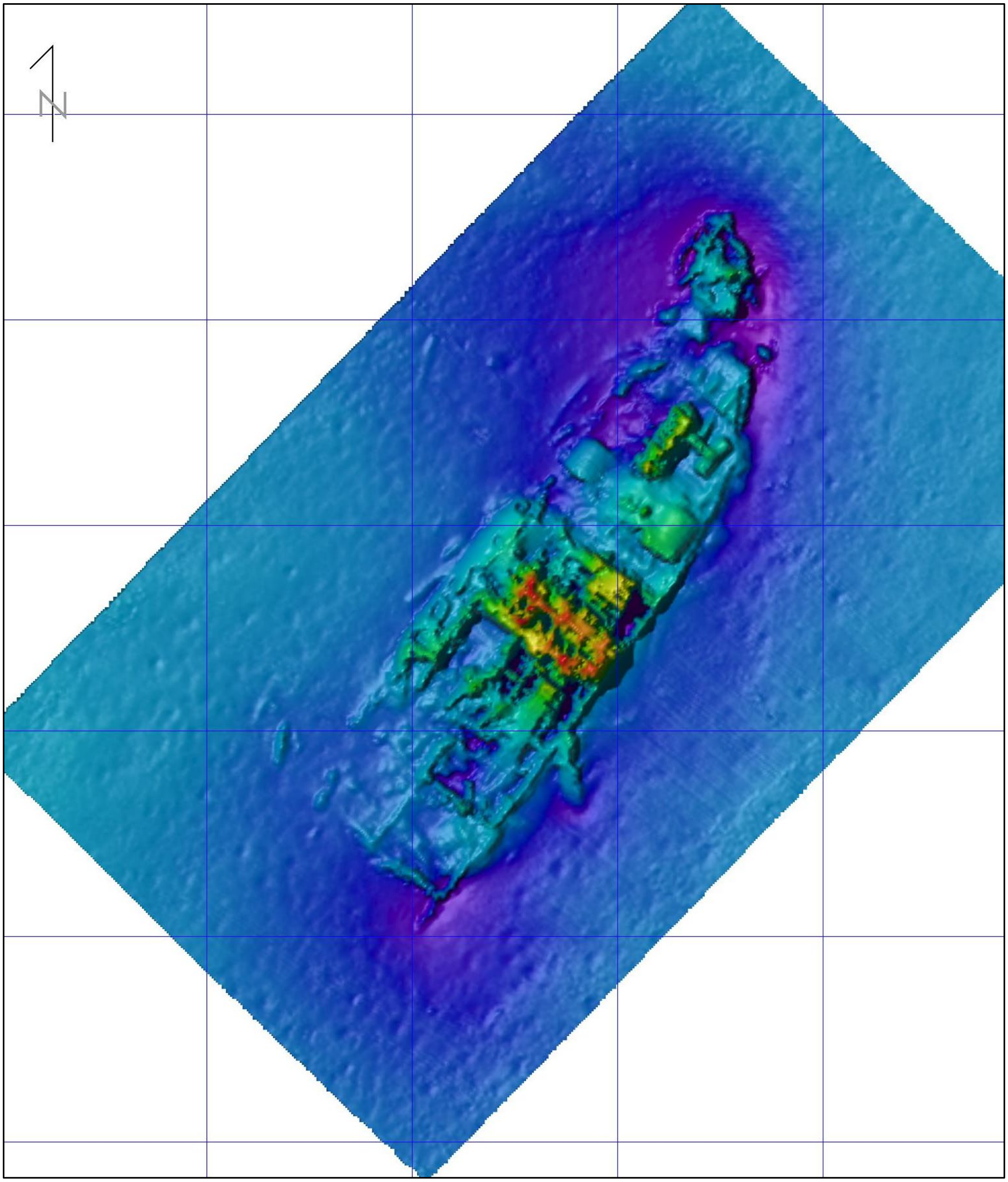


Figure 7-293 Reson 8125 scaled multibeam survey of the aft section of *Tamaulipas* wreck site.
Source: ADUS

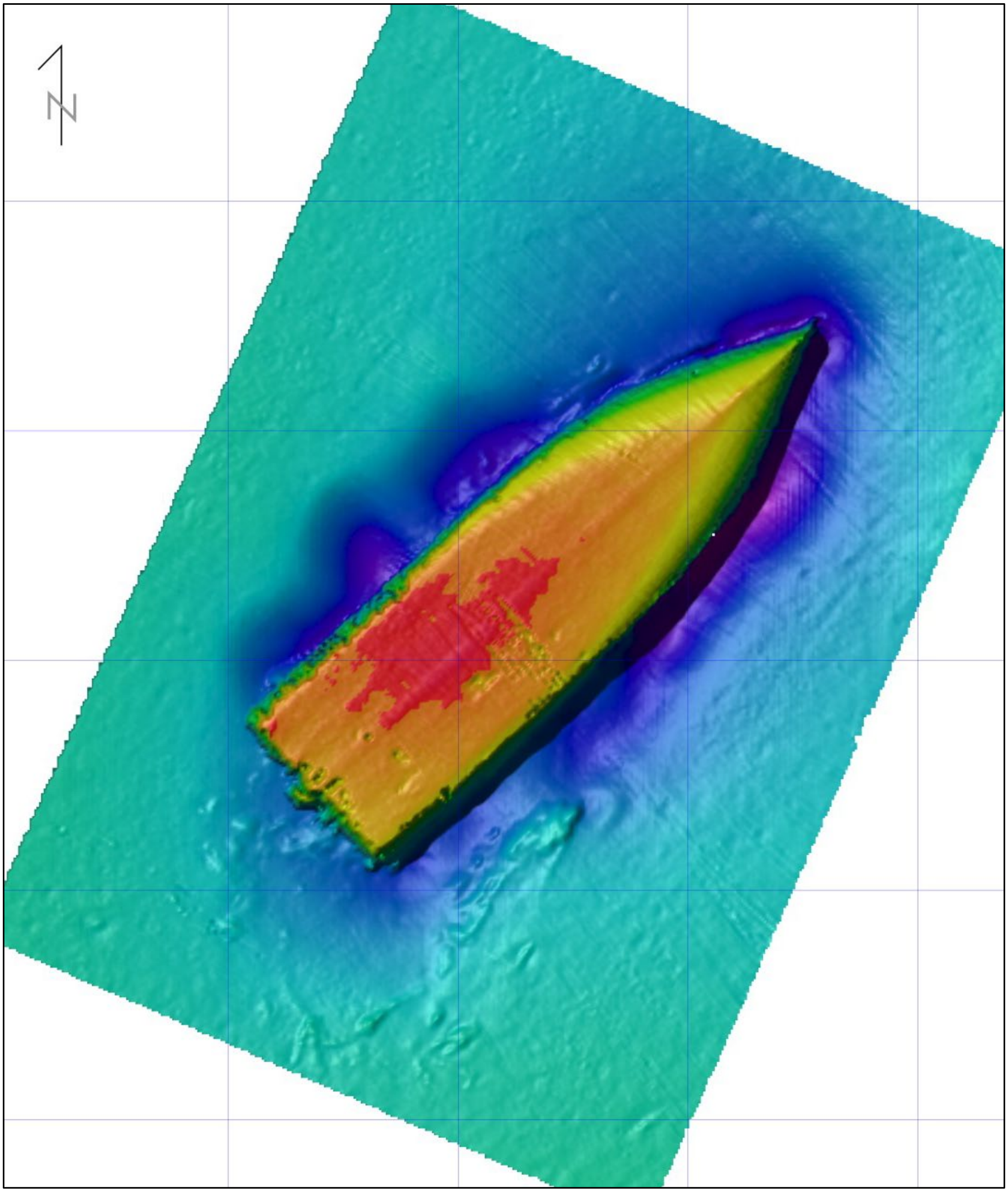


Figure 7-294 Reson 8125 scaled multibeam survey of the bow section of *Tamaulipas* wreck site.
Source: ADUS

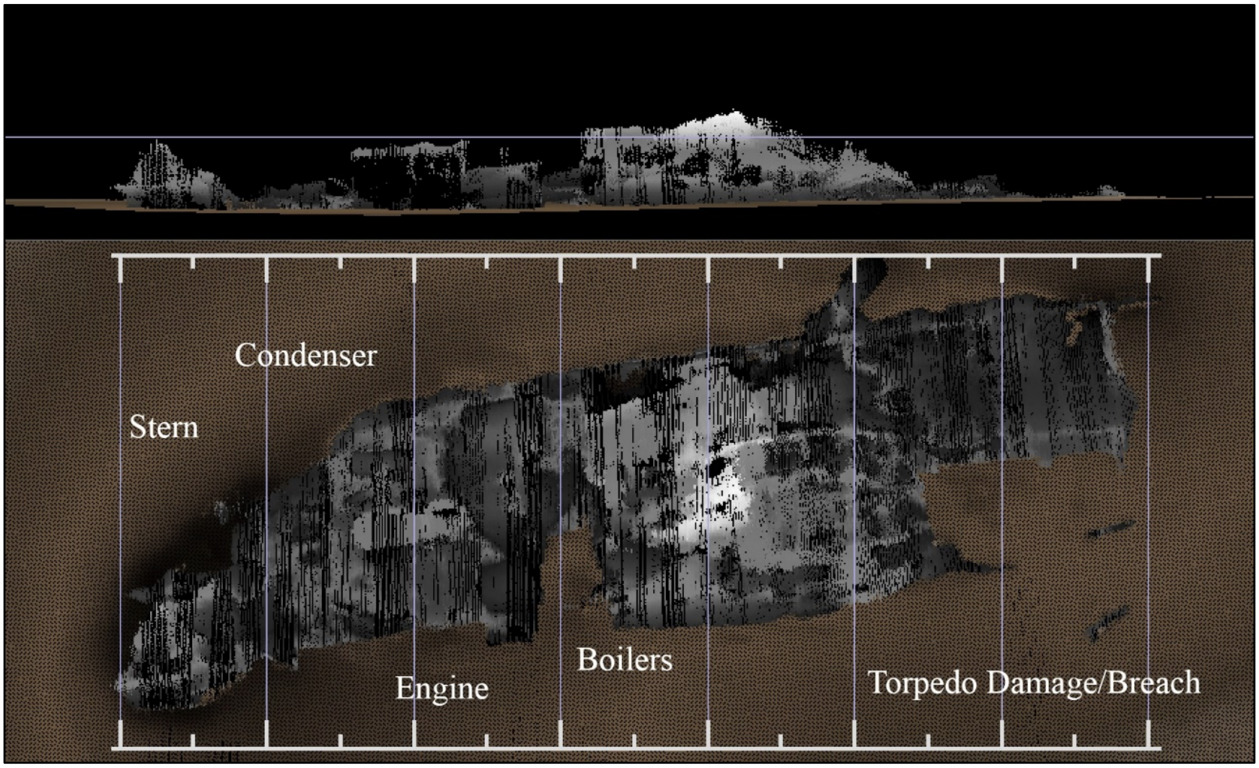


Figure 7-295 Multibeam SONAR visualization of the aft section of *Tamaulipas* wreck site scaled in 10-m grid.
Source: ADUS

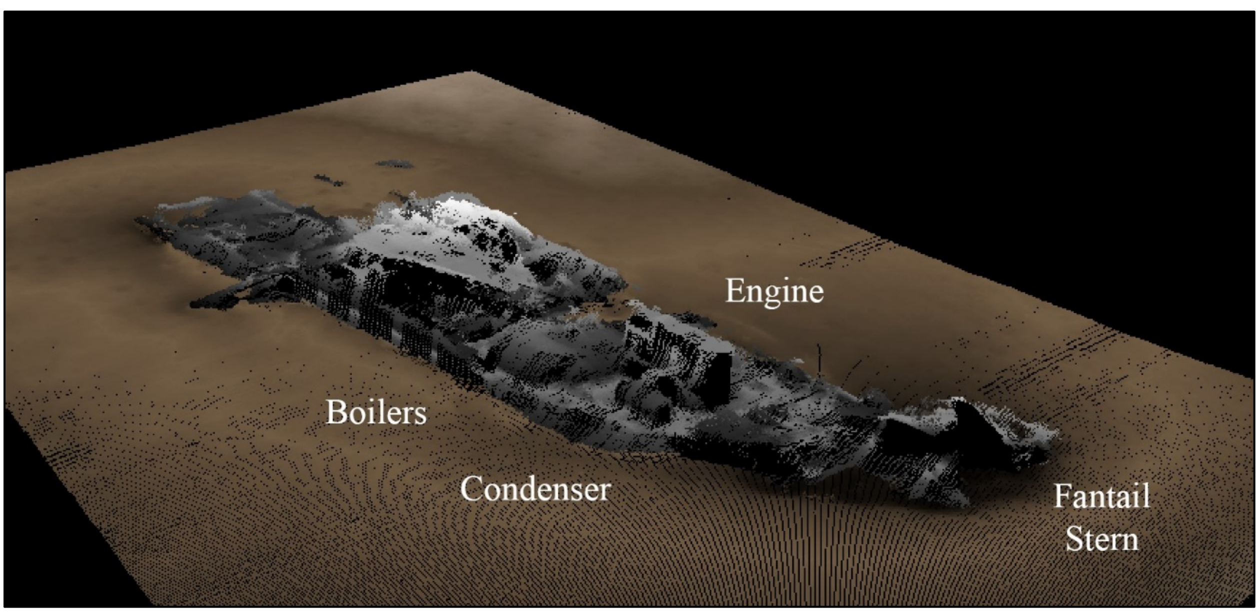


Figure 7-296 Isometric SONAR visualization of the aft section of the *Tamaulipas* wreck site.
Source: ADUS

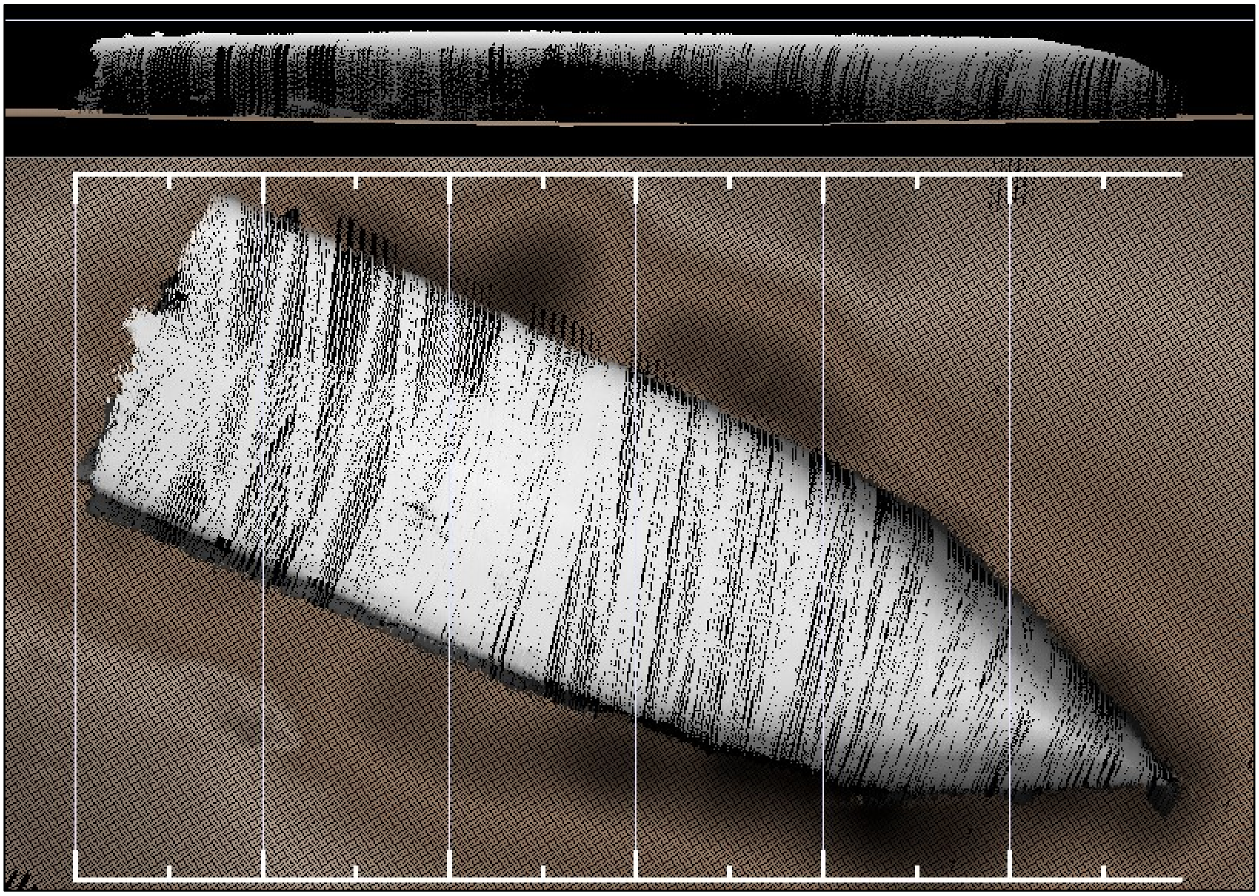


Figure 7-297 Multibeam SONAR visualization of the forward section of the *Tamaulipas* wreck site scaled in 10-m grid.
Source: ADUS

Tamaulipas originally was surveyed, photographed, and identified by US Coast Guard Cutter *Gentian* in 1943 (Figure 7-298). The team's dive assessment of the northern stern section area was completed in 2013. Divers were able to descend to the site, located at a depth of 155 ft, and record images of distinct features including the engines and boilers (Figure 7-299 and Figure 7-300). Dive conditions were favorable with visibility between 50 and 60 ft.

Large amounts of disarticulated hull and deck structure surrounded the engine and two boilers. The propeller and rudder were also visible. The distinct fantail stern was laying on its starboard side, with the steering exposed and visible (Figure 7-301). This section was contiguous and easily navigable up to the point where the forward section was sheared off.

The bow section of *Tamaulipas* was upside down with the hull structure facing the surface. Details showed much of the structure to be intact, with the potential for interior spaces to contain well-preserved material culture. During this survey divers were only able to access the stern section of *Tamaulipas*.

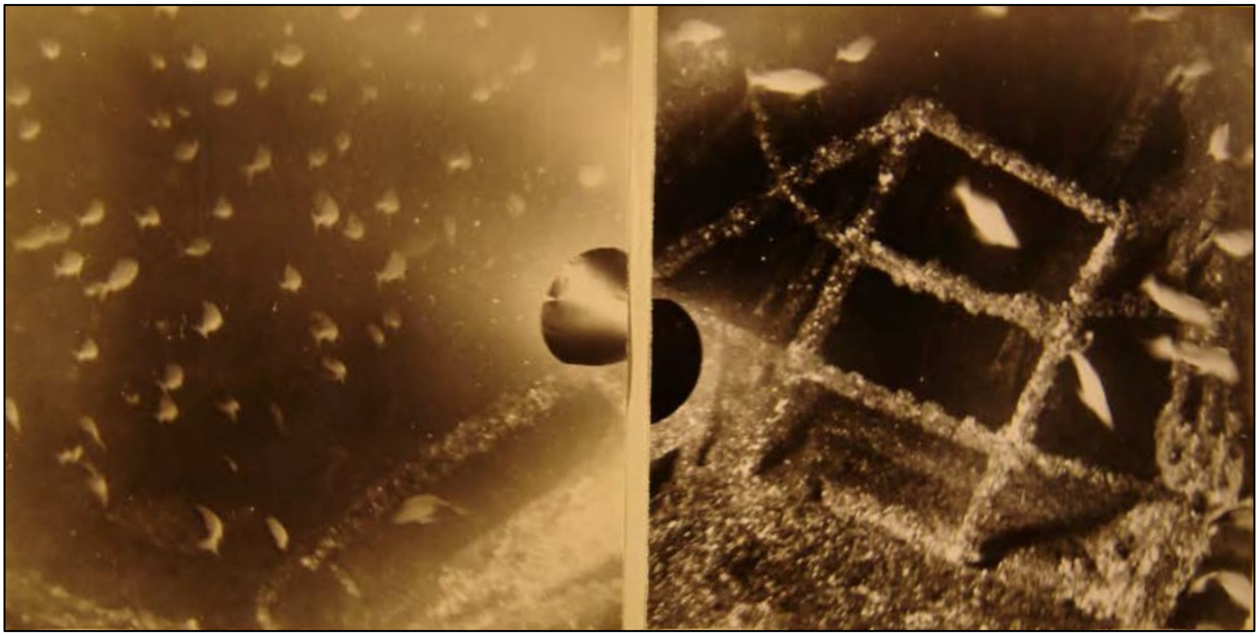


Figure 7-298 Life raft rack on wreck of *Tamaulipas* in 1943.
Source: DIO 1944

Figure 7-299 Divers over the northern stern section of *Tamaulipas*, examining the engine and boilers.
Source: NOAA

Figure 7-300 Triple expansion three-cylinder engine of *Tamaulipas*.
Source: NOAA

Figure 7-301 Steering quadrant of *Tamaulipas*.
Source: NOAA

7.42 Venore

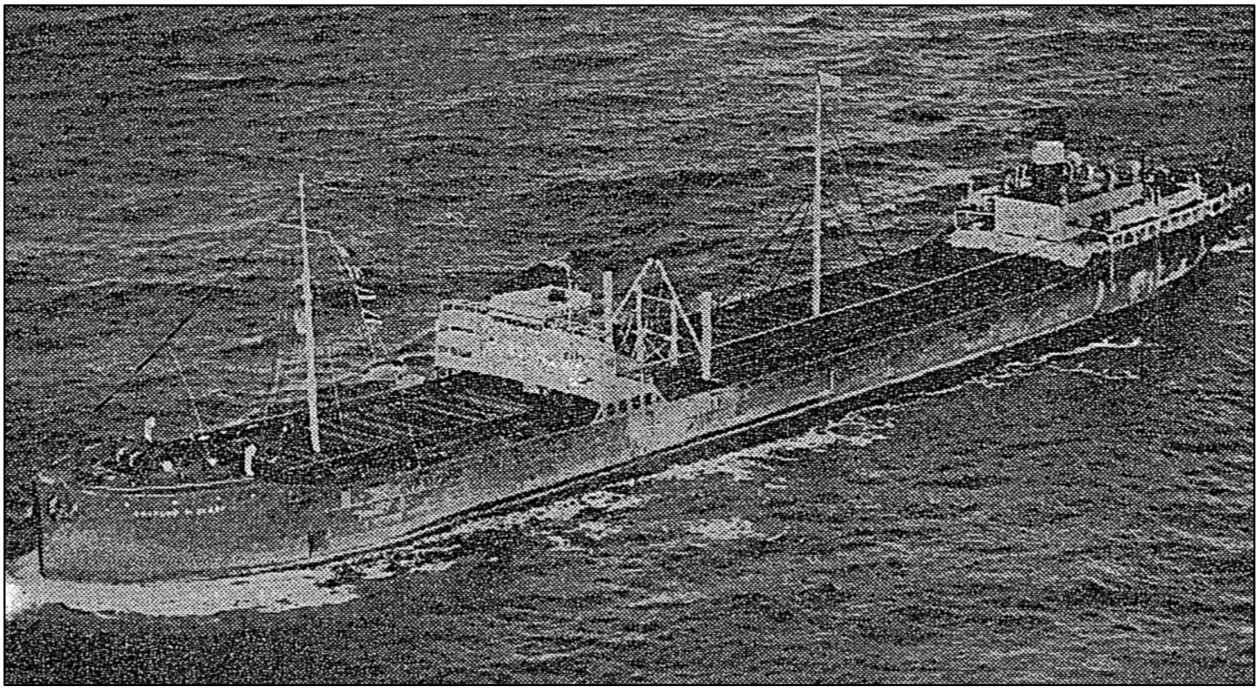


Figure 7-302 Photograph of *Venore* prior to WWII.
Source: *New York Times* 1942

Table 7-44 Characteristics of *Venore*

Characteristics	*Venore*
Year of Build/Type/Hull #	1921/Freighter/226114
Date Lost	28 June 1942
Position & Depth	Unlocated
Ship Characteristics	Length: 550.8' Breadth: 72.2' Depth: 43.7 Gross Tonnage: 8,017
Cargo	8,000 tons of ore
Survivors	24 (41 Total on board [17 dead])
Owner	Ore S.S. Corporation
Builder	Bethlehem Shipbuilding Corporation
Former Names	G. Harrison Smith; Charles G. Black
Lloyd's Register Details	Steel hulled freighter with riveted hull fastenings and an oil fired steam engine; vessel had three cargo holds the longest of which was 129 ft.
Port of Registry/Flag	New York, NY
Sunk by	U-*66*
Data Collected on Site	NOAA Screening Level Assessment 2013 (NOAA 2013d).

7.42.1 History

Venore was a combination ore and petroleum vessel built at the Sparrow's Point Plant in Sparrow's Point, Maryland (Table 7-44 and Figure 7-302, above). Originally launched on 12 July 1921 as *G. Harrison*

Smith, the steel-built freighter was built for the International Petroleum Company for the South American trade route, and at this point in time was one of the largest vessels ever constructed at the Sparrow's Point plant. *G. Harrison Smith* had a deadweight capacity of 20,000 tons with an overall length of 571 ft and 550.8 ft between perpendiculars, was 72.2 ft wide, and 43.7 ft in depth. It was designed for carrying a full cargo of either ore or oil in separate compartments. The ore cargo was carried in a narrow elevated hold 30 ft wide and 360 ft long. Cargo holds were divided by watertight bulkheads into three compartments, each of which had three large hatches extending the full width of the ore hold. Oil space, alongside and below the ore space, was divided by a longitudinal bulkhead extending from the keel to the ore hold. The foremost and aftermost compartments were for fuel oil and the tanks between these are for cargo oil. In 1926, *G. Harrison Smith* was acquired by the Standard Oil Company of New Jersey, New York and was renamed *Charles G. Black* (Figure 7-303) (Marine Engineering Log 1921:717; DIO 1987:16; Lloyd's Register of Shipping 1941). The dual capacity vessel was engaged in transporting oil from Baton Rouge to New York until 1940 when it was refitted for ore transport and sold to the Ore Steamship Corporation, and renamed *Venore* (Figure 7-304) (Standard Oil 1946:362).

Once refitted as exclusively an ore carrier, *Venore* had three operational decks with a submerged turret loading system. This system helped to facilitate the transfer of cargo oil from offshore loading to the terminals. *Venore* was a steel constructed vessel with riveted hull fastenings, and web and longitudinal style framing. The vessel had aft machinery with a twin-screw triple expansion steam engine with three Scotch boilers and could make up to 11.5 kts. The ship was originally built with heavy fuel oil bunkers, but was later refitted with three ore cargo holds, the longest being 129 ft. Lloyd's Register confirmed the vessel included a direction finder, echo sounding device, and a Gyro Compass (Lloyd's Register of Shipping 1930; 1940).

Figure 7-303 Photograph of the renamed vessel *Charles G. Black*.
Source: Seamen's Journal

Figure 7-304 Photograph of the refitted and renamed ore vessel, *Venore*.
Source: Seamen's Journal

In the late morning of 4 January 1942, *Venore* arrived in Cruz Grande, Chile after a long trip from America. Having taken the cargo of 22,700 tons of iron ore in 4 hours, the vessel was on its way out of the harbor and homeward bound towards Baltimore by that afternoon. Upon arriving at the Panama Canal, the crew of *Venore* reported hearing rumors of the German U-boat activity off of Hatteras. The captain, Fritz Dourloo, continued up the eastern seaboard with caution. The morning of 23 January, *Venore* was approximately 80 miles off Hatteras proceeding on a base course of 354°. This heading was changed by 15° every 15 minutes, zigzagging to prevent attack. Based on reports of U-boat attacks, Dourloo had opted to stay farther out shore, reasoning that if there were any U-boats, they would be working closer to the shoals where the most ships would be travelling. At about noon, a vessel was sighted astern. The overtaking ship drew closer to *Venore*, until it was possible to recognize the ship as the British tanker, *Empire Gem*. At twilight, the tanker was a mile off *Venore's* starboard quarter, running with its lights fully illuminated. As night fell, and *Venore* approached the Diamond Shoals, Dourloo ordered lights out except the vessel's dimmed sidelights, and proceeded through the darkness at 10 kts. At 1925 hours EWT, 5 miles southeast of Diamond Shoals Light, a sudden explosion was heard in the distance. About 1 mile away they could see the burning hull of *Empire Gem* (DIO 1987:16-17; Hickam, Jr. 1989:20).

The attack had come from U-*66* commanded by Richard Zapp who was patrolling in the Hatteras area. The crew aboard *Venore* could see a column of smoke and fire that climbed 500 ft in the sky surrounding *Empire Gem*. Captain Dourloo instantly navigated the vessel away from the burning tanker and pointed the bow toward shore. As *Venore* made its way toward the shoals, U-*66* followed. As *Venore* raced for shore, some of the confused and panicked crewmen began to lower the lifeboats despite not having any order to do so. A "slight hit" of the first torpedo to strike *Venore* was felt in the stern, and caused further panic, sending one man running astern and jumping overboard (DIO 1987:17). While the ship was still running at 10 kts three lifeboats with crew were being lowered. Two of them went to pieces as soon as they touched the water, and one was able to get clear with two survivors. (DIO 1942:3; Moore 1983:284; Hickam, Jr. 1989:20).

At 0324 hours, a second torpedo hit *Venore* on the port side into the #9 ballast tank (Figure 7-305). *Venore* instantly listed sharply to port, submerging the deck momentarily before righting itself. The remaining crew abandoned ship in the last lifeboat, the Captain and radio operator tried to scramble down the lifeboat falls but were unsuccessful. At 0445 hours EWT, the ship capsized to starboard and sank. The master, one officer, and 15 crewmen were lost. The 21 survivors in the last lifeboat were located about 62 miles north of Diamond Shoals on 25 January by the steamship, *Tennessee* and one additional survivor was recovered by the MV *Australia.*

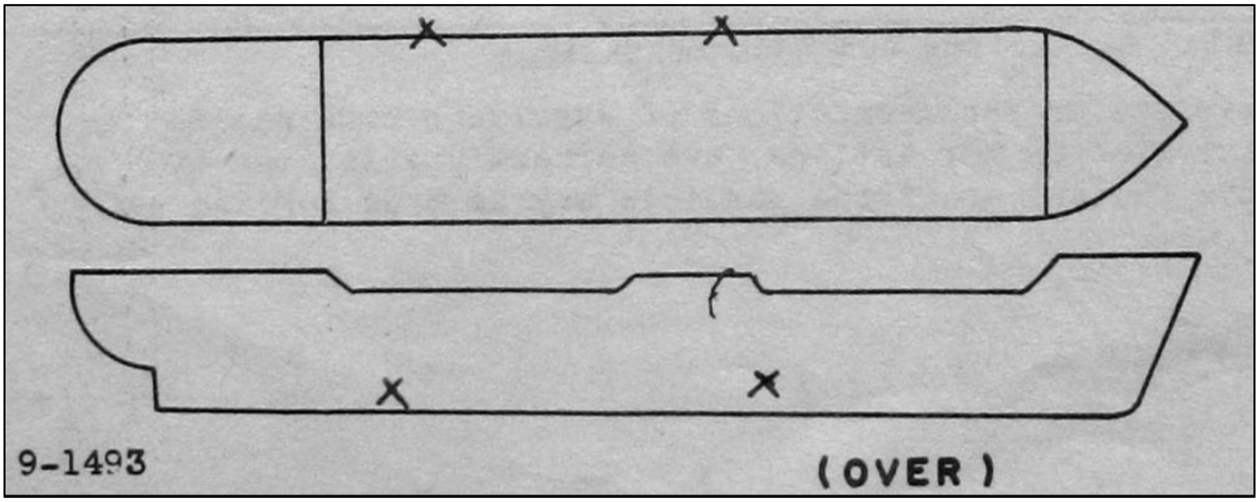


Figure 7-305 US Coast Guard diagram of the location of torpedo strikes on *Venore*.
Source: NARA

7.42.2 Archaeological Site Description

Despite the circumstances of its loss and proximity to shore, *Venore* has never been located. In 1944 the US Coast Guard Cutter *Gentian* survey conducted a series of drop camera surveys on a wreck they were convinced was *Venore*. However, the reported position of that target suggests the vessel remains they were investigating were actually remains of *Liberator*. It is anomalous that a vessel of this size in purportedly shallow water is not known. It is possible that the vessel drifted for some time before sinking or has merely been overlooked.

7.43 W.E. Hutton

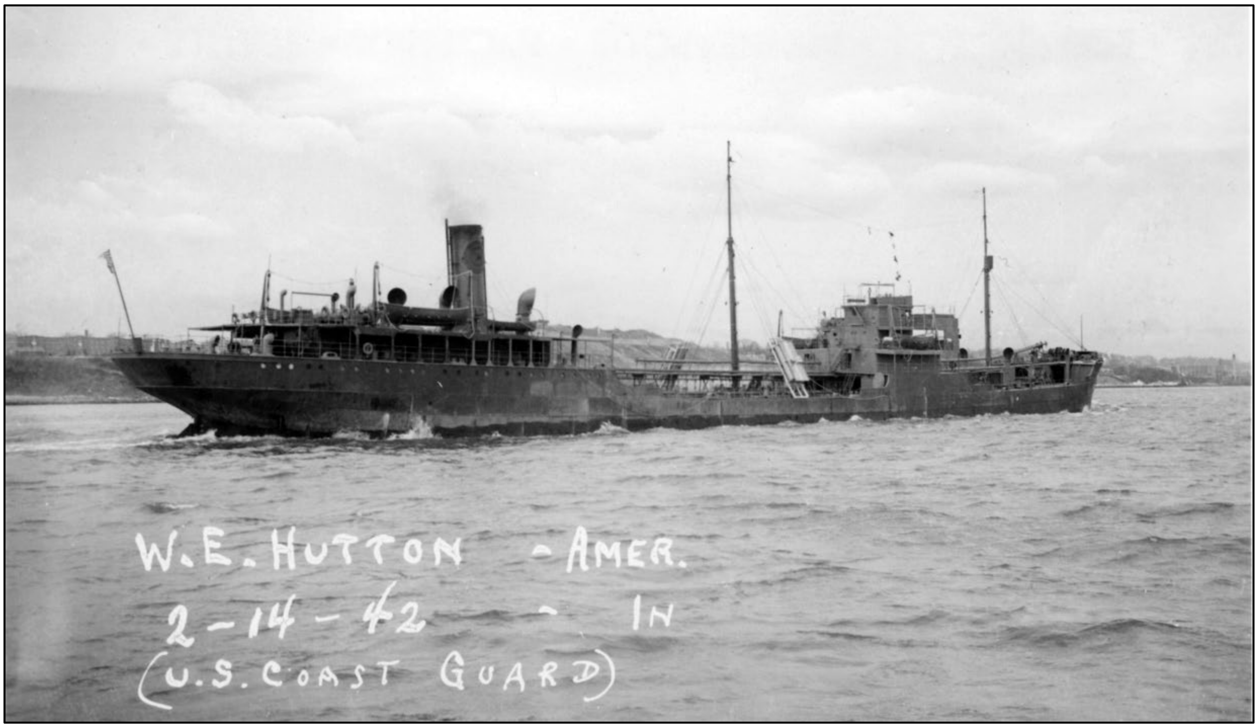


Figure 7-306 Photograph of *W.E. Hutton* 14 February 1942, location unknown.
Source: Steamship Historical Society of America

Table 7-45 Characteristics of *W.E. Hutton*

Characteristics	*W.E. Hutton*
Year of Build/Type/Hull #	1920/Tanker/219831
Date Lost	18 March 1942
Position & Depth	30 miles South of Cape Lookout, 120 ft deep.
Ship Characteristics	Length: 435.0' Breadth: 56.0' Depth: 32.0' Gross Tonnage: 7,076 tons
Cargo	65,000 barrels of heating oil (#2 Fuel)
Survivors	23 (36 Total [13 dead])
Owner	USSB, Pure Oil Company, Nederland, TX
Builder	Bethlehem Shipbuilding Corporation, Alameda CA
Former Names	Portola Plumas (USSB)
Lloyd's Register Details	Steel screw, 2 Decks, P.B. & F., Oil-fired vessel, aft machinery, triple expansion engine, 3 Scotch Boilers.
Port of Registry/Flag	Texas
Sunk by	U-*124* (Johann Mohr)
Data Collected on Site	Multibeam data 2010; Screening Level Risk Assessement (NOAA 2013g)

7.43.1 History

W.E. Hutton, originally named *Portola Plumas*, was built for USSB by Bethlehem Shipbuilding Co. in Alameda, California (Table 7-45 and Figure 7-306, above). The Alameda shipyard, formerly United Engineering Works, was added in 1916, at the onset of WWI, to build standardized cargo ships for USSB. *Portola Plumas* had its keel laid on 4 April 1919, launched on 30 August 1919, and was finally delivered to the Shipping Board on 20 April 1920. In 1920, *Portola Plumas* was one of 15 other identical Bethlehem Shipbuilding tankers that were delivered to the USSB. The ship was 435 ft. long, with a 56-ft. beam, and a 32-ft. draft. It was driven by a single screw triple expansion engine and three Scotch boilers and could make up to 10.5 kts, manufactured by the Bethlehem Shipbuilding Company. The steel tanker was constructed on the Isherwood system of longitudinal framing and had two fully operational decks. The USSB retained ownership of *Portola Plumas* until 1923. The ship was then sold to the Pure Oil Steamship Company of Philadelphia, Pennsylvania. Under the ownership of Pure Oil, the ship was renamed *W.E. Hutton* and began service as a petroleum tanker (Marine Engineering Log 1921; Lloyd's Register of Shipping 1930 and 1940).

On the night of 18 March 1942, *W.E. Hutton* was traveling from Smith's Bluff, Texas to Marcus Hook, Pennsylvania laden with 65,000 barrels of #2 heating oil—which is approximately 2 million gallons. The vessel was approaching one of the most dangerous areas of the east coast, approximately 20 miles southwest of Cape Lookout Light buoy. By this time, the U-boat threat was dire but convoys had not yet been coordinated. Consequently, *W.E. Hutton* was transiting unarmed and unescorted. All Captain Carl Flaathen could do was follow routing instructions and black out his ship (US Coast Guard 1945: 35; Moore 1983:287; Hickam, Jr. 1989:85; Ray 2008:17).

Johan Mohr in U-*124* was operating in this area and hardly an hour before spotting *W.E. Hutton*, had just succeeded in destroying petroleum tanker *Papoose*. At 2345 hours EWT, U-*124* fired two torpedoes towards the unsuspecting tanker. While one torpedo missed, the other hit the starboard bow near the stem post caving in the forepeak and carrying away both anchors. *W.E. Hutton* immediately sent a distress signal, which was acknowledged, and the crew set about lowering the lifeboats three-quarters of the way down (US Coast Guard 1945: 35; Hickam, Jr. 1989:85, Ray 2008:16).

Eight minutes after the first explosion, U-*124* fired another torpedo towards the stationary tanker. The torpedo struck the port amidships section, abaft the pilothouse. An enormous explosion erupted, blasting through the decks and shattering the pilothouse. *W.E. Hutton* was engulfed in a raging inferno. The ship was hastily abandoned with 15 men getting away in the two starboard lifeboats and 4 more men each on two rafts. Survivors reported seeing crewmates on fire jumping into the sea. *W.E. Hutton* sunk within one hour of the initial attack. At daybreak the survivors consolidated into a single raft and began rowing for shore. At 1035 hours EWT, they were picked up by the British merchant vessel *Port Halifax* and delivered to Savannah. Thirteen of the 36-man crew had been lost (US Coast Guard 1945:35; DIO 1987:146; Hickam, Jr. 1989:85; Blair 1996:519; Wynn 1997:101; Ray 2008:17).

The wreck of *W.E. Hutton,* just over one year later, caused the sinking of a passing ship. On 26 March 1943, *Suloide*, smashed into the wreckage of *W.E. Hutton* when it's rudder chain failed. *Suloide* drifted off and sank later in the day (DIO 1942:6).

7.43.2 Archaeological Site Description

The team conducted multibeam surveys of *W.E. Hutton* aboard the NOAA R/V *Nancy Foster* on Cruise Number NF-10-10-LF in 2010 using a mid-depth Simrad EM1002 System (95 kHz, 20 m-1,000 m). The level of resolution acquired was designed to provide detailed and extremely accurate positioning, as well as insight into site distribution (Figure 7-307).

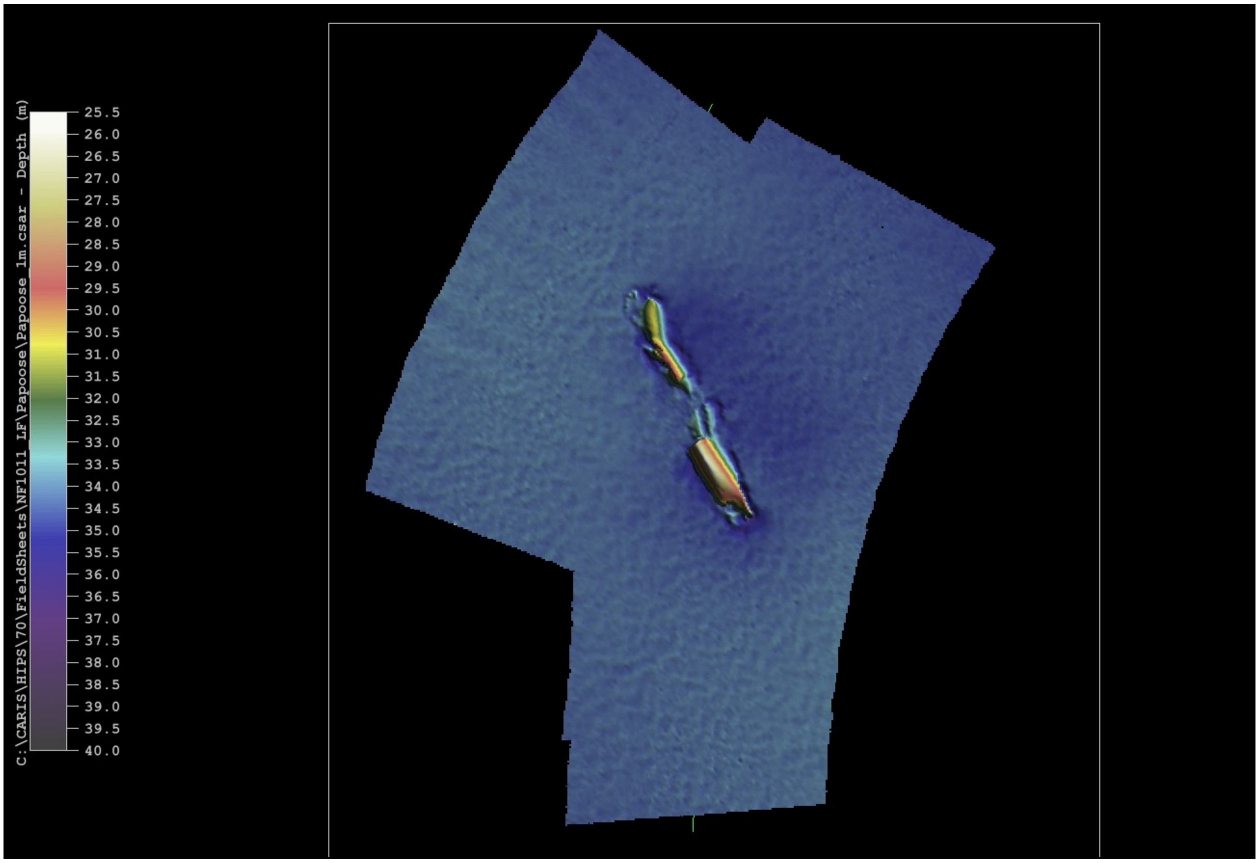


Figure 7-307 Multibeam survey of the wreck *W.E. Hutton*.
Source: NOAA

The *W.E. Hutton* archaeological site was comprised of two sections, with a gap separating the two. The site was oriented NE to SW, bow to stern, and both sections were turtled. The northern bow section measured approximately 203 ft in length and 40 ft at beam. The anchors at the bow were still in the vessel’s hawse pipes. Aft of the bow section was the large gap measuring approximately 145 ft. The southern stern section measured approximately 208 ft in length 55 ft at beam. This site had been misidentified for years as *Papoose* due to US Coast Guard Cutter *Gentian* survey reports, but has now been corrected (Barnette 2006:74-81).

7.44 William Rockefeller

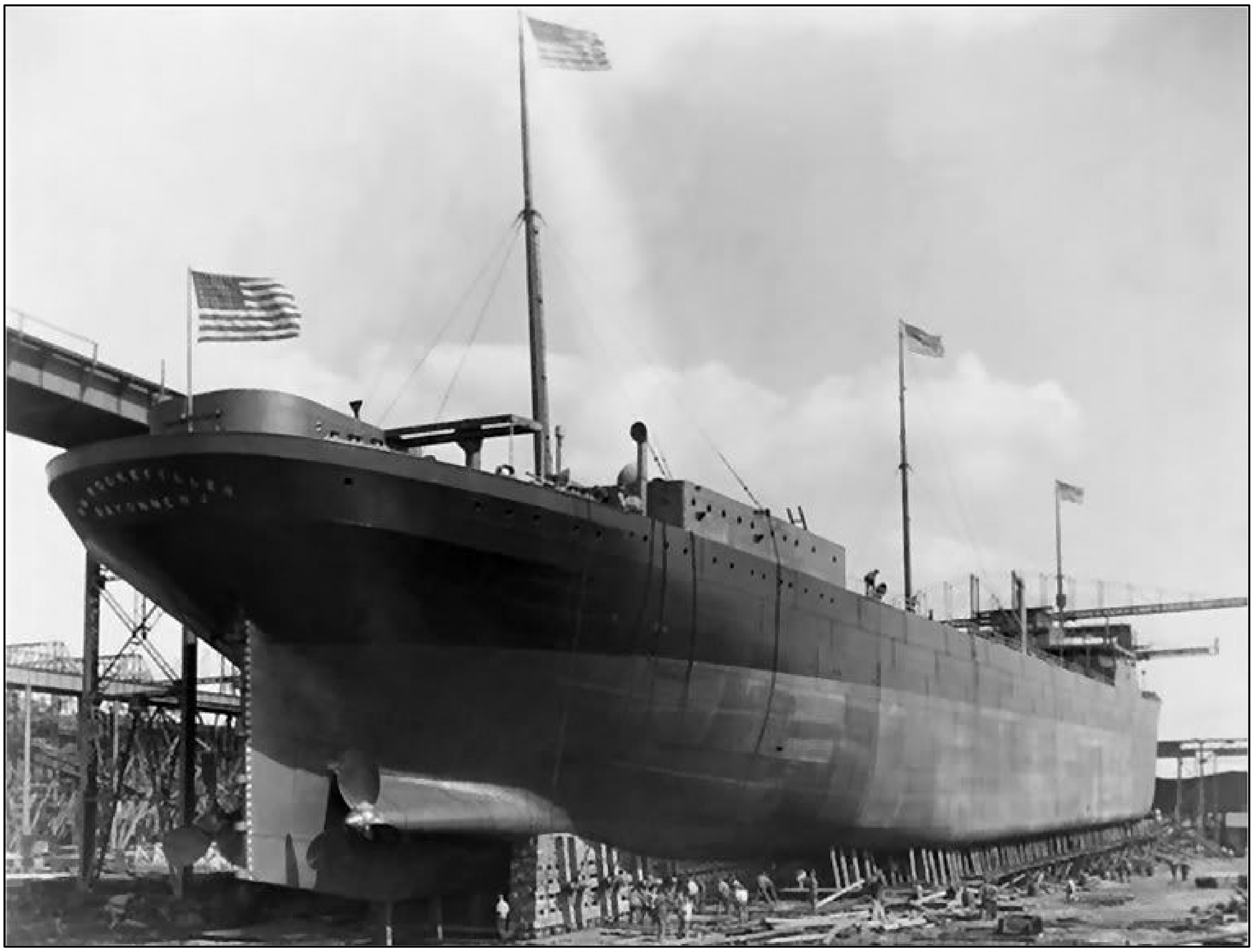


Figure 7-308 View of the stern on *William Rockefeller*.
Source: Mariners' Museum and Park

Table 7-46 Characteristics of *William Rockefeller*

Characteristics	*William Rockefeller*
Year of Build/Type/Hull #	1921/Tanker/261
Date Lost	28 June 1942
Position & Depth	Unlocated
Ship Characteristics	Length: 554.0'; Breadth: 75.0'; Depth: 48.0' Gross Tonnage: 14,054
Cargo	135,000 bbl of Bunker C fuel oil
Survivors	50 (44 crew and 6 Armed Guard) No Losses.
Owner	Standard Oil Co., of New Jersey
Builder	Newport News Shipbuilding, Newport News, VA
Former Names	None
Lloyd's Register Details	8 cargo tanks divided by an oil-tight centerline bulkhead; Stream reciprocating engine/2 propellers.
Port of Registry/Flag	Wilmington, USA
Sunk by	U-*701* Horst Degen
Data Collected on Site	NOAA Screening Level Assessment 2013 (NOAA 2013e).

7.44.1 History

William Rockefeller was the last of a series of tankers built for the Standard Oil Company and was sister ship to *John D. Archibald* (Table 7-46 and Figure 7-308, above). The tanker steamship was launched on 21 October 1921 and placed into service on 10 November, 1921. At this time private shipping interests had been placing orders for bigger and better tankers on a steadily increasing scale. The Standard Oil Company of New Jersey, by this time, had the largest tanker fleet under private control and was being further enlarged by the construction of 11 new tankers, including 2 of the largest tankers in the world to date, *William Rockefeller* and *John D. Archbold* (Oil Trade Journal 1921). This particular class of oil steam tanker was expected to be much more economical in operation that any similar vessel afloat at that time. *William Rockefeller* was propelled by a twin-screw triple expansion steam reciprocating engine with three Scotch boilers (Figure 7-309). The oil engines and boilers were designed and manufactured by Newport News Shipbuilding Company. The engines were capable of 1,500 horsepower, and could propel the vessel up to 10.5 kts. *William Rockefeller* had capacity for 146,745 barrels and a pumping rate of 7,000 barrels per hour and was one of the largest tanker's in the world (Figure 7-310; Oil Trade Journal 1921:Volume 12; American Bureau of Shipping 1930; Lloyd's Register of Shipping 1942; Standard Oil 1946:321).

William Rockefeller had 3 full-length operational decks, with 8 cargo tanks divided port and starboard by an oil-tight centerline bulkhead. The steel constructed steamer had longitudinal-style framing, aft machinery, a state-of-the-art fire extinguishing system, wireless direction finder, and Gyro compass. The ship was massive at 554 ft in length with a 75-ft beam and a depth of 48 ft. At 20,300 deadweight tons the ship was designed particularly for the Mexican trade bringing crude oil from Mexico to the Atlantic seaboard refineries (Oildom 1921; American Bureau of Shipping 1930).

On 27 October 1922 the ship was bound from Los Angeles to New York and carried a cargo of 22,000 tons of crude oil through the Panama Canal. This set the record for the largest cargo carried through the passage on any ship to date, surpassing *Marore* as the previous record holder set in July of 1922 (*Weekly Commercial News* 1921:9; *Oildom* 1921; American Bureau of Shipping 1930).

On 10 August 1929, *William Rockefeller* experienced a terrible accident. While discharging a cargo of crude oil at Pier 6, in Bayonne, New Jersey, fumes were ignited in the pumping room and caused an explosion that nearly ripped the ship in half and killed one man instantly, another died of his injuries later that evening. The resulting fire was so extreme that 40 members of the ship's crew had to leap into the water to escape and the vessel was towed out into the bay and doused by fire ships. The resulting damage cost an estimated $50,000 to repair (*Standard Union* 1929).

From the outbreak of war in Europe in 1939 until it's loss on 28 June 1942, *William Rockefeller* successfully completed 49 separate voyages delivering a total of 7,209,524 barrels of oil (Figure 7-311). That translates to 302,800,008 gallons of cargo. From 3 September 1939 through 15 March 1942 all but one of these cargoes were loaded at Corpus Christi, Texas (a single cargo was taken on in Baton Rouge, Louisiana). In March of 1942, *William Rockefeller's* route changed and began taking on cargo in Caribbean and South American ports. One long journey took Rockefeller from Curacao to Cape Town, South Africa; this single journey took place between 30 March and 2 June 1942. Upon return to the Caribbean, the tanker took on a cargo at Guiria on the Valdez Peninsula and delivered it to Aruba. Here, Captain William R. Stuart oversaw the loading of 136,697 barrels of fuel oil and set sail for New York in accordance with routing instructions dictated by British naval authorities at Aruba (Standard Oil 1946:321).

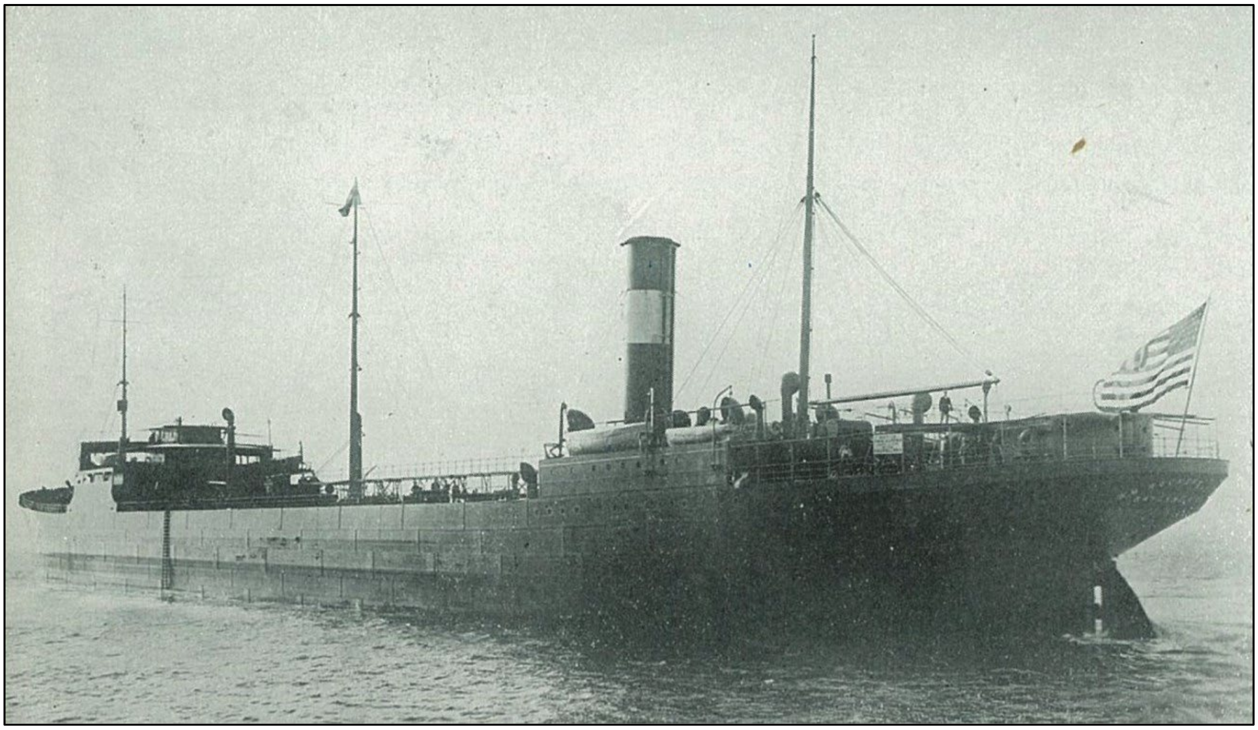


Figure 7-309 An early image of *William Rockefeller*.
Source: Standard Oil 1946

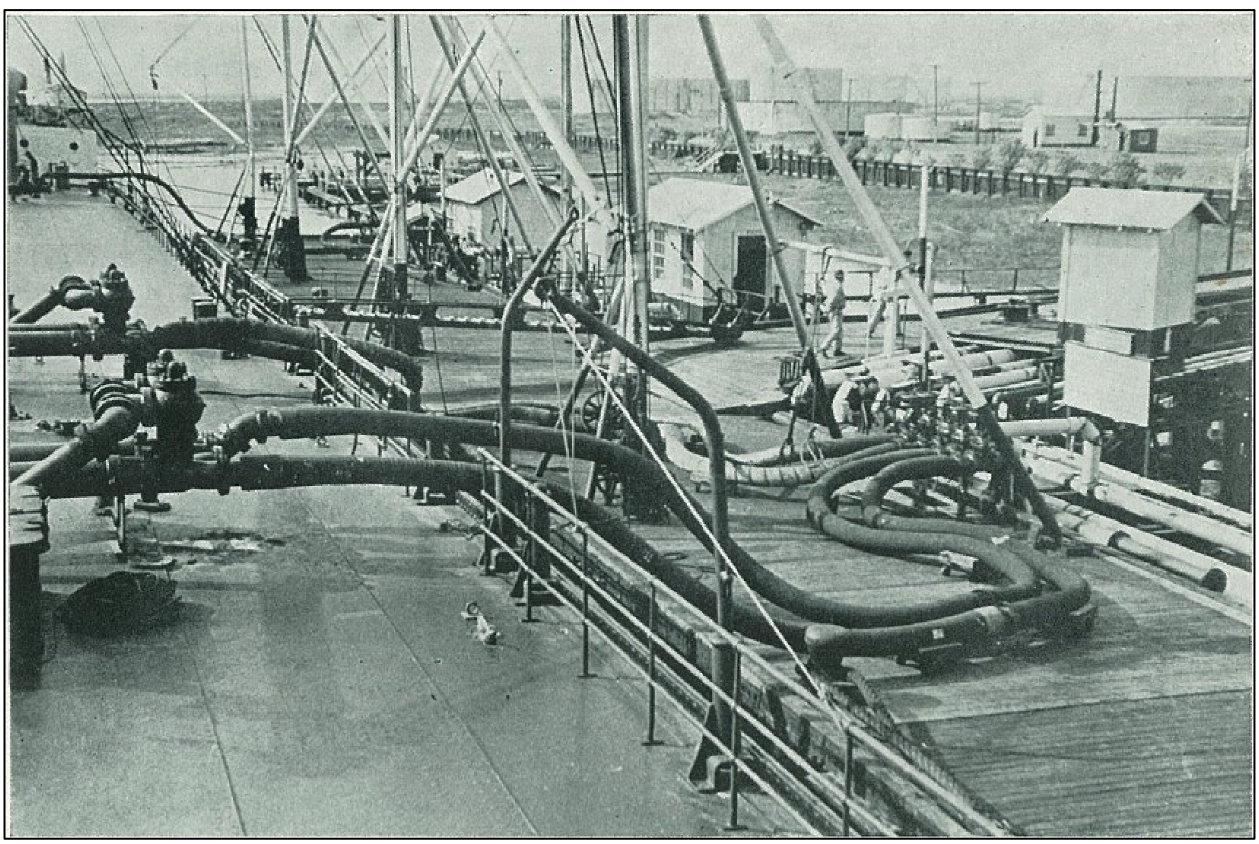


Figure 7-310 *William Rockefeller* loading oil at Harbor Island, Texas.
Source: Standard Oil 1946

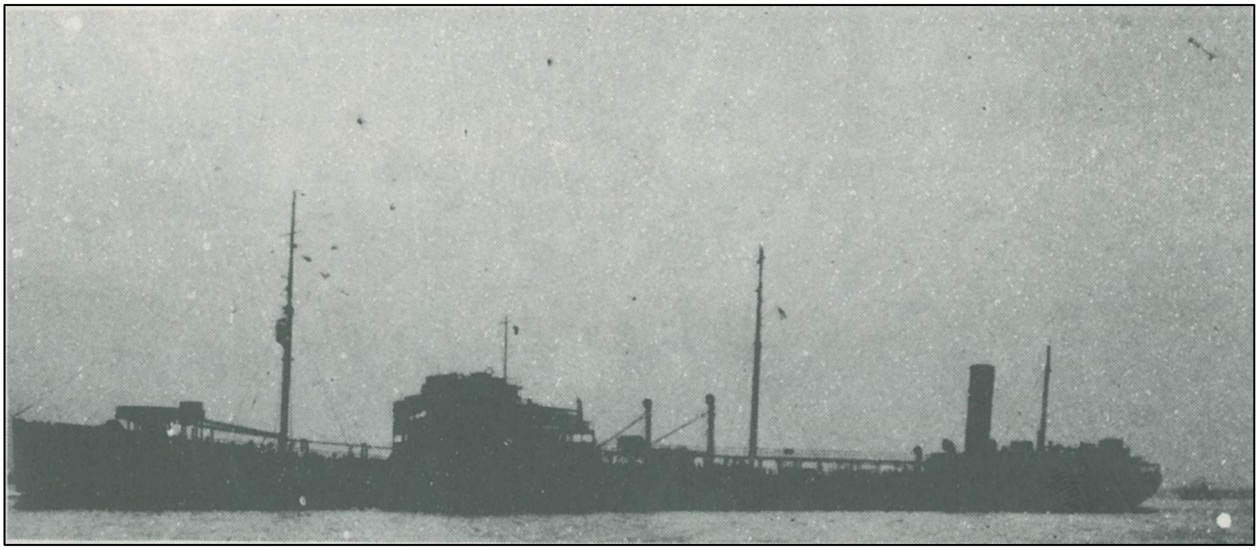


Figure 7-311 *William Rockefeller* during WWII.
Source: US Coast Guard

On 27 June 1942, at 1530 hours, *William Rockefeller* arrived off Ocracoke Lighthouse. A US Coast Guard patrol craft boarded *William Rockefeller*, issued them new routing instructions, and escorted them to a designated safe haven within the Hatteras minefield where they anchored overnight. Upon leaving the next morning, 83-ft USCGC *#470* and YP-*388* escorted the tanker with patrol planes circling overhead. Additionally, there was a six-man Naval Armed Guard gun crew onboard with a solitary 3-inch gun mounted on the stern deck (Standard Oil 1946:321; DIO 1987:403; Blair 1996:607; Offley 2014:209; Harrell 2013:122).

As the crew of *William Rockefeller* crept closer to Cape Hatteras, Kapitanleutnant Horst Degen of U-*701* was patrolling the same waters on a patrol that had mined the approaches to the Chesapeake Bay and sunk the small US Navy patrol craft YP-*389*. After deploying his mines, Degen was ordered to cruise around Cape Hatteras. On the morning of 28 June, the *William Rockefeller* would come right into U-*701's* path (USONI 1942c:13-14; Blair 1996)

By this time, convoy escorts and ASW defenses were beginning to successfully defend against U-boat attacks. Up to this point, not a single tanker had been sunk within the ESF throughout the entire month of June. At 1216 hours EWT on 28 June, Degen ordered the launch of two G7 electric torpedoes at the approaching tanker. It was clear, with calms seas and a light wind, as *William Rockefeller* continued on an unsuspecting course at 9.2 kts 16 miles ENE of Diamond Shoals Light Buoy. The torpedo hit the vessel amidships on the port side. The blast ripped a 20-ft hole in the side of the ship, spraying part of the tanker's cargo of oil over the rearmost half of the vessel and instantly flooding the pump room and the #5 tank (Figure 7-312). The fire spread across the ship extending from the bridge structure aft. Initially, Captain Stuart assessed the vessel to be salvageable and did not think it was necessary to abandon ship. However, a combination of the blast and the resulting smoke cut off communication with the aft section of the ship. The crew at the stern, some of whom were injured, began launching the lifeboats without orders. Realizing this, Stuart reluctantly gave the order to abandon ship (US Coast Guard 1945: 101; DIO 1987:403; Blair 1996:607; Offley 2014:210).

A counter attack was launched with aircraft communicating U-*701's* position. USCGC *#470* dropped a series of 7 depth charges without success. Degen and U-*701* was able to evade attack, but was not able to get off a second torpedo at that time. The survivors were picked up by USCGC *#470* and taken to Ocracoke Coast Guard station.

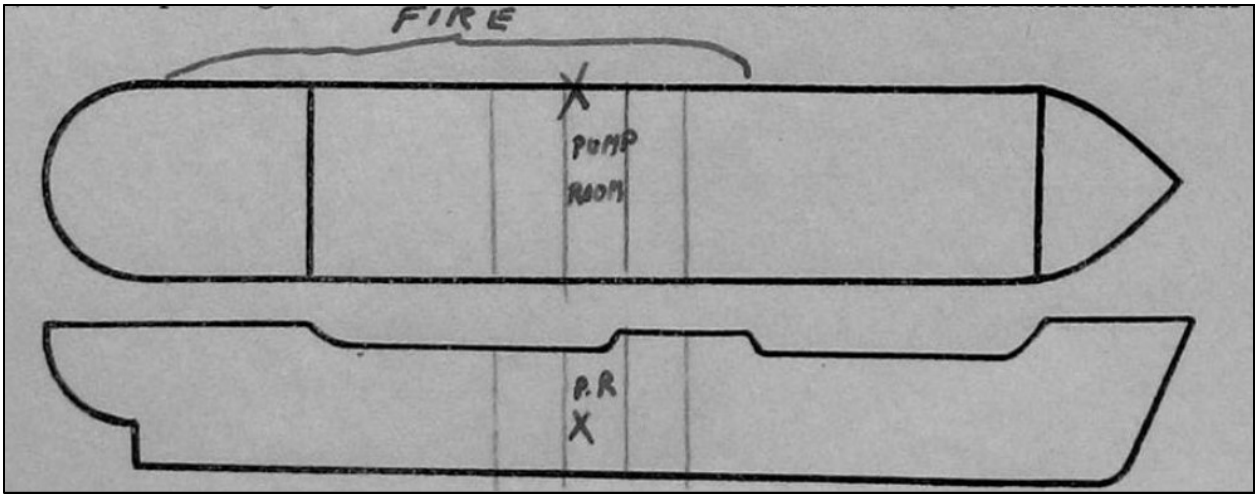


Figure 7-312 US Coast Guard diagram of the location of torpedo impact and fire aboard *William Rockefeller*.
Source: NARA

While there was hope that the hull of *William Rockefeller* might be saved, the fire had gotten out of control and it was abandoned. There are conflicting reports of the final location of the wreck. The ESF and US Coast Guard report the vessel sunk either 12 hours later on its own at 2338 hours EWT, or the following day via aircraft. Conversely, Horst Degen survived the sinking of his U-boat and was taken as a war prisoner. In interrogation reports, he states he sought out the still floating hull of *William Rockefeller* some 15 hours later and fired an additional torpedo, sinking the ship (USONI 1942c:13-14; US Coast Guard 1945: 101; DIO 1987:403; Blair 1996:607).

7.44.2 Archaeological Site Description

The remains of *William Rockefeller* have not been discovered. Given the contradictory reports associated with its loss, locating the site would require a very large search area. Given that the vessel is so large, it is likely it was lost in very deep water off the shelf, otherwise it would likely be known to the fishing and diving communities.

8 Allied Military Assets: Warships and Support Vessels

Seven Allied warships and support vessel losses associated with Second World War conflict off the North Carolina coast are herein described as individual archaeological sites. Six of these were commissioned military vessels, the seventh (tug *Keshena*) being under contract to the US Navy. As a result, their legal status differs from merchant vessel remains (see Section 12.1.1). Sites are presented in alphabetical order, with each site presented with a historical overview followed by an archaeological site description. Each site description, moreover, is intended to inform site analysis and interpretation throughout the report, as well as individual publications and studies produced by NOAA and partner agencies (see Section 1.2) emanating from this overarching body of research.

8.1 HMT Bedfordshire

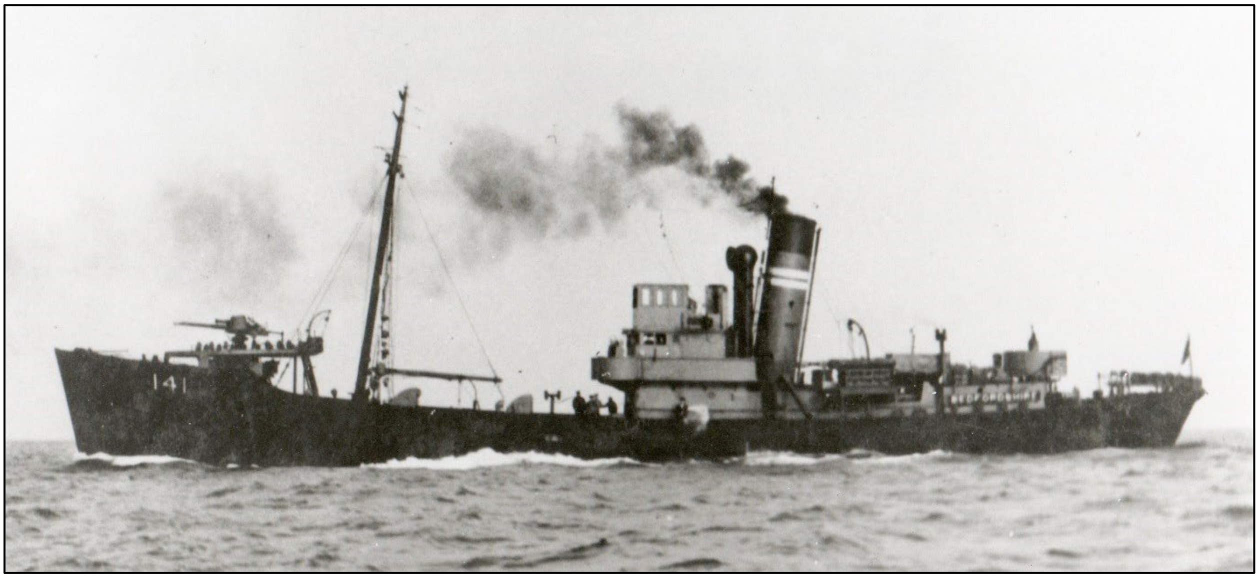


Figure 8-1 Port side view of HMT *Bedfordshire*, post-conversion.
Source: Bedfordshire and Luton Archives, 1996, UK

Table 8-1 Characteristics of HMT *Bedfordshire*

Characteristics	HMT *Bedfordshire*
Year of Build/Type/Hull #	1935/Fishing Trawler/988
Date Lost	12 May 1942
Position & Depth	20 miles S of Cape Lookout, NC: 105 ft
Ship Characteristics	Length: 162.3'; Breadth: 26.7'; Depth: 14.4' Gross Tonnage: 443
Survivors	0 (37 crew; all hands lost)
Owner	US Navy (on loan from British Royal Navy)
Builder	Smith's Dock Company, South Bank, Middlesbrough, UK
Former Names	Bedfordshire, HMS Bedfordshire
Lloyd's Register Details	Steel (Stl) hull, cruiser stern, triple expansion, three cylinder engine.
Duty Station	Morehead City, NC/USA
Sunk by	U-558
Data Collected on Site	Sector scan sonar, photo and video, full site survey, 2009; listed on NRHP.

8.1.1 History

Bedfordshire was built in 1935 at the Smith's Dock Company in South Bank, Middlesbrough, England. Displacing 900 tons, it was small compared to contemporary deep sea fishing vessels; when completed it measured 162.3 ft long, by 26.7 ft at breadth, with a 14.4 ft depth. The trawler was built upon the same plans as hull 987, the sister ship *Cambridgeshire*. The ship was ordered by the Bedfordshire Steam Fishing Company of Grimsby, which was part of a larger organization, Shire Trawlers, known locally as most trawler owning companies were by the family name, 'Markham-Cooks' (Hutson 1990:45). The vessel was intended primarily for fishing in the North Sea. With a triple expansion, coal-fired steam engine, *Bedfordshire* could reach a maximum speed of 12 kts (Farb 1985:112). Though adequate for its intended purpose, fishing, *Bedfordshire's* speed capabilities would ultimately be too slow for pursuing another quarry: German U-boats. The original design of *Bedfordshire*, as illustrated in Figure 8-2, displays deck arrangements and specific features of the vessel.

Bedfordshire was one of 16 trawlers built in 1935 at the Smith's Dock Company. Completed in early August, *Bedfordshire* was launched by Mr. Harry Markham-Cook and skippered by Albert Elletson. The ship's maiden voyage to Iceland was significant because *Bedfordshire* was equipped with the newly designed refrigerated fish locker, used to help keep the catch fresh (Hutson 1990:45; Shipbuilding on the River Tees 2013; Sassorossi 2015). Ostensibly intended to increase the trawler's endurance while working the fishing grounds, *Bedfordshire*'s coal-fired engine necessitated constant filling resulting in a difficult, exhausting task for those stoking the fires on long runs.

Bedfordshire operated in North Sea waters until the beginning of WWII, when many British trawlers were requisitioned by the Royal Navy for military operations. Prior to Germany invading Poland on 1 September 1939, fishing trawlers and other boats of British Royal Navy interest were gathered near a town called Lowestoft, in a place called the 'Sparrow's Nest.' The Nest would soon be transformed into a Royal Navy Patrol Service transit depot, with civilian crews and members of the Royal Navy Reserve making their way there under the looming clouds of war (Lund and Ludlam 1971:19; Sassorossi 2015). With the German invasion, England and France soon joined the fight to help Poland, declaring war on Germany on 3 September 1939.

Although little militarily action occurred immediately following the declaration, the Royal Navy was busy making full scale war preparations. The Sparrow's Nest was busy with trawlers of all types, ready to serve with the bigger ships of the Royal Navy. These vessels:

> ...had to be fast in order to operate with the Fleet, and their officers and crews were highly trained. Others were just ordinary trawlers purchased from civilian owners, armed, and refitted at naval dockyards. But whether they were commissioned to the Navy or the Reserve, all were essentially the same craft as those used for deep-sea fishing and they were largely officered and manned by men with practical fishing experience (Walmsley 1941:67).

Bedfordshire would be the latter of the two cases, soon bought by the Royal Navy and added to the many other trawlers requisitioned for military service.

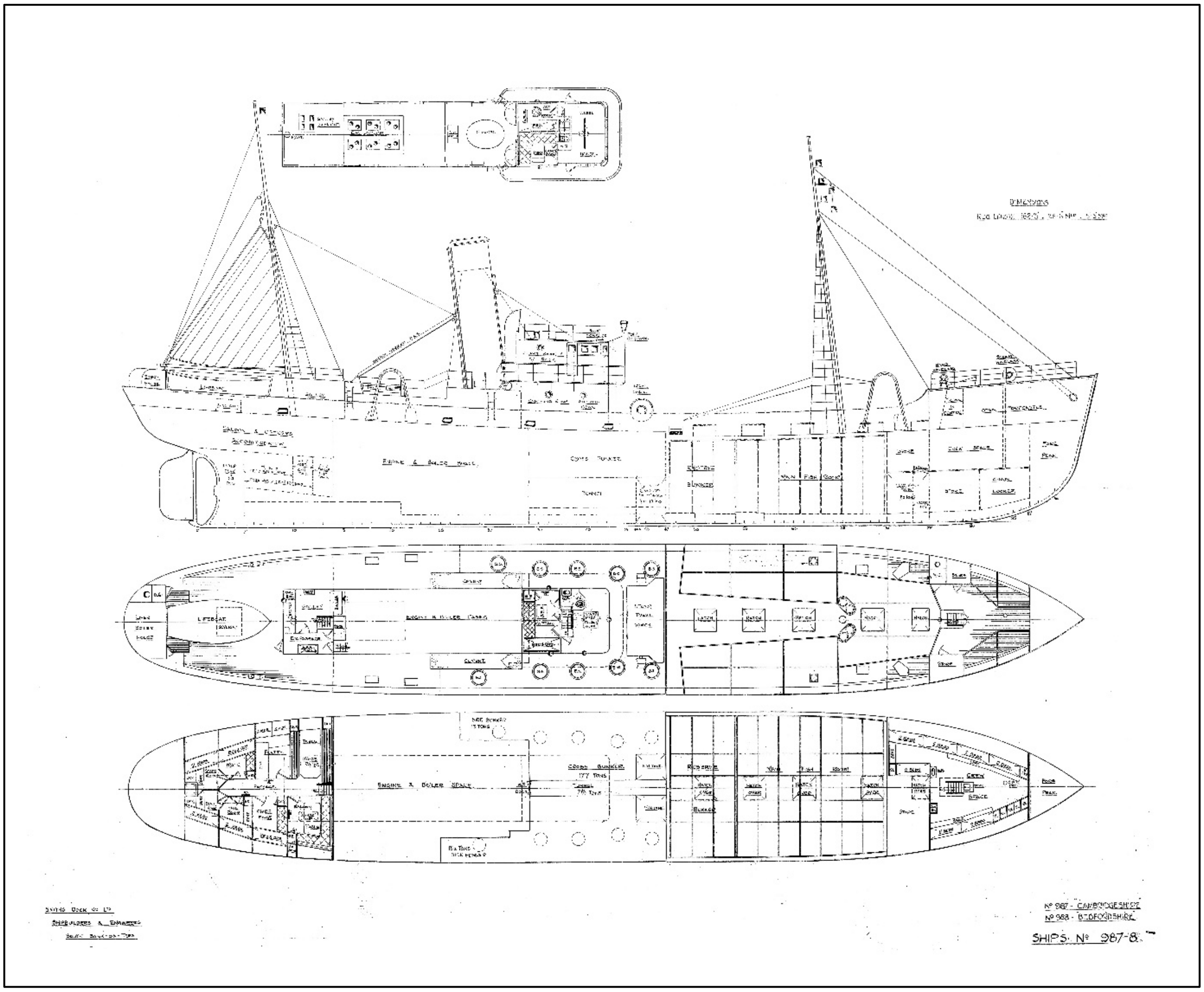


Figure 8-2 General arrangement of the *Bedfordshire*.
Source: Greenwich Maritime Museum

In October 1939, *Bedfordshire* was sold to the Royal Navy for conversion and given the designation HMT *Bedfordshire*. The military conversion of HMT *Bedfordshire* took place at Redheads, South Shields, and included outfitting the vessel with armaments as well as adapting the fish hold into a larger berthing area for additional crew. Like many other converted fishing trawlers at this time, higher priority ships received better equipment. However, the Royal Navy utilized all that it could,

> ...hurriedly renovated a number of fishing vessels, replacing fishing gear with minesweeping equipment and Asdic (an early and not-too-reliable detecting device that relied on sound impulses off submerged objects) submarine-hunting equipment. Fish holds were converted into wardrooms and sleeping space. Usually a single large caliber - but often antiquated - deck gun was installed along with the old World War I machine guns for defense of the boat from air attack (Naisawald 1997:20).

HMT *Bedfordshire* would be outfitted with older, WWI type equipment. A 4-inch, quick fire deck gun was mounted on the bow, located on an elevated platform designed specifically to use this gun. For anti-aircraft defense, HMT *Bedfordshire* received a second WWI era gun: a Lewis .303 caliber machine gun, located abaft of the funnel on a platform at the end of the engine room (Hickam, Jr. 1989:200; Hutson

1990:46; Naisawald 1997:20; Tony 2011; Sassorossi 2015). According to unpublished movement reports donated to the Bedfordshire Archives by a Mr. J.S. Munro, in December of 1940, a set of .50 caliber machine guns were also installed, along with a grenade-throwing device called a Holman Projector. Also included in the conversion were parachute rockets, another defense against enemy aircraft.

With its wartime conversions complete, HMT *Bedfordshire* took up escort and anti-submarine patrols around the Southwest coast of England and the Bristol Channel. During this time, HMT *Bedfordshire* became a seasoned patrol vessel surviving several attacks from aircraft, and completing numerous depth charge attacks on suspected U-boats. After two years of service based out of Devon, HMT *Bedfordshire*, along with 23 other vessels, were transferred to service in United States waters. After the Attack on Pearl Harbor on 7 December 1942, and Germany's declaration of war on the U.S. 4 days later, the U-boat war quickly began focusing on the East Coast of the United States. Beginning in January of 1941, heavy losses to merchant shipping in the ESF caused great concern. In support of the American effort, the Royal Navy dispatched 24 vessels, HMT *Bedfordshire* among them, for American waters on 15 February 1942 (Hutson 1990:47-51; Naisawald 1997:22-27).

By March, HMT *Bedfordshire* and the other 23 vessels of the Royal Naval Patrol Service arrived at the United States Naval Yard in Brooklyn, New York. The vessels were in need of some overhaul. They were re-painted and additional ventilation was installed. This was important for ships such as HMT *Bedfordshire*, which were built for service in the North Sea in cooler climates, but were now assigned to operate off the Carolinas where heat was a legitimate concern. At this same time, the engines were also modified to operate using a slightly lower quality of coal, which was cheaper and more readily available (Naisawald 1997:33). By late March, HMT *Bedfordshire* had been approved for service by the US Navy and was sent to operate off the coast of North Carolina.

While operating off North Carolina, HMT *Bedfordshire* participated in critical convoy duty. Following the sinking of U-*85* by USS *Roper*, HMT *Bedfordshire* provided support in the effort to patrol the site and aid in attempts to recover intelligence from the U-boat (Blair 1996:543). On 7 May 1942, HMT *Bedfordshire* made its last refill stop in Morehead City, North Carolina, and returned to patrol duty on 10 May 1942, rendezvousing with another British escort, *St. Zeno*, off of Cape Lookout to support a small convoy of merchant vessels making way toward Hatteras. HMT *Bedfordshire* and *St. Zeno* met the convoy at 1500 hours that afternoon and later that evening the two escorts and the convoy successfully made it to Hatteras, North Carolina. Afterwards, HMT *Bedfordshire* decided to resume its patrol station working a southwesterly route toward Morehead City and Cape Lookout, between Buoys 14 and 4. The vessel would continue to work in this fashion through the next day (Hickam, Jr. 1989:204; Naisawald 1997:47-48; Sassorossi 2015).

Meanwhile, Kptlt. Günther Krech onboard U-*558* was patrolling the waters off of Cape Lookout on his way down to the Gulf of Mexico. U-*558* spotted a small, lone vessel in the early morning hours of 12 May 1942. The vessel evidently did not notice Krech. U-*558* got into position to fire on what they had now correctly identified as a British anti-submarine trawler. Two torpedoes were fired and evidently both missed. However, Captain Davis and the crew of HMT *Bedfordshire* did not notice the tracks. This gave Krech the opportunity to reposition and fire a third torpedo. At approximately 0540 hours, Krech reported seeing a massive explosion that nearly lifted the small vessel out of the water before the remains sank immediately (DIO 1942; Hickam, Jr. 1989:205). U-*558* continued on to the Gulf of Mexico to continue attacking merchant shipping.

Destruction of HMT *Bedfordshire* was so abrupt and complete that no distress signal was sent. Of the 37 crewmembers there was not a single survivor. For several days the Navy was not even aware of *Bedfordshire's* loss since there were no witnesses, radio signal, or survivors. The first indication came when crewmembers began washing up on the beaches along the coast.

On 14 May, the Coast Guard recovered two identifiable bodies on Ocracoke Island. The bodies were of Sub-Lieutenant Thomas Cunningham and Ordinary Telegraphist Stanley Craig. These remains were respectfully buried on a small plot of land provided by a local resident. Nearly a week later, two additional bodies were discovered floating at sea by a vessel from the Ocracoke Coast Guard station. The bodies were not identifiable, but were in British attire. These men were also buried on the same plot of land as Cunningham and Craig, with their markers reading 'unknown British sailor'. The remains of a fifth HMT *Bedfordshire* crewman washed up near Swan Quarter, North Carolina. This was Ordinary Seaman Alfred Dryden. Dryden's body was initially buried near the Hyde County Poor House in Swan Quarter, however, Aycock Brown, a naval investigator, exhumed the body for inspection and Dryden was reinterred at Oak Grove Baptist Church in Creeds, Virginia. A sixth body washed ashore near Hatteras on 21 May 1942. Though this body was unidentifiable, Aycock Brown determined that given its location and timing that it is likely a crewmember of HMT *Bedfordshire* (Naisawald 1997:68). This unidentified sailor was buried near the Cape Hatteras Lighthouse near another gravesite containing crew from *San Delfino*.

The interment of the crew at sites in North Carolina became an important monument to celebrating and remembering this important part of WWII history. The gravesite at Ocracoke received a great deal of attention and has become an important part of the identity of the Island (Figure 8-3). In 1976, as part of the state's bicentennial celebration, the site was leased in perpetuity to the Commonwealth War Graves Commission and remains British Property to this day (Naisawald 1997:80). The site is currently cared for by the Coast Guard Stations at Hatteras and Ocracoke, and an annual formal service is held at the site every 12th of May.

8.1.2 Archaeological Site Description

During the 2009 field season, divers archaeologically documented the site of HMT *Bedfordshire* by conducting a full-scale pre-disturbance site survey of the vessel. This became the sole priority of the in-water survey conducted in 2009. An additional piece of survey equipment was incorporated to aid in site mapping. BOEM provided a sector scanning SONAR (Figure 8-4) enabling accurate positioning between the two disparate sections of the trawler's remains, each separated by approximately 25 meters.

The main section of HMT *Bedfordshire's* remains is much larger and better defined than the smaller bow piece. This stern section is approximately 145 ft long and extends from the forward section where the bow is broken off all the way to the stern, including the sternpost. Visible stern structure included the vessel's steel hull with sections of I-beams, hull plates, pipes, machinery and bulkheads. The foremost part of this section is almost entirely covered by sand with the exception of the port side, which retains vertical portions of hull and frames protruding through the sand. Approximately 30 ft aft of the break in the hull, the vessel's boiler can be found along the centerline of the wreckage. The single boiler, including a portion of the cylindrical uptake, provided the highest relief on the site, rising six ft from the bottom (Figure 8-5). From this boiler aft, much more of the wreckage remains above the sand and is more distinguishable.

Continuing to move aft along the site, portions of the reinforced boiler room's walls can be found along with portions of the original deck plating, vertical sections of the outer hull, deck support stanchions, and various other disarticulated constructional elements. Parts of the main trawl winch are still visible - evidence of the vessel's past history as a fishing trawler.

Aft of the trawl winch, at the very stern of the remains, however, are remnants of naval fittings and explosives. These components consist of portions of the vessel's depth charge rack, depth charge supports, and multiple unexploded depth charges (Figure 8-6). A combination of traditional diver mapping techniques (shown in Figure 8-7) and acoustic survey resulted in a detailed, completed site map of the vessel's remains, shown in Figure 8-8.

Figure 8-3 The British Cemetery on Ocracoke Island, North Carolina.
Source: NOAA

Both historical and modern anthropogenic processes, as well as natural elements have affected HMT *Bedfordshire's* remains. Although this site was not visited historically like many others during the US Coast Guard Cutter *Gentian* survey, it is expected much of the site's current formation resulted from the initial torpedo that struck the vessel, likely separating the bow and stern sections and causing the general collapse of vertical structures. It's location within a dynamic area south of Lookout Shoals exposes the remains to a variety of environmental conditions in terms of water temperature, current, salinity, visibility, and diversity of biological life. Despite the disarticulation of the vessel's structure, human remains are still presumed present within the site and have on occasion been observed by recreational divers.

The HMT *Bedfordshire* was listed on the NRHP on 31 July 2015 (reference number 15000421) due to its association with WWII activities off the United States East Coast and Gulf of Mexico. Its archaeological remains are significant at the national level under NRHP Criteria A and D with the period of significance being the year 1942 (Marx and Hoyt 2015a).

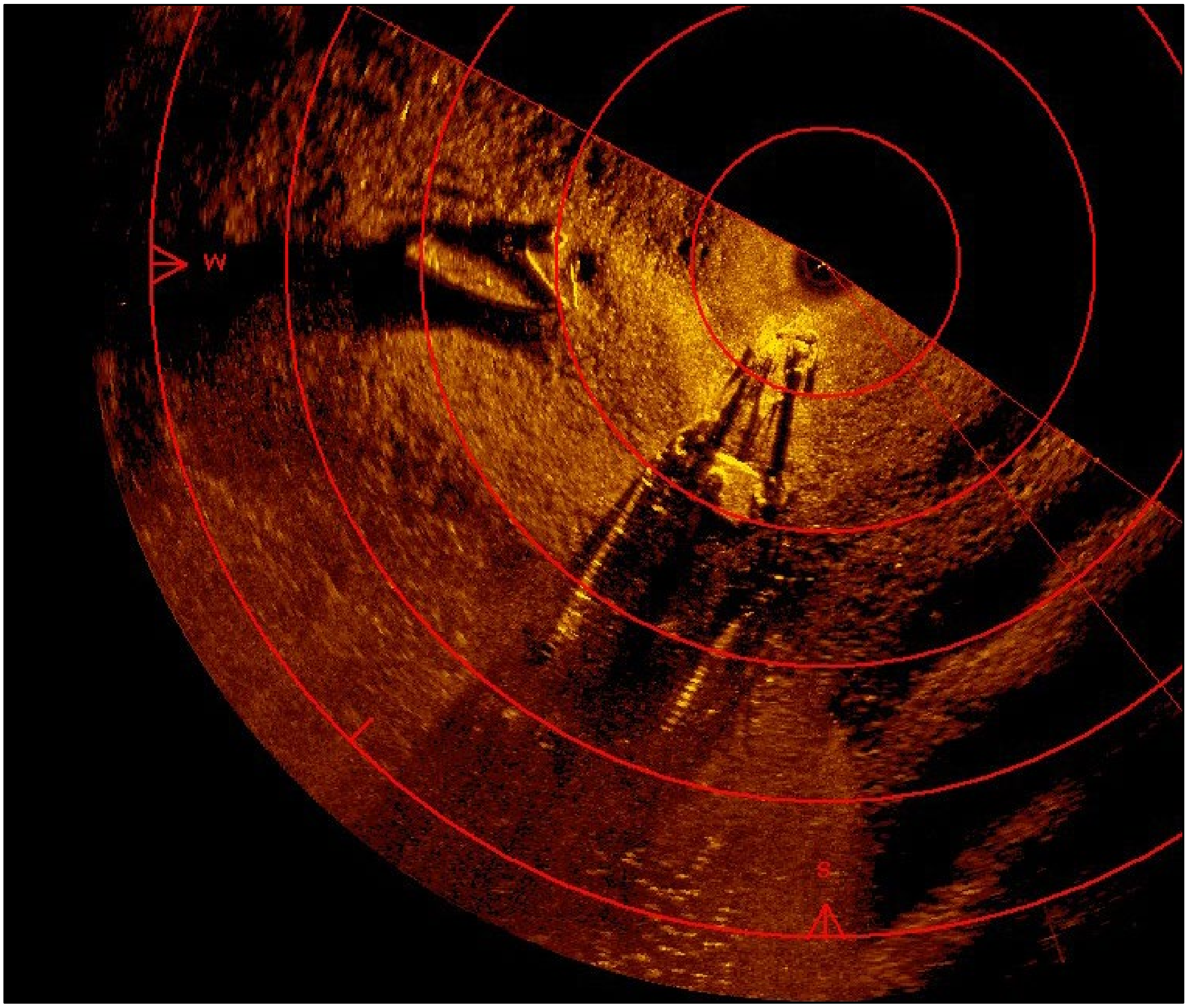


Figure 8-4 Sector scanning sonar data depicting the wreck of HMT *Bedfordshire*. This information was used to position the bow section (upper left) with respect to the stern section (center) during site mapping.
Source: BOEM

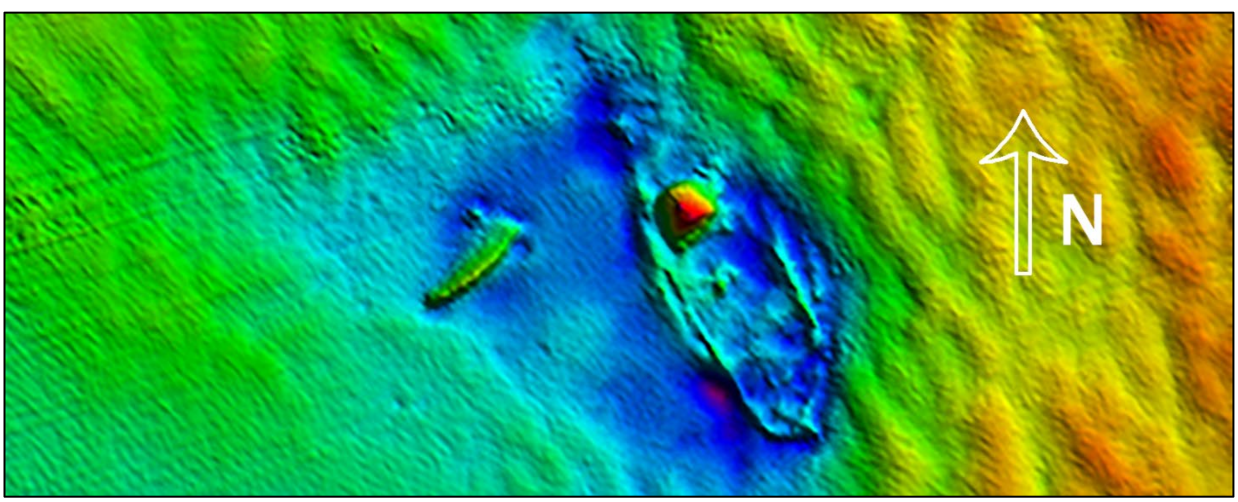


Figure 8-5 Multibeam sonar image of HMT *Bedfordshire* wreck site collected in 2016.
Source: NOAA

Figure 8-6 Remains of unexploded depth charges near the stern of *Bedfordshire*.
Source: NOAA

Figure 8-7 An archaeologist surveys the remains of HMT *Bedfordshire*.
Source: NOAA

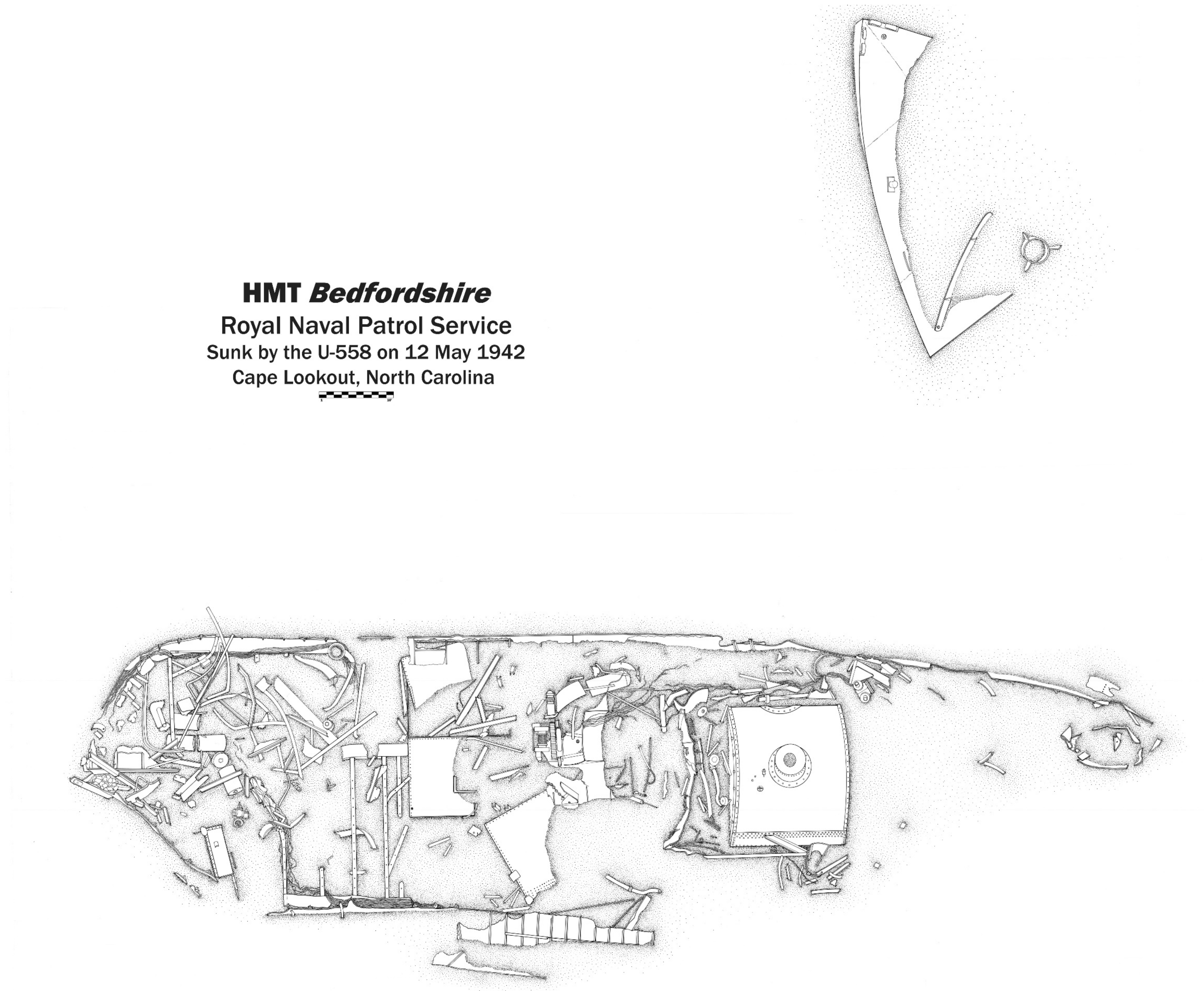


Figure 8-8 Finalized archaeological site plan of HMT *Bedfordshire* wreck site.
Source: NOAA

8.2 HMS Senateur Duhamel

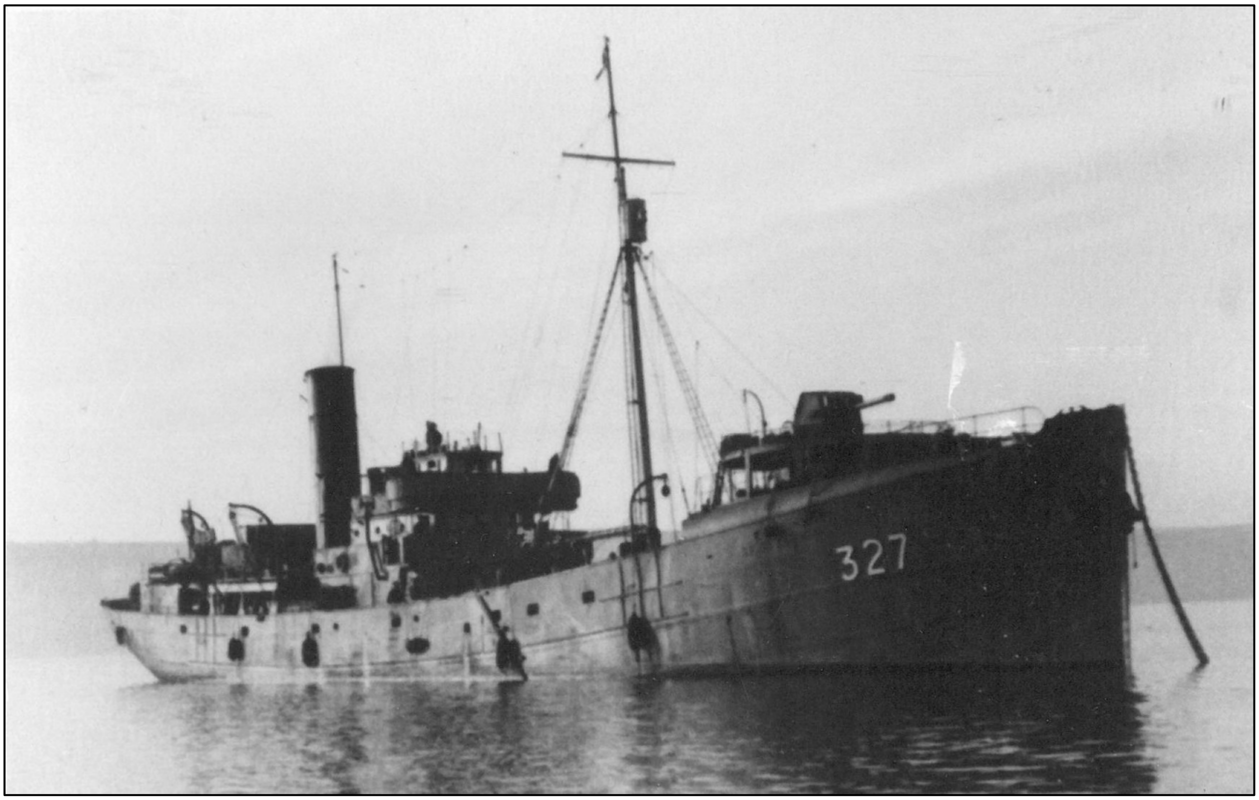


Figure 8-9 *Senateur Duhamel* at anchor, date unknown.
Source: James Reedy, Jr. Collection

Table 8-2 Characteristics of *Senateur Duhamel*

Characteristics	*Senateur Duhamel*
Year of Build/Type/Hull #	1927/Fishing Trawler/691
Date Lost	6 May 1942
Position & Depth	5 miles SW of Cape Lookout, NC: 65 ft
Ship Characteristics	Length: 192.3'; Breadth: 31.1'; Depth: 16.1' Gross Tonnage: 913
Cargo	N/A – ASW Trawler
Survivors	37 (37 Total on board)
Owner	US Navy (on loan from British Royal Navy)
Builder	Hall, Russell & Company, Aberdeen, Scotland (UK)
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, triple expansion steam engine, two boilers
Duty Station	Morehead City, NC/USA
Sunk by	Collision with USS *Semmes*
Data Collected on Site	Multibeam sonar survey and diver assessment 2012.

8.2.1 History

Senateur Duhamel was built in 1927 by Hall, Russell and Company in Aberdeen, Scotland. The vessel was bought by a French fishing company, Les Pecheries de Fecamp, shortly after being completed. *Senateur Duhamel* had an overall length of 192 ft and was powered by a triple expansion, coal-fired steam engine (Table 8-2 and Figure 8-9, above). The vessel worked as a commercial fishing trawler based in Fecamp, France and remained under the control of Les Pecheries de Fecamp until 1940.

Still used at the time as a fishing vessel, *Senateur Duhamel* was seized by the British Royal Navy and converted for anti-submarine patrol on 28 December 1940. *Senateur Duhamel*'s sister ship, *Joseph Duhamel*, was also seized at about the same time, 26 December 1940, as both were operating from the same area in France. Following the seizure by the British Royal Navy, *Senateur Duhamel* underwent the conversion process to equip the vessel for military service. Conversion orders, however, were not specified, nor were any 'standardized' conversions made. As a result, the precise changes made and armaments onboard the ship were unknown. Nevertheless, *Senateur Duhamel* would be commissioned HMS *Senateur Duhamel* under pennant number FY 327, making Belfast, Northern Ireland, its main operational base by December 1941. HMS *Senateur Duhamel* would ultimately see little action in British waters, being transferred to the US Navy in February 1942 (Lenton 1998:396; Toghill 2004:434; Sassorossi 2015). HMS *Senateur Duhamel* was sent along with 23 other British converted trawlers to help patrol the East Coast of the United States (including HMT *Bedfordshire*).

The conversions made to HMS *Senateur Duhamel* were pieced together through numerous sources. According to the unpublished correspondence of Mr. Norman Salmon to Mr. James R. Reedy, Jr., dated 17 March 1994, HMS *Senateur Duhamel* was outfitted with,

> ...60 odd depth charges with two throwers - one port, one starboard near the stern, two rails with depth charges to drop over the stern, a four-inch gun, Hotchkiss machine guns each side of the bridge, two aircraft parachutes with 400 ft of wire attached from two containers on top the of bridge housing, and last but not least a piece of equipment that can only be described as archaic, a "Holman Projector" that was mounted on a platform rather like a small boxing ring just aft of the funnel (Salmon 1994).

Corroborating the statement of Mr. Norman Salmon, are pictures he provided to Mr. James R. Reedy, Jr. showing two views of HMS *Senateur Duhamel* as a converted vessel. The two pictures (Figure 8-10 and Figure 8-11) below are from Mr. Norman Salmon and were included in the same unpublished correspondence.

These pictures show the deck gun, located at the bow, as well as the depth charge rails located at the stern. The 4-inch deck gun and platform and the depth charge rails exemplify the type of modifications and conversions made to trawlers utilized for anti-submarine patrols.

Following its transfer to American waters and a time of refitting in New York City, HMS *Senateur Duhamel* would operate out of Morehead City, North Carolina with another converted fishing trawler, HMS *Bedfordshire*, and help perform convoy escort duties. On 14 April 1942, HMS *Senateur Duhamel* was dispatched to help tow the tanker *Harry F. Sinclair*, *Jr.* The tanker was torpedoed 4 days earlier and lost a significant amount of its crew, but still managed to make it to Morehead City, North Carolina and eventually up to Baltimore, Maryland (Hickam, Jr. 1989:162;). HMS *Senateur Duhamel* returned to anti-submarine patrol duty operating again from Morehead City.

A few weeks after the salvage of *Harry F. Sinclair, Jr.*, HMS *Senateur Duhamel* was on patrol near Beaufort Inlet, North Carolina amidst a slight fog. In the haze the crew spotted another ship, USS

Semmes, about a mile away and flashed the message "what ship?" The light temporarily blinded the crew of USS *Semmes* and before a reply was sent, the bow of the ship smashed into HMS *Senateur Duhamel*. After the collision, USS *Semmes* backed away and USS *Roper*, a destroyer, was called in for assistance. With the two ships apart, HMS *Senateur Duhamel* started to sink and was eventually lost entirely. However, the entire crew survived, uninjured (DIO 1942; Hickam, Jr. 1989:201; Sassorossi 2015). HMS *Senateur Duhamel* sank in 65 ft of water, and was relocated by the Navy and Coast Guard in 1943 (DIO 1944). In the spring of 1944, the Navy Salvage and Coast Guard demolished the vessel's remains to clear a 40-ft navigable clearance, which was confirmed at the time by wire-dragging (DIO 1945:40).

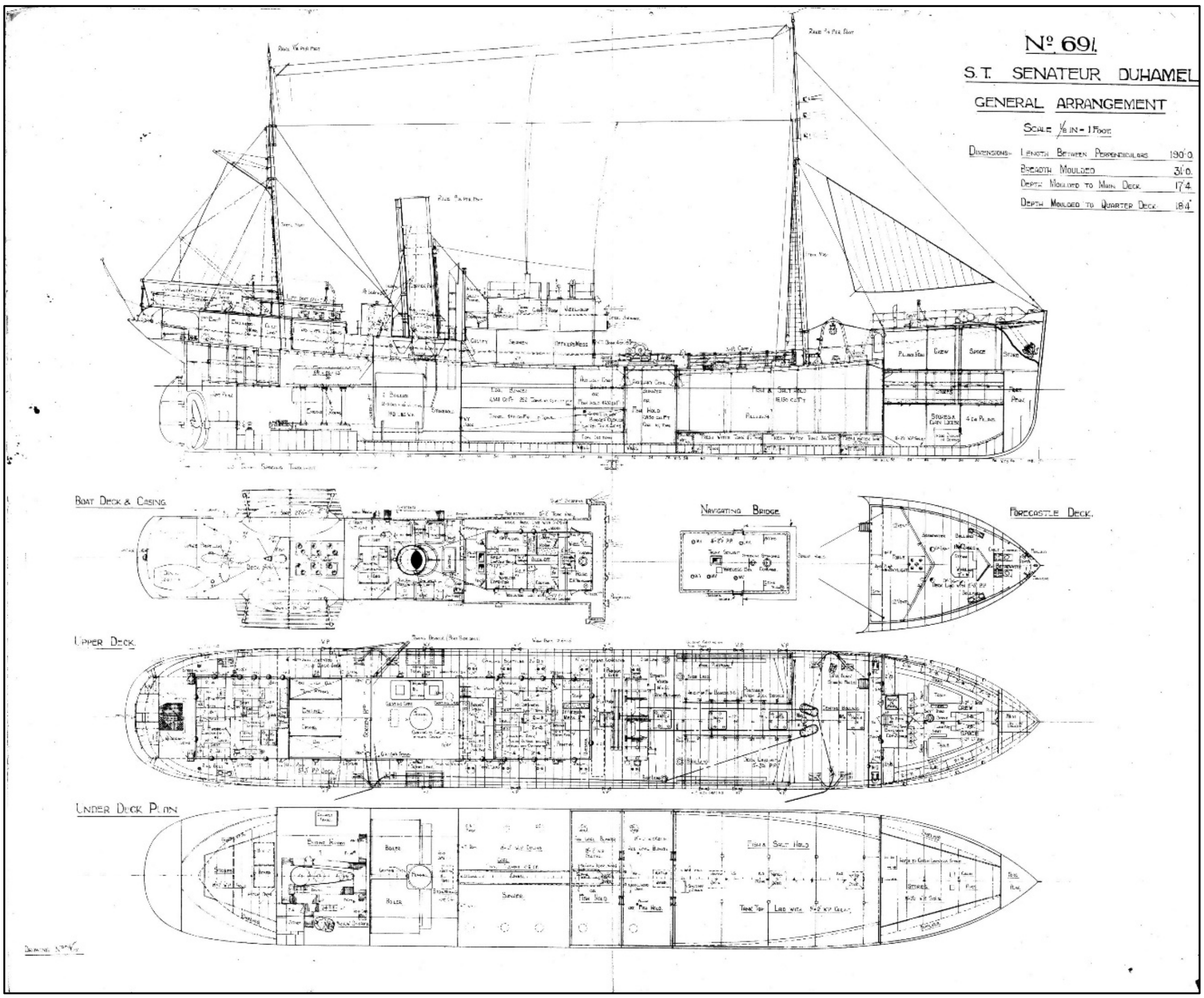


Figure 8-10 General arrangement of *Senateur Duhamel*.
Source: Aberdeen Maritime Museum

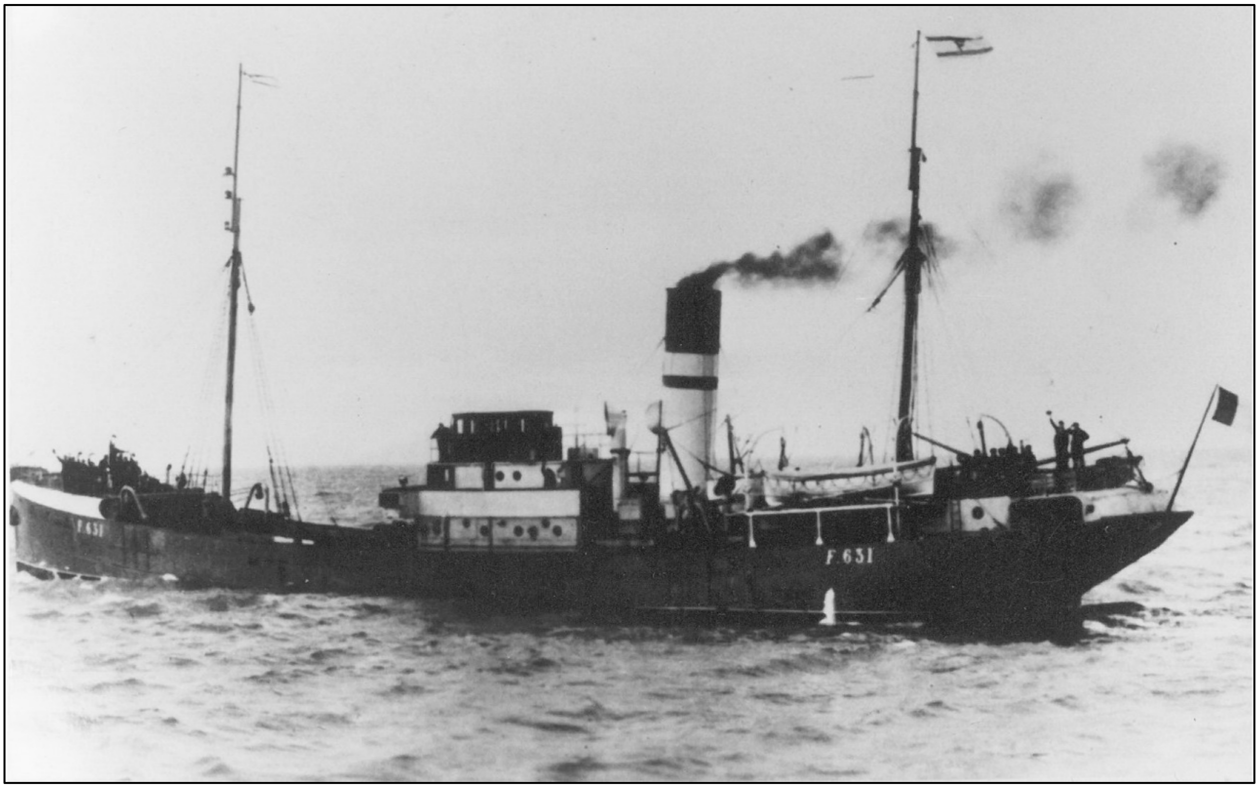


Figure 8-11 HMS *Senateur Duhamel* displaying post-conversion armament.
Source: James R. Reedy, Jr.

8.2.2 Archaeological Site Description

The remains of the British anti-submarine Trawler HMS *Senateur Duhamel* were extensively recorded during the FY2012 field season. An AUV from SRI International was deployed to conduct a targeted acoustic survey of the site, using high-resolution multibeam sonar. In addition to targeted multibeam surveys, the research team also conducted reconnaissance diving operations on HMS *Senateur Duhamel*, to better ground-truth and interpret the results of the sonar survey.

HMS *Senateur Duhamel* is located in an average of 60 ft of water near Cape Lookout Shoals, North Carolina. The small converted ASW Trawler is largely broken up and in an area so close to the shoals that visibility is often in the 0-10 ft range. Conducting the high-resolution multibeam survey, therefore, provided the most detailed overview of the site in a short amount of time, a task which would have been very difficult for divers given the low visibility along the site (Figure 8-12).

Following the high-resolution multibeam data acquisition, divers conducted photo and video surveys of the site to aid in feature identification. As expected, this site has extremely poor visibility; divers had little more than 5 ft of visibility and very low light conditions. Nevertheless, the photo and video survey focused on capturing images of smaller features such as deck machinery that were difficult to discern from the multibeam sonar imagery (Figure 8-13 and Figure 8-14).

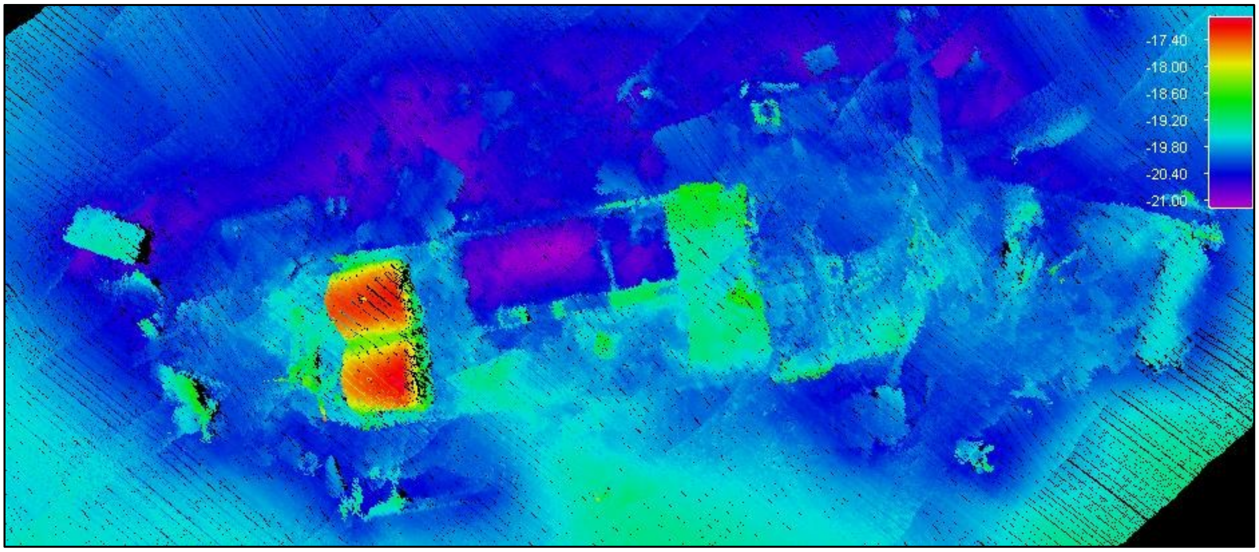


Figure 8-12 HMS *Senateur Duhamel* sonar survey results color rendered to accentuate features of high vertical relief.
Source: SRI/NOAA

Figure 8-13 Boiler face of the portside boiler on HMS *Senateur Duhamel*.
Source: NOAA

Figure 8-14 Mast partner/derrick or gun mount on HMS *Senateur Duhamel*.
Source: NOAA

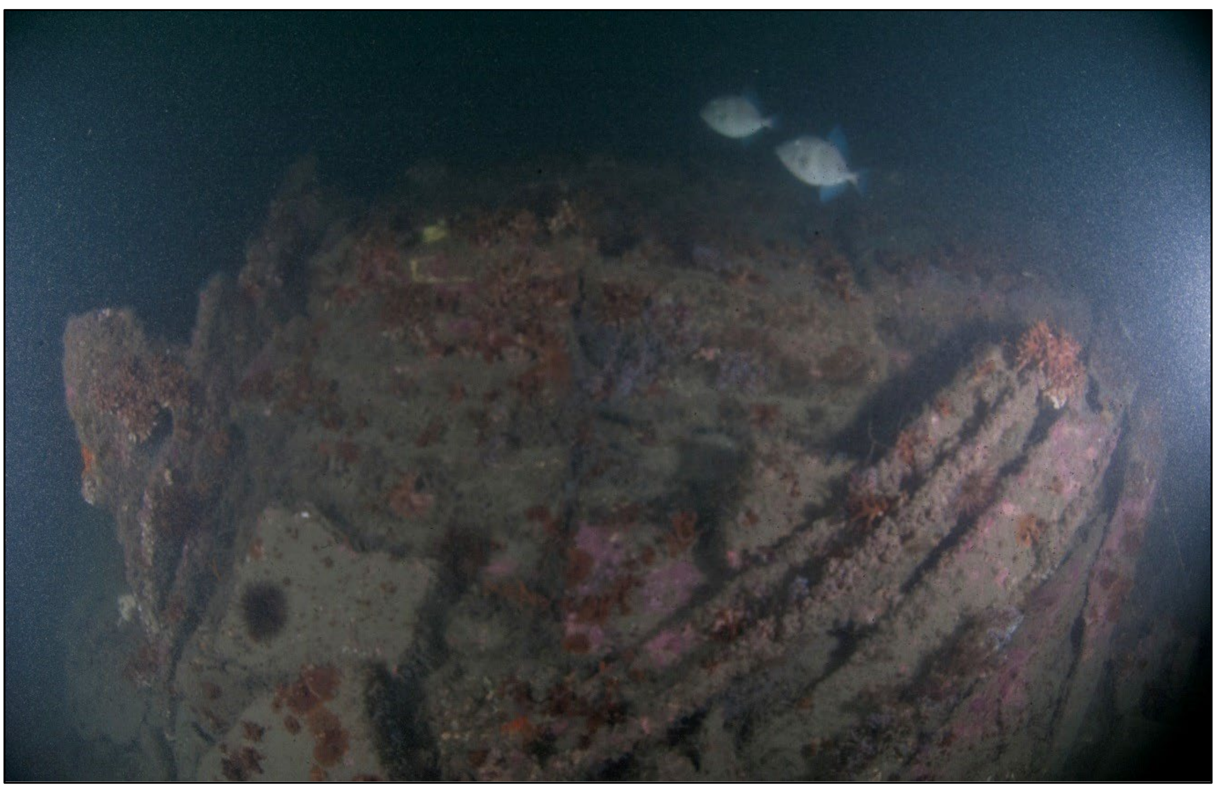


Figure 8-15 Amidships ballast pile on HMS *Senateur Duhamel*.
Source: NOAA

Figure 8-16 Trawl winch near the stern of HMS *Senateur Duhamel* site.
Source: NOAA

The ship's remains were dispersed along an area 209.54 ft long and 73.16 ft wide. Though mostly contiguous through the ship's long axis, sections of debris extend along both the port and starboard sides. These remains are consistent with the Coast Guard and Navy's program of demolishing vessel remains deemed hazards to navigation. Nevertheless, the ship's internal arrangement was visible through the various bulkheads and compartmentalization. Likewise, the boilers and machinery were mostly intact in their respective positions inside the hull. Much of the remaining structure, however, exhibited very low relief, with portions of the vessel partially or completely buried in sand. Diver surveys located and documented numerous features (Figure 8-15 and Figure 8-16).

8.3 USS YP-389

Figure 8-17 ***Cohassett*** **being launched by Bethlehem Steel Co. in Quincy, Massachusetts.**
Source: Hart Nautical Collections, MIT

Table 8-3 Characteristics of USS *YP-389*

Characteristics	USS *YP-389*
Year of Build/Type/Hull #	1941/ Fishing Trawler/1512
Date Lost	19 June 1942
Position & Depth	25 miles Southeast of Hatteras Inlet in 320ft.
Ship Characteristics	Length: 102.5 ft Beam: 22.1 ft; Draft: 10.6 ft; Displacement 170 tons;
Cargo	N/A Military duty
Survivors	18 survivors, 6 dead (24 total crew)
Owner	German Navy
Construction Details	Steel (Stl) hull, 4 six-cylinder diesels
Builder	Bethlehem Shipbuilding Co. Quincy, MA
Former Names	Cohasset, USS AMc-202
Duty Station	Hatteras Minefield/Morehead City, NC
Sunk by	U-*701*
Data Collected	Multibeam survey data and ROV photo and video collection, photomosaic 2009.

8.3.1 History

The USS *YP-389* was a steel hulled fishing trawler originally named *Cohasset*. The vessel was requisitioned and converted for anti-submarine patrol duty by the US Navy during the Second World War. The primary duty of the USS *YP-389* was to patrol the Hatteras minefield, warning any merchant vessels that may stray off course, and also to deter U-boat activity within the area. Like most district patrol vessels, YPs were not expected to actively engage enemy ships. Rather, their role was to support those larger Navy and Coast Guard vessels running escort and patrol duties. In so doing, the YPs were mainly dispatched to search for and rescue survivors of torpedoed ships, patrol minefields, serve as temporary aids to navigation, and otherwise assist vessels in the area. Generally, they were far too small and too slow, lacked adequate armaments, and had no protective armor and were, therefore, not expected to participate in direct engagement against U-boats. Yet, this was the fate slated for USS *YP-389* when, on 19 June 1941, U-*701* encountered the unsuspecting patrol boat. Since USS *YP-389* was small, U-*701* did not want to expend a valuable torpedo and felt that the U-boat's 88-mm deck gun was more than adequate for the task of dispatching such a small vessel. This initiated an engagement that resulted in an exchange of surface gunfire between the two vessels lasting an hour and a half. In the end, USS *YP-389* was sunk and U-*701* continued to attack vessels along Hatteras. Then, two weeks later, U-*701* was itself sunk by Army aircraft not far from the final resting place of USS *YP-389*.

Despite the extraordinary events of 19 June 1942, much of USS *YP-389*'s history was forgotten or overlooked in the larger scheme of the Battle of the Atlantic, despite the 'David vs. Goliath' nature of its loss and the astonishingly brave actions of its crew (*New York Times* 1942a:9).

Though listed as simply a 110-ft trawler in shipbuilding logs, the actual dimensions of *Cohasset* upon completion were 102.5 ft long, 22.1 ft in beam, with a draft of 10.6 ft, or even more precisely as having drafts of 8 ft fore and 11.6 ft aft (Table 8-3 and Figure 8-17; *Christian Science Monitor* 1941:5; USN Headquarters Fifth Naval District 1942b:1). The vessel was propelled by four 6-cylinder diesel engines capable of 91 horsepower each and manufactured by New London Ship and Engine Company of Groton, Connecticut (Lloyd's Register of Shipping 1941, 1942; *New York Times* 1942a:9).

Cohasset and her sister trawlers were constructed with few amenities since they were only intended for coastal fishing with a crew of around four persons. The vessels contained only one head, no ventilation system, a tiny mess area with a small galley, and no fresh water showers. These conditions made living onboard difficult at best for a crew of four fishermen, but truly miserable for a 24 person naval crew as assigned after the ship's conversion into military service (USN Headquarters Fifth Naval District 1942a:1; Hoyt 1978:141; Hickam Jr. 1989:285).

The vessel's fishing career was cut short when, in early 1942 every "suitable yacht, fishing trawler, and seagoing craft that the Navy had been able to lay its hands on was being pressed into service with the Inshore patrol" (*The Washington Post* 1941). *Cohasset* entered military service on 6 February 1942 and was reclassified as AMc-*202.* After serving as a coastal minesweeper for a brief period*,* AMc-*202* was reassigned to patrol duty and re-designated USS *YP-389* (USN Headquarters Fifth Naval District 1942a:1; Radigan 2008a; 2008b).

USS *YP-389* departed its New London base on 25 May, and transited to a new duty station in Hatteras, North Carolina. Here, the ship's main duty was patrol duty along the newly-established Hatteras Minefield (USN Headquarters Fifth Naval District 1942a:1; 1942c:1; Hoyt 1978:141; Gardiner and Chesneau 1980:152; DIO 1987:353, 405, 407; Radigan 2008a; 2008b). The ESF had once considered these minefields to be the greatest safeguard against German U-boats for merchant ships traveling along the North Carolina coast. Merchant vessels passing through the area could seek refuge within the large anchorages encompassed by the minefields without the danger of surprise U-boat attacks. Despite the initial hopes and preemptive confidence of the US Navy, the mines had yet to sink any U-boats and had, in fact, resulted in a friendly casualty: Esso tanker *F.W. Abrams* (DIO 1987:191-193; Hickam, Jr. 1989:275,286).

It was largely due to the sinking of *F.W. Abrams* that the Navy decided to station the USS *YP-389* off the Cape Hatteras minefield to prevent further friendly-fire incidents until administrators could decide whether to remove the mines or leave them in place. Prior to its departure for Hatteras, USS *YP-389* re-fitted from minesweeping to a coastal patrol configuration. New armaments consisted of one 3-inch gun, two .30-caliber machine guns, and depth charge racks at the stern of the vessel containing merely 4 depth charges with two spares stored onboard (COM5 1942d; USN Headquarters Fifth Naval District 1942b:1; *New York Times* 1942a:9; Hoyt 1978:141; DIO 1987:352; Hickam, Jr. 1989:285-286).

On 18 June 1942, Commanding Officer Lt. Roderick J. Phillips took the vessel out for its first patrol along the Cape Hatteras minefield. Lt. Phillips' only task was to cruise along from the minefield's north to south buoy and return on the reciprocal track; a drudgingly dull duty (Hoyt 1978:142; DIO 1987:353; Hickam Jr. 1989:285-286). Meanwhile, unknown to Lt. Phillips and the crew of USS *YP-389*, Kptlt. Horst Degen and U-*701* arrived two days prior and were eager to exploit busy shipping lanes off Hatteras (USONI 1942b:10-13; DIO 1987:425; Hickam Jr. 1989:286-287). U-*701* had gone to periscope depth several times on 17 and 18 June only to find a small patrol vessel on the surface hindering their ability to engage merchant shipping. On the evening of 17 June, Degen surfaced the boat to charge batteries when he noticed a sub chaser challenging him with a series of Bs from a signal lamp. Instead of staying and fighting, Degen, who believed the small vessel was trying to ram him, decided to submerge and leave the scene.

When Kptlt. Degen surfaced early on the morning of 19 June, he again spotted a small vessel and decided to be rid of it so he could continue the mission of hunting merchant ships. Thus, at 0245 hours on 19 June, and much to the surprise of USS *YP-389's* watch crew, Kptlt. Degen brought U-*701* to the surface within firing range of USS *YP-389*, along the inshore side of the patrol boat. At nearly the same moment the general alarm button was pressed onboard the YP boat, U-*701*'s gun crew opened fire with machine guns. It did not take long for the German's tracer rounds and bullets to find their target. In an effort to escape, Lt. Phillips and the acting quartermaster, Signalman McPherson, turned the stern of USS *YP-389* towards the submarine to reduce the vessel's profile and run from their assailants. To the dismay of Lt. Phillips, U-*701* was much faster than the small patrol boat and the submarine began to close ground. To make matters worse, the 88-mm gun crew onboard the U-boat also commenced firing on the fleeing YP.

The first 88-mm shell missed USS *YP-389*, but the second shot found its mark killing one man and injuring three others as they came through the hatch from the crew's quarters to the foredeck. Despite the CO's quick decision to call the Coast Guard for help and the assurance that help was on the way, there was little doubt that the only chance for safety was to head for shore around the minefield, into shallower water and hope the U-boat commander would not follow.

In an ironic turn of fortune for the U-boat crew, USS *YP-389*'s gunners began to return fire with their .30-caliber machine guns. While causing virtually no damage to the submarine boat, the tracer rounds and muzzle flashes from USS *YP-389*'s guns helped the German gunners zero in on the patrol craft. As soon as Lt. Phillips realized this, he ordered the gunners to cease fire and decided to try a new tactic: he ordered the depth charges dropped set at their shallowest setting in an attempt to slow U-*701's* chase or, at the very least, provide a temporary screen.

While momentarily slowing Kptlt. Degen's pursuit, USS *YP-389*'s depth charges exploded too far below U-*701* to harm the submarine. Meanwhile, another one of the U-boat's 88-mm rounds struck the stern of the YP boat, and Fireman 3/C Wilson Burnette Cole was struck in the back by a piece of shrapnel while operating the depth charge racks. Cole managed to free the depth charges but would not survive as additional rounds from U-*701*'s 88-mm gun (including an incendiary round) struck USS *YP-389*'s stern and instantly killed the Fireman (USN Headquarters Fifth Naval District 1942b:1-2; *New York Times*

1942c:24; USONI 1942e:2, 1942b:12-13; Hoyt 1978:142-143; DIO 1987:353-354, 425-426; Hickam, Jr. 1989:288-290).

In U-*701's* effort to sink USS *YP-389,* the gun crew used any round available in the ready-use locker resulting in a mixture of SAP (semi-armor piercing), HE (high-explosive), and incendiary rounds (USONI 1942c:12). After nearly an hour and a half of battle and receiving over 50 German rounds with few misses, one 88-mm shell set off USS *YP-389*'s carbon dioxide fire extinguishing system in the engine room forcing the men in the engine room out onto the deck and into the firing path of the U-boat. Kptlt. Degen, by this time, had U-*701* within 200 yards of the patrol boat and most of the submarine's 88-mm shells were easily hitting USS *YP-389*. Another round exploded in the chart room setting it on fire and another hit a fuel tank adding to the conflagration of the stern that had been burning since being hit with the incendiary round that killed Wilson Cole. Lt. Phillips, looking around, saw most of the small vessel on fire and decided it was time to save his now exposed crew. Since the gunfight destroyed the life rafts and the crew could not reach the lifeboats because of the incoming gunfire, Lt. Phillips ordered his men overboard in life preservers. Lt. Phillips maintained control of USS *YP-389* until each surviving member of his crew had gone over the side, then he left the vessel running at full speed and abandoned ship himself.

Once in the water he managed to find his men and rounded them up in time to watch U-*701* cruise past them still chasing and firing upon the now empty YP boat. Kptlt. Degen continued to chase USS *YP-389* until one of the 88-mm rounds destroyed the engine room and left it dead in the water. After approaching and finding the vessel empty of survivors the Germans fired several more rounds into the ship and watched it sink near the Diamond Shoals Lightship Buoy and 5 to 6 miles northeast of buoy #4 in the minefield area. Kptlt. Degen made a quick search for survivors but, finding none, he assumed they had escaped in a lifeboat and resumed his war cruise. The USS *YP-389'*s crew however, were floating in the water near where they abandoned ship and would not be discovered until 0800 hours by two Coast Guard cutters.

The crew of USS *YP-389* and the Naval command commended Lt. Phillips' actions in attempting to save his vessel and most of his crew as extraordinary and heroic in light of the aggressive attack by U-*701* (USN Headquarters Fifth Naval District 1942c:1,2; *New York Times* 1942c:24; USONI 1942e:2; 1942c:12-13; Hoyt 1978:142-143; DIO 1987:353-354, 425-426; Hickam, Jr. 1989:288-291; Cressman 2000:105). Thanks to those actions, USS *YP-389* only lost 6 members of its 24 crew, despite being attacked for nearly an hour and a half at close range (USN Headquarters Fifth Naval District 1942c:1; *Los Angeles Times* 1942d:4; *New York Times* 1942a:9; 1942b:2; 1942c:24; *The Washington Post* 1942b:1,2; 1942c:7; Hickam, Jr. 1989:285). Ultimately, however, things did not end well for Lt. Phillips. In a court of inquiry into the loss of USS *YP-389*, the board found that "Lieutenant Phillips failed to close the enemy and ram him or force him to submerge; and further, that he failed to do his utmost to 'take, capture, and destroy the said enemy as it was his duty to do so, by reason of which failure the said USS *YP-389* was sunk and the enemy submarine escaped." The court further recommended that Lt. Phillips be brought to "General Court Martial" for "(1) Failure to seek encounter with the enemy; and (2) culpable inefficiency in the performance of his duty." Additionally, the court even blamed Lt. Phillips for failing "to have his vessel ready for enemy action by reason of which inefficiency the USS *YP-389* was brought under heavy enemy fire and eventually sunk" (Gentile 1993:233).

The USS *YP-389* and small naval vessels like it represented a time during the Second World War when Allied victory was questionable and the US Navy was still reeling over the Japanese attack on Pearl Harbor and unable to muster the forces to fight naval wars off both American coasts. During this time, the available forces were so limited that it was impossible to remove naval vessels from their current fleets no matter the threat level elsewhere (DIO 1987:24). In the interim, small requisitioned patrol vessels were put into service and thrust against Germany's U-boats; the battle between U-*701* and USS *YP-389* epitomizes the inherent mismatch of these opposing forces, and the tenuous start to America's involvement in the Battle of the Atlantic.

8.3.2 Archaeological Site Description

The final resting place of USS *YP-389* has remained uncertain since its loss in 1942. The combination of the chaotic circumstances of its loss and the deep waters where it likely went down left its exact whereabouts in a shroud of mystery. In the early 1970s, efforts to locate the remains of the Civil War ironclad USS *Monitor* resulted in several expeditions. One such expedition took place in 1973 onboard Duke University research vessel *Eastward* led by Dr. John Newton. During the course of this survey several targets were identified, and once they were determined to not be *Monitor*, the team moved on. One of these targets was classified as a 'twentieth century trawler' and subsequently dismissed after a cursory survey (Figure 8-18). It was later suggested by Dr. Robert Sheridan that this trawler might in fact be the remains of USS *YP-389* (Watts 1981; Sheridan 2004).

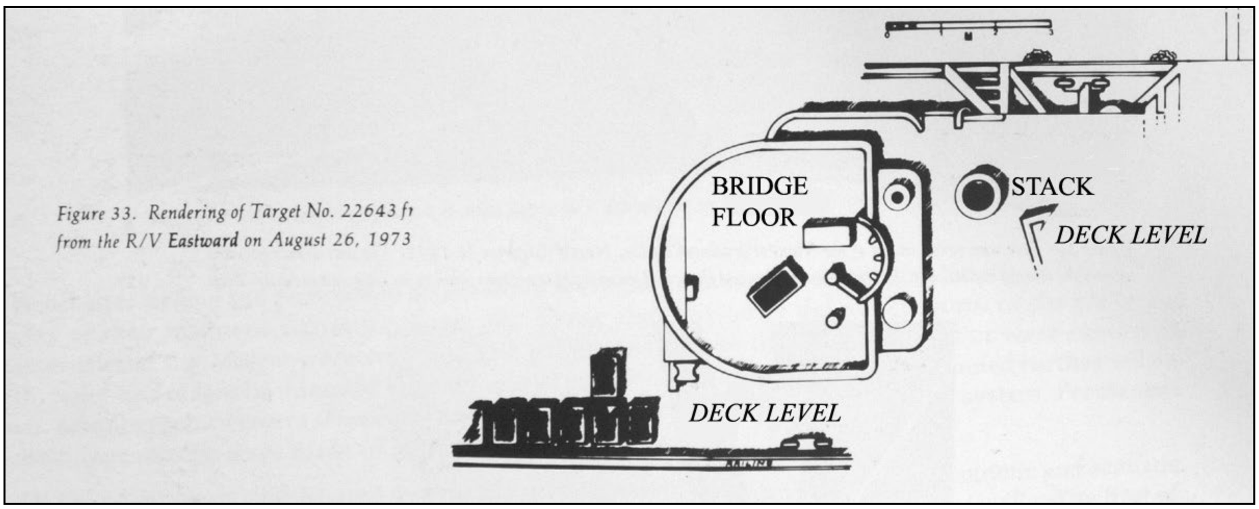


Figure 8-18 Artist rendition of Wreck #1 from 1973 R/V *Eastward* expedition.
Source: Investigating the Remains of the USS *Monitor*, G.P. Watts, 1981

Armed with this information, MNMS set out to relocate and possibly identify the site observed in 1973. Given the margin of error inherent between LORAN and GPS positioning, a small search area was developed and surveyed with multibeam sonar from the NOAA R/V *Nancy Foster* during FY09. This survey generated a small anomaly that was of the appropriate size and location to be the trawler located in 1973 (Figure 8-19).

The most distinctive features on the site were the fore and aft gallows frames. These arch-like features associated with USS *YP-389*'s career as a fishing trawler are positioned on the gunnels opposite each other in sets on the port and starboard side of the vessel. These features were clearly discernable in both historic photographs and on the vessel itself (Figure 8-23 and Figure 8-24). The large open main hold amidships was also consistent with what would be expected on a vessel of this type. These features definitely establish the vessel was designed as a trawler.

The feature which ultimately confirmed the identification as that of USS *YP-389* was the presence of a 3-in. 23-caliber deck gun located near the bow of the vessel (Figure 8-27 and Figure 8-28). The support structure holding this weapon in position had deteriorated over time and the gun was no longer upright but instead lying on its side. This was the type of deck gun installed on USS *YP-389* during the conversion process. This feature, combined with the location and other observable features of the site such as dimensions and construction style, allowed for positive identification of the vessel as USS *YP-389*.

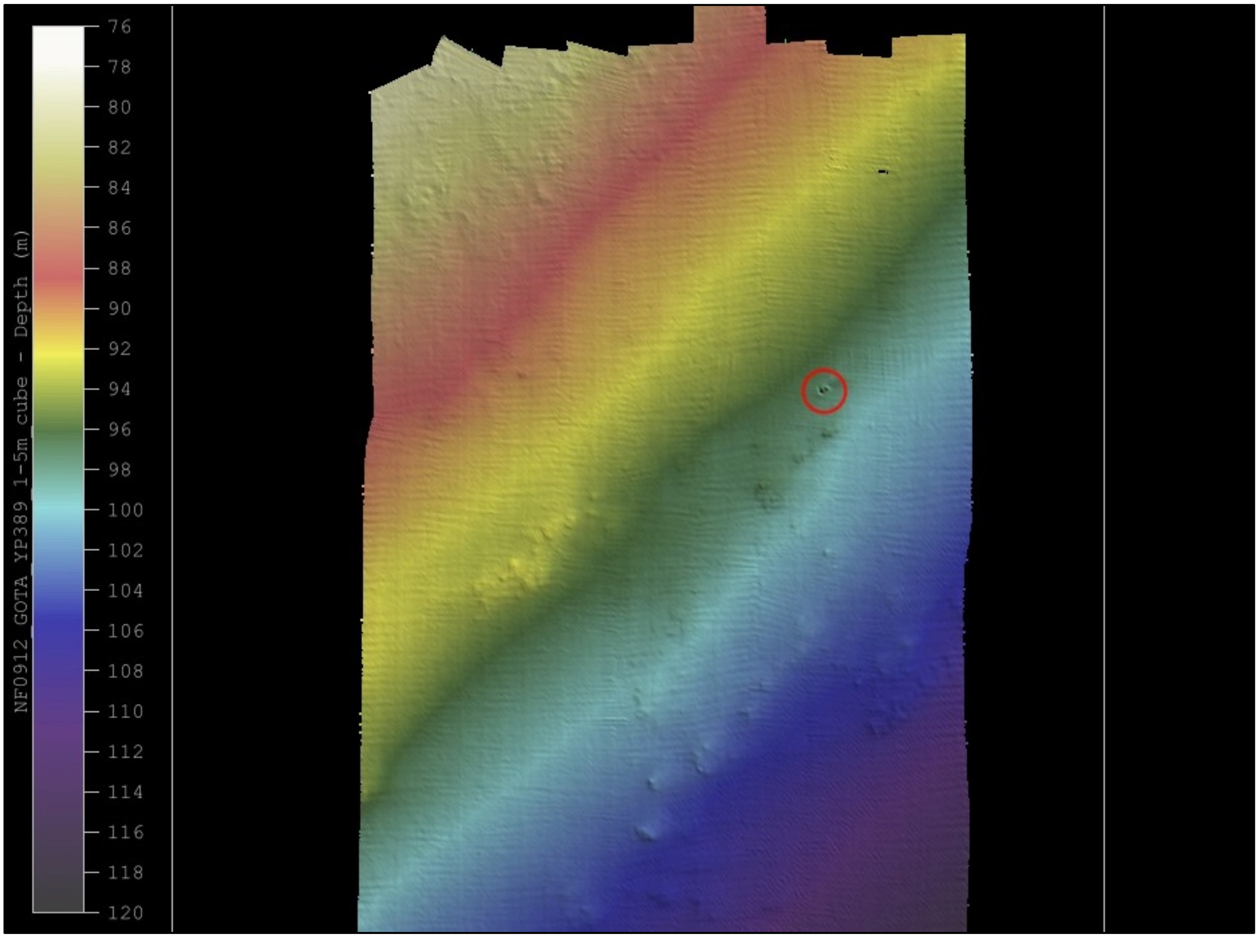


Figure 8-19 Survey area depicting the location of USS *YP-389*.
Source: NOAA

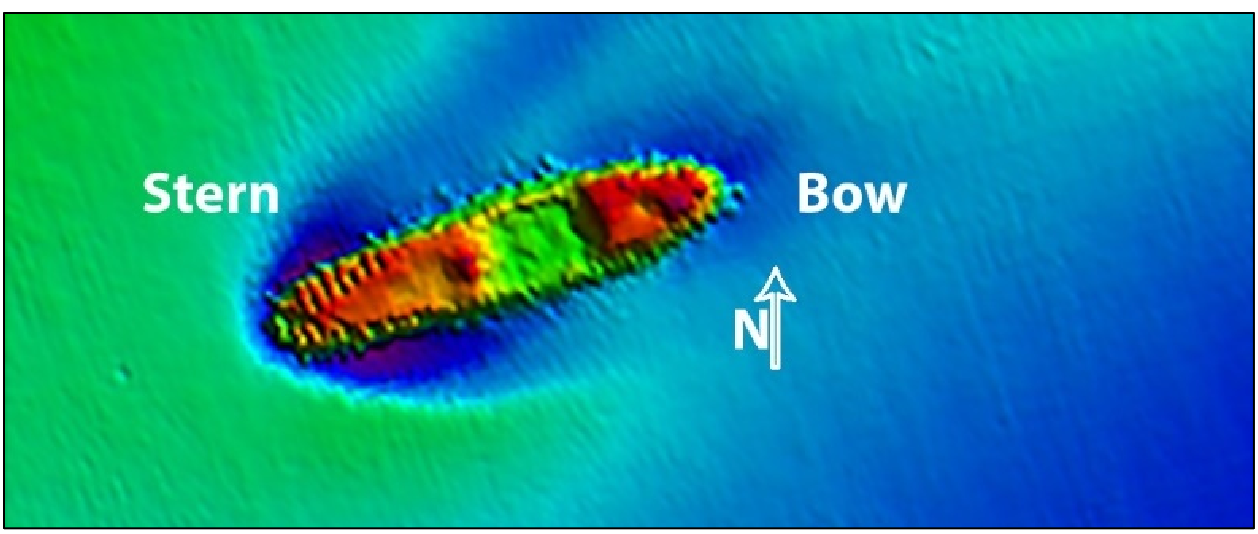


Figure 8-20 2016 Multibeam data of *YP-389*.
Source: NOAA

Figure 8-21 Remains of a porthole from the deckhouse on USS *YP-389*.
Source: NOAA

At the stern of the vessel, there appeared to be little evidence of depth charge racks that are known to have been located in this area. It may be these features are still there but could not be identified in the survey imagery. Likewise, .30 caliber machine guns were also known to be on the vessel but were not located in this survey. It is likely that remains of these features still exist but are obscured by disarticulated debris.

The site was sitting on hard sand and did not appear to have settled deeply into the sediment as evidenced by the fact that the entire propeller and rudder assembly were above the surface of the sediment (Figure 8-29). Astern below decks was evidence of a collection of what appeared to be large batteries. These can be seen between the frames of the outer hull (Figure 8-29).

Moving forward, just in front of where the bridge house was located, was the large trawl winch just abaft the main hold. Amidships in the main hold there was a large concentration of brick. The brick was distributed throughout the center of the hold and was likely intended as ballast stone to provide more stability to the vessel.

Near the centerline at the bow, just forward of the deck gun, was a large set of bits positioned fore and aft. There was also a large outer frame that delineates where the forecastle deck level would have been (Figure 8-22). It is likely the actual decking between these outer frames would have been wood and had deteriorated completely. This elevated upper deck level was also the most likely position upon which the deck gun would have been mounted. While no post-conversion photographs have been located to confirm this, it seems this is the case as it would have given the best field of fire and also account for the gun currently lying on its side as the base eroded.

While the vessel sits on an even keel referring to it as 'intact' is a bit of a misnomer. It was intact in the sense that the primary structure has not collapsed and the vessel was contiguous stem to stern all the way up to the deck level despite some evidence of an amidships break in the hull (Figure 8-20). However, the hull plating on the entire vessel had fallen away and was flayed out in the sand surrounding the site. As a result the vessel appeared incomplete. All of the frames were present and upright but the hull plating was gone, giving it the appearance of a ship under construction revealing the structural skeleton of the vessel (Figure 8-25 and Figure 8-26). It is likely that a slight dissimilarity in the alloys of the rivets and the hull plates resulted in a cathodic reaction, corroding the metal of the hull plates through which the rivets passed. As this surrounded hole corroded to the point of losing contact with the actual rivet, the hull plate simply fell away. Damage resulting from the repetitive shelling and subsequent burning during the fight with U-*701* probably also factored into the USS *YP-389's* structural condition at the time of discovery.

As an unvisited wreck the material culture remains are plentiful. Navigational lights, portholes, and other small artificats are located throughout the site as well as a large cache of small ammunition (Figure 8-21 and Figure 8-22).

This site is the only accessible example of a commissioned US Navy vessel lost off North Carolina as a result of enemy action during the Battle of the Atlantic. In February 2016, NOAA submitted paperwork to the NPS NRHP program seeking a Determination of Eligibility (DOE) for the USS *YP-389*. The DOE is done to determine if a site is eligible or not for potential listing on the NRHP (Marx, et al. 2015). As of 22 March 2016, the paperwork is still currently under review by NPS.

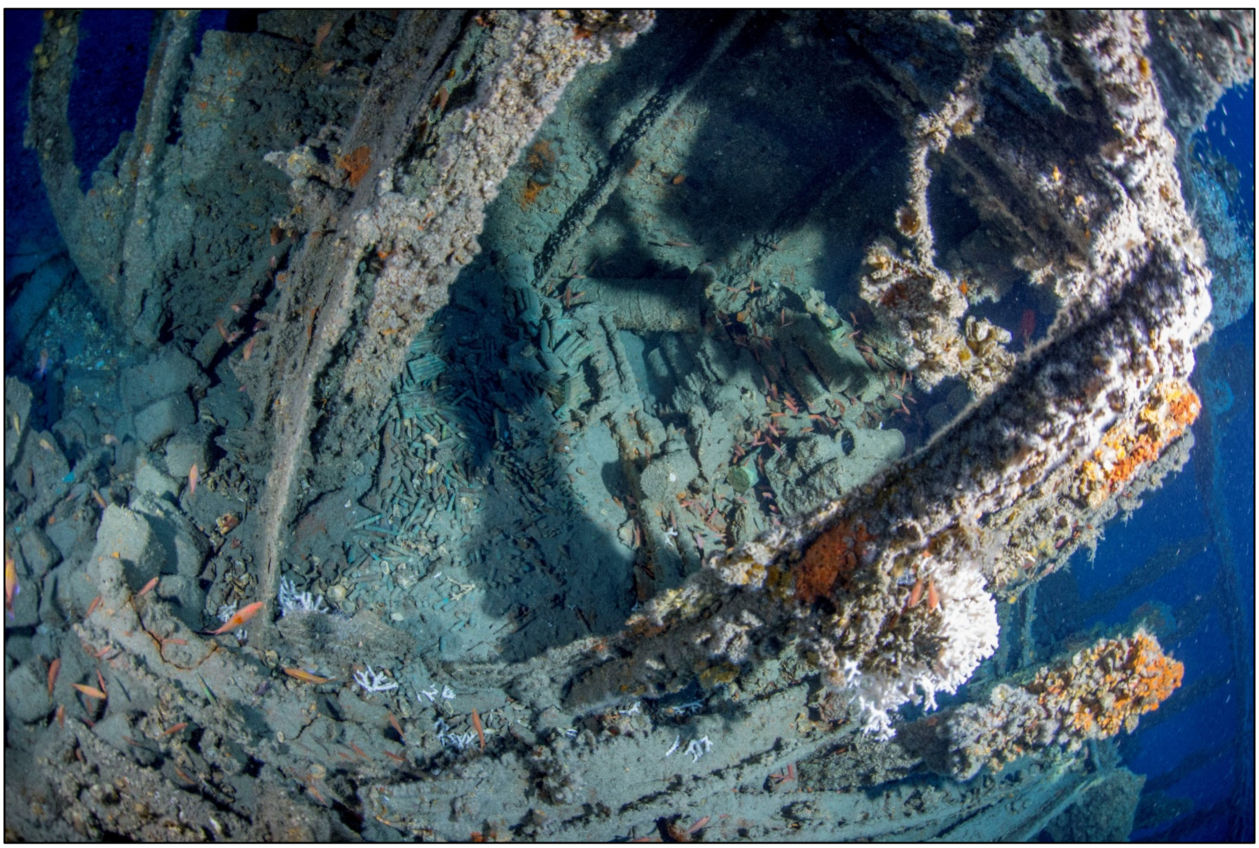


Figure 8-22 Ammunition locker on *YP-389*.
Source: Kirill Egorov – Project Baseline

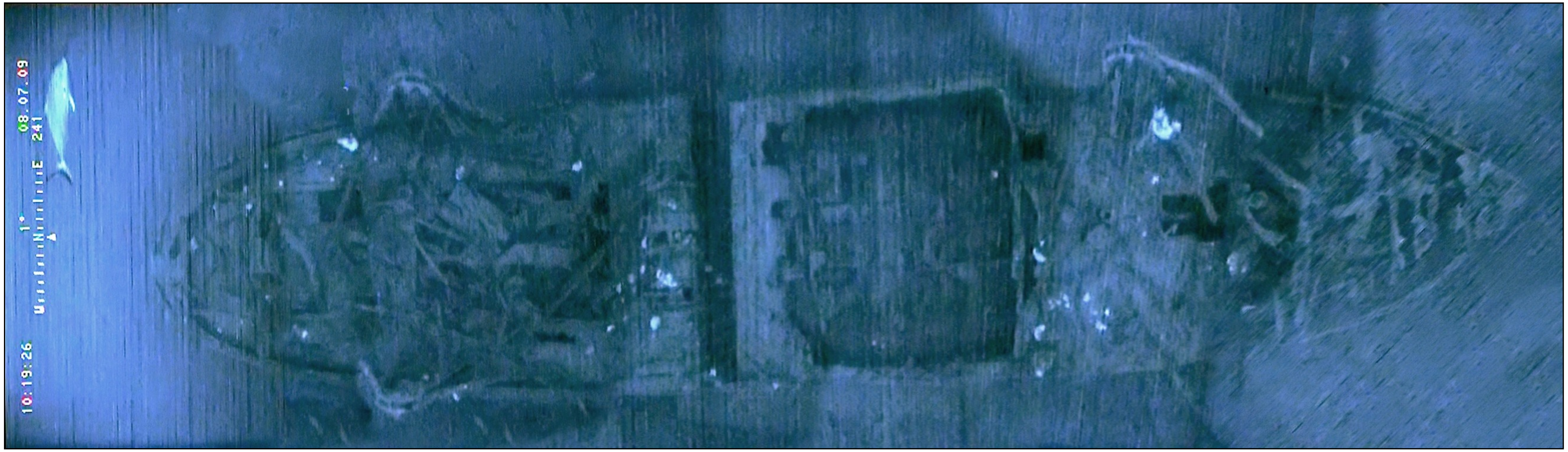


Figure 8-23 Photomosaic base on ROV footage of USS *YP-389*.
Source: NOAA

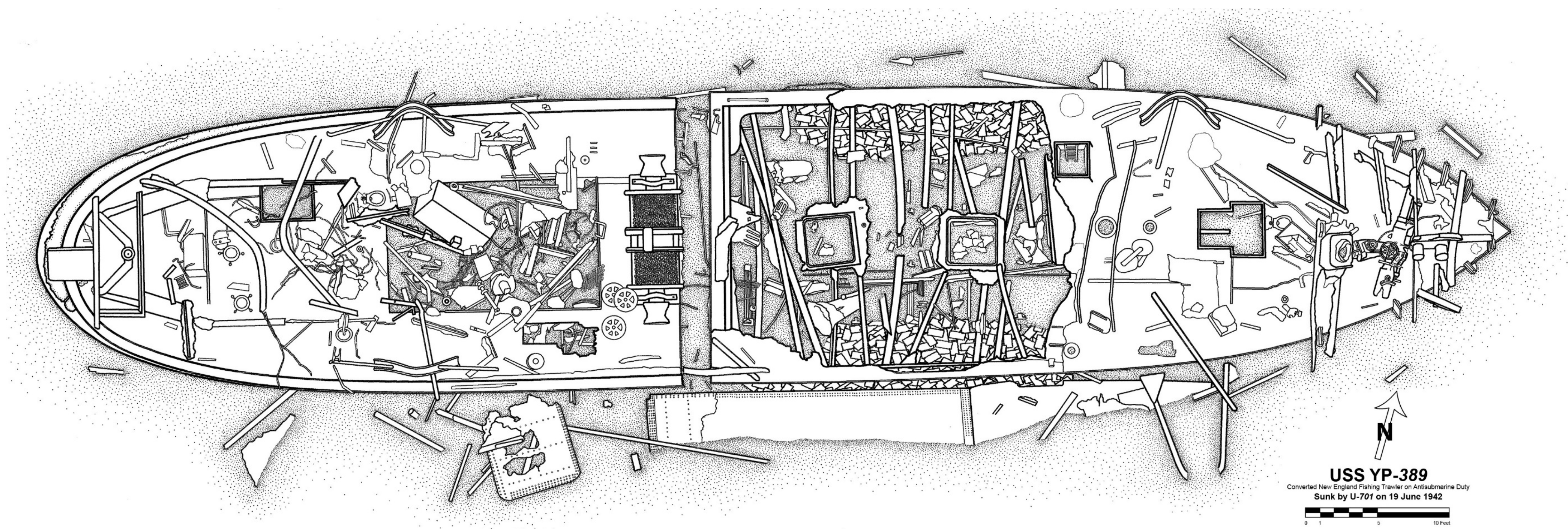


Figure 8-24 Site sketch based on photographic data from ROV footage.
Source: NOAA

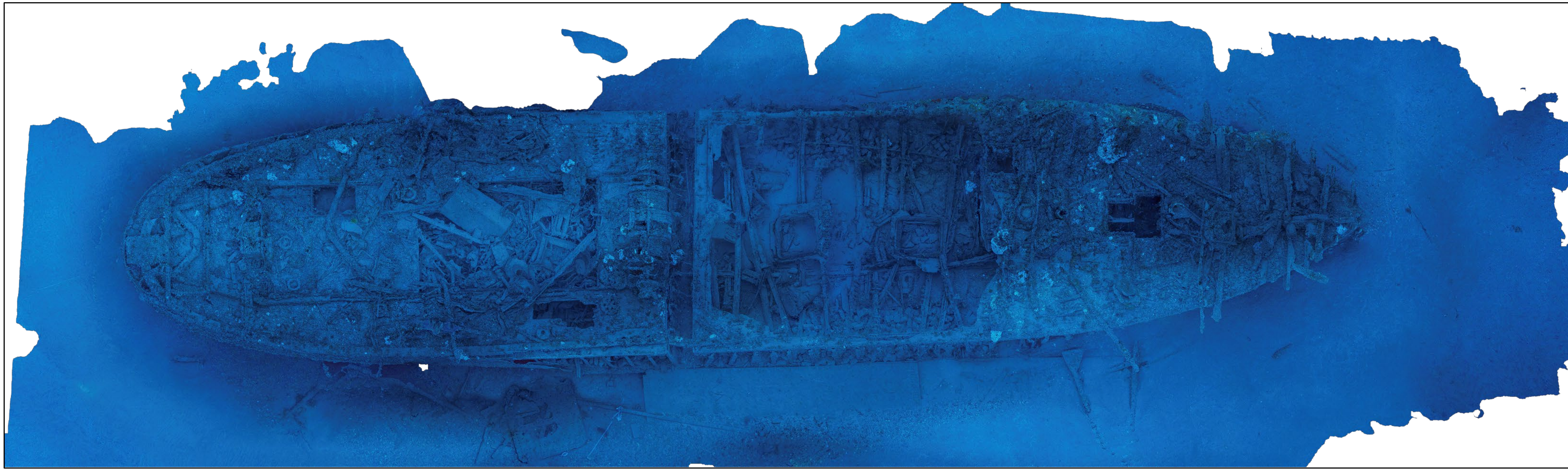


Figure 8-25 Plan view orthographic photomosaic of *YP-389* created from photogrammetric model.
Source: NOAA and Project Baseline

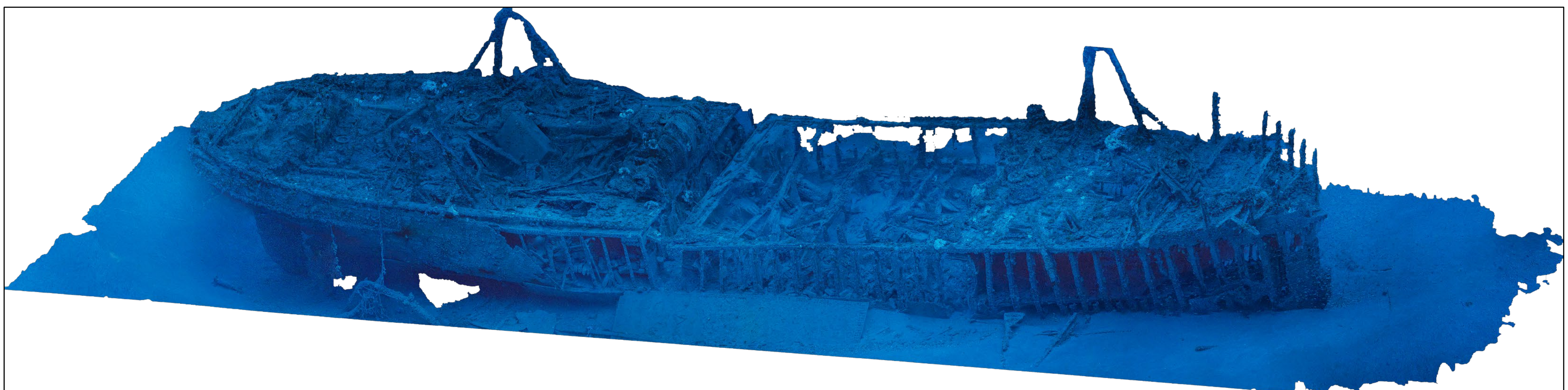


Figure 8-26 Perspective view orthographic photomosaic of *YP-389* looking at the starboard side of the wreckage.
Source: NOAA and Project Baseline

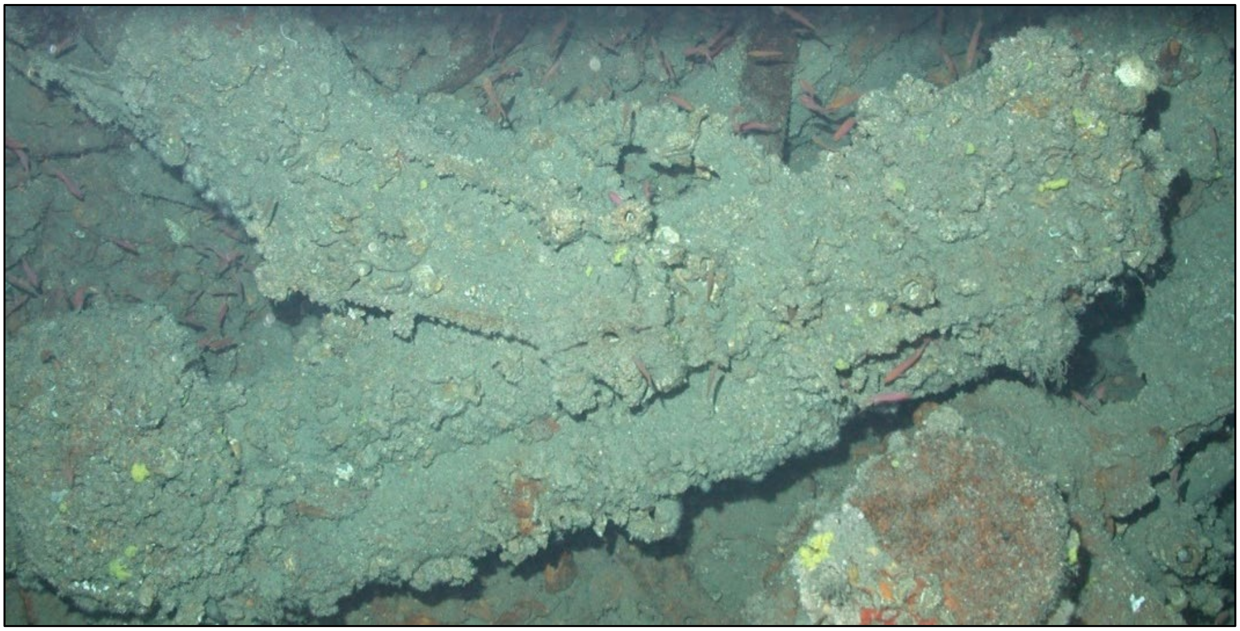


Figure 8-27 3-inch 23-caliber deck gun as observed via ROV dive on USS *YP-389* during NF-09-12.
Source: NOAA

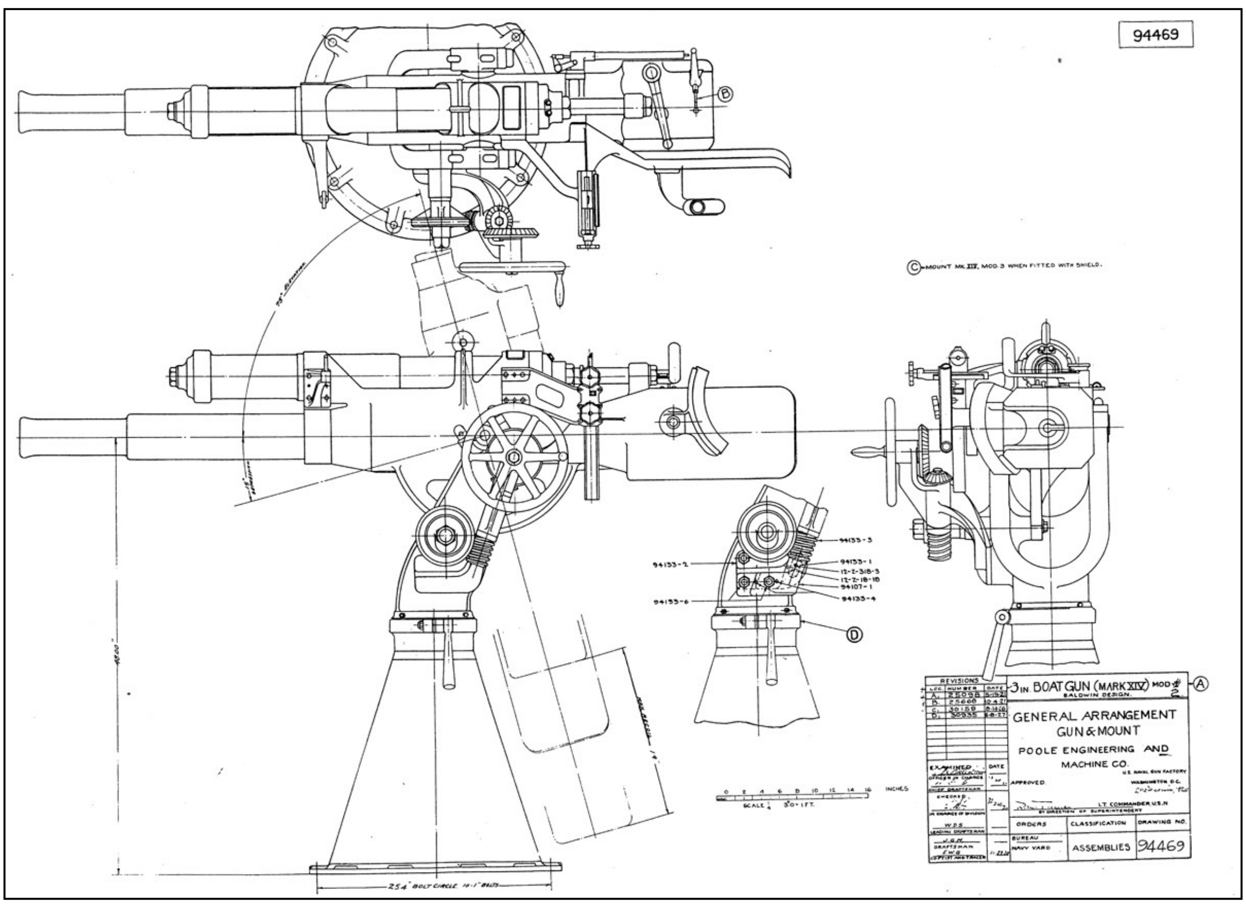


Figure 8-28 Schematic of a typical 3-inch 23-caliber deck gun as found on USS *YP-389*.
Source: Navy Department, Bureau of Ordnance - Gun Mount And Turret Catalog, Ordnance Pamphlet 1112

Figure 8-29 Cache of batteries near the stern (left) and the prop and rudder assembly on USS *YP-389*.
Source: NOAA

8.4 Keshena

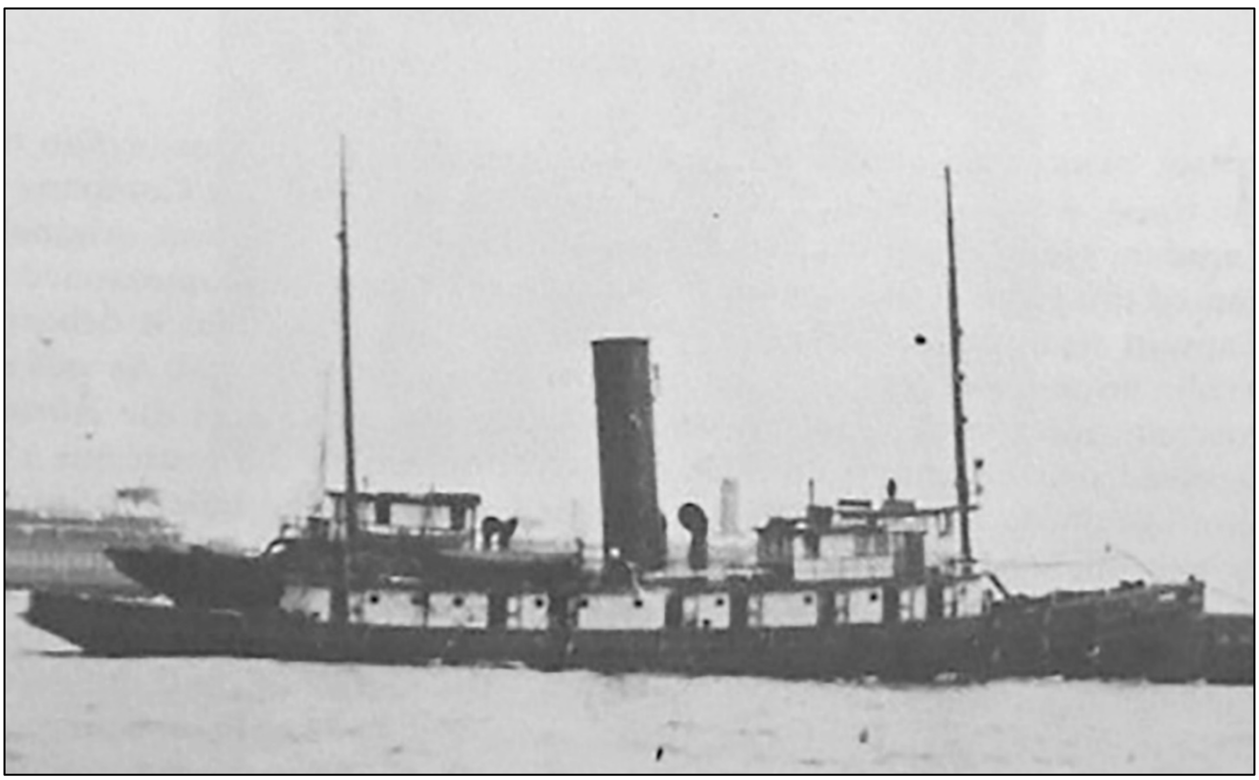


Figure 8-30 *Keshena*, date and location unknown.
Source: Mariners' Museum and Park

Table 8-4 Characteristics of the *Keshena*

Characteristics	*Keshena*
Year of Build/Type/Hull #	1919/Tug/2039
Date Lost	19 July 1942
Position & Depth	20 miles SW of Cape Hatteras, NC 85 ft
Ship Characteristics	Length: 142' Breadth: 27.5' Depth: 14.6' Gross Tonnage: 427
Cargo	N/A
Survivors	15 (17 Total on board [2 dead])
Owner	United States War Shipping Administration
Builder	Whitney Brothers Company, Superior, WI
Former Names	N/A
Lloyd's Register Details	Steel (Stl) hull, one deck, triple expansion steam engine 17", 23", 48"
Port of Registry/Flag	Philadelphia, PA/USA
Sunk by	Friendly Mine
Data Collected on Site	Full site plan, photomosaic, and photo and video 2010.

8.4.1 History

Keshena was constructed in 1919 by the Whitney Brothers Company based in Superior, Wisconsin. Whitney Brothers Company responded to the boom in shipbuilding from Emergency Fleet Corporation orders. Though principally engaged as tug operators, pile drivers, and dockbuilders, Whitney Bros. was awarded a contract to build 10 identical 150-ton deadweight tug boats to be delivered by 10 December 1919: *Huckey, Hulver, Humaconna, Humrick, Keshena, Klokee, Kivon, Kitchi, Kolda*, and *Kaleen* (

Table 8-4 Characteristics of the *Keshena*

and Figure 8-30, above) (Usher 1914:1888; *Marine Review* 1920:18; USSB 1923:279).

Whitney Brothers vessels ordered by the EFC were 141 ft and 3.5 inches between perpendiculars with a moulded beam of 27.5 ft and a moulded depth of 16 ft, 3 inches (there is a discrepancy in the depth measurement between Lloyd's and the yard contract; Lloyd's states 14 ft, 6 inches). They were fitted with two coal-fired boilers and triple expansion steam engines capable of 800 horsepower. In the series of 10 vessels constructed, *Keshena* was the fifth to be launched. The vessel was launched 24 March 1919 and was officially delivered on 23 September of the same year (*Marine Review* 1920:18).

As WWI was over by the time *Keshena* was delivered, the vessel entered civilian service. In 1923, the tug was sold to Southern Transportation Company in Philadelphia, Pennsylvania (at the point of sale Lloyd's reports Gross Tonnage at 427 and USSB reports 429). Southern Transportation Company operated *Keshena* until 1942 when it was acquired by the United States Government. *Keshena* was owned by the United States War Shipping Administration operating as a rescue and salvage tug until the time of its loss (USSB 1923:151).

On 15 July 1942, a merchant convoy consisting of 19 merchant ships and 5 military escorts was attacked south of Cape Hatteras, North Carolina. Three merchant ships, *Bluefields*, *Chilore,* and *J.A. Mowinckel*, were torpedoed by U-*576*. Two escaped with severe damage while the third, *Bluefields*, sank in a matter of minutes. Nearly 30 men were injured during the attacks, one of which would later die from his wounds. In the ensuing pursuit, a coordinated attack between aircraft and armed escort and merchant vessels resulted in the sinking of the offending U-boat, with all hands lost. In the hours that followed, a series of miscommunications resulted in the two damaged merchant ships erroneously navigating into the Hatteras Minefield. They would be severely damaged yet again (COM5 1942e; Hoyt 1978:168-171; Hickam, Jr. 1989:285-287; Bright 2012).

On 19 July 1942, *Keshena* was one of two tugs dispatched to tow the merchant vessels *Chilore* and *J.A. Mowinckel* out of the Hatteras Minefield. After striking mines, both vessels were abandoned and left afloat within the minefield. Over the next couple of days, several channels were swept so that the tugs could reach the damaged ships and tow them into Hatteras Inlet. In the course of this salvage operation, *Keshena* moved out of the safe channel, and itself struck a mine at 1630 hours on 19 July 1942. The tugboat sank within 10 minutes. Although 15 crew were rescued, 2 members of *Keshena*'s crew were killed in the accident. The remaining tugboat succeeded in removing *Chilore* and *Mowinckel* from the minefield. *Chilore*, however, would eventually sink in the mouth of the Chesapeake Bay while being towed to Norfolk, Virginia for repairs (Hoyt 1978:168-172; Moore 1983:164; DIO 1987:411-421; Hickam, Jr. 1989:285-287).

8.4.2 Archaeological Site Description

Having been lost in shallow water proximate to shore, the tugboat's final location was well known to the Navy and Coast Guard. For a year after its sinking, pilots from MCAS Cherry Point, North Carolina would use the boat's visible mast as a target for aerial bombing practice. Sometime in the summer of 1944 the Navy Salvage Service demolished the vessel's remains to clear a navigable area down to a depth of at least 40 ft. Thereafter, *Keshena's* remains were marked on nautical charts (DIO, Fifth Naval District 1945:35-36). During the 2010 field season, a survey of the tug *Keshena* resulted in a complete archaeological site map and series of photomosaics (Figure 8-33).

At a depth of 85 ft, the wreck of *Keshena* is very accessible. Many features are easily identifiable. The vessel sits upright with a slight list, but with many features still evident. The bow section of the vessel is intact up to the main deck level with two anchors and the anchor windlass still in place. Just aft of the windlass the vessel breaks down significantly into a scattered debris field of beams and hull plating (Figure 8-31). The boilers are in place amidships, just forward of the engineering space where the disarticulated remnants of the engine are located on the starboard side with the condenser offset towards the port side of the vessel (Figure 8-33).

The stern section and fantail are intact but evidently disconnected from the keel as this portion of the hull is on a 45-degree angle in relation to the rest of the hull (Figure 8-32). The steering quadrant is exposed and beneath the fantail a blade of the propeller protrudes above the sediment (Figure 8-33). Given its proximity to shore, relatively shallow depths, and overall intact condition, *Keshena* is perhaps one of the most frequently visited archaeological sites in the Hatteras area.

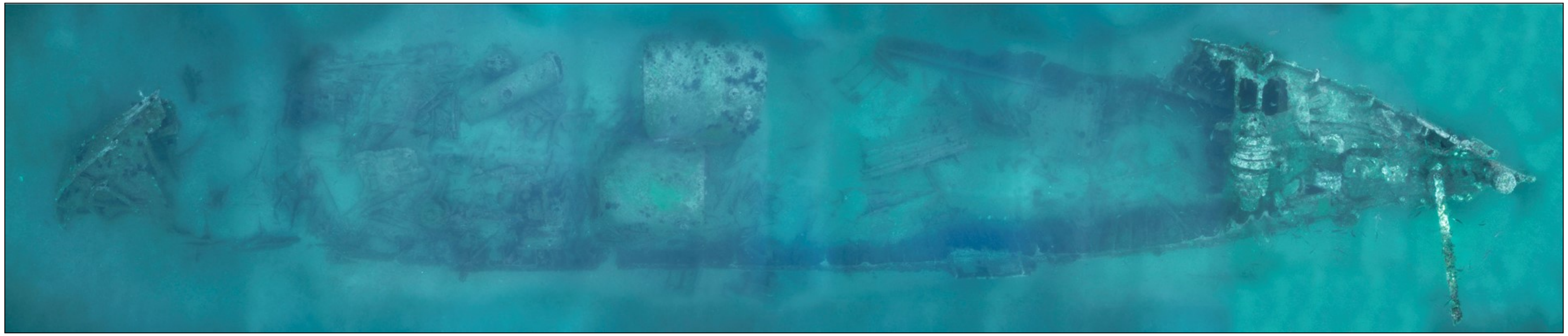


Figure 8-31 Planview photomosaic of *Keshena* - Source: NOAA

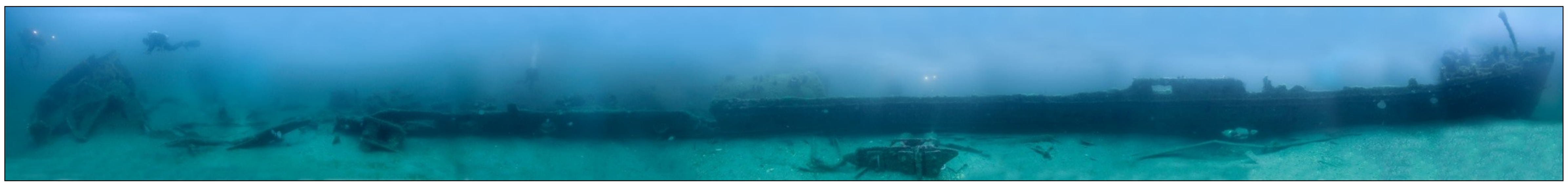


Figure 8-32 Profile photomosaic of *Keshena* -Source: NOAA

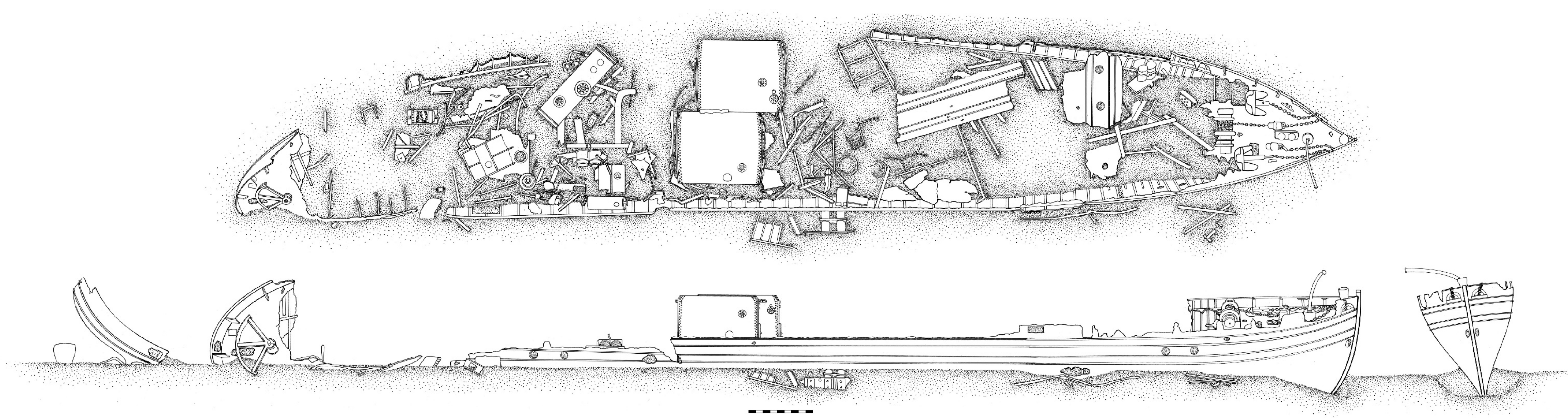


Figure 8-33 Plan and profile mosaic and archaeological site plan of *Keshena*, with bow and stern detail - Source: NOAA

8.5 USS Cythera (PY-26)

Figure 8-34 Image of USS *Cythera* prior to conversion at the Philadelphia Navy Yard.
Source: NARA

Table 8-5 Characteristics of USS *Cythera*

Characteristics	USS *Cythera*
Year of Build/Type/Hull #	1907/Steel Hulled Yacht/213125 (Lloyd's)
Date Lost	2 May 1942
Position & Depth	Unknown; 115 Miles SE Hatteras. Reported in Grid DC1591 (35 17'N 75 24'W)
Ship Characteristics	Length: 214' 8'; Breadth: 27' 6''; Depth: 16 1'' Gross Tonnage: 602
Cargo	n/a
Survivors	2 (71 Total Crew [69 dead lost])
Owner	US Navy (Given by Harkness Family)
Builder	Ramage & Ferguson Ltd. Scotland, UK.
Lloyd's Register Details And Merchant Vessels of the United States	Steel (Stl) hull, Steam Screw (St.s), Single Screw, Machinery amidships, Oil-fired Steam, Quadruple-expansion four-cylinder steam engine (Q4Cy), 2 bopilers, Engine 1350 IHP.
Port of Registry/Flag	USA
Sunk by	U-*402* (Siegfried Freiherr von Forstner)
Data Collected	n/a Location Unknown

8.5.1 History

USS *Cythera* has the distinction of being one of the oldest warships sunk in the Battle of the Atlantic, as well as being the only American vessel from which POWs were taken back to Germany from the East Coast of the United States. The vessel (Table 8-5 and Figure 8-34) also served in the First World War. The 212-foot, 602-ton, steam yacht *Agawa* (as it was originally named) was built in 1906 in Scotland as a luxury yacht for William L. Harkness, a weather investor who earned his wealth from Standard Oil (Morgan and Taylor 2011). The vessel was constructed elegantly and was a near-sister ship to Harkness's other yacht *Gunilda*, which sunk in Lake Superior in 1911. For the first decade of *Agawa's* life the yacht participated in races and other general yachting activities.

With the outbreak of WWI and the subsequent need for patrol vessels, Harkness donated the use of *Agawa* and the yacht was commissioned USS *Cythera* (SP-*575*) on 20 October 1917. Predominantly, the boat engaged in escorting and towing subchasers in European waters before being transferred to the Mediterranean for escort and patrol duty. At the conclusion of the war, *Cythera* was decommissioned and returned to the Harkness family on 19 March 1919 (Morgan and Taylor 2011).

Just a few short weeks after the Pearl Harbor attacks and America's official entry into the Second World War, the Harkness family again sold *Cythera* back to the Navy for one dollar on New Year's Eve, 1941 (Blair 1996, Sables 2005, Morgan and Taylor 2011). From January of 1942 through the following March, *Cythera* was converted once more as a patrol craft in the Philadelphia Navy Yard. Once the conversion was complete, the *Cythera* was recommissioned as the USS *Cythera* (PY-26) (Figure 8-35 and Figure 8-36).

The most conspicuous modification to *Cythera* was the addition of two depth charge racks at the stern of the vessel, and the addition of two 3-inch deck guns fore and aft. There were also four .50 caliber machine guns added, although only two appear in the photographs, visible at amidships. The vessel, which was white prior to conversion, was painted entirely gray, and all the port lights were covered or blacked out. Berthing spaces inside the vessel consisted of hanging bunks and picnic tables were placed in the crew's quarters. Additionally, radio communications equipment was added (NARA: File PY-26, Record Group 19).

During the two months that the USS *Cythera* was commissioned, the vessel was under the command of Lieutenant Commander Thomas Wright Rudderow and presumably underwent some sea trials (Sables 2005). On 1 May 1942, USS *Cythera* departed Norfolk, Virginia enroute to Pearl Harbor via the Panama Canal with orders to join the Pacific Fleet (Sables 2005; Morgan and Taylor 2011).

While less than a day underway on its first deployment, the vessel was hit by two torpedoes, broke in half, and sank rapidly. Next, two depth charges detonated as the vessel went down. James M. Brown and Charles H. Carter were the only two of the crew of 71 to survive (Blair 1996:544; NARA: File PY-26, Record Group 19).

Kapitanleutnant Freiherr Siegfried von Forstner of U-*402* had been stalking the vessel for several hours. Kptlt. Forstner then submerged U-*402*, and fired a spread of three torpedoes, two of which found their mark. Once USS *Cythera* sunk von Forstner captured the only two survivors, floating amongst the wreckage, making James Brown and Charles Carter the first naval prisoners of war in Germany; both lived through the war. Kptlt. Forstner, Knights Cross recipient and former student of U-boat ace Otto Kretschmer, was reported to have treated the POW's quite well onboard U-*402*. He gave his sweater to the oil-covered Brown, and allotted both men a drink of brandy. During the trip to France, both men were given cigarettes and allowed atop daily to get fresh air; they departed for the POW camp on amiable terms with U-*402*'s crew (Blair 1996:544).

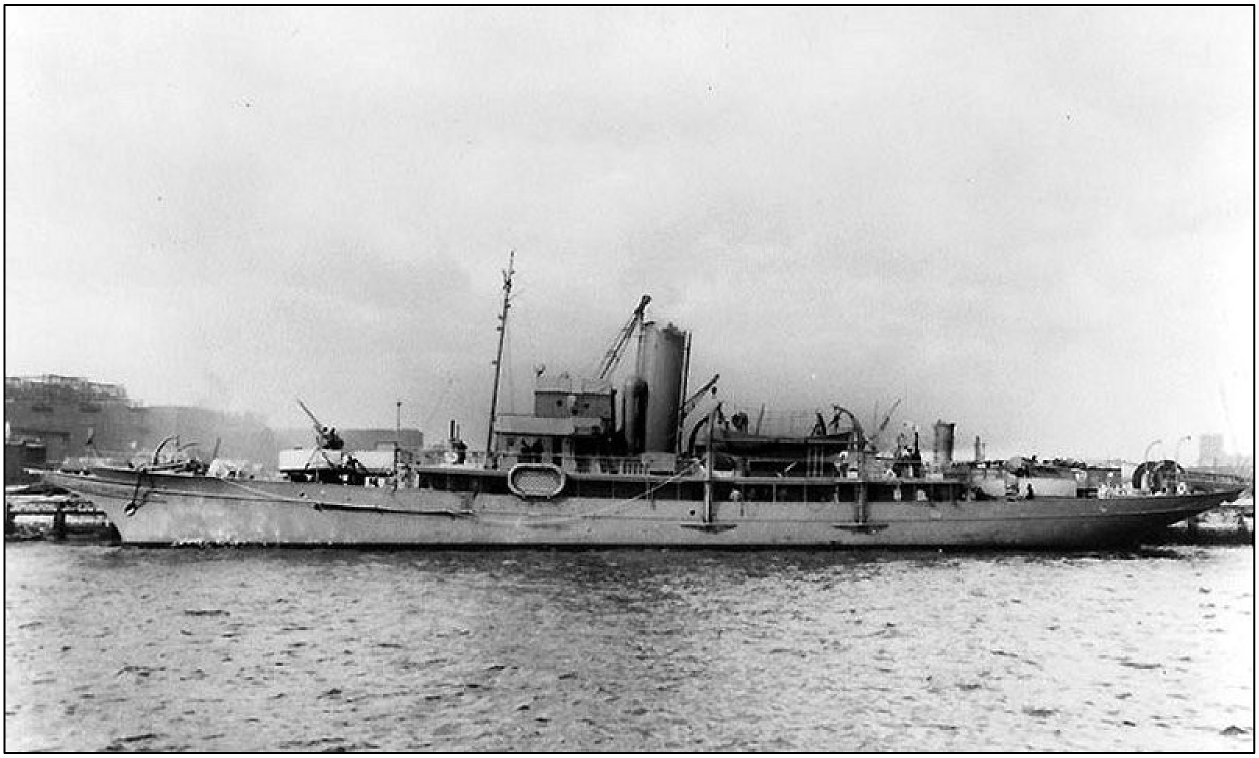


Figure 8-35 USS *Cythera* post-conversion with hull painted gray.
Source: Navy History and Heritage Command

The incident with USS *Cythera* highlighted an interesting circumstance in terms of how the US Navy armed and equipped converted patrol vessels. U-*402* was operating in an area off Cape Hatteras that, by mid-1942, was under constant air patrol. The group of U-boats in the area during this time reported strong anti-submarine patrols (Blair 1996:544). In fact, on 14 April U-*85* had been sunk off the Outer Banks, making it the first German submarine sunk by the American Navy off the east coast (Hoyt 2009). "Granted freedom of action, most of the [type] VIIs [U-boats] hauled away from Hatteras" yet, U-*402* remained (Blair 1996:544). With the constant air patrols, U-*402* would have been prevented from surfacing during daylight, thus only able to operate on the surface under the cover of dark.

When approaching USS *Cythera,* at an early hour of the morning, U-*402* was on the surface. It is not certain if enough daylight existed for visual contact. USS *Cythera*, however, had no underwater sound equipment. The Navy could not supply the equipment or the training to its converted patrol craft. Despite making a zigzag course, and (presumably) stationed lookouts, without proper sonar equipment, *Cythera* was blind. To be within an area so heavily patrolled that nearly all of the U-boats had been driven further offshore, yet to be unable to detect an enemy submarine, was USS *Cythera's* fatal flaw.

8.5.2 Archaeological Site Description

The remains of the wreck site have not been located, and there has not been any historical effort undertaken at present. The only position information reported for the location of the attack comes from the U-boat commanders' war diary, which places it within a relatively large grid square. The likely position is far offshore and likely in deep water. For these reasons it is improbable that the site will be located in the near future. Yet, its unique design, construction, armaments, and conversions should make the vessel's remains easily identifiable if ever located.

The narrative of the sinking indicated the vessel sunk quickly and may have been broken into two pieces, if not more, and all accounts highlight the devastation wrought by two modern torpedoes exploding into an aged, lightly built yacht. Nevertheless, since the vessel was steel hulled a high degree of preservation should be expected, if any remains are ever found.

Figure 8-36 USS *Cythera* post-conversion showing armament.
Source: NARA

8.6 USS Atik (former Carolyn)

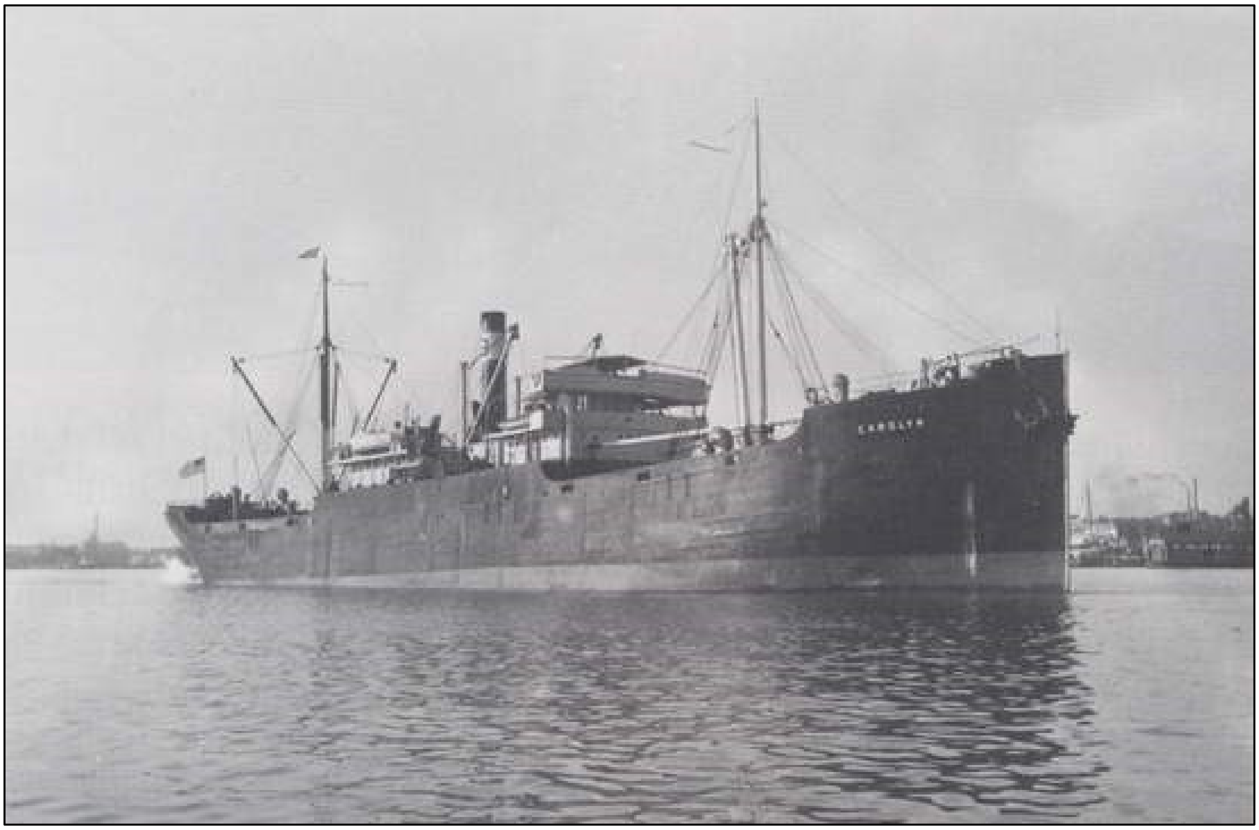


Figure 8-37 *Carolyn* before conversion to USS *Atik* (AK 101).
Source: Steamship Historical Society of America

Table 8-6 Characteristics of *Atik*

Characteristics	*Atik*
Year of Build/Type/Hull #	1912/Cargo Ship/158
Date Lost	27 March 1942
Position & Depth	325 miles NE of Cape Hatteras, NC Not officially located
Ship Characteristics	Length: 313.5' Breadth: 46'' Depth: 22.7' Gross Tonnage: 3,209
Cargo	Pulpwood floating cargo.
Survivors	0 (141 Total on board [all hands lost])
Owner (last)	US Navy
Builder	Newport News Shipbuilding & Dry Dock Co., Newport News, VA
Former Names	*Carolyn* (A.H. Bull S.S. Co., Inc., 1912-1942)
Lloyd's Register Details	Two decks (Steel) and web frames, longitudinal framing – bracketless system, fitted for oil fuel.
Port of Registry/Flag	New York, NY/USA
Sunk by	U-*123* (Reinhard Hardegen)
Data Collected	n/a-location unknown

8.6.1 History

Built and completed in Newport News, Virginia in July 1912 as a merchant ship for the A.H. Bull Steam Ship Company, *Carolyn* operated initially out of New York, New York. During WWI, *Carolyn* was given the identification number ID-*1608* in case it was needed for military service, but it never was requisitioned by the Navy (Radigan and Priolo 2013). *Carolyn* continued to operate in a commercial capacity for the A.H. Bull Steam Ship Company until the Second World War found its way across the Atlantic Ocean. Following the declaration of war and the beginning of German U-boat attacks along the East Coast, *Carolyn* was called into service by the Navy.

Carolyn and a second cargo vessel owned by A.H. Bull Steam Ship Company, *Evelyn*, were taken over for naval use by Mr. Huntington Morse and Mr. S. H. Heimbold of the US Maritime Commission. The two vessels were originally built at the same time in Newport News, Virginia and shared the same characteristics and dimensions (Table 8-6 and Figure 8-37, above). The two vessels were going to be part of a new defense program utilizing a technique from WWI. Reviving the Allied practice whereby British and Allied cargo ships were outfitted with concealed armament, these disguised ships would then be able to lure and attack U-boats. These vessels operated with a merchant and naval crew and were called 'Q-ships' (Gannon 1990:304-306).

Carolyn and *Evelyn* were to be outfitted in the same fashion and the conversion process took place in Portsmouth, New Hampshire in early 1942. The vessels were outfitted with four 4-inch deck guns, 50 caliber machine guns, two of which were concealed, as well as 6 depth charge mounts, 4 other fifty caliber machine guns, and other complements of small arms. *Carolyn* was designated USS *Atik* (AK-*101*) and *Evelyn* named USS *Asterion* (AK-*100*), each carrying a crew of 141 sailors, including 6 officers. Both vessels were completed and put into service in February 1942 (Radigan and Priolo 2013; Navy History and Heritage Command 2015).

As part of the ruse, the ships would travel independently (alone) along a straight, non-zigzagging course, and purposefully emit large clouds of smoke, visible well over the horizon. It was on one such patrol that U-*123*, operating as second American war patrol, spotted the peculiarly moving ship. It was late in the afternoon on 27 March when the U-boat began its track of the ship, and as night fell U-*123*'s commander, Kptlt. Hardegen, noticed some even more perplexing movements: the ship's smoke emissions reduced and it began a zigzagging course along its previous base course. Piqued, but not daunted, U-*123* continued to track and plotted a firing solution; a single torpedo was sent into the hold of this middling-sized freighter. A smaller-than-expected explosion resulted and the U-boat's radioman intercepted an apparent distress call from merchant ship '*Carolyn*.' Not wanting to expend another torpedo, and confident the ship no longer posed a threat, Kptlt. Hardegen brought U-*123* around to the ship's starboard side to commence a gunnery attack. As he observed lifeboats being lowered away, Kptlt. Hardegen also noticed that the ship was beginning to gain speed, turn, and make aggressive maneuvers. Hardegen abruptly realized the ruse when the freighter's seemingly awkward bulwarks fell away, revealing a hidden arsenal of guns (Gannon 1990:323-324).

Having successfully lured a U-boat quarry into range, USS *Atik* was posed to sink a U-boat which, if successful, would be the first such sinking in American water. Their target, however, was hastily making a run at full speed on the surface. A hail of artillery and machine gun fire poured from USS *Atik's* decks, however, and several hits were landed on the U-boat. Ultimately, however, U-*123* out ran the Q-ship and sought safety in the inky darkness of the night. While Kptlt. Hardegen cursed himself for being lulled into such an obvious trap, USS *Atik* returned to the 'distressed' lifeboats launched to bait the U-boat closer. Once relocated, USS *Atik* was brought to a stop to re-embark the boats and their occupants. Unbeknownst, U-*123* was lurking a short distance away. Having returned submerged and determined to dispatch the duplicitous merchantman-turned-warship, Kptlt. Hardegen lined up an attack at the ship's engine room and machinery. A second torpedo sent USS *Atik* on a slow, belaboured trip to the seafloor (Gannon 1990:325-326).

Buoyed up by its prophylactic cargo of pulpwood—indeed to mitigate the effect of torpedo strike to the ship's hold—USS *Atik* slowly settled by the bow. In the course of the events, the Q-ship's radio operator had issued numerous distress messages. As the ship slowly settled, the entire crew (presumably) had ample time to make it into lifeboats. U-*123* lingered submerged to witness the ship's sinking. As USS *Atik* slipped below the surface, more explosions hammered the ship: boilers being doused, active depth charges, secondary munitions, etc. The ship was a total loss; U-*123* slipped away. USS *Atik's* crew remained in their lifeboats, awaiting rescue. Throughout the night, however, weather conditions deteriorated considerably. Survivors from USS *Atik* were never found, casting a quiet pall over US Navy commanders as disagreements over the Q-ship program were grimly settled (Gannon 1990:323-329).

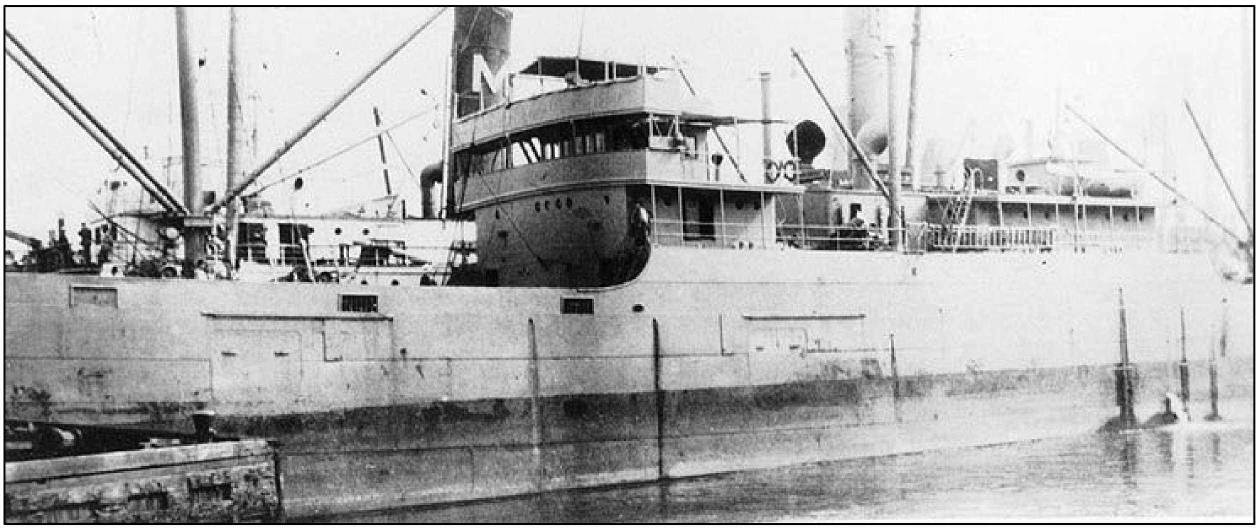


Figure 8-38 *Carolyn* moored pier side, circa 1917-18. US Navy photo # NH 102438.
Source: US Navy

Archaeological Site Description

The remains of this vessel have never been located, and there has not been any known historical search effort undertaken. The only position information reported for the location of the attack came from vague positions radioed by the ship's crew following the U-boat attack, and also from U-*123's* war diary; both placing it within a relatively large grid square, several hundred miles offshore of Cape Hatteras. The likely position is far offshore and likely in deep water. Search efforts by the US Navy subsequent to USS *Atik's* loss failed to find either wreckage or survivors, casting further doubt upon the report positions. For these reasons, it is improbable that the site will be located in the near future. Yet, its unique design, construction, armaments, and conversions should make the vessel's remains easily identifiable if ever located (Figure 8-38).

A confounding factor, however, may be the ship's pulpwood cargo loaded to provide buoyancy to the hull in the event of a torpedo strike. Kptlt. Hardegen reported the vessel sinking very slowly; it is possible the ship drifted, partially buoyant, a very long distance from the attack location before finally coming to rest upon the seafloor. If ever located, however, the ship's large quantity of armaments should make it easily identifiable.

8.7 USCGC Bedloe (WSC-128) and Jackson (WSC-142)

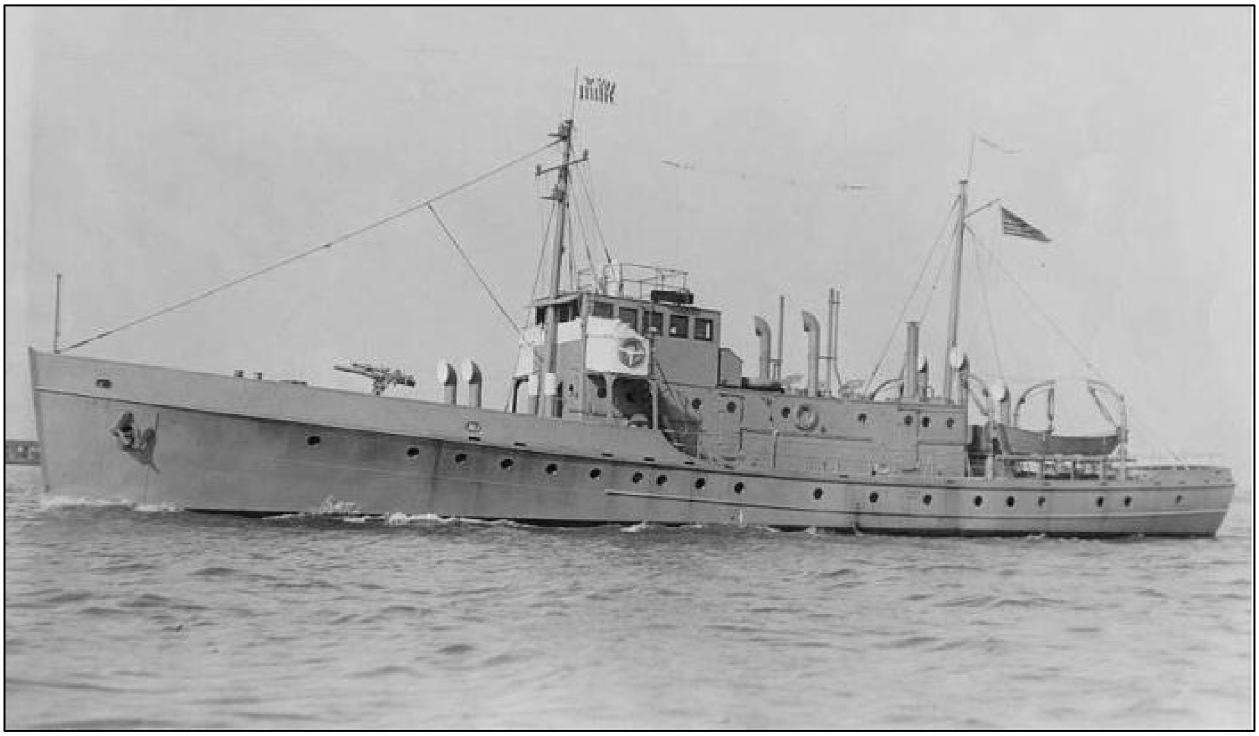


Figure 8-39 USCGC *Jackson* after commissioning in 1927, prior to conversion to an anti-submarine vessel.
Source: US Coast Guard Photo # 16079-A – J.N. Heuisy

Table 8-7 Characteristics of USCGC *Jackson*

Characteristics	USCGC *Jackson*
Year of Build/Type/Hull #	1927/*Active*-Class Cutter/323 &336
Date Lost	14 September 1944
Position & Depth	USCGC *Jackson*: 8 miles E of Oregon Inlet, NC, 80 ft. USCGC *Bedloe:* 25 miles ESE of Oregon Inlet, NC, 150 ft.
Ship Characteristics	Length: 125' Breadth: 23.6' Draft: 7.6' Displacement: 232 tons
Cargo	N/A
Survivors	USCGC *Jackson:* 19 (41 total onboard [22 lost]) USCGC *Bedloe:* 12 (38 total onboard [26 lost])
Owner	US Coast Guard
Builder	American Brown Boveri Electric Corp., Camden, NJ
Former Names	USCGC Bedloe: ex-Antietam
Lloyd's Register Details	n/a
Duty Station (at time of loss)	Morehead City, NC
Sunk by	Foundered in Hurricane
Data Collected on Site	Multibeam, photomosaic 2018.

8.7.1 History

The bulk of naval fighting which took place off the North Carolina coast happened between January and August, 1942. Towards the end of this period German U-boats were directed away from the American east coast in response to the institution of a robust convoy and air patrol system. Collectively, American naval defenses had ostensibly nullified almost every advantage a U-boat might have in operating off the American coast, and otherwise made operating too costly in terms of German losses. Though U-boats left these waters, however, the threat of return continued for the remainder of the war. Thus, the need to maintain the convoys and patrols persisted and American naval activity, which still focused on convoy escorts and anti-submarine patrols, never slowed.

In the remaining years of the Battle of the Atlantic, the North Carolina coast was host to the occasional U-boat visit—a combination of the Germans probing for weakness or complacency in the American defenses and continued lack of success in other theaters—as well as numerous sinkings resulting from weather and collisions. The final chapter in the Battle of the Atlantic off the North Carolina coast, therefore, took place under such circumstances in September 1944. Two US Coast Guard cutters, both having served the entire war as patrol and escort vessels, were lost during a rescue/salvage mission gone awry when they were dispatched to aide a torpedoed freighter. Both foundered at sea in one of the largest hurricanes to ever hit the Hatteras area.

US Coast Guard cutters *Bedloe* and *Jackson* commissioned 17 years prior, were designed, built, and intended for an entirely different purpose than anti-submarine warfare. Both cutters were part of the *Active* class of boats: a smaller 125-ft long patrol boat commonly referred to as the 'buck and a quarters' (Figure 8-39, above). Thirty-three of these vessels (WSC 125 thru WSC 157) were ordered by the US Coast Guard in the mid-1920s as Prohibition enforcement patrol boats. As conceived, "…the CG developed offshore patrol vessels for an outer ring and inshore patrol craft for an inner one. The 125-ft cutters were the first class to be designated for the outer patrol" (Scheina 1982:45). At a cost of $63,173 each, the American Brown Boveri Electric Corporation of Camden, New Jersey completed all 33 *Active* class boats by May 1927 (see Table 8-7 for original general arrangements).

The vessels served in their role as Prohibition enforcement boats until the repeal of the Eighteenth Amendment, thereafter dispersing to more generalized Coast Guard service roles. For cutters *Bedloe* and *Jackson*, this meant a re-assignment to New England and years of hard duty maintaining navigable channels and breaking ice during the frozen winter months. This duty took toll on each of the boats, and both required extensive repairs and upgrades by 1935. Thereafter, the cutters were again re-assigned, this time into the Great Lakes and served until being called out by the US Navy in 1940. During this duty station USCGC *Bedloe* (then *Antietam*) made headlines by hosting Max Nohl's 1937 recording-breaking dives to 420 ft in Lake Michigan using an experimental mixed gas diving helmet (Galecki 2005:50-72).

With the prospect of the United States entering the Second World War looming, the US Navy was quietly making plans to upgrade its small, aging anti-submarine fleets. As a result, cutters *Jackson* and *Bedloe* were quietly recalled from their respective Great Lakes duty stations and ordered into New Jersey shipyards for major upgrades to support naval operations in the Atlantic. Upgrades and modifications included depth charge racks, minesweeping gear, radio direction finding (RDF) gear, plating over windows and portholes, and additional berthing spaces to accommodate additional crew (Figure 8-40). These changes would prove the first of many for the cutters during the war, as periodic returns to the shipyards brought additional modifications to internal spaces, propulsion systems, armaments, and sonar gear (Galecki 2005:72-81).

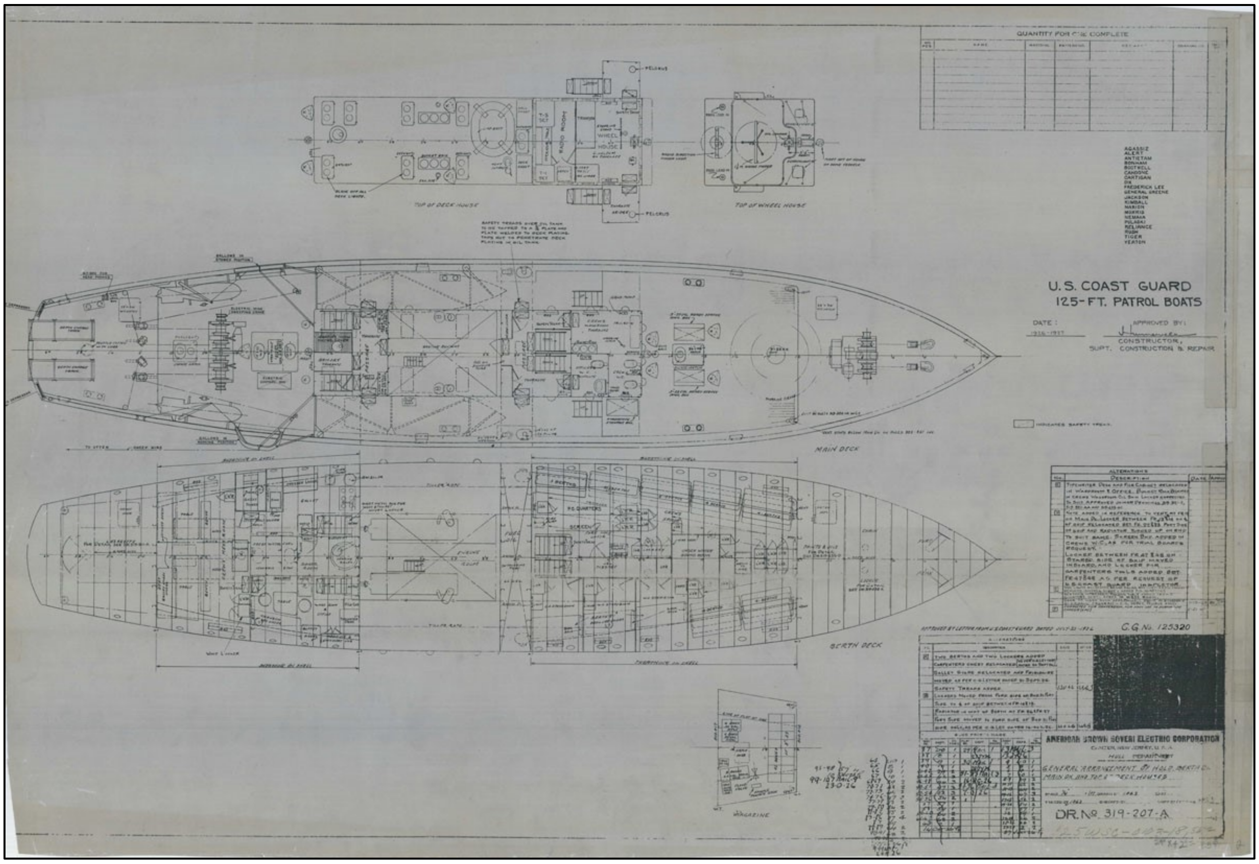


Figure 8-40 Updated plans for modifications to the Active-class cutters made by the US Navy beginning in 1940.
Source: NARA

Both vessels proved workhorses for the US Navy. They spent years running convoy escorts, rescuing or aiding damaged merchant ships, and operating throughout the Eastern, Gulf, and Caribbean Sea Frontiers. Their service, however, was not without hazard and perhaps the most menacing threat to the cutters and crew during the Battle of the Atlantic was the ships themselves. Commanding Officers from both boats grew increasingly wary about their cutters' stability and handling characteristics. After one visit to the yard in particular, USCGC *Bedloe's* Executive Officer, Ed Bartley, made some troubling observations:

> [Following the refit] their previously stable cutter was now difficult to control, veering off course with no change in rudder angle and randomly drifting from side to side. Even with the addition of the auxiliary rudders, the crew found that it was nearly impossible to hold the vessel on a steady course….Bartley attributed the problem to an increase in the center of gravity, resulting from the redistribution of weight in the vessel. The wheelhouse extension, the extra electronic equipment for the radar, the gun decks and the pair of 20-mm guns, plus their two ready service lockers filled with ammunition, all added a substantial amount of new weight to the topside of the vessel, where it exerted maximum leverage on the center of buoyancy (Galecki 2005:118).

Similar problems plagued USCGC *Jackson* as well, and the crews of each sought to remedy the situation with improvised ballast—repairs which were never submitted to or approved by either the US Navy or Coast Guard. Only marginal improvements were gained, however, and each cutter remained dangerously unwieldy in heavy seas (Galecki 2005:119-125).

By mid-1944, both cutters were working the convoy routes between New York, Norfolk, and Morehead City, North Carolina. On the night of 12 September, U-*518* spotted and attacked an independently sailing freighter with a single torpedo. The freighter, *George Ade*, was hit in the starboard, stern area of the ship. Its rudder was disabled, but the ship was not sinking. Armed Guard crews onboard *George Ade* spotted U-*518*'s conning tower a short distance away and opened fire. U-*518* fled unharmed and *George Ade* was stuck, dead in the water; a rescue group was called up from nearby Morehead City (Galecki 2005:129-131).

Meanwhile, the US Army, Navy, and Weather Bureau had been tracking a tropical storm-turned-hurricane moving past the Windward Islands on an approach to the US east coast. As rescue and salvage operations were underway to locate and take *George Ade* under tow, the prospect of an Atlantic hurricane loomed over the whole mission. As the contingent of tugboats and anti-submarine vessels—including USCGC *Bedloe* and *Jackson*—departed Morehead City enroute to *George Ade*, the US Navy was learning of the losses of 381-ft destroyer USS *Warwick* and minesweeper YMS-*409* in the Caribbean. Worse yet, the storm was building and narrowing its track to the Hatteras coast. The storm was so impressive, it was dubbed the 'Great Atlantic Hurricane' by the US Weather Bureau (Galecki 2005:138-139).

Having located and established a tow with *George Ade*, the group's best chance was to make haste for Norfolk and shelter within the Chesapeake. They could not, however, make way fast enough and at dawn on 14 September, the group was overtaken by the hurricane. By 1000 hours, waves were rolling at over 100 ft high, and both cutters were in a dire situation. First visual contact was lost, then the boats themselves began to labor in the heavy seas. A series of towering waves rocked USCGC *Jackson* first; the cutter capsized and sank at 1030 hours. Most of the crew escaped into life rafts. The crew onboard USCGC *Bedloe* fared little better; at 1306 hours the cutter also capsized and sank (Johnson 1987:239; Galecki 2005:139-155).

For the 79 officers and crew of the cutters, their situation was going to get worse before it got better. Though all of USCGC *Jackson's* crew got off the boat safely, 8 of USCGC *Bedloe's* crew went down with the vessel. In the water, they were relegated to ill-provisioned life rafts, and were left tossing in the storm's waves. As the sun set on 14 September, the Great Atlantic Hurricane had passed, but the ordeal of the crews was far from over; a series of miscommunications and assumptions among Navy and Coast Guard administration left the cutter's passing unnoticed for days. As a result, the survivors were rescued after having spent nearly 58 hours in the water. During that time, many of the crews perished from exposure and dehydration. Only 31 of the original 79 survived to be rescued (Figure 8-41) (Scheina 1982:46-47; Johnson 1987:239-240).

The loss of Coast Guard cutters *Bedloe* and *Jackson* constituted the greatest loss of life the Coast Guard sustained in American waters. Their sinking is one of the top maritime losses in Coast Guard history. Largely at fault—according to the conclusion of Bryan Galecki's 2005 study—was the compromised stability of the boats following over a decade of accumulated modifications and additions of equipment, armament, and personnel. Having been built to serve light, fast patrol boats with a moderate endurance, they were repurposed to haul larger crews over longer distances for coastal convoy duty, and were subsequently outfitted with an array of heavy equipment and armaments. As a result, the raging seas of a massive hurricane were simply too much for the cutters.

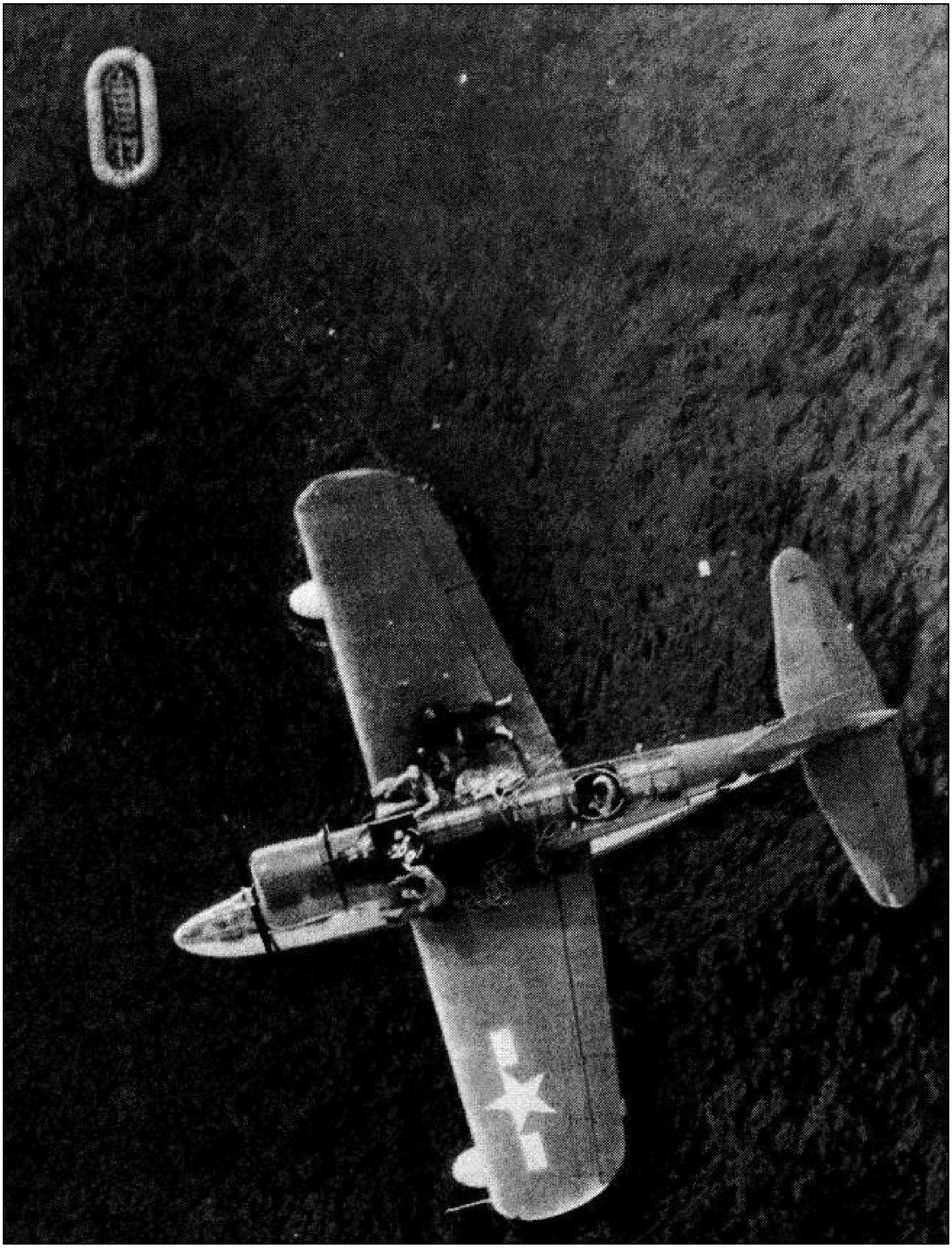


Figure 8-41 A Navy Kingfisher sea plane taking survivors aboard while awaiting a motor lifeboat to take USCGC *Jackson*'s survivors ashore.
Source: Galecki 2005:172

8.7.2 Archaeological Site Description

USCGC *Jackson* or *Bedloe* were visited briefly during the course of the survey. Both vessel's locations are publically known and are regularly visited by recreational diving and fishing boats operating (mainly) out of Oregon Inlet. The site of USCGC *Jackson* was discovered first, in the early 1990s, resting in shallow water 8-10 miles east of Oregon Inlet. Diver and researcher Bryan Galecki (2005:4-9) conducted historical research sufficient to deduce that the site was one of the two cutters, but there was not sufficient evidence present to determine if it was USCGC *Bedloe* or *Jackson*. In 1991, divers recovered artifacts which included a name plate bearing the name of one of USCGC *Jackson's* crew. In 2004, another group of sport divers discovered the remains of an Active class cutter in 150 ft of water 25 miles southeast of Oregon Inlet (Galecki 2005:253-257). Now, *Bedloe* was found. The research and discovery process surrounding the identification of these boats was featured in a 2006 episode of the television series *Deep Sea Detective* of the former History Channel.

Multibeam sonar survey and limited diving operations took place at the sites in 2018 (Figure 8-42 and Figure 8-43). Geophysical data was collected at both sites. Researchers affiliated with the project from Coastal Studies Institute have visited the sites as well, completing a photogrammetry survey of the USCGC *Jackson*. Their observations, corroborated by the reports published by Bryan Galecki (2005), are that USCGC *Jackson* rests upright in 80 ft of water. The bow section is broken forward of the wheelhouse and sits with a slight list to starboard (Figure 8-45). The 3-inch deck gun and mount are detached and resting in the sand 10-15 ft off the bow. A small, disarticulated area separates the bow and stern sections, and the area between the break back to the fuel tank bulkheads is mainly a debris field (Figure 8-44). Aft of the fuel tank is the engine room containing the diesel engines, and abaft there are areas in various degrees of structural degradation. Where once 3-inch shells were deposited around the site, none can be found, and several features along the vessel's stern were wrapped with fire hose, including the depth charge racks, after apparent attempts to remove and/or salvage them. As a result, the overall site integrity at USCGC *Jackson* has been substantially diminished.

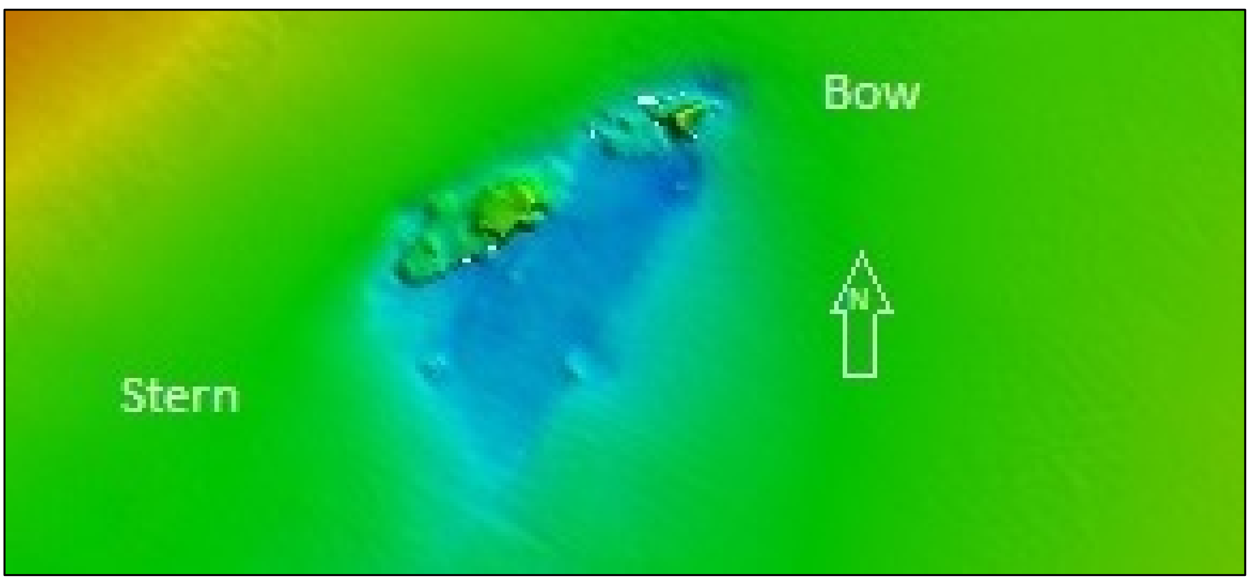


Figure 8-42 Multibeam Sonar Survey of USCGC *Jackson*.
Source: NOAA

USCGC *Bedloe*, on the other hand, is almost completely intact resting on its port side. Unlike USCGC *Jackson*, USCGC *Bedloe's* weather deck and wheel house remained intact, along with other prominent exterior features such as the 3-inch gun). It would appear, as was the case with U-*701*, U-*85* and U-*352,* that USCGC *Bedloe's* higher level of archaeological integrity is largely the result of its relatively recent discovery and depth; both of which has substantially limited human impacts at the site when compared to USCGC *Jackson*. Both sites, however, still constitute historic military properties and should be further archaeologically documented and considered for the NRHP.

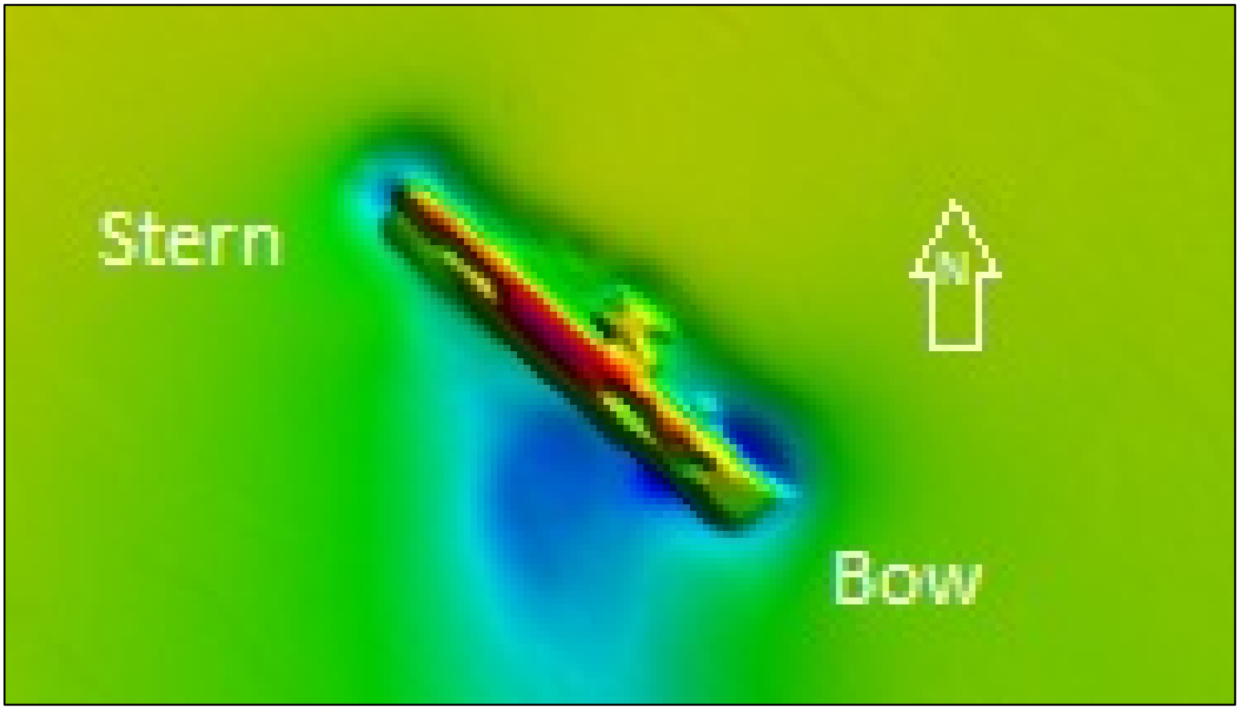


Figure 8-43 Multibeam Sonar Survey of USCGC *Bedloe*.
Source: NOAA

Figure 8-44 Plan view orthographic photomosaic of USCGC *Jackson* wreck site.
Source: John McCord, UNC-CSI

Figure 8-45 Starboard side profile view orthographic photomosaic of USCGC *Jackson* wreck site.
Source: John McCord, UNC-CSI

9 German Military Vessels

Four German U-boats were lost along the North Carolina coast during the Battle of the Atlantic. Site descriptions for each vessel's remains are presented numerically. As with the Allied military assets, German U-boat remains are subject to special status and protection (see Section 12.1.2). Each site description, moreover, is intended to inform site analysis and interpretation throughout the report, as well as individual publications and studies produced by NOAA and partner agencies (see Section 1.2) emanating from this overarching body of research.

9.1 U-*85*

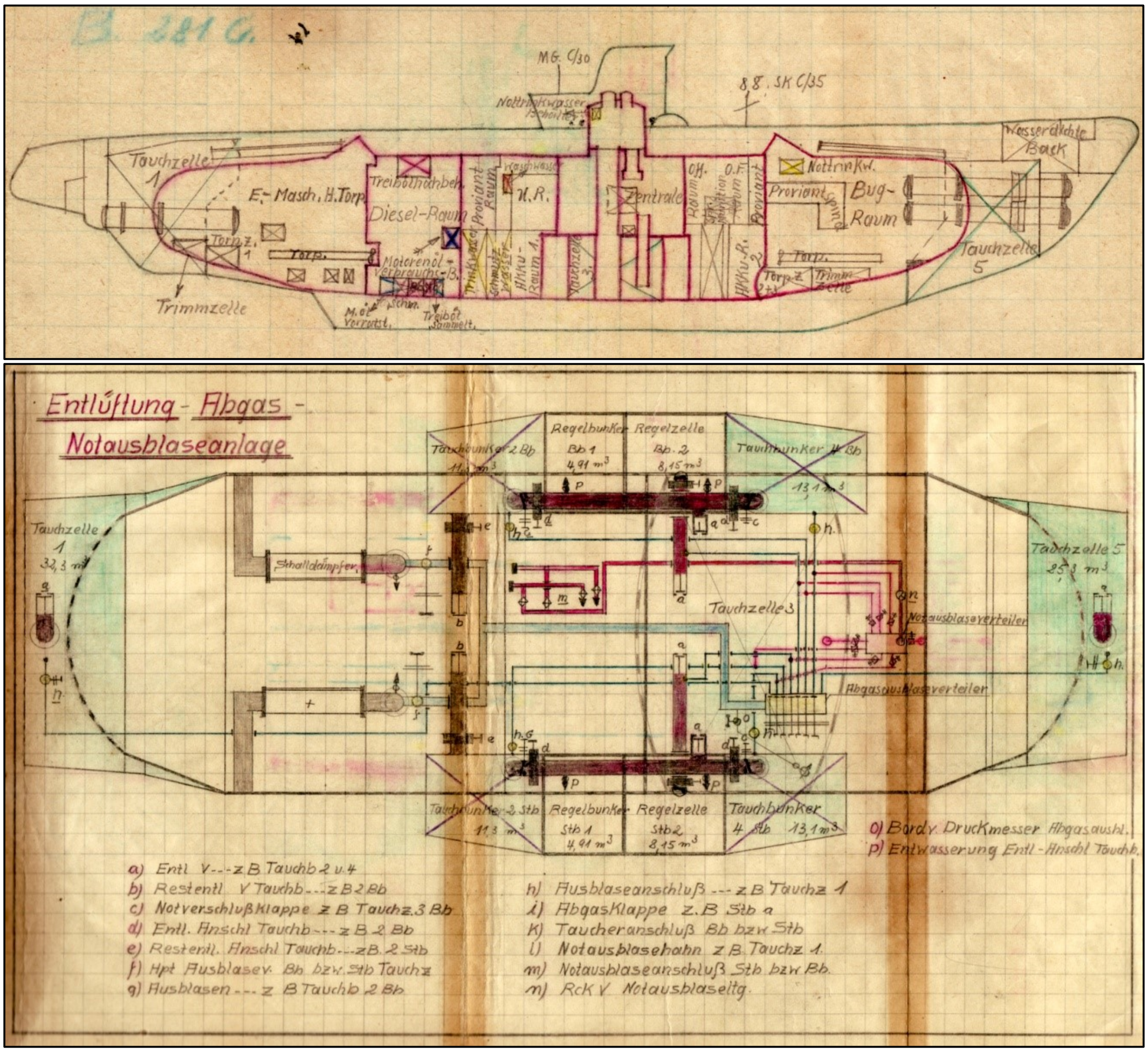


Figure 9-1 General Arrangement (top) and Diagrams of the flooding, venting, low pressure exhaust gas, and emergency blowing systems (bottom) recovered from Type VIIB U-*85* recovered from Obermaschinist Heinrich Adrian.

Source: NARA

Table 9-1 Characteristics of U-*85*

Characteristics	U-*85*
Year of Build/Type/Hull #	1939/Military Type VIIB U-boat/281
Date Lost	14 April 1942
Position & Depth	13 miles ENE of Oregon Inlet, NC Depth: 90 ft
Ship Characteristics	Displacement 753/857 tons(surfaced/submerged) Length: 66.5 m (220') Beam: 6.2 m (20') Draft: 4.7 m (15.7') Engines: 2,800 bhp/750 hp (2-shaft diesel/electric); Speed 17.2/8 kts (surface/submerged); Armament: 14 Torpedoes, 88-mm deck gun, 20-mm anti-aircraft;
Cargo	n/a
Survivors	0 (46 onboard [all hands lost])
Owner	German Navy
Construction Details	Steel (Stl) hull, Diesel /Electric Motors
Builder	Flender Werke AG, Lübeck, Schleswig-Holstein, Germany
Port of Registry/Flag	Germany
Sunk by	USS Roper
Data Collected	Still and video photography collection; photomosaics; site plan, high-resolution Reson multibeam survey; listed on NRHP; photogrammetric model.

9.1.1 History

U-*85* was the third Type VII-B built at Flederwerft in Lübeck (Figure 9-1, above). The keel was laid on 18 December 1939, it was launched on 10 April 1940, and it commissioned by 7 June with the Feldpost number 40 935. U-*85* was attached to the Third Flotilla based at Kiel and La Palice from June 1941 until the time of loss on 14 April 1942 (Wynn 1997:64). U-*85* was adorned with the emblem of a wild boar on the conning tower (Figure 9-2) (Högel 1999:52).

Figure 9-2 Emblem which adorned the conning tower of the U-*85*. A rose was later added between the teeth of the boar.

Source: Högel 1999:52

Command of U-*85* was given to Oberleutnent zur See Eberhard Greger of the naval class of 1935. Greger was born on 15 September 1915, in Lieberose, Netherlands. He began his naval career in the surface fleet as the Second Watch Officer on the destroyer *Wolfgang Zenker* from February through October 1939. In October, Greger began attending the U-boat training school and by January 1940 was assigned to the U-*30* as First Watch Officer. The U-*30* was a Type VII-A commanded by Fritz Julius Lemp; one of the most famous U-boat commanders of the war. In October 1940, Lemp was given command of the U-*110*, a Type IX-B. At this time Greger joined Lemp for the Baubelehrung phase of the U-*110* construction, after which he resumed his position as First Watch Officer.

Greger remained in this position on U-*110* until April 1940, at which point he began the U-boat commander's course. During this time Greger and his soon to be crew participated in Baubelehrung during the final phases of construction of the U-*85*. Submarine school and Baubelehrung are an important time in the training of a U-boat crew. During this time, the crew familiarizes themselves with the intricacies of their particular U-boat, especially as it pertained to their specific duties (Figure 9-3). After completion of his training he was formally assigned a crew and officially given command of the U-*85* (Figure 9-4; Busch and Röll 1999:86).

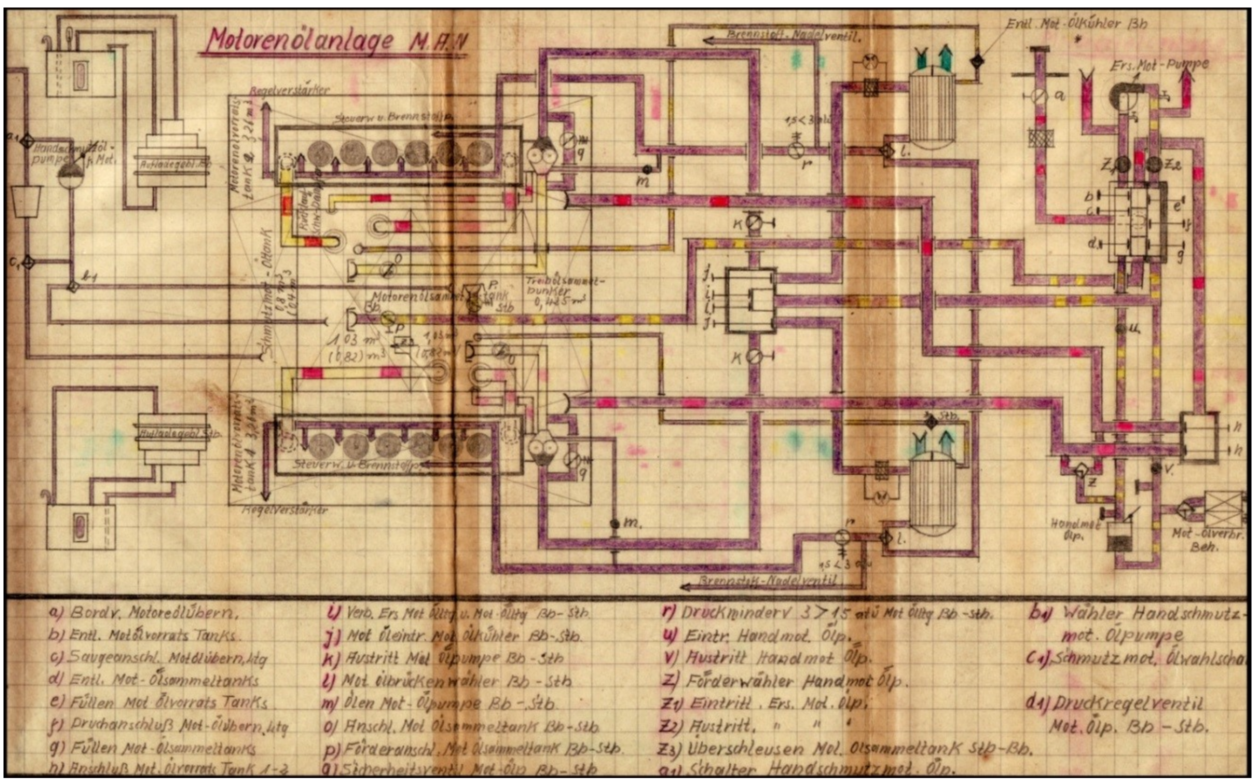


Figure 9-3 Diagram for the U-*85*'s engine lubricating oil system by Obermaschinist Heinrich Adrian likely done during Baubelehrung. This was recovered from Adrian after the loss of the U-*85*.
Source: NARA

ObltzS. Greger's first war patrol as Captain began on 28 August 1941. U-*85* was assigned to Group *Markgraf* along with 13 other U-boats dispatched to patrol for convoys Southwest of Iceland. Setting out from Trondheim, U-*85* immediately was subjected to harassment by patrolling antisubmarine aircraft. The first and second days of the patrol were not fruitful due to such cover and the necessity to conduct evasive crash dives. Over the next two days, U-*85* encountered one freighter that escaped, and another that was determined to be too small to be worthwhile. On 2 September, U-*85* was spotted by a patrolling aircraft, which dropped three depths charges to no effect (USONI 1942a:4).

Days went by with no luck. Döenitz and the Oberkommando der Marine (OKM) [German High Command of the Navy) were completely unaware that British code-breakers were successfully reading German naval Enigma encoded signals. In an effort to maintain this secret, the British decided to reroute convoys around known U-boats rather than to act tactically against them. Contact with convoys was extremely difficult. ObltzS. Greger was unaware of this, and likewise unaware that his former Captain, Fritz Julius Lemp, was partially responsible as a result of allowing U-*110* and its secret materials to fall into British possession (Wynn 1997:64).

In an effort to increase the possibility of contacting a convoy, Group *Markgraf* was ordered spread out over a larger area. Finally, on 9 September, U-*85* and U-*81* came across Slow Convoy 32. U-*81* was able to sink one ship, but U-*85* fired and missed its target. However, ObltzS. Greger was able to radio a contact report stating that he had come across a massive convoy with as many as 65 ships. As a result of this contact report, Döenitz activated the wolf-pack tactics by calling for all Group *Markgraf* U-boats to report to ObltzS. Greger's position (Blair 1996:361; Wynn 1997:64).

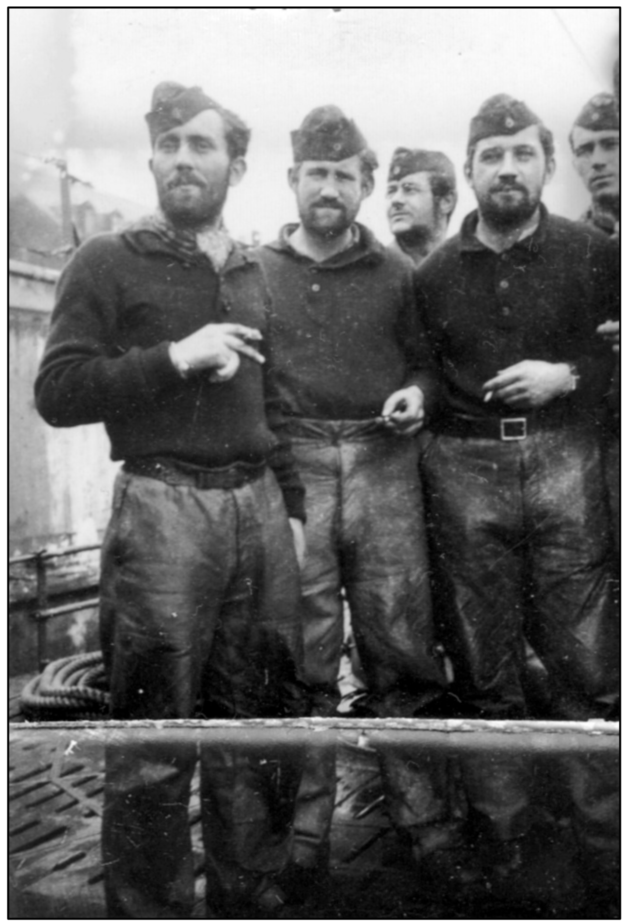


Figure 9-4 Crew members on the deck of the U-*85*.
Source: NARA

During the attack on Slow Convoy 42, ObltzS. Greger fired five torpedoes, all of which were failures, described as "hot tube runners" (USONI 1942a:4). U-*85* was able to sink one ship, the 4,748-ton British freighter *Thistleglen* on 10 September. In response, the Canadian escorts HMCS *Skeena* and HMCS *Alberni* delivered a very accurate depth charge counter-attack. ObltzS. Greger and his crew narrowly escaped. The following day U-*85* surfaced with the intent to conduct repairs and resume patrol. During test diving, however, ObltzS. Greger determined that U-*85* was not able to dive with the requisite effectiveness. The damage from the depth charge attacks was so great that he had no other alternative but to abort the rest of the mission and return St. Nazaire for yard repairs (USONI 1942a:4; Blair 1996:361).

Although ObltzS. Greger had to abort, the wolf pack attack that he instigated continued for six more days. Several U-boats attacked and, in the end, were responsible for the loss of 19 ships for a total of 74,574 tons. Up to that point, this was the second most successful attack on a convoy since the war began. ObltzS. Greger arrived at their new base at St. Nazaire on 18 September after 22 days at sea and U-*85* began repairs (USONI 1942a:4; Blair 1996:361).

Following repairs U-*85* transferred from St. Nazaire to Lorient on 11 October. After taking on fuel and fresh provisions, Obltzs. Greger was ready to take U-*85* on its second war patrol. This was a very frustrating and disappointing patrol for U-*85*. British intelligence on U-boat locations was so effective that the convoys were easily evading U-*85* and other boats operating in the North Sea. In addition to elusive convoys, the U-boat also was plagued by rough weather and heavy antisubmarine patrols. After having spent 43 days in the North Atlantic and being occasionally depth-charged by planes, U-*85* found little and attacked nothing. ObltzS. Greger and his men returned to Lorient unsuccessful (USONI 1942a:4; Wynn 1997:64).

The crew of U-*85* enjoyed an extended stay in port. They did not embark on their third war patrol until 8 January 1942. By this time, the United States had entered the war and Germany was prompt in bringing U-boats to the East Coast of the United States. U-*85* was among the second wave of Type VIIs to be deployed in American waters. Due to the expanse of the area patrolled, wolf pack tactics were not as practical and many vessels, though still in loose groups, effectively were operating individually. U-*85* took a patrol station between Newfoundland and Nova Scotia (Wynn 1997:64). U-*85* had no luck until 21 January. In the mid-Atlantic, ObltzS. Greger fired four torpedoes at what was judged to be a 10,000-ton steamer. The crew of U-*85* claimed to have scored at least one hit, but the vessel evidently did not sink and no confirming Allied records of this incident are known (USONI 1942a:7).

On 28 January, while operating off Newfoundland, U-*85* was attacked with depth charges in what the crew described as a "baptism of fire" (USONI 1942a:7). The U-*85* was rocked, but not seriously damaged. This attack was attributed to Aviation Machinist Mate First Class Donald L. Mason. Mason attacked a U-boat on the surface in the same reported position on 28 January. Believing that he had been successful, his first report on the action was a radio message stating, "Sighted sub, sank same" (USONI 1942d). This utterance is a famous quote in American naval history and certainly the most famous American naval quote in reference to the U-boats of WWII (Hickam, Jr. 1989:67).

On 8 February, U-*85* along with U-*654* found and attacked the southwest bound Convoy ONS 61. U-*654* was able to sink one vessel in this convoy, while ObltzS. Greger fired at least 3 torpedoes with no hits. On the following day, ObltzS. Greger spotted an Allied merchant vessel, the 5,408-ton British freighter *Empire Fusilier*. ObltzS. Greger sank this vessel with torpedoes, the only success of the patrol. Shortly after, U-*85* headed for St. Nazaire, returning on 23 February 1942 (USONI 1942a:7; Wynn 1997:64).

By 21 March 1942, U-*85* once again sortied from St. Nazaire, this time for what would be its final patrol. On this patrol U-*85* would again enter American waters, this time specifically off the coast of the United States. ObltzS. Greger and his crew had a reasonably uneventful crossing. However, this was the first group of boats dispatched to operate in the United States with the assistance of a U-tanker. This was an enormous advantage for operating in such remote waters, especially for the Type VIIs, which were not intended to have such a range. Though the re-supply operations during this deployment were problematic due to inexperience, it still represented an important development in the nature of the U-boat war against the United States. (USONI 1942a:8; Blair 1996:729; Wynn 1997:64).

Off the New Jersey coast, U-*85*'s crew found their first target on 10 April. It was 4,904-ton Swedish freighter *Christina Knudsen* outbound from New York to Cape Town. ObltzS. Greger sunk the ship with two torpedoes and then proceeded directly for his station off Cape Hatteras (USONI 1942a:8; Wynn 1997:64). On 13 April 1942, U-*85* was sitting in shallow water off of Bodie Island lighthouse waiting for targets. Earlier that day the four-stack destroyer USS *Roper* set out from Norfolk on its way to Cape Hatteras for antisubmarine patrol. Just after midnight, USS *Roper* was approaching the Wimble Shoals area when they detected a weak radar contact (Figure 9-5). The crew of USS *Roper* did not suspect much at first, but dutifully pursued the contact (USONI 1942a:8; Wynn 1997:64).

Figure 9-5 The four stack destroyer USS *Roper* at sea.
Source: NARA

ObltzS. Greger, being in very shallow water, evidently decided that they would try to escape on the surface. The U-boat's speed was far greater on the surface versus traveling submerged, and moving faster would increase the chances of getting to deep water. However, USS *Roper* was swiftly closing. It was now suspected on board the destroyer that they may, in fact, be pursuing a submarine. These suspicions were confirmed when one of the crew witnessed the track of a torpedo narrowly miss, running close down, the port side. ObltzS. Greger had fired one torpedo from his stern tube in an attempt to shake his pursuer, but to no avail (Figure 9-6).

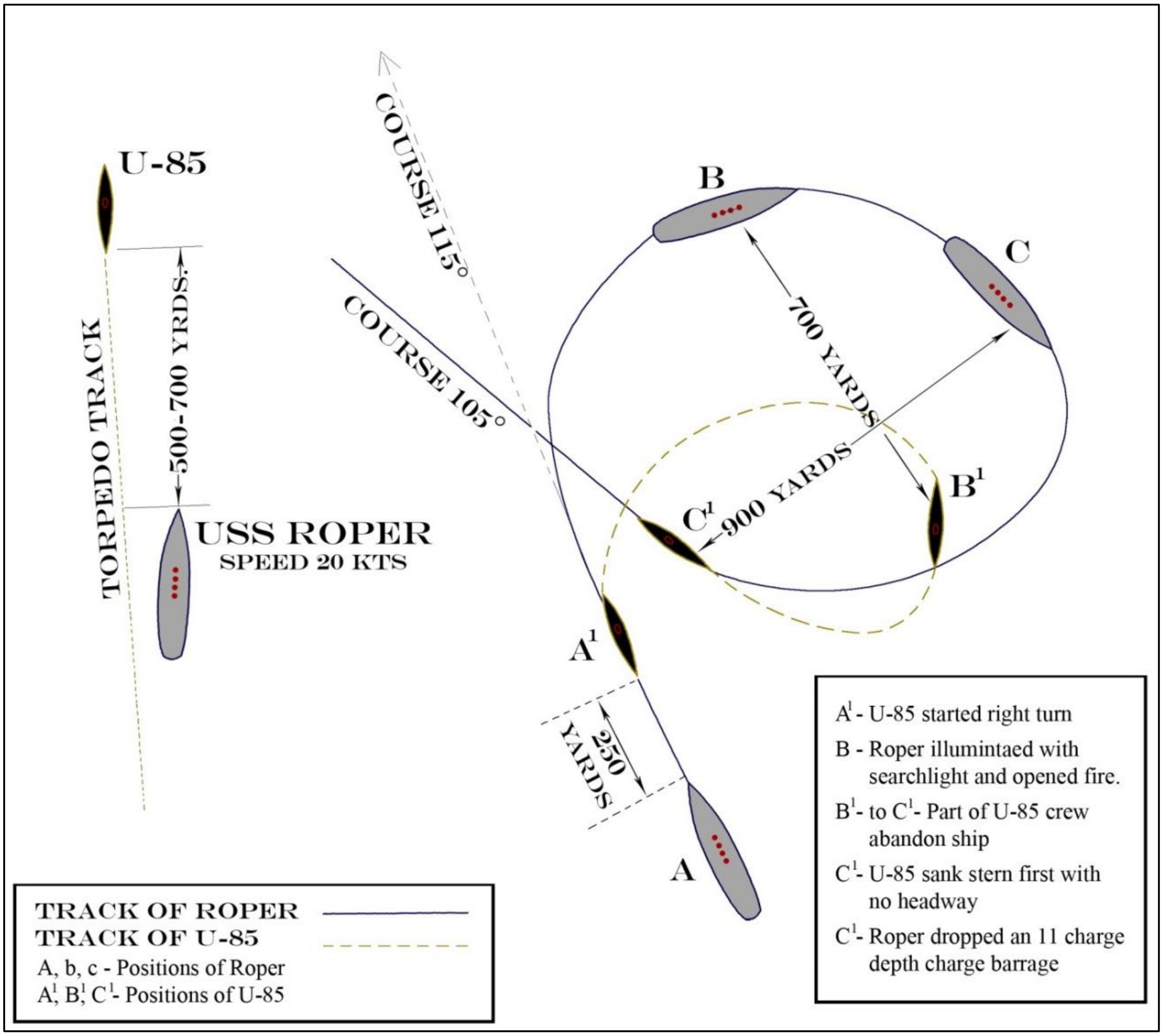


Figure 9-6 Details of the engagement between U-*85* and USS *Roper* based on USS *Roper*'s action report.
Source: USONI 1942a

As the gap between the vessels narrowed, it became clear that this encounter would play out as a surface engagement between the two vessels. The crew of USS *Roper* manned their machine guns and 3-in deck guns (Figure 9-7). As German sailors attempted to exit the conning tower to man their guns, they came under heavy fire from USS *Roper*. The destroyer not only had the advantage of more surface artillery, but was able to man their guns sooner. This prevented the crew of U-*85* from getting to their guns at all. A decisive blow was dealt by USS *Roper* when a well aimed 3-inch shell breached the U-boat's pressure hull just aft of the conning tower (USONI 1942a:8; Wynn 1997:64).

At some point, ObltzS. Greger made the decision to scuttle and abandon U-*85*. The crew of USS *Roper* observed the U-boat sinking at the stern and watched as the crew jumped into the water, begging for rescue. During this time, USS *Roper*'s sonar operator developed what was believed to be an additional contact (which was likely just U-*85*). Concerned that U-boats might be operating in packs as they did in other regions, USS *Roper* did not want to take the chance of being sunk by an additional U-boat. As a result, rather than rescuing the crew of U-*85*, USS *Roper* rode right through the mass of sailors in the water and dropped an additional 11 depth charges to ensure that it was sunk. The deployment of the depth charges killed the entire remaining crew of U-*85*. USS *Roper* then retreated for fear of another boat in the area. USS *Roper* returned after daylight and recovered the bodies of 29 sailors and later interred them in Hampton Roads, Virginia (USONI 1942a:8; Wynn 1997:64).

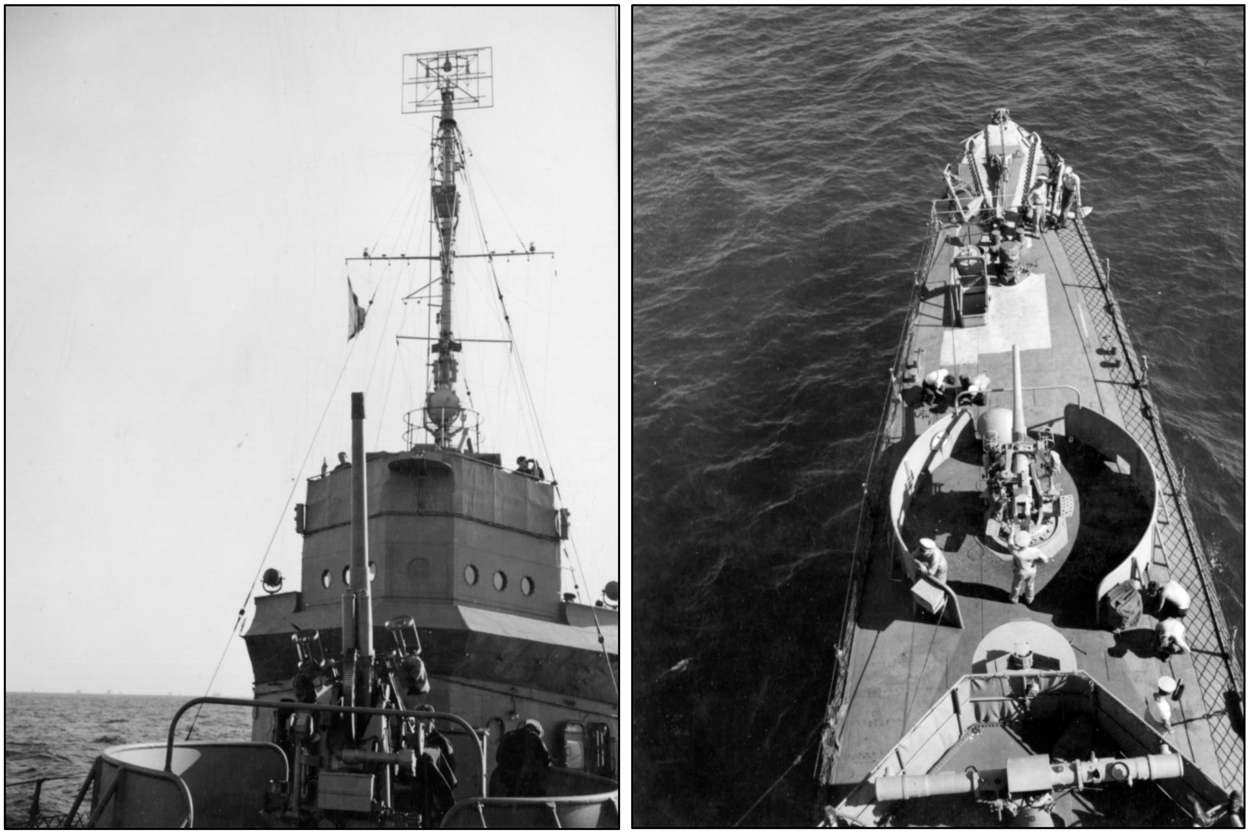


Figure 9-7 The 3-inch deck gun on board USS *Roper* that sunk U-*85*.
Source: NARA

9.1.2 Archaeological Site Description

Since U-*85* was lost in such shallow water, there were high hopes within the US Navy for salvaging the vessel and acquiring valuable intelligence. Navy hard-hat divers were on site almost immediately. What they were hoping to recover was a four-rotor Enigma machine. Germans had recently added a fourth rotor to this encrypting device, which prevented Allied forces from reading their naval code. Had they been more vigilant in locating this device at that time it could have significantly changed the Battle of the Atlantic. The divers did not locate the Enigma. They did, however, recover several items from the vessel. The 20-mm bridge gun was recovered. The 88-mm deck gun was dismantled, the IZO torpedo aimer, the gyro-compass, and an unexploded depth charge were likewise recovered (USONI 1942a:9; Blair 1996:543).

After this, U-*85* was left alone for nearly 20 years. In the late 1960s an avid sport fisherman, Ray Wingate, located the wreck site. Rod Wagner was deployed by Wingate to confirm the find, which was done by the recovery of a brass flare gun with U-*85* inscribed on the barrel. Wingate and Wagner had exclusive access to the site until 1975, when salvage diver Art LePage learned of its location and began contracting Wingate to run a regular charter service. From this point on the site has been regularly visited by groups of sport divers (Keatts and Farr 1994:81; Bunch 2003:52).

Over the years, the site has been nearly completely stripped of artifacts by looters. Previously, 88-mm deck shells littered the site and now not a single one can be found. All of the hatch covers have been removed. The inside of the wreck has been dredged out by sport divers seeking to loot artifacts. The degradation of the site continued steadily from the 1970s until at least 2002. Various individuals kept most of the artifacts recovered. Despite this desecration, the U-*85* remains an important historical resource for understanding the Battle of the Atlantic, as well as a key economic draw for the diving community of North Carolina (Keatts and Farr 1994:81; Bunch 2003:52).

The site now rests in approximately 100-110 ft of water about 14 miles east of Oregon Inlet. The currents shift and the site can be nearly calm or have a substantial current. Depending on currents the visibility and the water temperature vary greatly. In the summer months it can be expected to be around 75 degrees F on the surface and in the mid 60s on the bottom. Visibility can range from 10 to over100 ft.

According to reports, the U-boat laid on its starboard side with an approximately 54 degree list. At the bow the outer hull was gone exposing the pressure hull and the four forward torpedo tubes. Some of these tubes still had visible torpedoes inside. It was also possible that the remains of a torpedo stored externally at the stern may be visible. Documentation of ordnance was a high priority. Aft of the conning tower there was visible battle damage from USS *Roper*'s 3-in deck gun, which had been expanded by sport divers as a point of egress to the interior of the pressure hull (Farb 1985:45; Keatts and Farr 1994:81; Bunch 2003:52).

Documentation of degradation of the U-*85* archaeological site was a high priority for the study. Data collected during this expedition can be used to compare to earlier representations of the site. It was important to note what was natural degradation due to formation processes, and what was caused by interference with the site by looters, allowing for an assessment of impact that will allow for educated recommendations for future mitigation.

Imagery and local divers' records of the site clearly show the decline of integrity over the years, particularly as compared to the data collected by NOAA between 2008 and 2015, and especially when cross-compared to the other U-boat vessels located in North Carolina waters. Tracking the cause and rate of these changes, however, is difficult. Consequently, subsequent investigations focused on how best to collect detailed rapid assessments that can be used to look at impacts to the site over time, specifically via high-resolution remote sensing and photography-based techniques.

Photomosaics and photogrammetry are one technique well-suited to this purpose. They can create an overall representation of the site in a single dive and are reasonably repeatable given similar site conditions, mainly light and visibility. Collecting imagery along U-*85* over the course of this survey resulted in multiple representations of the site spanning 8 years (Figure 9-16 through Figure 9-19).

In addition to photographically produced data, high-resolution multibeam data have been collected from the site. These data also include the surrounding seabed, often clearly depicting scour patterns and deposition of sediment. While it is assumed from anecdotal evidence from divers over the years that the level of sediment distribution does not vary as dramatically here as other highly dynamic areas, such as U-*701*, understanding how the site interacts with the surrounding environment is still important to understand the long-term impacts of that environment (Figure 9-8 through Figure 9-15).

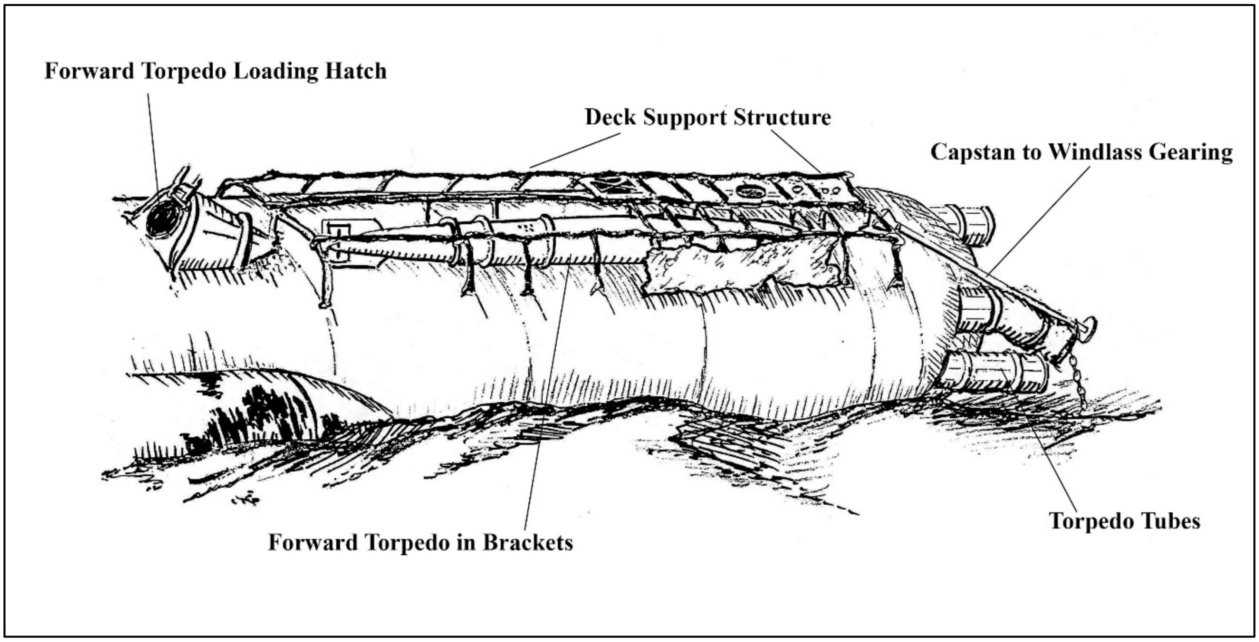


Figure 9-8 Artist's rendering of the U-*85* bow circa 1990s.
Source: Jim Bunch

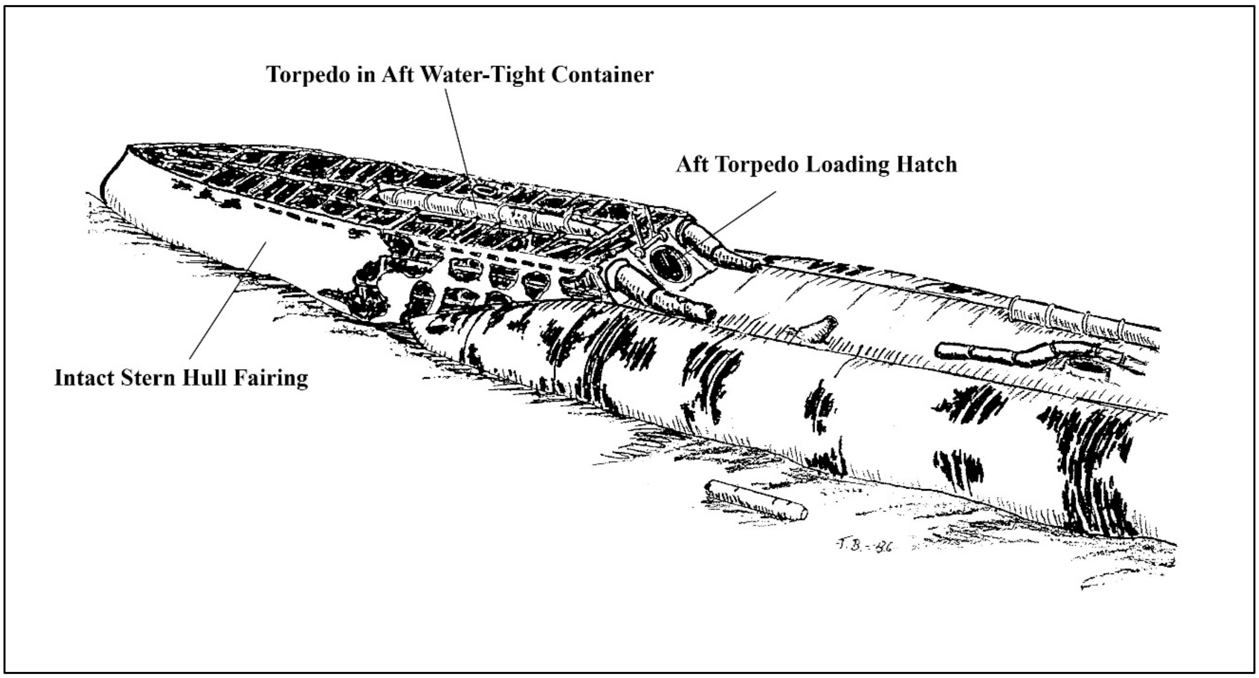


Figure 9-9 Artist's rendering of the U-*85* stern circa 1990s.
Source: Jim Bunch

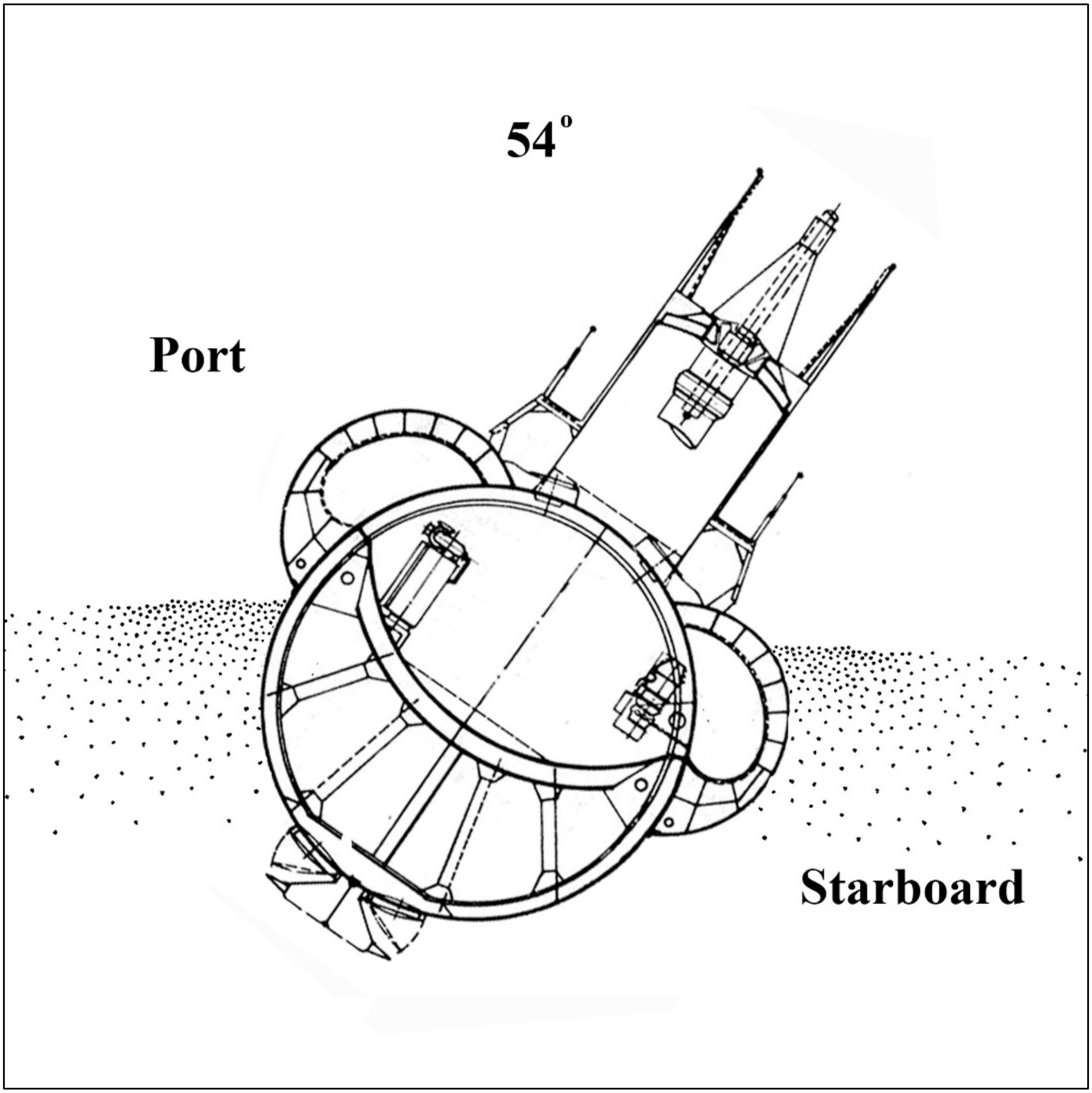


Figure 9-10 U-*85* angle of orientation in sediment.
Source: NOAA

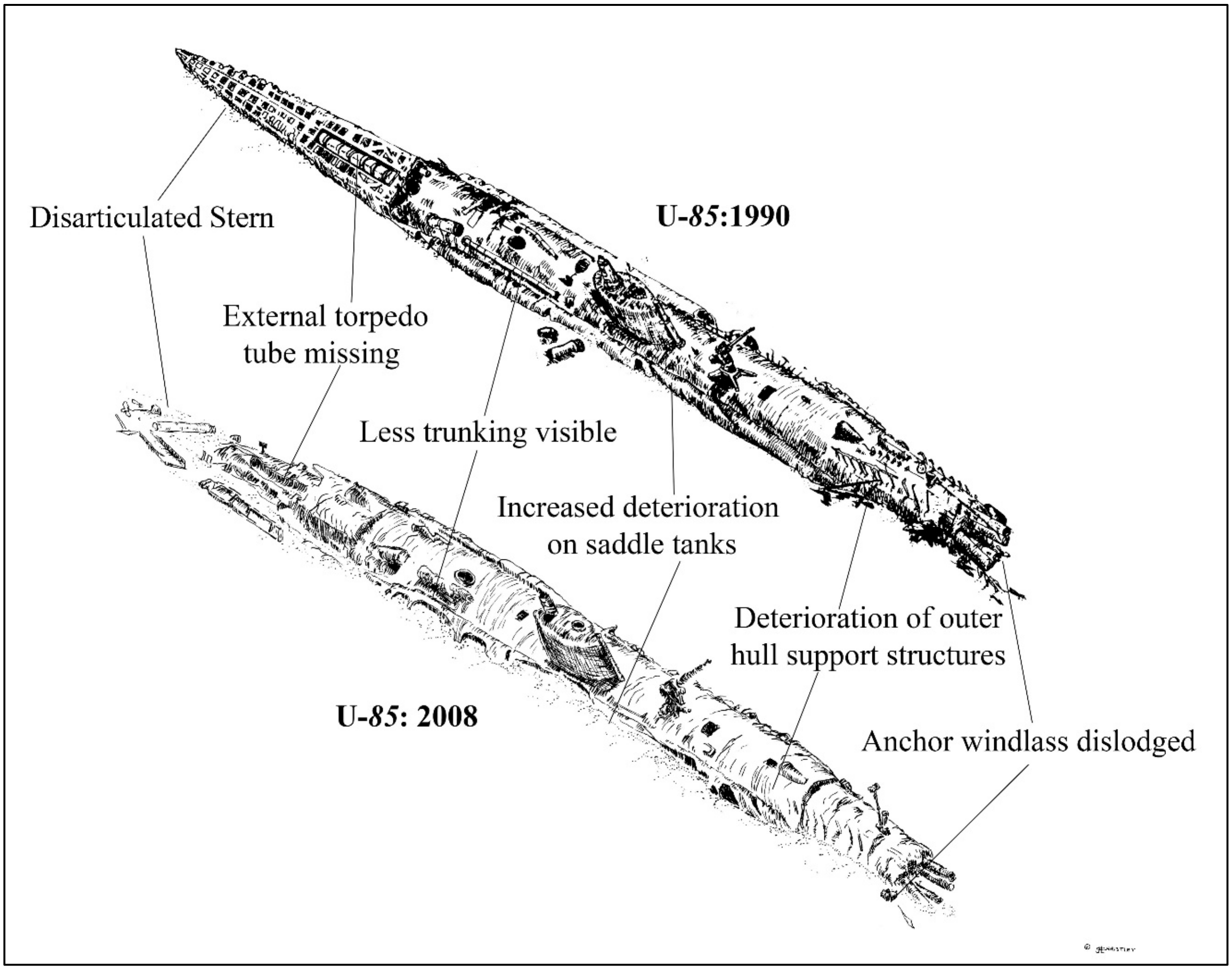


Figure 9-11 Artist's interpretation of U-*85* from video and still imagery in 1990 (top) and 2008 (bottom), of the site over an 18-year period.
Source: James Christley

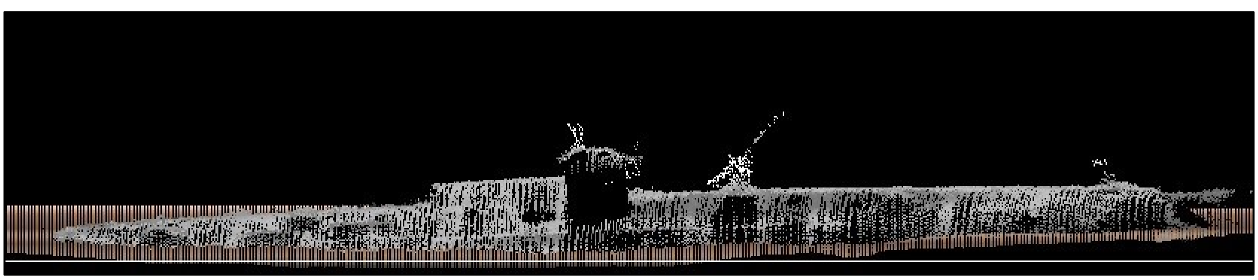


Figure 9-12 Starboard profile view multibeam SONAR visualization of the U-*85* wreck site scaled in 10-m grid.
Source: ADUS

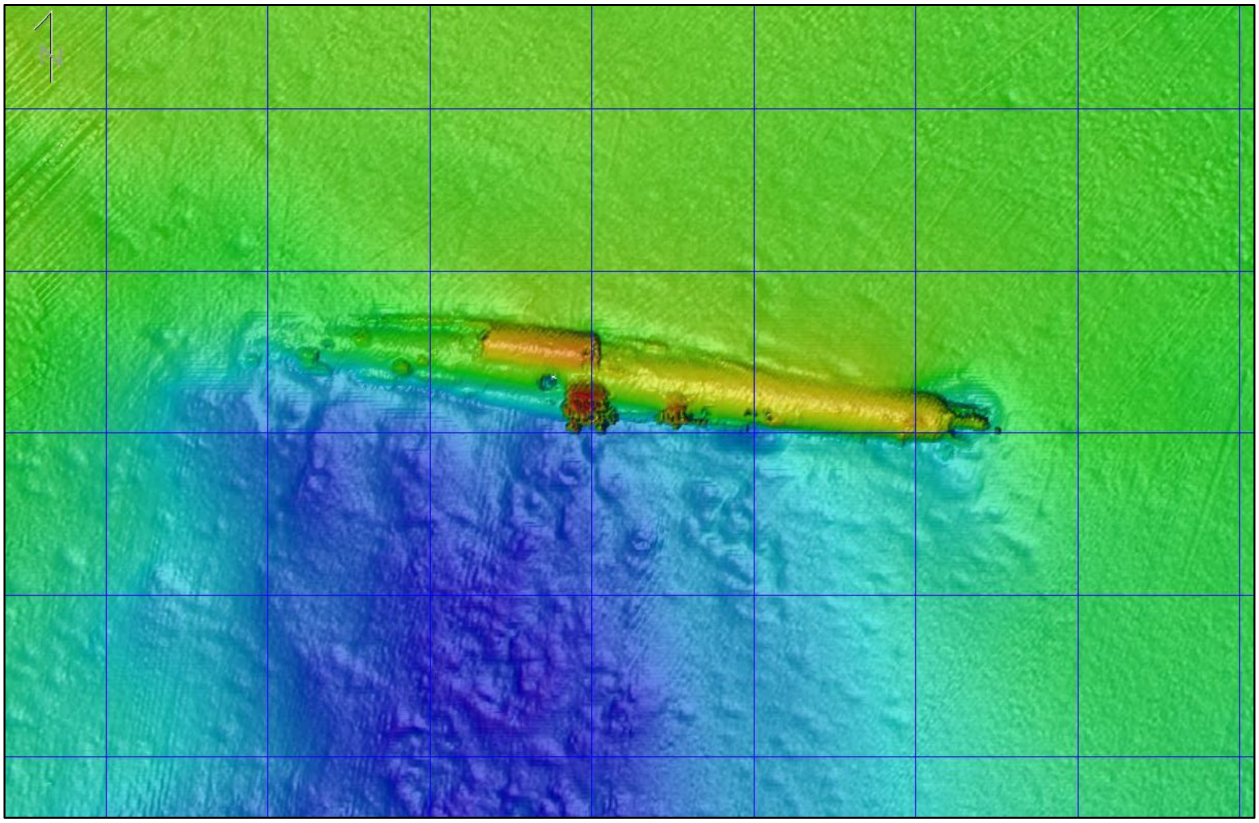


Figure 9-13 Reson 8125 scaled multibeam survey of U-*85* wreck site.
Source: ADUS

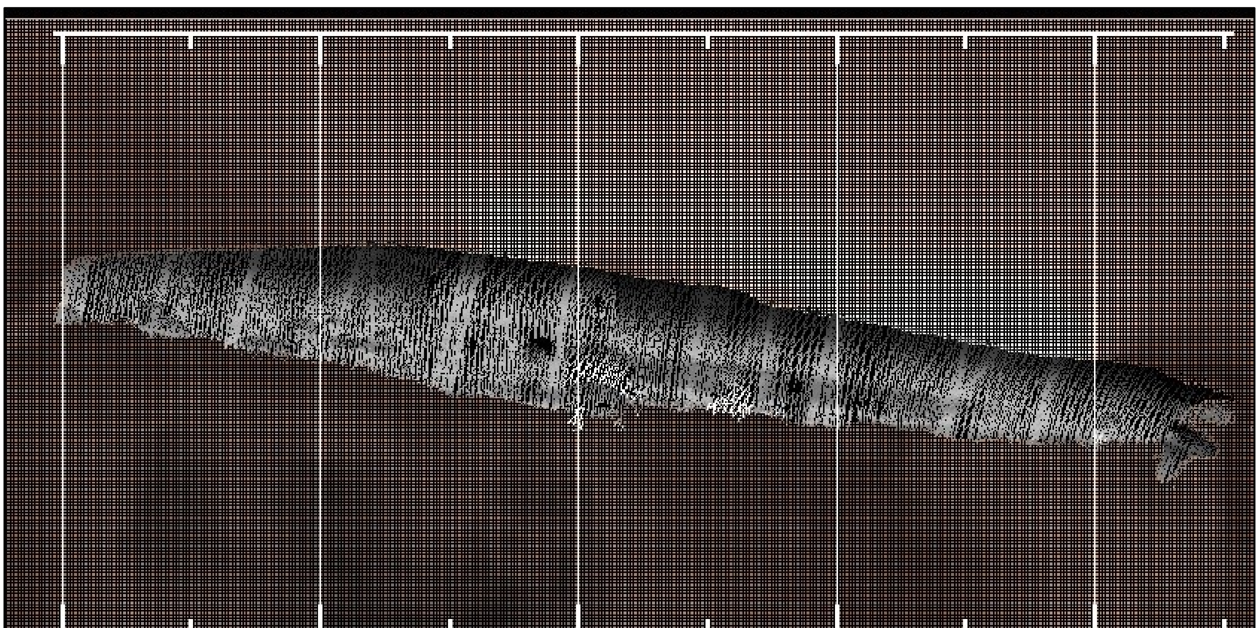


Figure 9-14 Plan view multibeam SONAR visualization of the U-*85* wreck site scaled in 10-m grid.
Source: ADUS

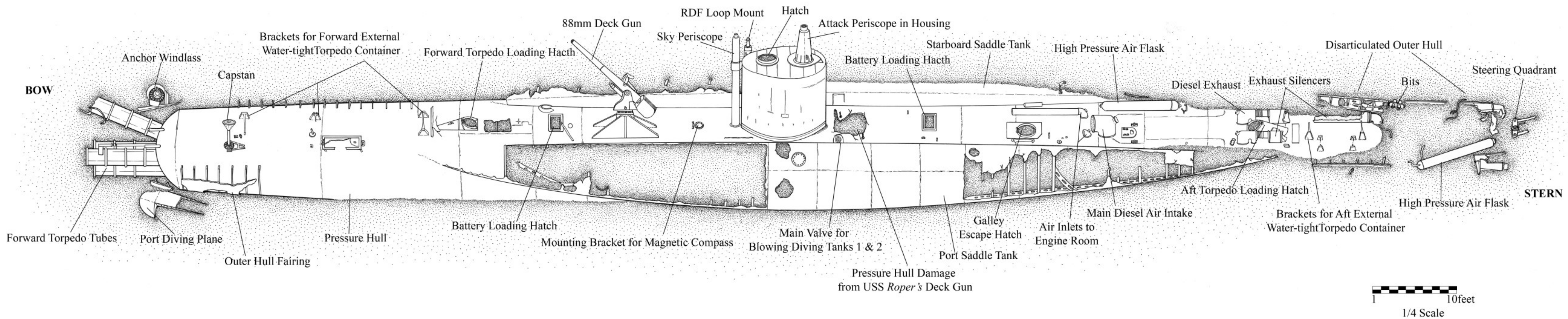


Figure 9-15 Completed archaeological site plan of U-*85*.
Source: NOAA

Figure 9-16 Photgrammetric model of U-*85* in circa 2015.
Source: John McCord, UNC-CSI

Figure 9-17 Photomosaic of U-*85* in 2008.
Source: NOAA

Figure 9-18 Photomosaic of U-*85* in 2009.
Source: NPS Submerged Resources Center

Figure 9-19 Photogrammetric model of U-*85* in 2015.
Source: John McCord, UNC-CSI

9.1.3 Description of Impact at the Site of the U-*85*

- Very little outer hull fairing remains. This is believed to be a result of both natural process, but also in large part to improper anchoring of vessels into the archaeological site and very crude looting attempts for large artifacts.
- The forward torpedo and container are missing.
- The stern torpedo is missing, which is believed to have occurred in 2007.
- All hatch covers have been removed; both the fore and aft torpedo loading hatches, the fore and aft battery hatches, the galley escape hatch and the main conning tower hatch are all open and the covers have been removed.
- All ready ammunition containers have been removed.
- A number of 88-mm shells which were known to be present on site have all been removed by looters.
- The 88-mm deck gun has been nearly completely stripped of components, including the harnesses, gunsights, and control wheels.
- The 20-mm anti-aircraft gun was recovered contemporaneously by the Navy.
- RDF Loop removed.
- Sky Periscope removed.
- Miscellaneous small scale hardware removed throughout.
- Stern section has been disarticulated on a massive scale; this is purportedly the result of recent illegal salvage attempts; however, this also could be the result of improper anchoring or trawling.
- Entire magnetic compass assembly removed.
- Hull damage aft of conning tower has purportedly been enlarged intentionally to gain access to the interior.
- A number of artifacts and features from the interior of the site are known to have been removed.
- It is known that private salvage divers used various mechanical devices to loot internal content by illegal dredging in order to gain access further inside. During this crime, a large degree of damage occurred.
- The Enigma encoding machine was looted by divers. The divers were subsequently directed to hand over the material to the State of North Carolina.
- Many personal effects and equipment of the crew have been recovered.
- No human remains have been reported, however it is possible that remains of crew are still on board.

9.1.4 Features Believed to be Threatened at the Site

- Very few outer hull features remain, but there are still features that could be threatened.
- The anchor windlass is intact, but it shows evidence of recent salvage/looting attempts. The windlass is dislodged from its mount and lying disarticulated on the seafloor. There are natural fiber rope ties around the feature. This is evidence of an extraction method whereby looters attach ropes to the object and then tie it to the boat above, using the throttle of the surface vessel to dislodge the piece.
- The interior of the vessel has been heavily impacted; however there may still be a great deal of threatened cultural material inside.

Despite the natural and anthropogenic impacts to U-*85*, the property still retains enough integrity to meet the NRHP Criteria A and D and be of national significance. Ample archaeological information can still be obtained from the shipwreck and research questions can be answered about its construction, weaponry, sinking, and crew. U-*85* is a rare example of a Type VII-B German U-boat and its location off North Carolina makes it the only one of its kind off the United States available for study. U-*85* was listed on the

NRHP on 12 November 2015 (reference number 15000805) due to its association with WWII activities off the United States East Coast and Gulf of Mexico (Marx and Hoyt 2015b).

9.2 U-*352*

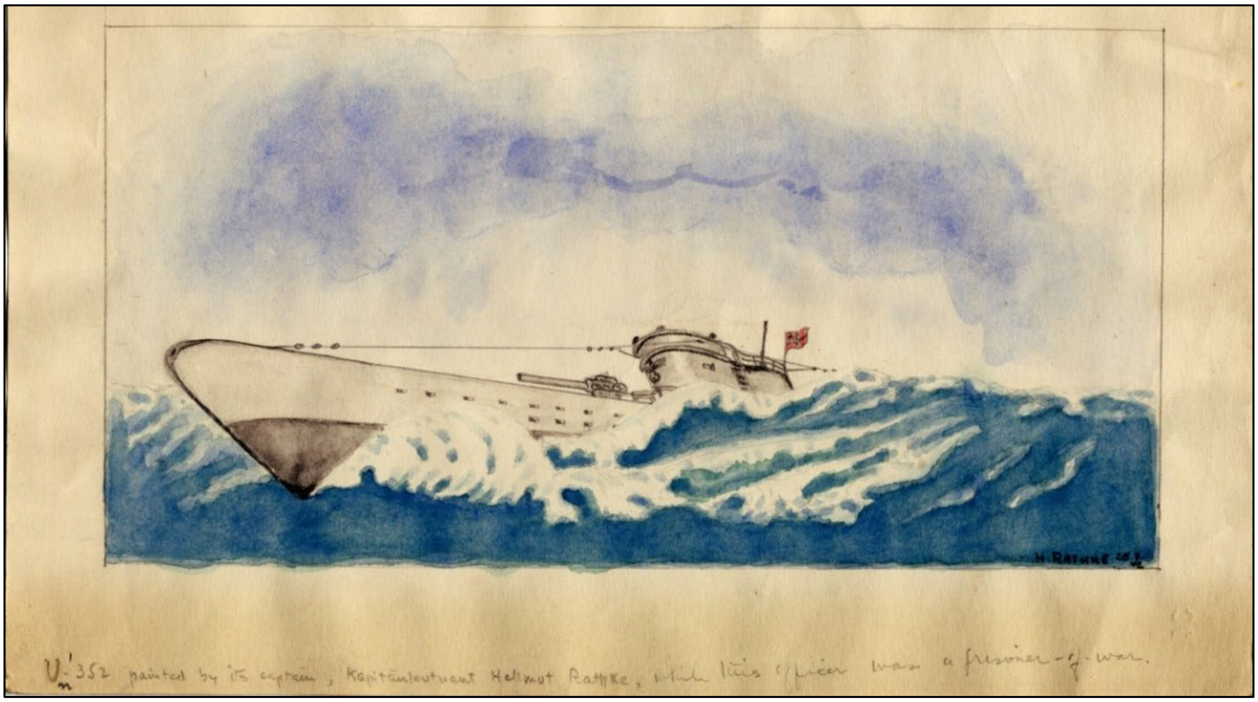


Figure 9-20 A watercolor of the U-*352* at sea, painted by its Captain, Hellmut Rathke.
Source: NARA

Table 9-2 Characteristics of U-*352*

Characteristics	U-*352*
Year of Build/Type/Hull #	1940/Military Type VIIC U-boat/471
Date Lost	9 May 1942
Position & Depth	22 Miles ESE Beaufort Inlet Depth: 115 ft
Ship Characteristics	Displacement 761/865 tons (surfaced/submerged) Length: 67.1 m (220'); Beam: 6.2 m (20'); Draft: 4.8 m (15.7') ; Engines: 2,800 bhp/750 hp (2-shaft diesel/electric); Armament: 14 Torpedoes, 88-mm deck gun, 20-mm anti-aircraft;
Cargo	n/a
Survivors	15 lost / 33 Survivors
Owner	German Navy
Construction Details	Steel (Stl) hull, , Diesel/Electirc Motor
Builder	Flensburger Schiffsbau-Ges, Flensburg, Schleswig-Holstein, Germany
Port of Registry/Flag	Germany
Sunk by	USCGC *Icarus*
Data Collected	Still and video photography collection; low-resolution Simrad multibeam survey; photomosaics; site plan, high-resolution Reson multibeam survey; listed on NRHP.

9.2.1 History

Kapitänleutnant Hellmut Rathke was awarded command of the U-*352* almost immediately upon the completion of U-boat training school (Table 9-2 and Figure 9-20, above). He began Baubelehrung in July and took full command on 28 August 1941 (USONI 1942b:5; Busch and Röll 1999:207). By January 1942, Kptlt. Rathke and his crew had completed their requisite training in the Baltic and were ready to begin active patrol duty. On 15 January 1942, U-*352* transferred from Kiel to Bergen, where they sortied on their first patrol five days later.

U-*352* was part of Group *Schlei* and was ordered, along with 12 other U-boats, to converge on an area West of Rockall and begin seeking convoys. This patrol mission was recalled shortly after its deployment due to the initial successes of the American offensive. Döenitz, commander of the U-boat arm, was eager to put heavy pressure on the newly opened theatre, and was receiving favorable reports on shipping along the United States Eastern Seaboard. Group *Schlei* was to return to France and begin preparing for deployment to United States Waters (USONI 1942b:5; Wynn 1997:232).

However, U-*352* would not be reaching United States waters with the rest of Group *Schlei*. Eight of the 12 boats were again redirected to Iceland, the Faroes, and Scotland. This northern patrol duty was, in part, carried out by Kptlt. Rathke in U-*352*. They spent several weeks at sea, which were largely uneventful. Kptlt. Rathke attempted to carry out at least one attack, but was thwarted by the depth charges of nearby escort corvettes. No serious damage, however, was sustained on the first patrol of U-*352*, but no shipping were sunk either and the vessel retuned to St. Nazaire on 26 February empty handed (USONI 1942b:5; Wynn 1997:232).

In St. Nazaire, U-*352* underwent minor repairs and was ready for a second war cruise. This time Kptlt. Rathke was heading for the United States East Coast. U-*352* set out from St. Nazaire on 7 April 1942. As this was early in the U-boat offensive against the United States, some operational procedures were changing. Wolf pack tactics were proving impractical for the scale of the area covered, and fuel limitations, especially for Type VIIs, truncated operational range. As such, U-tankers were coming into use. On the crossing to the United States, Kptlt. Rathke was scheduled to resupply with U-tanker U-*459*, one of the first such boats for that purpose. The transfer of fuel to the U-*352* took place approximately 500 miles northeast of Bermuda. After Kptlt. Rathke was fully re-provisioned, he set a course for his operational area off the coast of North Carolina (USONI 1942b:5; Hickam, Jr. 1989:182; Blair 1996:575; Wynn 1997:232).

Beginning on 5 May 1942, far to sea off Hatteras, U-*352* began a game of cat-and-mouse with the Swedish merchant vessel *Freden*. Kptlt. Rathke moved into position twice, each time firing a torpedo from the bow. Each torpedo missed. Despite having missed, the crew onboard *Freden* witnessed the torpedoes pass, believed they would be hit, and decided to abandon ship. In order to launch the lifeboats, *Freden's* engines were stopped, at which point U-*352* passed them without notice and lost contact. Meanwhile, since *Freden* was not attacked or sinking, and upon gaining some more confidence, the ship's commander ordered everyone back aboard to resume passage (Wynn 1997:232).

The following day, Kptlt. Rathke came across *Freden* again after conducting a search to regain contact. Over the next several hours Kptlt. Rathke got off an additional two torpedoes, both of which also missed. However, once again, the crew on *Freden* panicked and took to the lifeboats. Evidently during the process of launching boats *Freden* turned stern-to the U-*352*, so as to present a smaller target. Kptlt. Rathke mistook this maneuver for the vessel fleeing at full speed and gave up chase. The crew of *Freden* drifted in their lifeboats all night. On the morning of 7 May, they happened to drift by their completely untouched vessel and reboarded for a second time and continued their journey. This event has been described as an "amazing story of ineptitude on both sides" (Wynn 1997:23).

On 9 May, U-*352* instigated the engagement that would end in its demise. Kptlt. Rathke spotted the 165-ft USCGC *Icarus* on antisubmarine patrol off Cape Lookout. U-*352* closed for an attack. In a scenario similar to the onset of USS *Roper*’s engagement with U-*85*, USCGC *Icarus* got a sonar contact shortly before observing a failed torpedo attack. Kptlt. Rathke had fired at the Cutter, but the torpedo malfunctioned and detonated a safe distance from its intended target (Figure 9-21; USONI 1942b:7; Hoyt 1978:123; Hickam, Jr. 1989:188; Blair 1996:575; Wynn 1997:232).

Lieutenant Commander Maurice Jester onboard USCGC *Icarus* reacted immediately. He sent out five depth charges from the Y-gun, which damaged U-*352* so badly they decided to play dead and lay still on the bottom, hoping to go unnoticed. USCGC *Icarus* began dropping depth charges systematically and eventually forced the U-boat back to the surface. As the crew of U-*352* prepared to scuttle, several began emerging from the conning tower preparing to jump overboard. Fearing that they may attempt to man their deck guns, crew onboard USCGC *Icarus* responded with heavy machine gun fire, which resulted in the deaths of several of the U-boat’s crew (USONI 1942b:7; Hoyt 1978:123; Hickam, Jr. 1989:188; Blair 1996:575; Wynn 1997:232).

U-*352* sank while the majority of the crew was able to escape. USCGC *Icarus* stood off for approximately an hour to await instructions on how to proceed. They then returned to the site and collected 33 survivors, one of which died shortly thereafter. The survivors of U-*352* were the first German submariners captured by American forces in the war (Figure 9-22 and Figure 9-23). They were later interrogated and remained in various prisoner of war camps for the duration of the war, often intermingling with survivors from U-*701* (USONI 1942b:7; Hoyt 1978:123; Hickam, Jr. 1989:188; Blair 1996:575; Wynn 1997:232).

9.2.2 Archaeological Site Description

Strangely, the salvage attempts conducted by Navy divers just days after the event were as fruitless as they were on U-*85*. Navy salvage vessel *Umpqua* located and sent divers to the site but did not recover anything of military importance. Following the departure of the salvage operation, and a subsequent depth charge attack on the site three months later, the U-*352* was essentially undisturbed for decades with the remains of as many as 13 men interred inside.

In 1975, a group of recreational divers from Morehead City relocated the site of the U-*352*. The discovery was made by Claude Hall, George Purifoy, Rodd Gross, and Dale McCullough. Since that time, U-*352* has been consistently visited by divers. The site itself has been met with some controversy over the years. Unexploded ordnance was an issue during the 1980s. Diver safety was a concern insomuch as an inadvertent explosion might harm someone, at which point the US Navy intervened by sending divers to remove external hazards and weld closed access points. This was intended to limit interference with hazardous materials inside the hull and also served to protect the human remains of the German sailors interred within. However, a diver eventually pried these hatches open to access the interior of the U-boat, which has thereafter been accessible to divers wishing to penetrate the hull (Farb 1985:193; Gentile 1992:203; Keatts and Farr 1994:56, 97, 103-105). Looters desecrated the site – a war grave – by removing many portable artifacts and some larger items, such as the 20-mm gun.

Sea life at the site of U-*352* is prolific and typical of a subtropical marine ecosystem. The wreckage itself has transformed into an artificial reef, providing habitat for a variety of organisms in an otherwise barren sandy bottom. The site is heavily encrusted with coralline algae and supports an array of sessile colonial cnidarians. On the site of the U-*352*, the density of *Hemanthias vivanus*, commonly called red barbier baitfish, was such that it often hindered photographic documentation (Figure 9-24 and Figure 9-25). A similar population density of amberjack (*Seriola dumerili*) was also present.

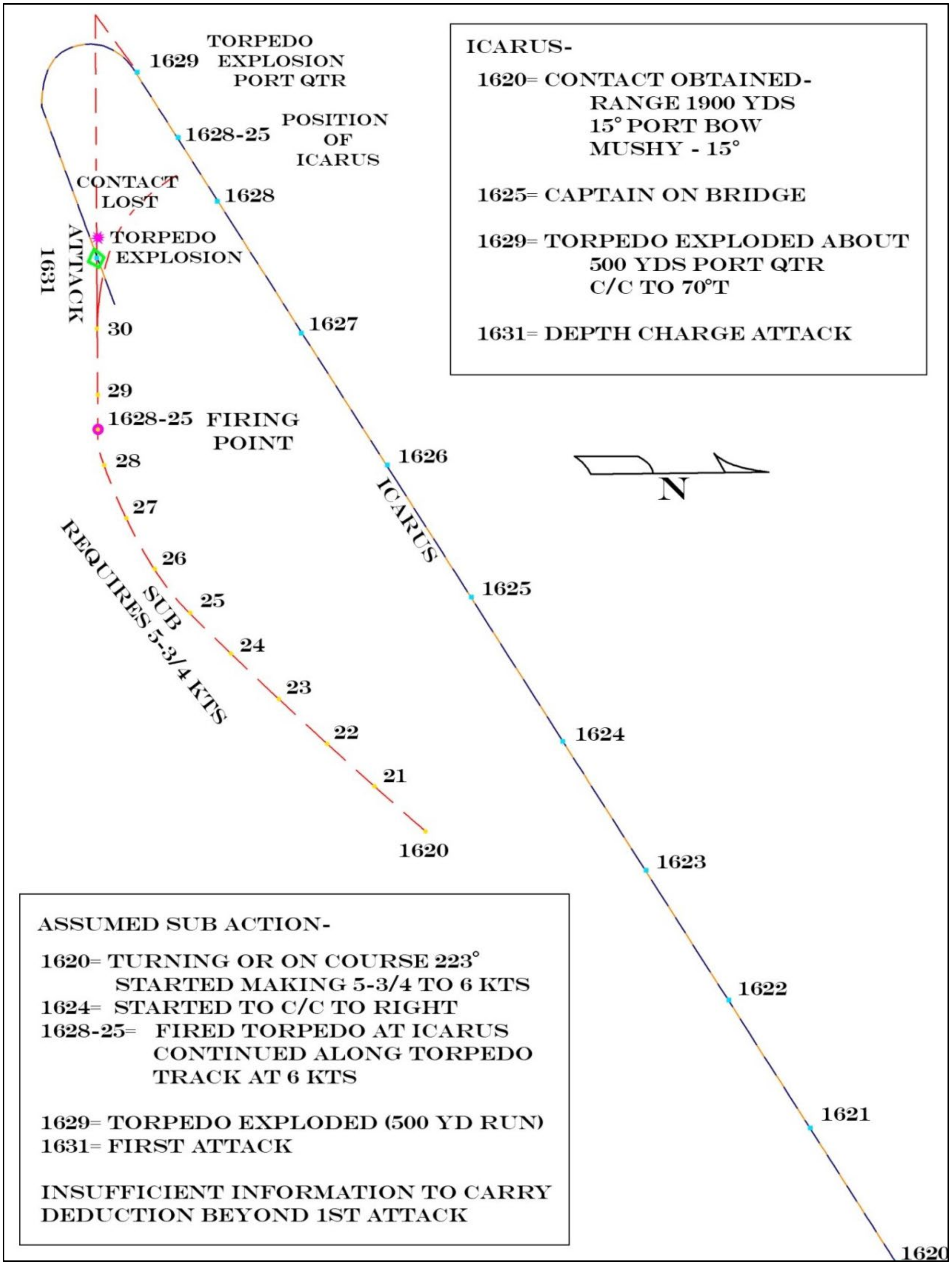


Figure 9-21 Details of the engagement between USCGC *Icarus* and the U-*352*.
Source: USONI 1942b

Figure 9-22 USCGC *Icarus* unloading Prisoners of War from U-*352*.
Source: NARA

The wreck lies in 115 ft of water with the pressure hull intact resting at a 35 degree list on its port side. The outer hull fairing at the bow and stern is largely broken down, as is the deck level and conning tower fairing. Due to the significance of the U-boat sites to this study, a very detailed approach was taken and U-*85*, U-*352* and U-*701* were investigated several times over the course of a 7-year period. As a result, numerous data products were generated for these vessels, particularly U-*352*, owing in part to its accessibility. Given the long-term nature of this survey, a wide range of different technologies were utilized from year to year. Having different types of datasets applied to the same site provided a level of confidence and reasonable expectations as these technologies and survey techniques were applied to other targets in the survey area.

These surveys ranged from low-resolution multibeam surveys (Figure 9-26) to diver based archaeological recording and high-resolution multibeam point cloud models. Each approach offered different levels of quality, time commitment, and accuracy.

In the inaugural year of this study's field operations, 2008, the primary focus was documentation of the U-boat sites off North Carolina. During this field season, U-*352* was documented in detail. Subsequent follow-up from that study allowed for periodic monitoring of this on other U-boat sites. These sites were visited again in 2011, 2012, and 2013 and were the subject of photomosaic surveys and acoustic data collection (Figure 9-27 through Figure 9-36).

Figure 9-23 Prisoners being processed by United States officials. Hellmut Rathke pictured second from left.
Source: NARA

Photomosaics in both plan and profile view were collected and processed creating two detailed depictions of the site. Collection of photographic information on this site had not been possible in previous investigations due to conditions of visibility. These mosaics are used for two technical purposes: first, data collected in subsequent years can provide further comparative data to track changes to the sites over time, and second, having collected data on this particular site using varying technologies and methodologies, this allows for a comparison of the techniques employed from both the perspectives of accuracy and usefulness.

Having a wide range of survey techniques applied to the same site illustrated various levels of detail and accuracy of each approach. The high-resolution multibeam survey was by far the fastest, lowest risk (doesn't require divers to enter the water), and least weather dependent, while also having the benefit of being the most accurate for positioning and scale. The photomosaic yielded a far more visually intuitive product, and required minimal in-water time given adequate environmental conditions. The mosaic also added a level of detail not quite achievable with sonar imagery; however, the development of the product required some interpretation on the part of the modeler and thus is less definable in terms of accuracy and error. The detailed diver based survey took far more time, but provided the best interpretive product. It allowed researchers to interact with features on the bottom and work through details in situ. Far more small detail is achievable and it allows for a greater identification of and emphasis upon selected features. When combined as above, a very detailed an accurate understanding of the site was achieved.

The 6-mm resolution multibeam surveys were further processed by ADUS for enhanced visualization. Assigning color values to particular points and adding occlusion objects within the model allows only certain points to be seen on any given viewing angle to achieve this. The results are easily viewed in scaled 3D through ADUS' WreckSight software.

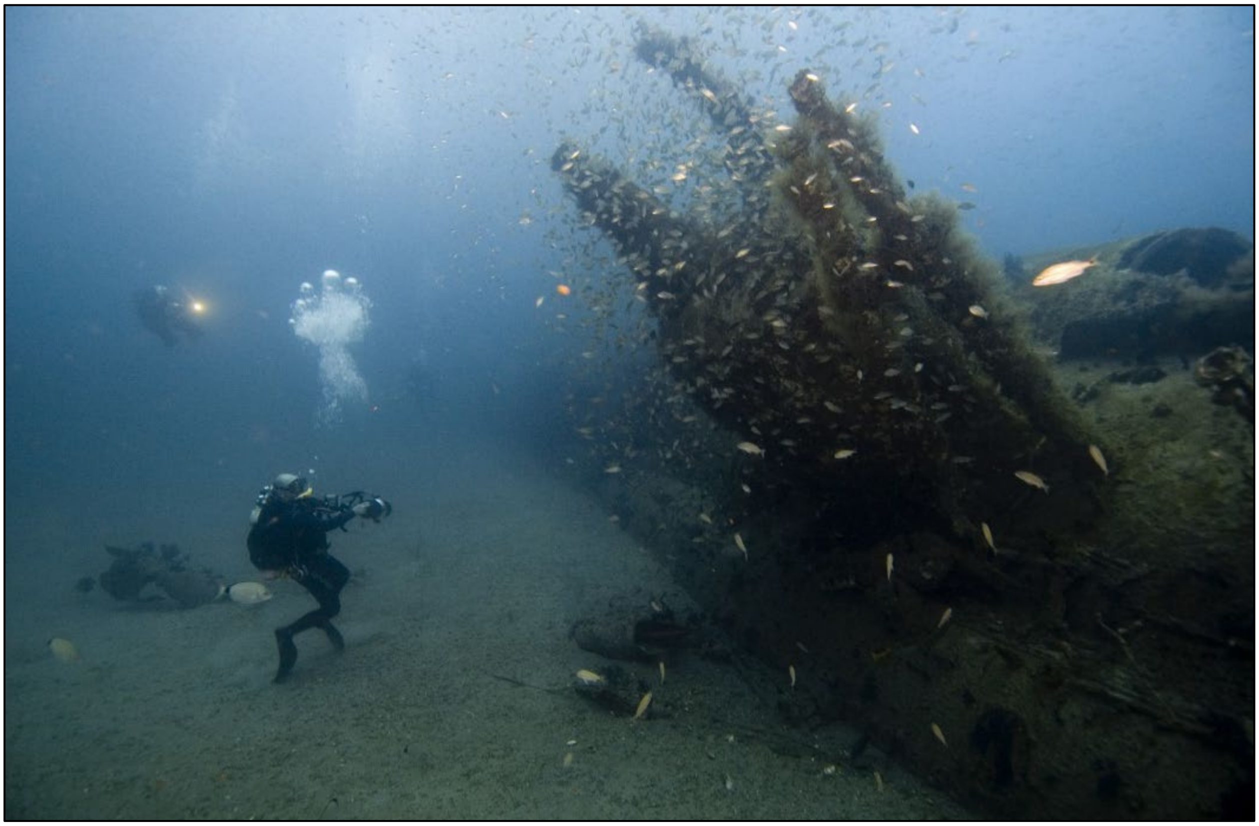


Figure 9-24 Divers conduct preliminary site investigation of the U-*352*, July 2008.
Source: NOAA

Figure 9-25 Image of the port saddle tank on U-*352* obscured by the presence of *Hemanthias vivanus*.
Source: NOAA

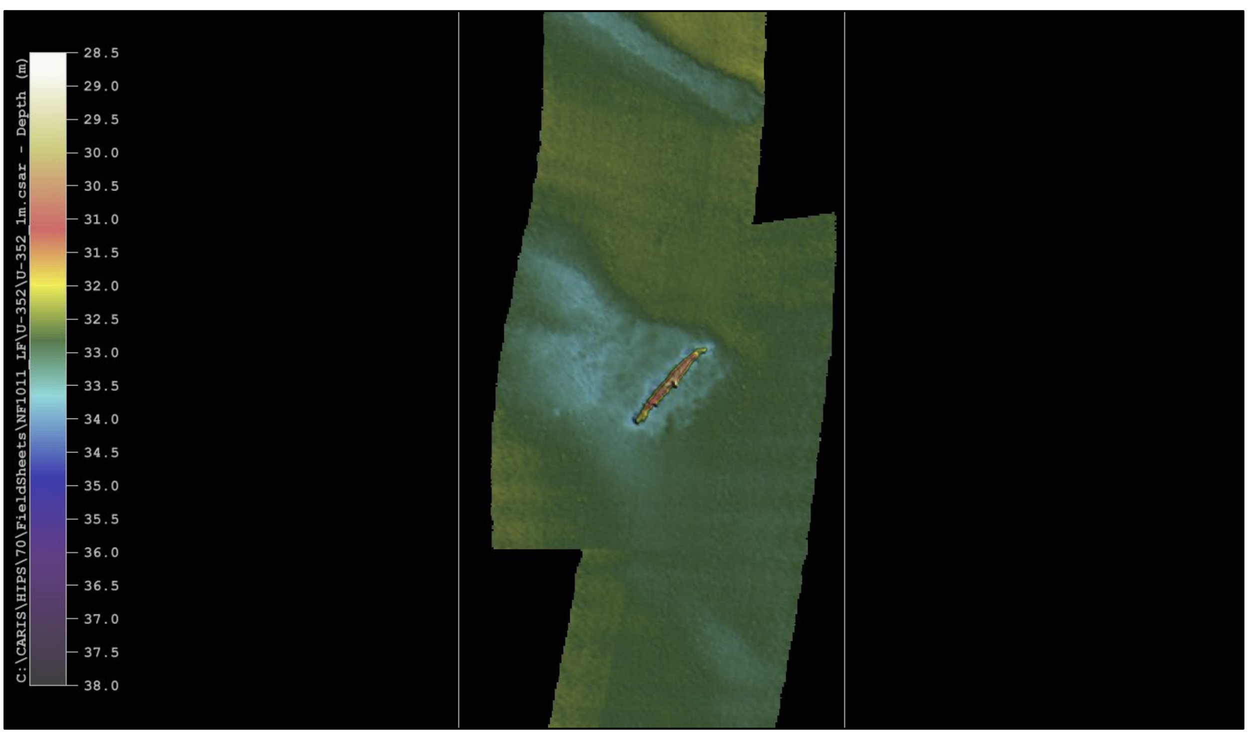


Figure 9-26 Multibeam survey of the wreck of U-*352* in 2010.
Source: NOAA

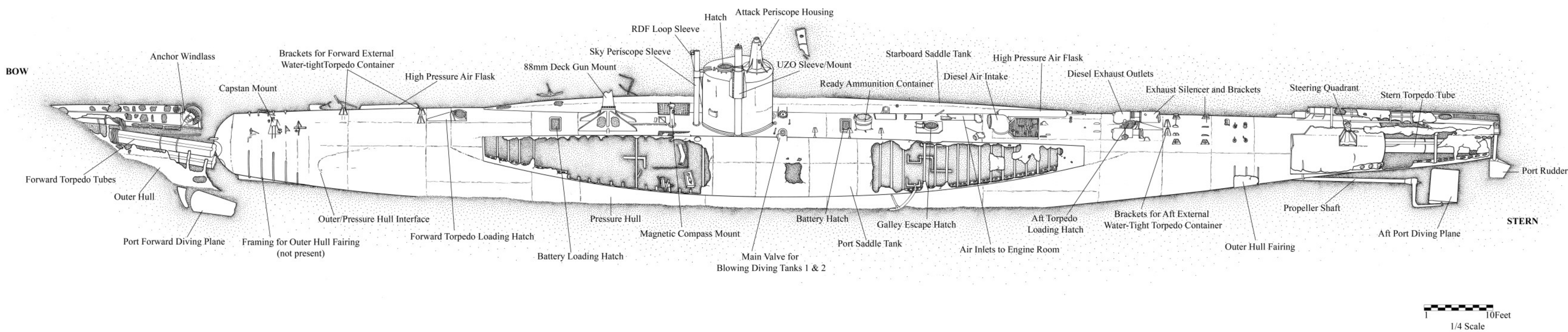


Figure 9-27 Final archaeological site plan of the U-*352* wreck site.
Source: NOAA

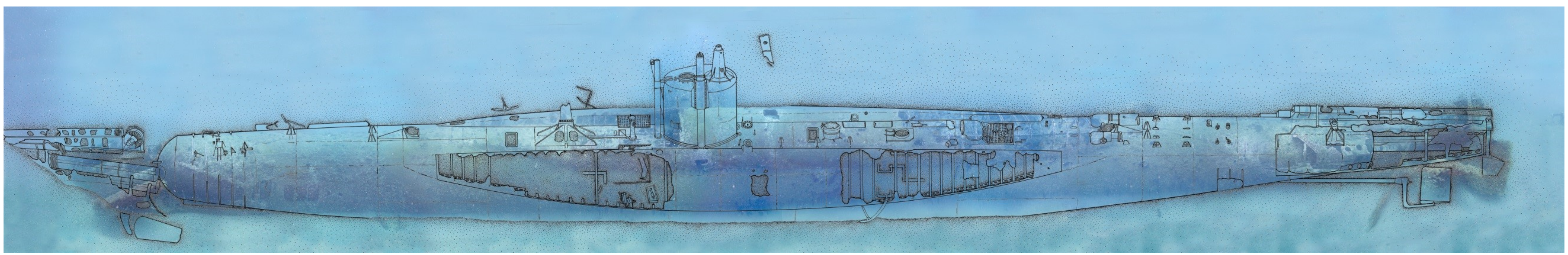


Figure 9-28 Combined 2012 plan view mosaic with 2008 archaeological site plan transposed.
Source: NOAA

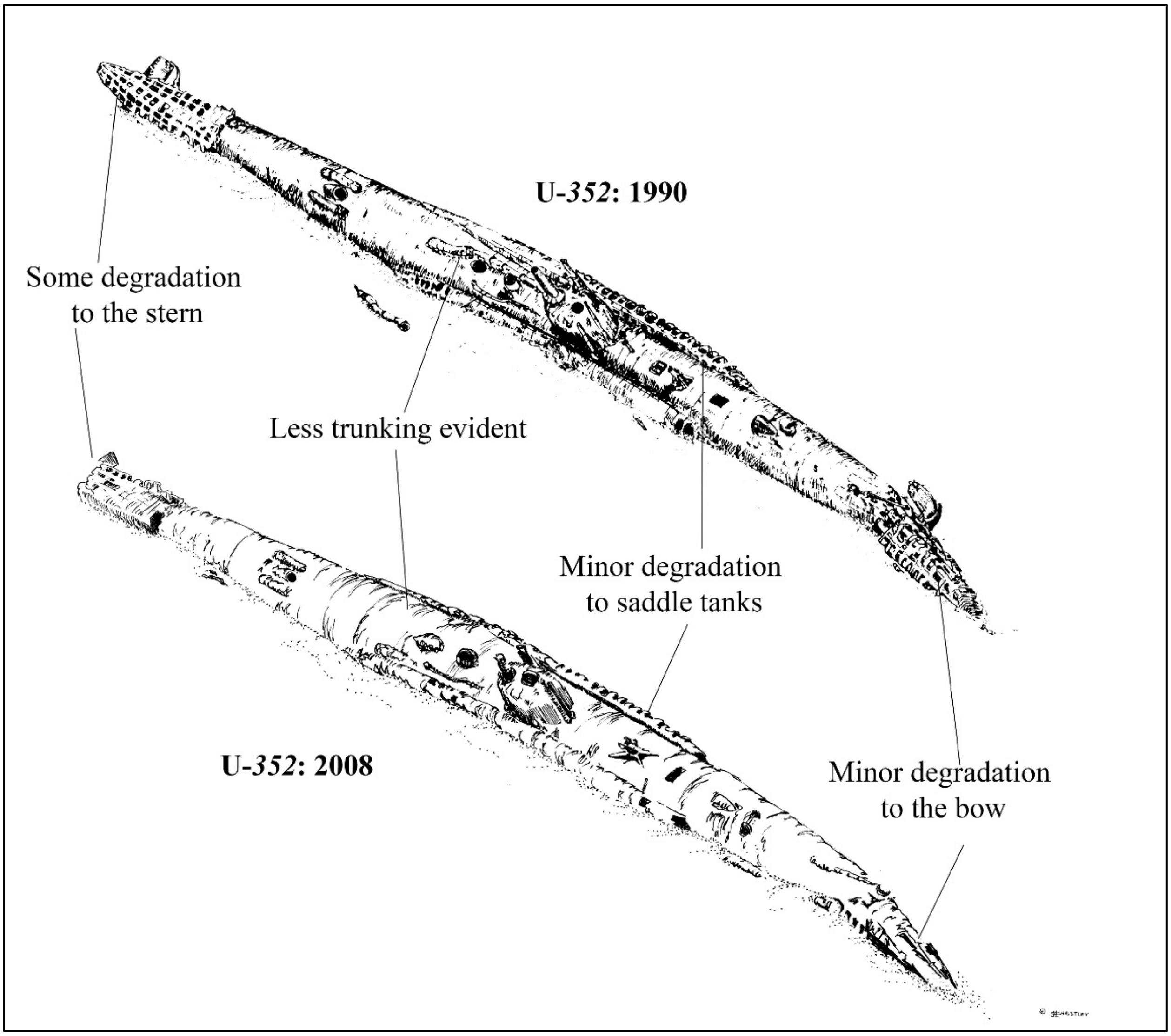


Figure 9-29 Artist's interpretation of U-*352* from video and still imagery in 1990 (top) and 2008 (bottom), of the site over an 18-year period.

Source: James Christley

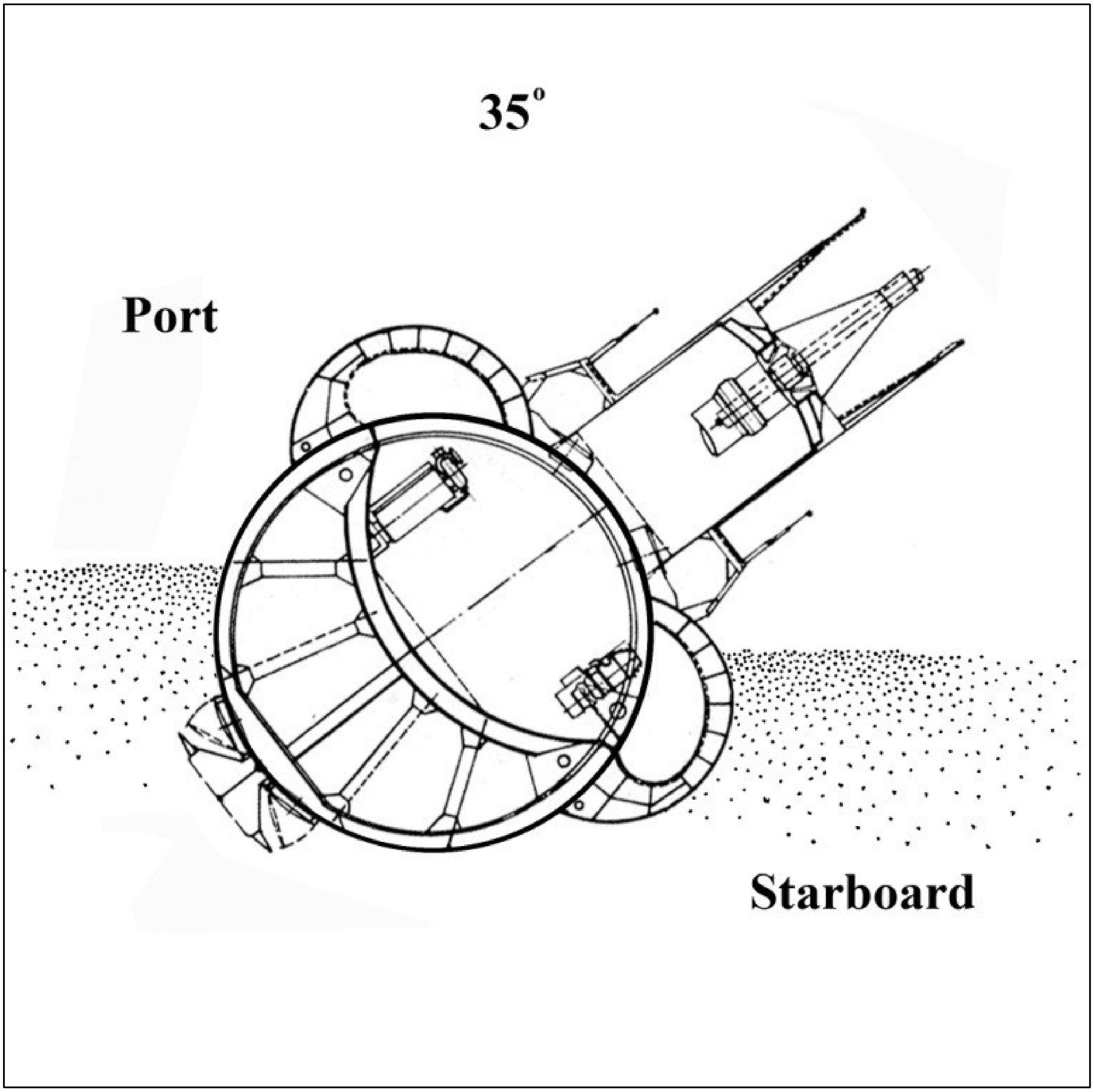


Figure 9-30 U-*352* angle of orientation to the sediment.
Source: NOAA

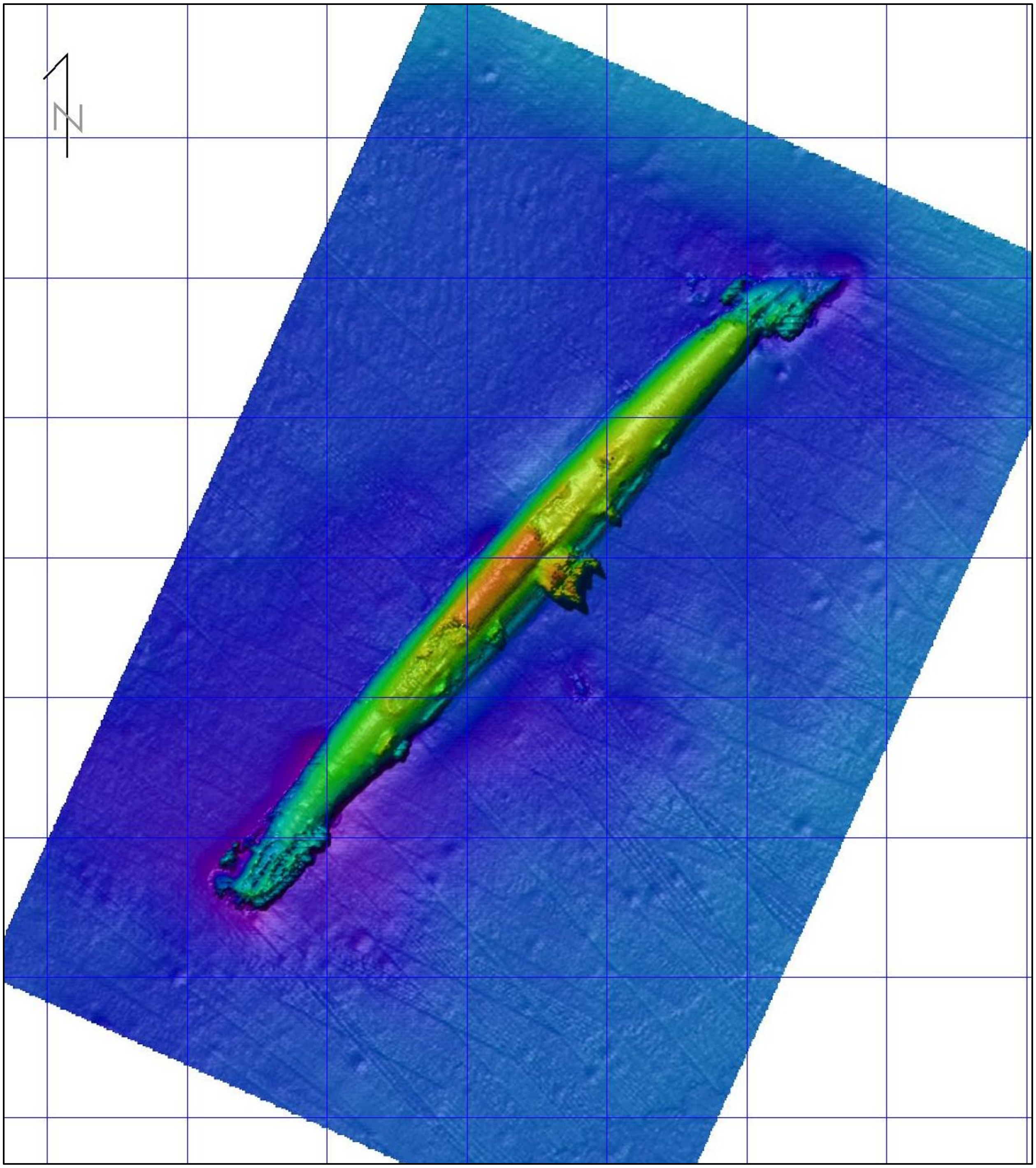


Figure 9-31 Reson 8125 455 kHz 6-mm scaled multibeam survey of U-*352*.
Source: ADUS

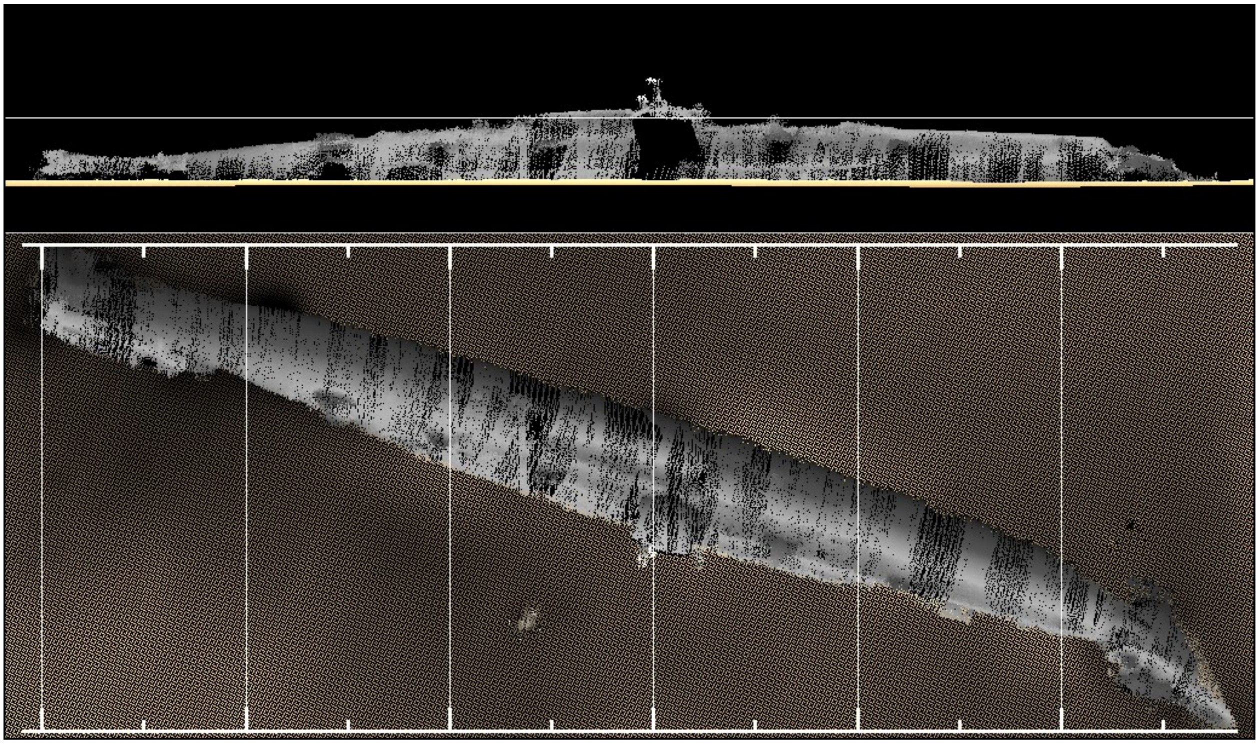


Figure 9-32 Multibeam SONAR visualization of the U-*352* wreck site scaled in 10-m grid.
Source: ADUS

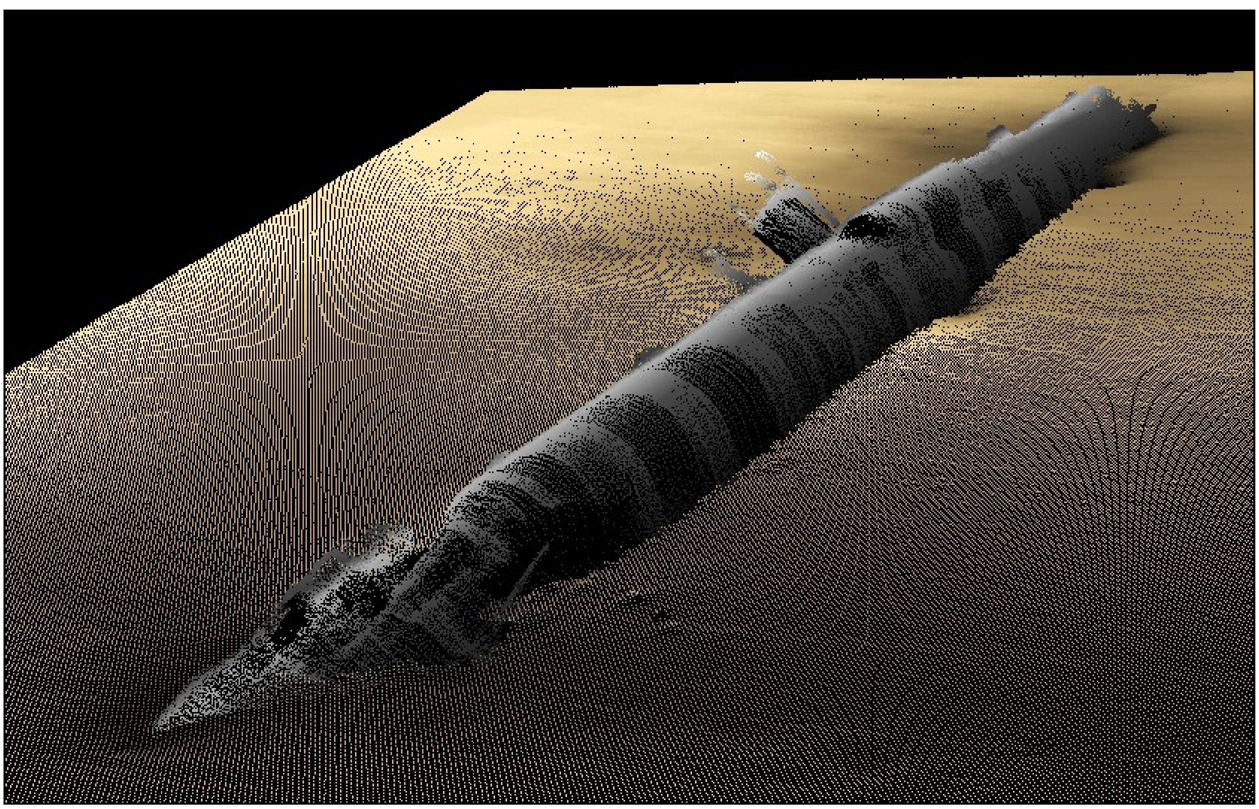


Figure 9-33 Isometric SONAR visualization of the U-*352* wreck site.
Source: ADUS

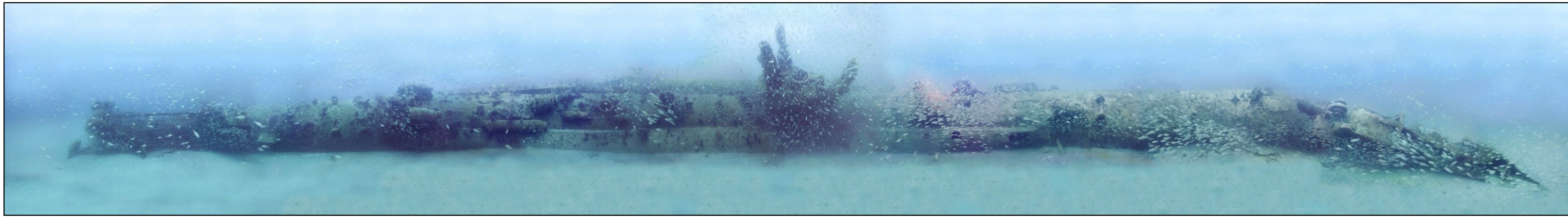


Figure 9-34 Profile mosaic of U-*352* collected during 2012.
Source: NOAA

Figure 9-35 Plan view mosaic of U-*352* collected during 2012.
Source: NOAA

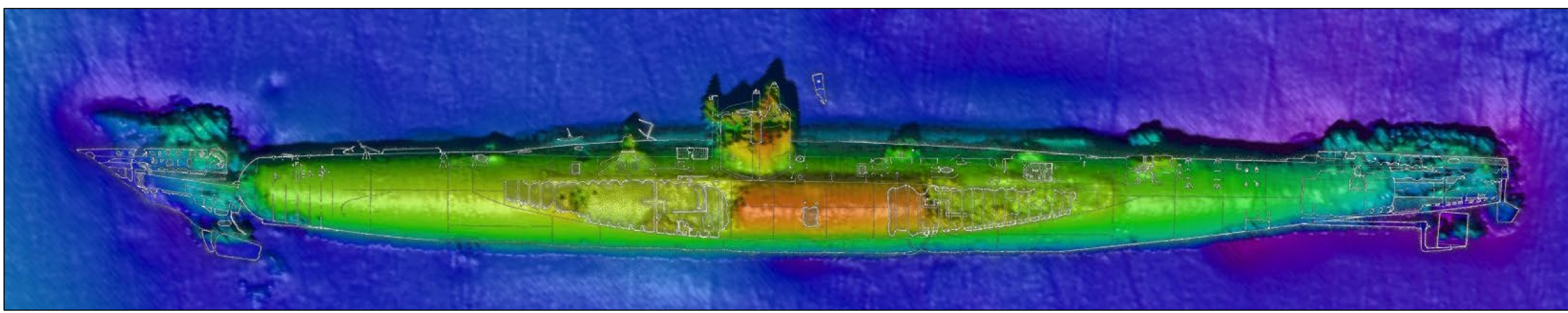


Figure 9-36 Plan view high-resolution multibeam data collected in 2011 with transposed line drawing of the 2008 archaeological site plan.
Source: NOAA/ADUS

9.2.3 Description of Impact at the Site of the U-*352*

- At least one propeller has been recovered.
- All hatch covers have been opened and removed; this includes the fore and aft torpedo loading hatches, the fore and aft battery hatches, the galley escape hatch, and the main hatch on the conning tower.
- The RDF loop is missing.
- The sky periscope appears to have been removed, though a greater degree of the housing remains.
- The 20-mm anti-aircraft gun has been removed.
- The 88-mm deck gun was dislodged from its mount during the sinking event and may be within a 100 m radius of the site.
- The magnetic compass housing has been removed.
- There is strong evidence of various minor pieces of hardware having been removed in 2008.
- The capstan for the anchor is missing, though has not necessarily been looted.
- The forward ready ammunition container is missing.
- The aft ready ammunition container has had the lid and contents removed (some of this may have been the result of the Navy's unexploded ordnance removal effort).
- A much greater degree of deterioration of the outer hull fairing is represented, due to natural processes. However, it must be noted that pictorial evidence over the course of the last 18-20 years reveals that much of this deterioration has been largely static and has not been getting much worse. This would have to be confirmed via corrosion potential analysis.
- Sections of the saddle tanks have also been deteriorating naturally.
- Some of the framing for the stern structure has been removed, likely as a result of improper anchoring or dragging nets.
- An array of artifacts are known to have been looted from the interior.
- Human remains are known to have been disturbed at this site; no reports of such activity have occurred for some time.

9.2.4 Features Believed to be Threatened at the Site

- Externally, few items remain to be looted, but various small pieces of hardware are still threatened.
- The anchor windlass at the bow is exposed and could be a potential target.
- Attack periscope and sleeve could be removed.
- Torpedoes and tubes are possibly threatened. This would be a larger undertaking that would be destructive on a large scale.
- Internal contents of the hull are still highly threatened.
- Human remains on site are known to still exist within the hull. Though not typically an item looted, their disruption is a desecration of a war grave protected by the Sunken Military Craft Act.

U-*352* is significant to American maritime history, military, and historic archaeology as it was the first U-boat sunk during WWII by the US Coast Guard off the American East Coast. U-*352* was listed on the NRHP on 12 November 2015 (reference number 15000804) due to its association with WWII activities off the United States East Coast and Gulf of Mexico. U-*352's* archaeological remains are significant at the national level under NRHP Criteria A and D (Marx and Hoyt 2015c).

9.3 U-*576*

Figure 9-37 An image of U-*576* and crew.
Source: Ed Caram Collection 2011

Table 9-3 Characteristics of U-*576*

Characteristics	U-*576*
Year of Build/Type/Hull #	1940/Military Type VIIC U-boat/552
Date Lost	15 July 1942
Position & Depth	30 miles S of Cape Hatteras Depth: 690 ft
Ship Characteristics	Displacement 761/865 tons (surfaced/submerged) Length: 67.1 m (220') Beam: 6.2 m (20') Draft: 4.8 m (15.7') Engines: 2,800 bhp/750 hp (2-shaft diesel/electric) Armament: 14 Torpedoes, 88-mm deck gun, 20-mm anti-aircraft
Cargo	n/a
Survivors	0 survivors, all hands (45)lost
Owner	German Navy
Construction Details	Steel (Stl) hull, Diesel/Electric Motor
Builder	Blohm &Voss, Hamburg, Germany
Port of Registry/Flag	Germany
Sunk by	SS *Unicoi* and VS-9 aircraft aerial attack
Data Collected	R/V *Okeanos Explorer* MB data and Blueview AUV based MB survey 2014; laser scanning, photo and video 2016, listed on NRHP.

9.3.1 History

U-*576*, ordered on 8 January 1940, was the 25th U-boat built by Blohm & Voss shipyard in Hamburg, Germany. The keel was laid on 1 August 1940, and the boat was launched on 30 April 1941 (Table 9-3 and Figure 9-37, above) Westwood 1984:12). U-*576* was commissioned on 26 June 1941, and put under the command of Kapitänleutnant Hans-Dieter Heinicke. Born in Thüringen, Germany on 18 May 1913, Heinicke became an officer candidate on 1 April 1933. He moved up the ranks and finally became a Kapitänleutnant on 1 April 1941, just prior to U-*576*'s launch. His only naval experience prior to U-*576* was serving as a watch officer of the U-boat tender *Wiechsel* in 1939 and 1940, as well as a senior lieutenant during two war patrols on U-*73* in February through April 1941. U-*576* was the only U-boat he commanded and he earned no decorations during his career. Sea trials were completed under the scrutiny of the U-Bootsabnahmekommission (U-boat Acceptance Commission). Babelhrung training took place between 26 June and 1 September, 1941 where U-*576's* crew became familiar with their submarine and made sure it was ready for sea (Busch and Röll 1999).

U-*576* was attached to the seventh U-boat Flotilla based at St. Nazaire, France. Between 27 September and 5 October, 1941, U-*576* moved from Kiel, Germany to Bergen, Norway and then from Bergen to Kirkenes, Norway. During that period it loaded supplies and fuel for its first mission. Kptlt. Heinicke and his 45 crew members embarked from Kirkenes on their first war cruise on 6 October 1941. For the 31-day mission, the U-boat patrolled the Barents Sea off Murmansk, Russia without sinking any ships. U-*576* returned to Kirkenes on 5 November. After moving to Bergen for re-supplying, the U-boat departed Bergen on 11 December for its second war patrol off Ireland and the United Kingdom. Over a period of 13 days, again, Kptlt. Heinicke was unsuccessful and returned to St. Nazaire.

Despite U-*576*'s disappointing first and second war patrols, Dönitz felt Kptlt. Heinicke was a capable commander and chose to send his U-boat across the Atlantic a few months later to work in American waters. The first wave dispatched to American waters consisted of 16 U-boats (6 Type IXs and 10 Type VIIs), including U-*576*, and was designated Operation Paukenschlag (Drumbeat). U-*576* left St. Nazaire on 20 January 1942, to start the German push across the Atlantic to attack merchant shipping near the Canadian and American shores (Blair 1996:704-732).

Kptlt. Heinicke sailed U-*576* west and operated off Nova Scotia where there was a confluence of traffic heading back and forth from Europe. On 14 February 1942, U-*576* sunk its first ship 50 miles from Sable Island, the 6,900-ton unescorted British armed freighter *Empire Spring*. U-*576* turned for home and arrived back in St. Nazaire on 28 February. While U-*576* never reached American waters during its third patrol, its 40-day mission was a success and U-*576*'s crew was granted a month of rest before its next trip.

On 29 March 1942, U-*576* departed St. Nazaire on its fourth patrol, this time heading on a more southerly track. It arrived off Virginia, where it sank unescorted American merchant vessel *Pipestone County* on 21 April. U-*576* now turned north and while off New York fired a single torpedo at the Norwegian *Tropic Star*, but missed. A few days later, Kptlt. Heinicke reached Cape Cod and spotted a northbound convoy. He fired broadside on four merchant vessels steaming close together and hit one, Norwegian freighter *Taborfjell*. It sank, making a third kill for U-*576*. As the submarine returned to France it spotted and followed a large convoy, but lost contact on 3 May before reaching its port, St. Nazaire, on 16 May after a 49-day patrol (Blair 1996:546-729).

A month later, on 16 June 1942, U-*576* departed St. Nazaire for its fifth and final war patrol. This time Kptlt. Heinicke set course for the busy shipping lanes off Cape Hatteras. After taking on additional supplies from the 'milch cow' U-*460*, U-*576* arrived off Cape Hatteras on 10 July 1942. The next day Kptlt. Heinicke sighted a northbound convoy and followed it instead of immediately attacking in hopes of gaining time to allow nearby U-*402* to get to the area to assist. During that period U-*576's* crew lost contact with the convoy. U-*576* and U-*402* then split and took up independent positions off Cape Hatteras. U-boat command received few reports from U-*576* but on 19 July it noted that,

> In the sea area off Hatteras, successes have dropped considerably. This is due to a drop in the traffic (formation of convoys) and increased defense measures. Of the boats stationed there in the recent period, only two, U-*754* and U-*701,* have had successes. On the other hand, U-*701* and U-*215* have apparently been lost, and U-*402* and [U-]*576* were badly damaged by depth charges or bombs. This state of things is not justified by the amount of success achieved (BDU 1942b:30309a).

U-*576* radioed to command on 13 July that it had sustained irreparable damages to its main ballast tank and was operating with ballast tank #5 flooded and possibly a ruptured saddle fuel tank. The damage was the result of an aerial depth charge attack by an American patrol plane, though so many American patrol planes attacked U-boats and reported sinkings in the area between 12 and 14 July that it is uncertain which flight crew was actually responsible (see Hickam, Jr. 1989:285; Blair 1996:626-627). Regardless, U-*576* stood out to sea on 13 July in an attempt to make repairs without further harassment from American anti-submarine patrols.

At this point in the historical narrative, little information is available and sources digress into a vague description of U-*576'*s activity. Most simply state that, having assessed the damage to the U-boat, Kptlt. Heinicke deemed repairs inoperable while underway and aborted the war patrol. A short time thereafter, while enroute back to France, U-*576* came upon a large, escorted convoy - KS-520. U-*576,* serendipitously finding itself in the proverbial right place at the right time, attacked (Hickam, Jr. 1989:286; Blair 1996:627 [though Blair hedges by qualifying his statement as "perhaps limping home"]). The insinuation, therefore, was that Kptlt. Heinicke stumbled upon the convoy after making the decision to not risk his crew and boat in a mismatched engagement with a damaged warship. Review of German BDU records, however, told a different story.

As per standard protocols, Kptlt. Heinicke radioed his boat's position, along with other strategic information, to U-boat command regularly while on war patrol. Examination of *U-576's* reported locations in the days following its near loss to aerial attack yielded an interesting alternative to the otherwise vague general historical narrative (Figure 9-38). U-boat movements were centrally directed by Döenitz's command staff to a similar degree that Allied convoys were administrated. Their records indicated the boat was ordered into the area off Cape Hatteras, MQK grid CA. Here, at 0230 hours on the 11th of July, the U-boat spotted a northbound convoy moving near the continental shelf break (Figure 9-38, Position A) just south of Hatteras, around 20 miles from where the boat would eventually attack KS-520 4 days later (Figure 9-38, Position E). *U-576* trailed the convoy for an hour before losing sight, spending the rest of the day searching for the ships (Figure 9-38, Positions B and C). Remaining on station off Hatteras, sometime between the 13th and 14th, the U-boat was attacked by a patrol aircraft, thereafter moving offshore to assess the damage at Position D (Figure 9-38) (BDU 1942b:30309a; Bright 2012:239-241).

Being at a position nearly 130 miles from where the KS-520 convoy was attacked by U-*576*, it does not appear that Kptlt. Heinicke simply aborted the war patrol. Had he done so, he would have been too far offshore to encounter the convoy whilst making a course for France. Instead, review of the boat's positions implied that Kptlt. Heinicke purposefully chose to bring U-*576* back into the shipping lanes off Hatteras. What followed was "…as audacious an attack as any German submarine ever attempted" (Hickam, Jr. 1989:286) as Kptlt. Heinicke brought a damaged submarine up against an escorted convoy of 19 merchant vessels under the protection of 5 US Navy and Coast Guard surface escorts, in addition to aerial coverage provided by a flight of aircraft from VS-9 out of MCAS Cherry Point, North Carolina.

Though in the aftermath it appeared a foolhardy decision to press a lopsided engagement, several factors were initially aligned in favor of U-*576*.

An archaeological battlefield analysis revealed numerous tactical advantages that availed for U-*576* to exploit prior to the attack. First, the U-boat had both the wind speed/direction and sun position necessary to conceal its approach with respect to the convoy; a sort of submarine 'weather gauge.' Likewise, despite the seemingly insurmountable perimeter of the armed escorts, they were actually arrayed very far apart, leaving numerous gaps in their coverage. As a result, U-*576* was able to approach through their screens undetected. Having aligned itself offshore of the convoy, right on the edge of the continental shelf, U-*576* was also poised over an ideal escape route into deep water under the mélange of mixing water currents from the Labrador and Gulf Streams. Finally, U-*576* employed a torpedo attack strategy which it had previously used (successfully) against a convoy during its fourth war patrol as a sort of hit-and-run tactic (Bright 2012:239-245).

Having experienced very little success on previous war patrols, U-*576* found itself in American waters in April 1942 reliving its comparative lack of success. As other U-boats made historic patrols off the US Coast, U-*576* seemed incapable of similar accomplishment. Off Cape Cod, Kptlt. Heinicke attacked Norwegian freighter *Tropic Star*; one torpedo hit but did not explode and the freighter continued on. Next, spotting a small convoy on the morning of 30 April, U-*576* made an interesting tactical adjustment. Taking aim at 4 overlapping ships, Kptlt. Heinicke fired all of his remaining torpedoes at them. Two managed to find a mark, and small Norwegian freighter *Tabrofjell* sank (Blair 1996:546). Apparently, Kptlt. Heinicke deduced that the chances of ill-aimed shots and dud torpedoes would be mitigated by firing a large spread at the most concentrated area of a convoy; at least one was bound to strike. In this first instance, it worked; and he escaped unharmed.

Less than three months later, Kptlt. Heinicke and U-*576* were back off the American coast, and again dogged by very little success. Largely responsible for this condition, however, was now the veracity of American anti-submarine patrols and the efficacy of a methodically operated convoy system. Nevertheless, U-*576* arrived with a singular mission: sink merchant vessels. Undaunted by the damage sustained in the days prior, when a large convoy entered Kptlt. Heinicke's periscope on the afternoon of 15 July, a review of the situation must have seemed somewhat optimistic. All the aforementioned tactical advantages were in U-*576's* favor. Kptlt. Heinicke lined up the biggest ships in the convoy. They were far larger than any he was credited with sinking before; much larger, in fact. This attack, if successful, had career-making potential in a service that worshiped its U-boat heroes. Not surprisingly, then, he fired a full bow salvo – all four torpedoes in the Type VII's forward tubes – at the largest concentration of ships. Then, he waited.

As the four torpedoes surged forward into the convoy, one of the Coast Guard cutters, *Triton*, picked up a sonar contact on the far side of the convoy. Miles from U-*576*, the cutter began a depth charge run that lasted 10 minutes. Less than 5 minutes after USCGC *Triton*'s depth charge run, another set of explosions occurred. These were U-*576's* torpedoes hitting, in sequence, freighter *Chilore*, tanker *J.A. Mowinckel*, and freighter *Bluefields*. All four torpedoes struck a target. At this point, however, the initiative of the engagement abruptly shifted: U-*576* surfaced inside of the convoy. Armed guards onboard American merchant freighter *Unicoi* spotted the U-boat and opened fire. Kingfisher aircraft on patrol above simultaneously dropped aerial depth charges. Nearly as quickly as it began, the attack on KS-520 was over. U-*576* went down with all hands lost (ComScorn Nine 1942; Bright 2012:102-104).

The first two vessels hit—*Chilore* and *J.A. Mowinckel*—escaped, but with severe damage, while the third—*Bluefields*—sank in a matter of minutes. Nearly 30 sailors were injured during the attacks, one of which would later die from his wounds. In the hours that followed, a series of miscommunications resulted in the damaged merchant ships erroneously navigating into the Hatteras minefield. They were severely damaged yet again by the explosions of friendly mines. After clearing a path to the stricken vessels, three tugs, *Keshena*, *Relief*, and *J.P. Martin* were dispatched to tow their hulks from the minefield. While participating in salvage operations, *Keshena* also struck a mine and sank, with the loss of two lives (Standard Oil Company 1946:363-372; Hoyt 1978:168-172; DIO 1987:411-421; Hickam, Jr. 1989:285-287; Blair 1996:626-627).

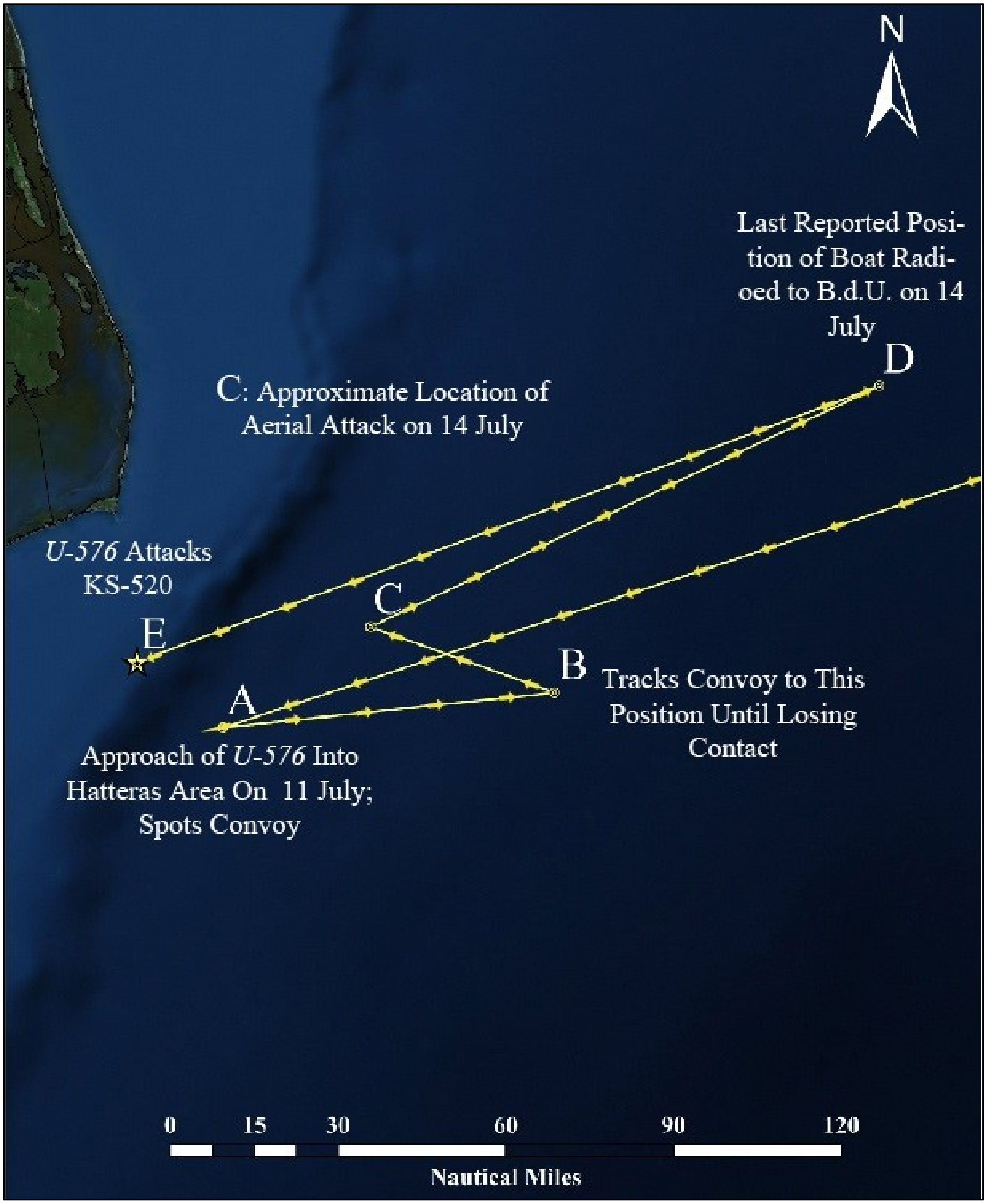


Figure 9-38 Plotted positions of U-*576,* based on BDU records, from 11 July through 15 July.
Source: Bright 2012:240

Constituting a single naval action of comparatively little consequence when viewed against the larger, more involved convoy battles elsewhere in the Atlantic, the KS-520 attack represented more than a single U-boat attacking a convoy. The event, in fact, marked a shift in strategic initiative off America's Eastern Seaboard. In the 7 months prior, U-boat operations had gone virtually uncontested in American waters, especially in the shipping lanes off Cape Hatteras. With the attack of KS-520, however, Allied institution of a strict and aggressive convoy system, accompanied by air escort, proved too daunting for German raiders. The significance of this shift would reverberate throughout the entire Atlantic. Once the Allies gained the advantage in American waters, never again would German U-boats assail the Allies with such gruesome efficiency. Instead, they were forced into other theaters of operation where, for the remainder of the Battle of the Atlantic, they would find only mixed success.

9.3.2 Archaeological Site Description

Of all the German U-boats lost off the coast of North Carolina during the Second World War, U-*576* was the only one whose final resting place was not definitively known at the outset of this study. As research in the early years of the study incrementally established the feasibility of possibly locating the U-boat, efforts were directed at searching for U-*576* and, by proxy, delineating the larger KS-520 battlefield. Fortunately, as a Type VIIC U-boat, any intact exposed hull remains would be immediately identifiable as such.

Ultimately, the search centered on the objective of first locating *Bluefields*, as it would likely have a more discernable acoustic signature owing to it being a far larger vessel. Once *Bluefields* was identified, a narrowing of the search field could be conducted based upon the assumption that U-*576* would be in close proximity. In 2013, the team located the site of *Bluefields*, and the following year the team found U-*576* in closer proximity than originally suspected, lying only 250 m almost due west of *Bluefields*. The site lies in approximately 690 ft of water, some 60 ft shallower than *Bluefields* (Figure 9-39 and Figure 9-40).

When initially identified, only a single high-resolution multibeam survey was conducted on the site. This survey, however, provided a reasonable degree of detail on the site's remains. The high level of intact structure and preservation seems to be incomparable to other known U-boat wreck sites. The boat appears to rest on reasonably solid bottom substrate. While some scour is observable from the bathymetric imagery, it also appears that very little of the vessel's remains are settled in or under sediment.

The vessel rests at an approximate 55° angle to its starboard side (Figure 9-41). Acoustic imagery suggests that both propellers, rudders, and dive planes are all observable and intact. The entire outer hull fairing appears intact with no discernable damage or degradation. This is also true for the conning tower fairing, which appears to be completely intact, including the cutwaters and the magnetic compass housing. On the bridge there is some indication that the 20-mm antiaircraft gun may still be intact and in its original position. The base/mount is evident but there is no indication of a barrel (Figure 9-42 through Figure 9-44). Likewise, forward of the conning tower, the 88-mm main deck gun is clearly present and intact. The feature appears to be stowed for diving. The level of resolution is not sufficient to determine the absence or presence of smaller features on the main gun such as sights or harnesses, but it is likely these features also remain.

Only the port side of the vessel is visible from the available data, but no damage from the aerial bombardment or the deck gun attack is visible (Figure 9-46 through Figure 9-50). It is possible these signatures are either too small for the level of resolution available from the data, or are located on the starboard side of the vessel which is not captured in the imagery. It is also possible that repairs affected by the crew resulted in this damage being less conspicuous when viewed remotely.

It also appears that there may be some preservation of the wooden deck. While it is unclear precisely how much deck structure remains, there is certainly some preservation. Lying just beneath the deck are the main air inlets and diesel exhaust trunking, as well as ammunition lockers, loading hatches, pressurized air cylinders, and watertight torpedo containers.

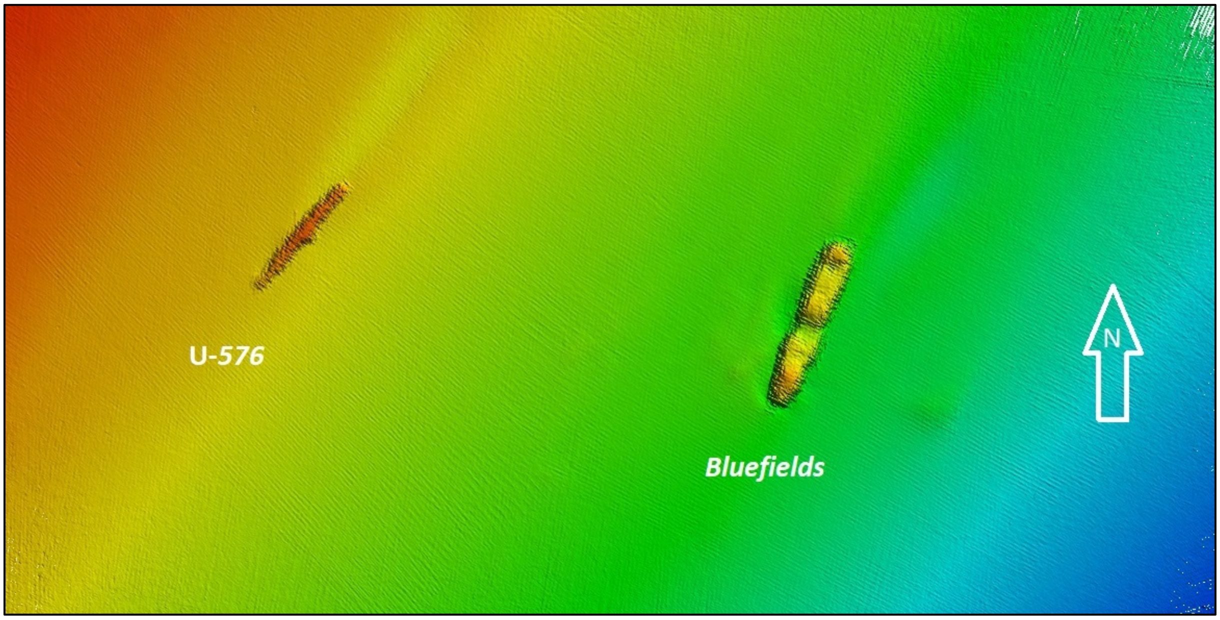


Figure 9-39 NOAA R/V *Nancy Foster* multibeam survey imagery of U-*576* (left) and *Bluefields* (right).
Source: NOAA

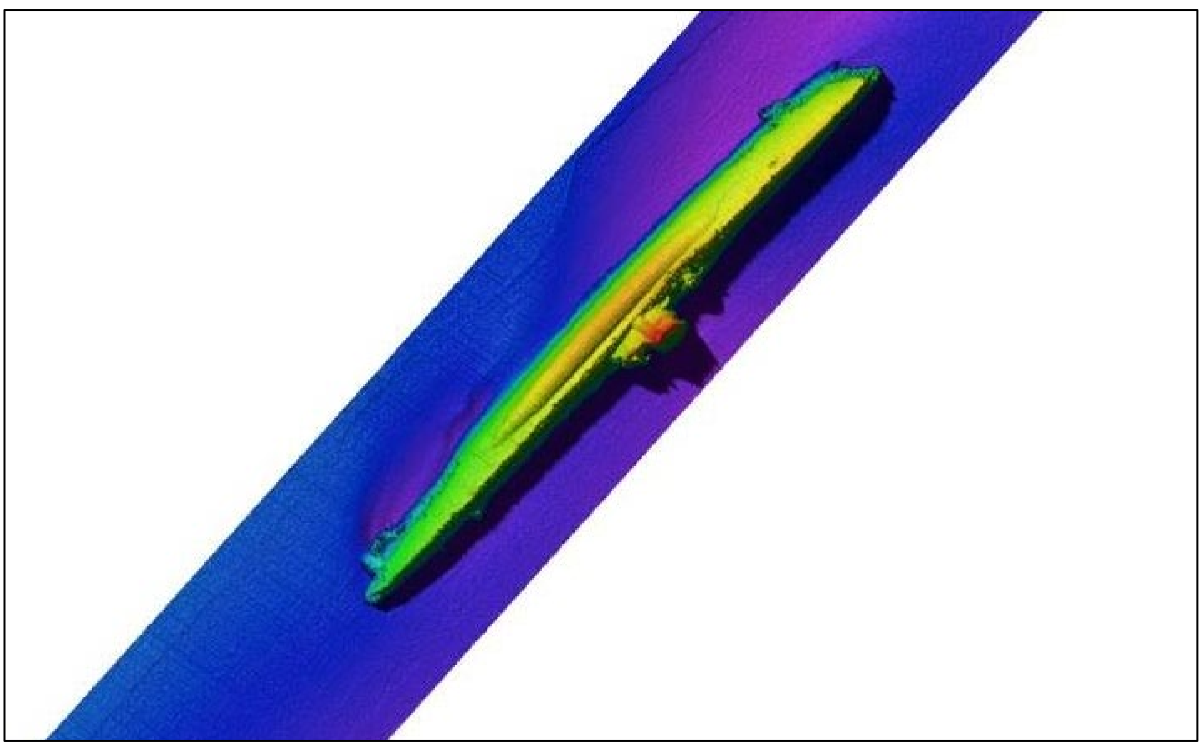


Figure 9-40 Multibeam sonar image of U-*576*.
Source: NOAA/SRI

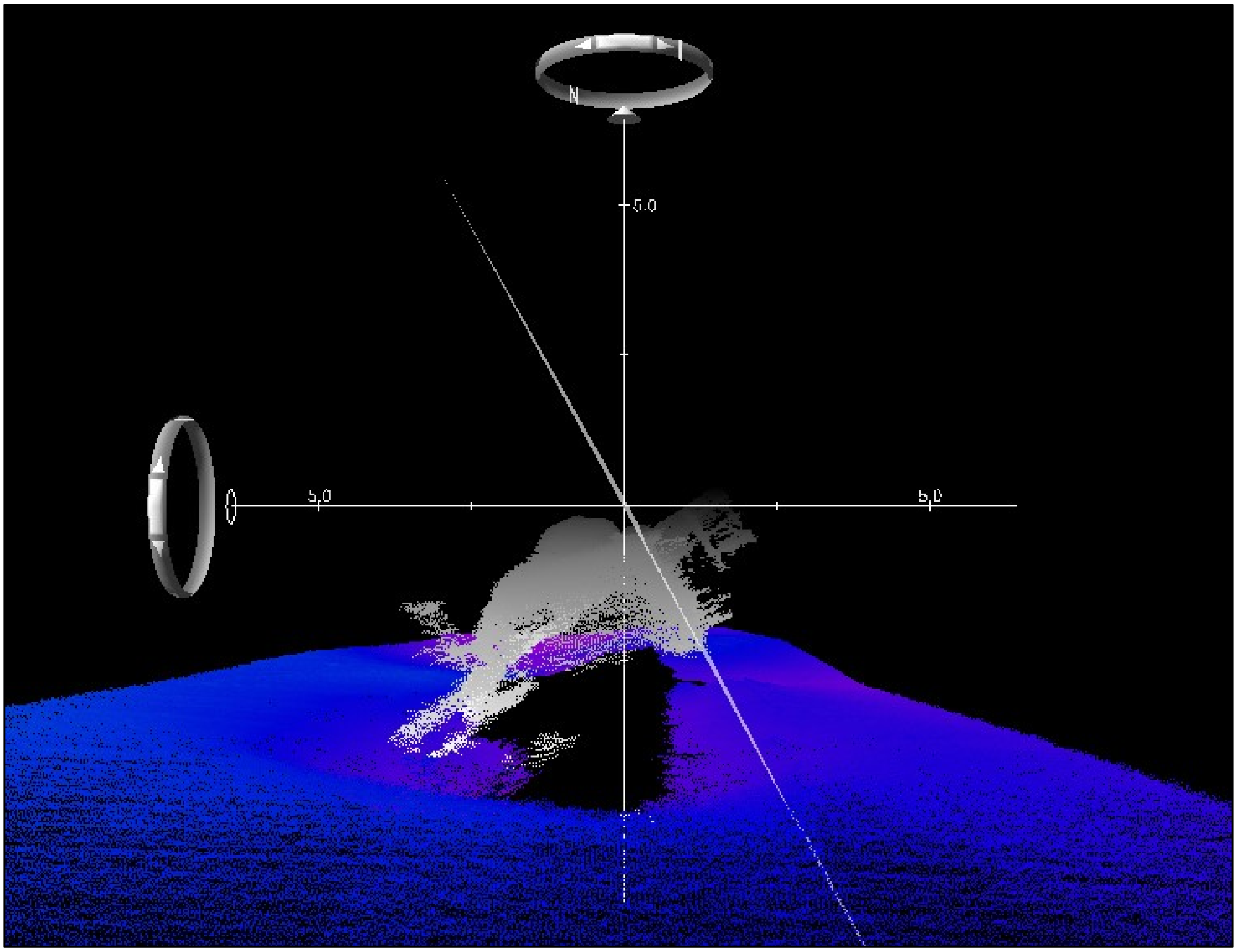


Figure 9-41 Multibeam imagery illustrating that U-*576* is lying on its starboard side with a 55-degree angle.
Source: NOAA/SRI

In 2016 the research team was able to return to the KS-520 sites to collect additional high-resolution data. The survey package focused on the use of manned submersibles to allow researchers to make first-hand observations and collect photos and video. Laser scanning was conducted to generate extremely accurate point cloud models of the sites as well.

The combination of photography, observation, and laser scanning provided far more detail than previous multibeam surveys. The resulting data show an extremely high level of preservation and site integrity. The only features that do not remain intact are hand railings and aerial radio wires that ran fore and aft (Figure 9-45). Likewise, the wooden decking is completely gone, exposing the steel support frames, and the barrel of the 20-mm gun is not present. It is possible that the barrel and breach of the flak gun were stowed separately as some earlier version of this gun required removal and storage prior to diving (Stern 1991:100).

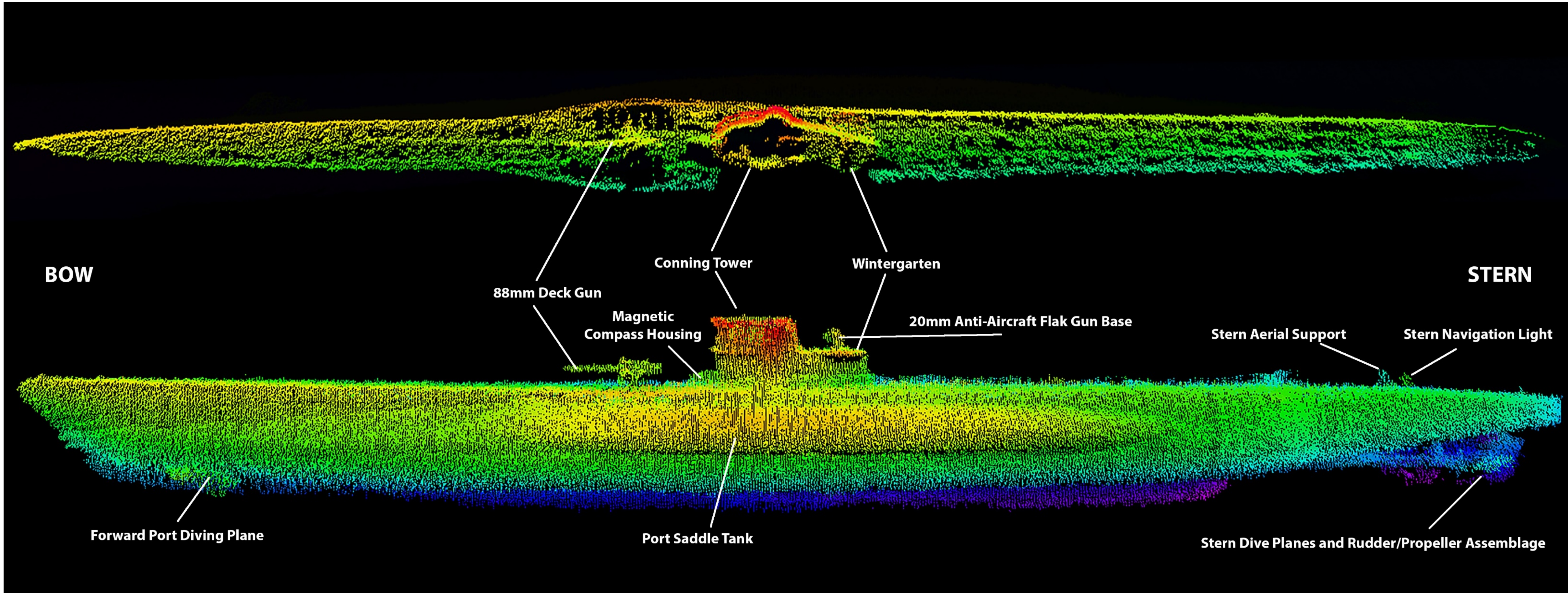


Figure 9-42 Processed multibeam point cloud of U-*576* in plan and profile view.
Source: NOAA/SRI

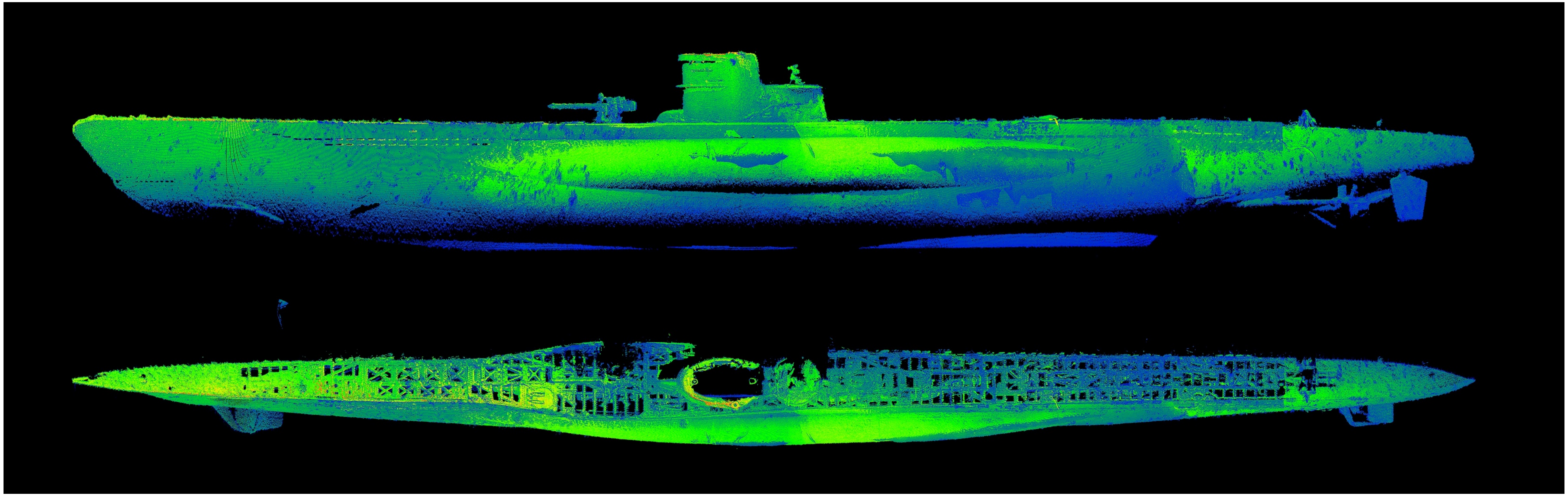


Figure 9-43 Clean ULS500 laser scan of U-*576* in plan and profile view.
Source: NOAA/2GRobotics/Sonardyne

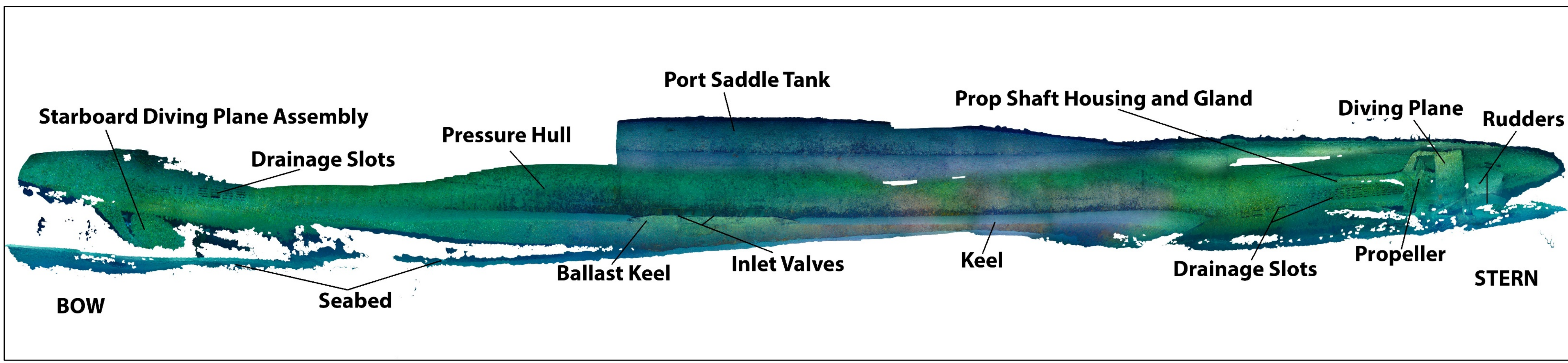


Figure 9-44 Partial photogrammetric model of the bottom of U-*576*.
Source: NOAA and BOEM – Images collected by William Hoffman

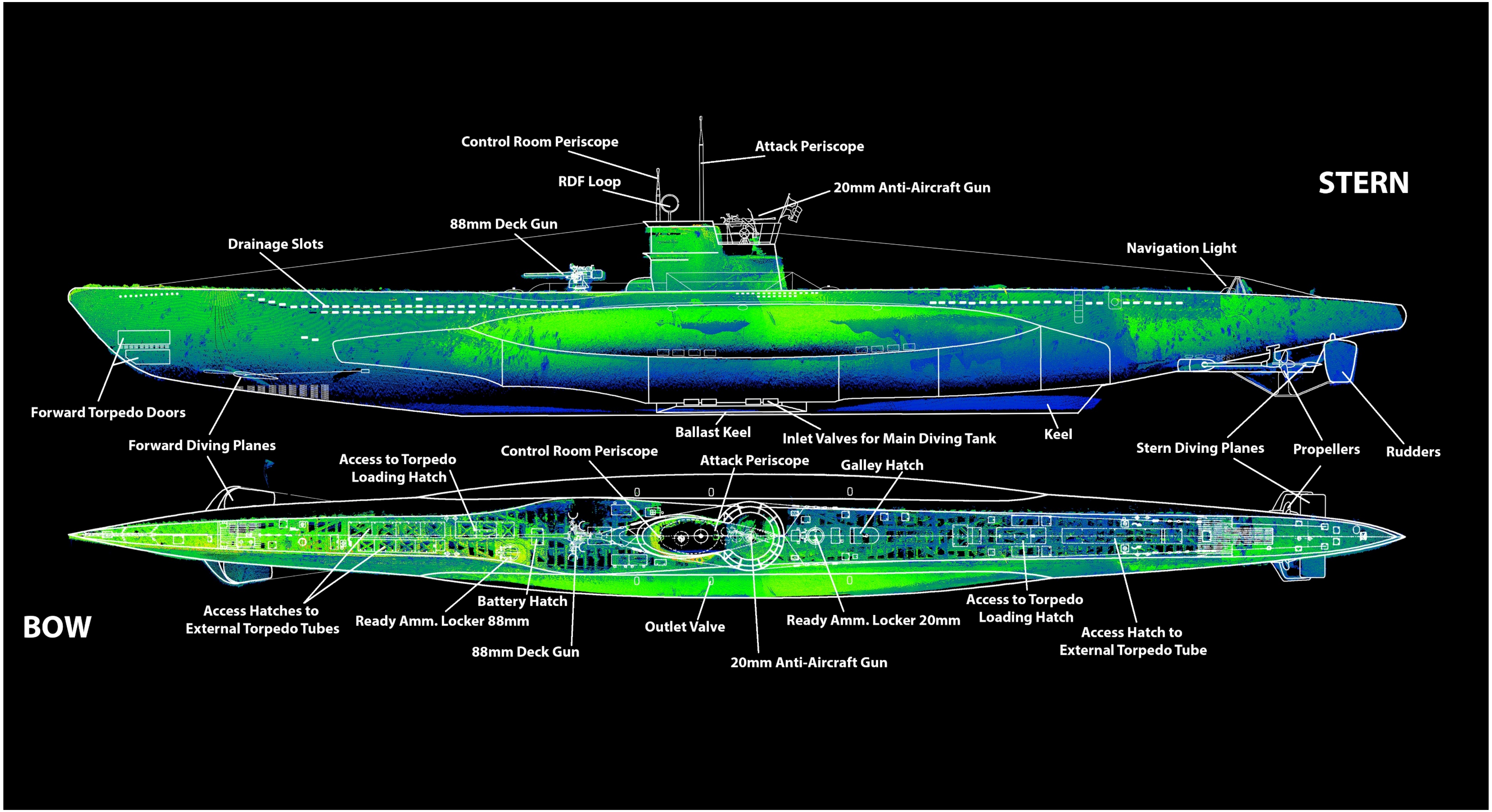


Figure 9-45 ULS500 laser scan of U-*576* with builder's plans overlaid and labeled features.
Source: NOAA/2GRobotics/Sonardyne

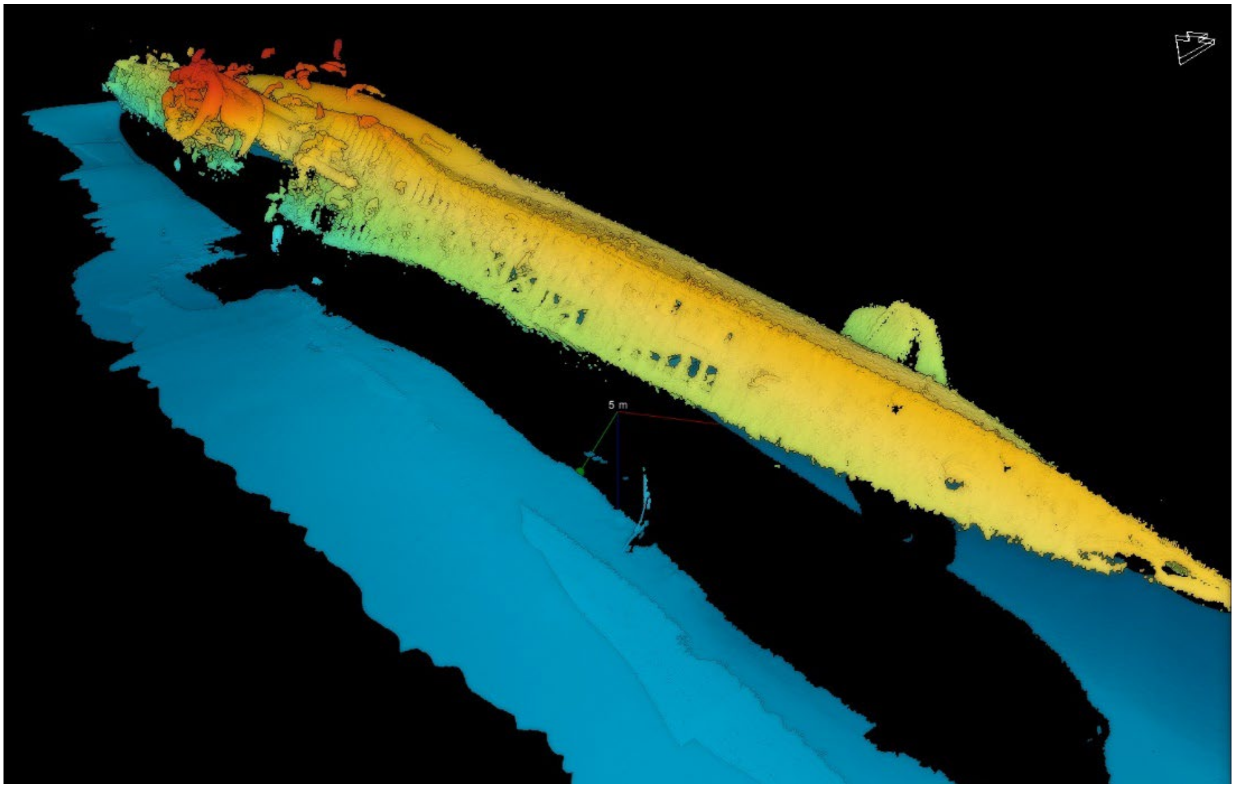


Figure 9-46 Isometric view of laser data on U-*576* focusing on the bow in the foreground.
Source: NOAA/2GRobtics/Sonardyne

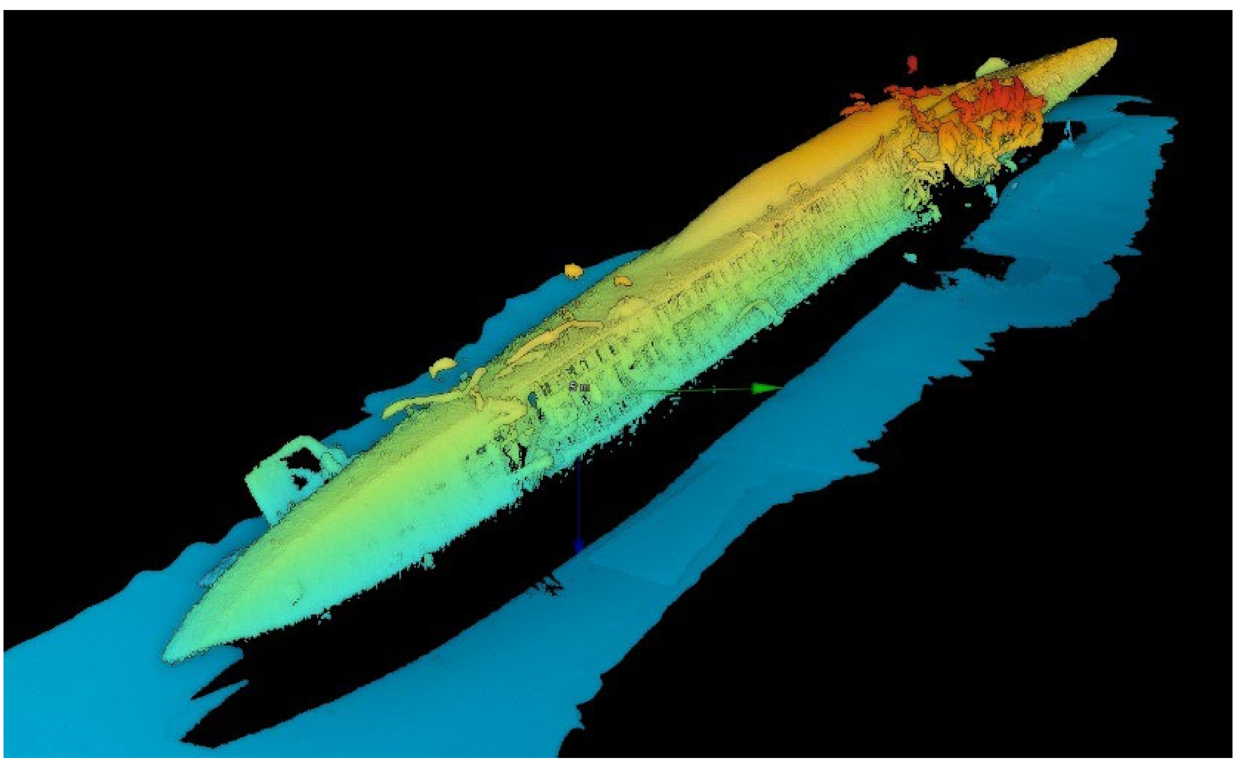


Figure 9-47 Isometric view of laser data on U-*576* focusing on the stern in the foreground.
Source: NOAA/2GRobtics/Sonardyne

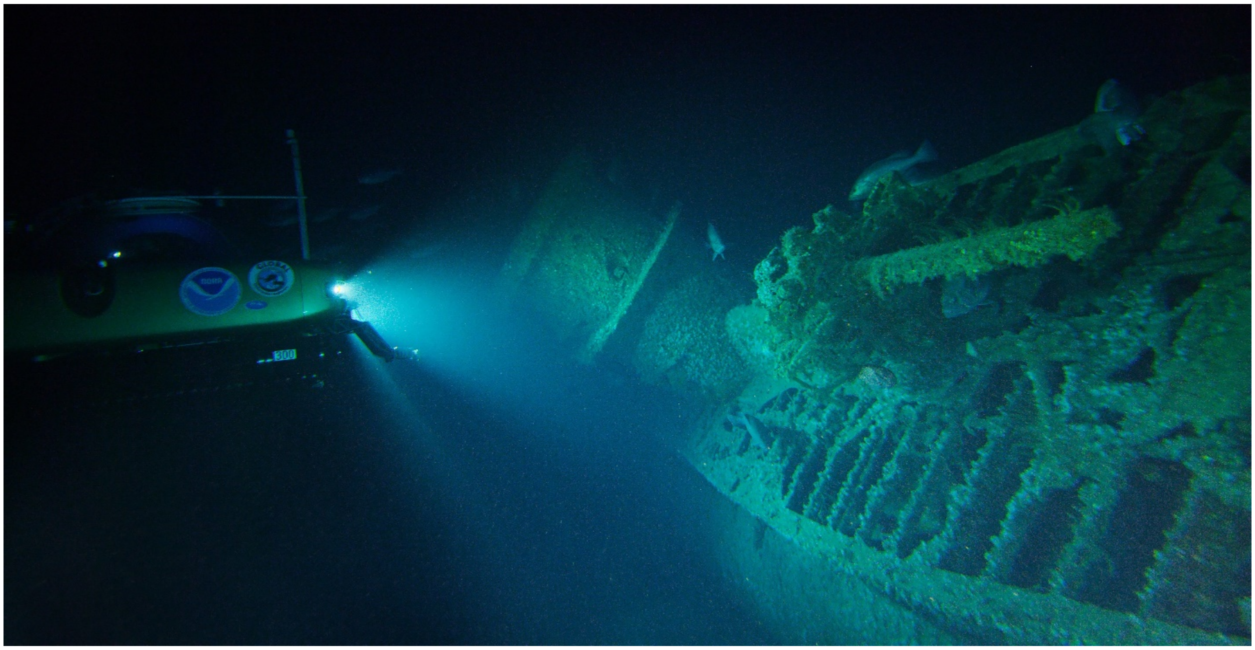


Figure 9-48 Deck gun and conning tower of U-*576* taken on the first dive to the site.
Source: John McCord, UNC-CSI

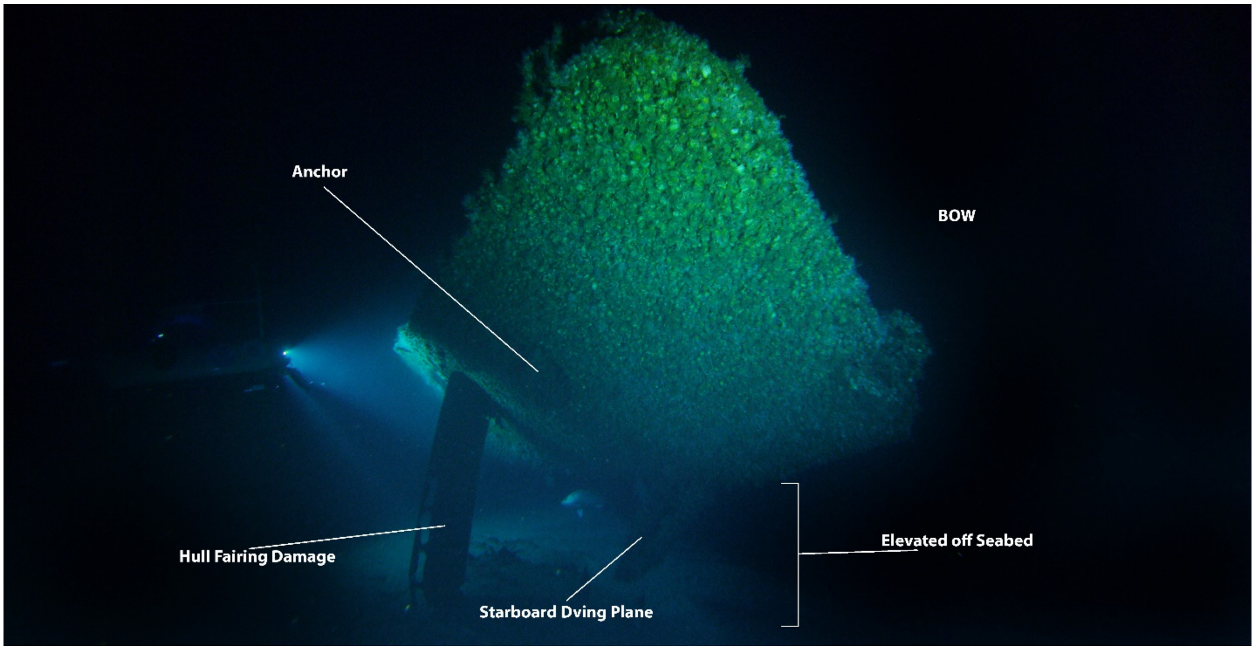


Figure 9-49 Bow view of U-*576*.
Source: John McCord, UNC-CSI

No definitive damage from the attack is observable, and no further damage from the sinking event can be seen (no impact damage to the seabed or hull structure) (Figure 9-46 through Figure 9-50). As built, Type VII U-boats were designed to operate at a depth of 750 ft. As this site rests in just under 700 feet of water, it is located in an environment within its operational range. Had it sunk in deeper water, some pressure damage might have been observable. Consequently, many components that might have indicated a cause of sinking (ballast system, valves, pipes, hull penetrators, etc.) are all obscured by the fact they remain in place inside the outer hull fairing and beneath the intact deck framing. Thus observations are limited to only external features.

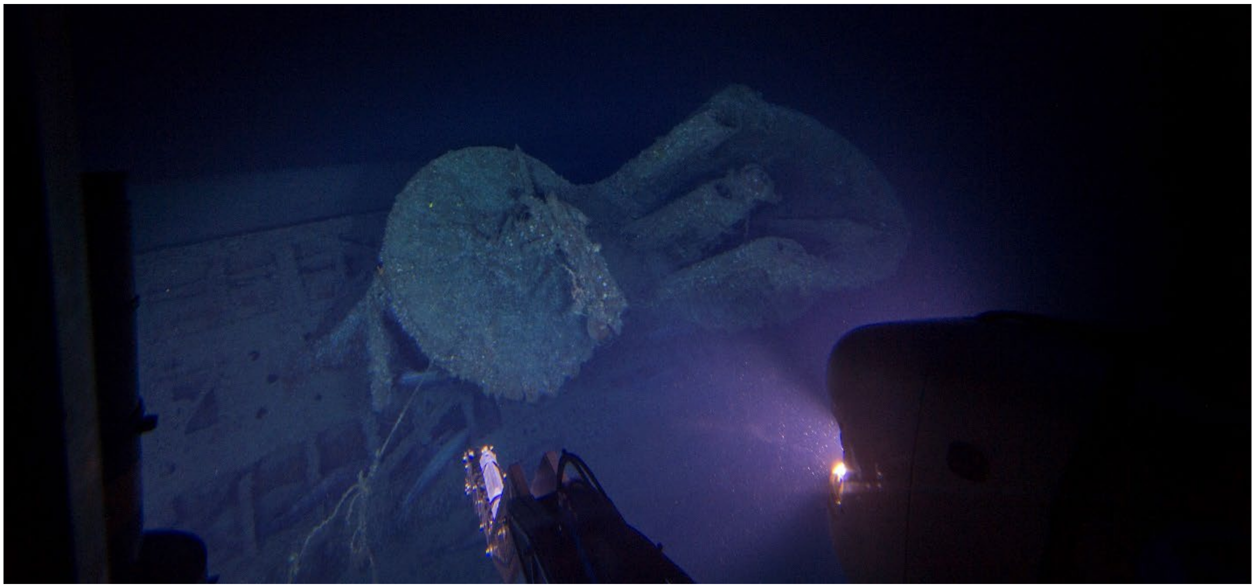


Figure 9-50 View of wintergarten/tower and 20-mm flak gun.
Source: Joseph Hoyt – NOAA

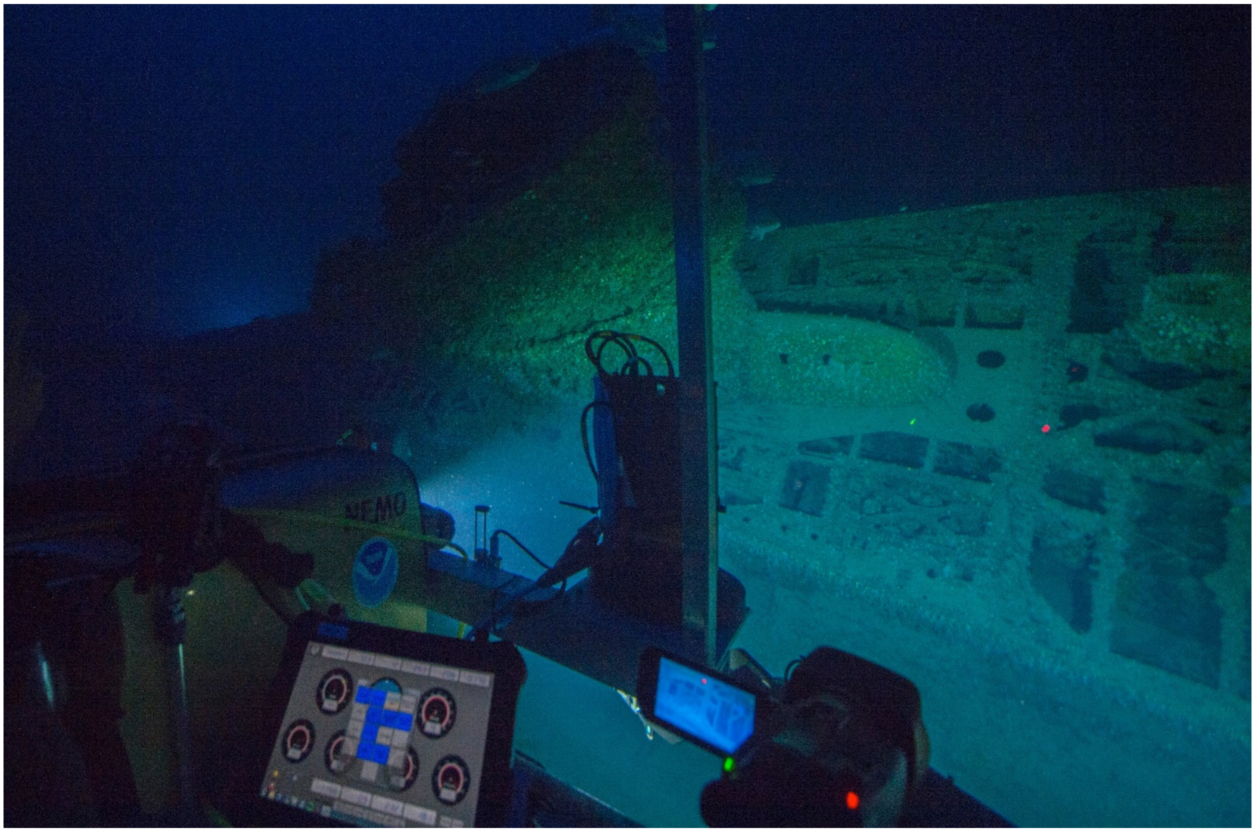


Figure 9-51 View of the conning tower on U-*576*.
Source: Joseph Hoyt – NOAA

The vessel is sitting on a hard substrate. The surrounding seabed is rocky in areas with an apparently shallow layer of sand. As such, the vessel has not settled into the seabed at all. The remains rest on the starboard saddle tank, the large amidships bulge that could be filled with air or flooded with water to control the vessel's buoyancy. Since these features increase the beam amidships it has had the effect of essentially propping the U-boat up, such that the bow and stern sections fore and aft of the saddle tanks are not in contact with the seabed at all (Figure 9-52).

Figure 9-52 Stern view of U-*576* showing steering gear. Note the steering gear does not touch the seabed.
Source: Robert Carmichael – Project Baseline

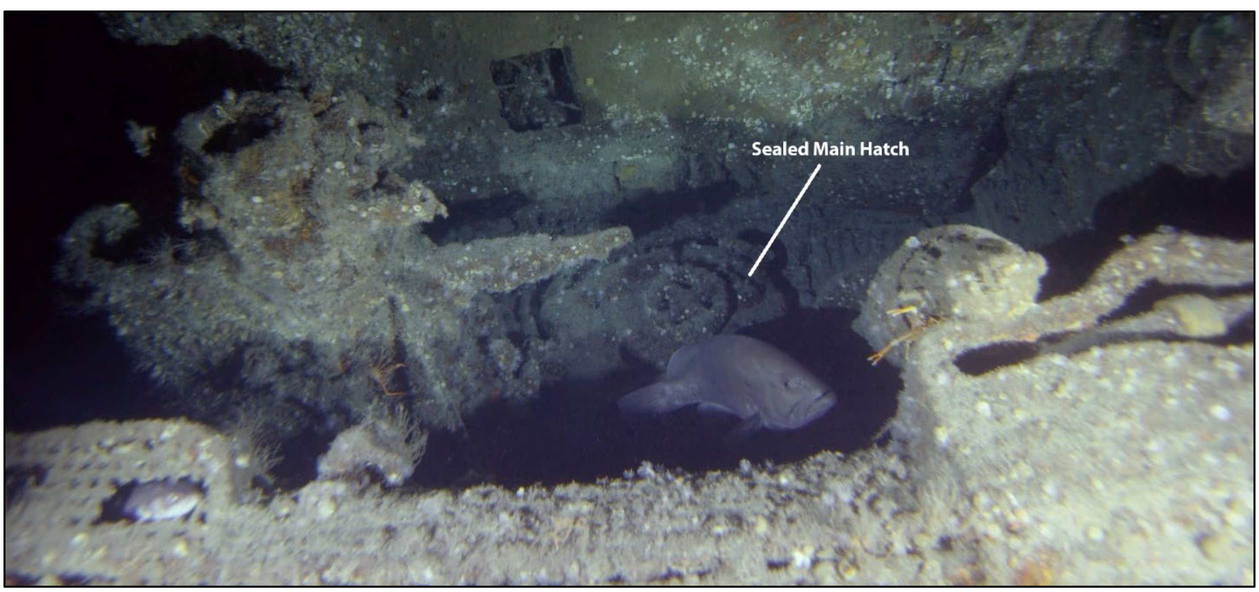


Figure 9-53 Conning tower floor with view of sealed main hatch.
Source: John McCord, UNC-CSI

The first observations that were made on the site were to assess the state of several areas of egress into or out of the pressure hull to determine if the crew had attempted to ditch into the water column. These points were primarily the main hatch in the conning tower, galley escape hatch, and battery-loading hatch (Figure 9-53). It may have been possible to get out via the fore and aft torpedo loading hatches as well. Observation of all of these areas reveals that none of the hatches are disturbed and remain closed. As such, it can be concluded that the entire crew remains are still located inside the sub and the site is therefore regarded as a war grave.

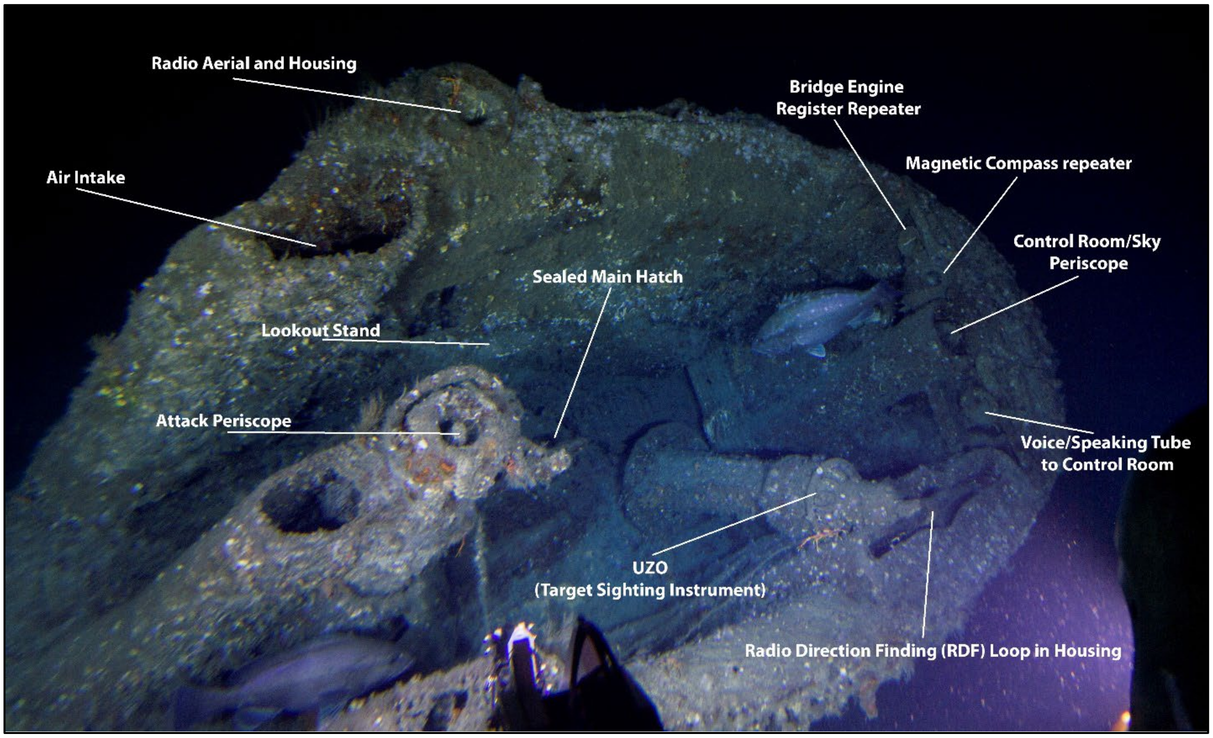


Figure 9-54 View of U-*576* conning tower annotated to highlight features.
Source: Joseph Hoyt – NOAA

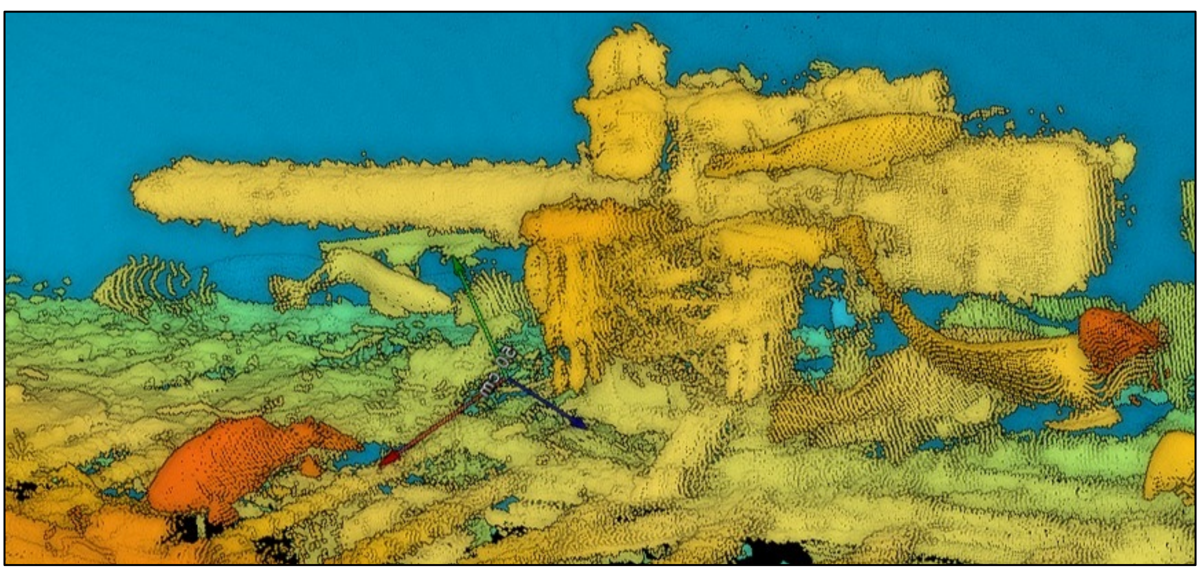


Figure 9-55 ULS500 laser scan image of 88-mm deck gun viewed from port side.
Source: NOAA/2GRobotics/Sonardyne

Several features are still in situ on the conning tower (Figure 9-54). Both the attack and sky periscope are stowed in their housings, as is the radio direction finding loop. The UZO, a mechanism for sighting and ranging targets, is slightly off its mount but otherwise intact. The bridge instruments for the engine revolution register and the magnetic compass are present and the glass faces of the gauges are still intact (Figure 9-51).

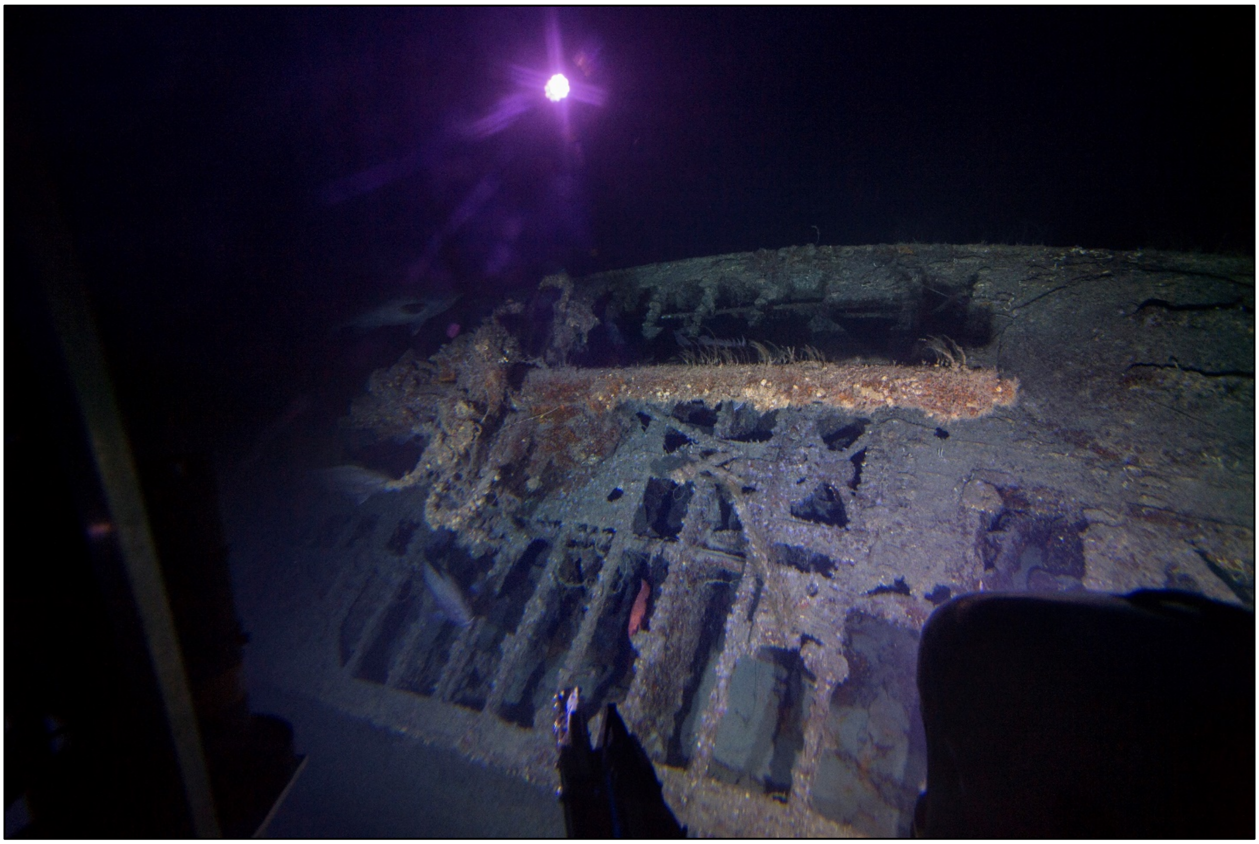


Figure 9-56 Image of 88-mm deck gun from the starboard side. Watertight ammunition locker can be seen in upper right.
Source: Joseph Hoyt – NOAA

The conning tow area and the 88-mm deck gun are the two most prominent features on the deck of U-*576*. Here again the level of preservation is high. The 88-mm gun is stowed in its diving position, and the sight, control wheels, and firing harnesses are all intact. Just forward of the gun on the portside deck is the ready ammunition locker. This was a watertight container for storing rounds for the deck gun. This container is still sealed and likely contains a number of rounds (Figure 9-56).

There is only one area of discernable damage to U-*576*. On the starboard side, slightly aft of the forward diving plane, a portion of the outer hull fairing is dislodged. It appears "peeled' back but is still attached along the forward trailing edge (Figure 9-57). This area is isolated and no similar damage is evident anywhere else on the vessel. The cause of this damage is not apparent, however, it is possible that the damage occurred recently. The area surrounding the damaged hull fairing has significant flash, or surface rust (Figure 9-57). Such surface rust typically indicates recent disturbance, or exposure of surface metal that had not been previously exposed to the environment. This can cause the bright orange surface rust until enough time passes and the area becomes encrusted with marine growth and takes on a more homogenized appearance of the remaining structure. It seems two possible explanations exist: one, historic damage could have stressed the hull structure and the subsequent metal fatigue in a particular area may degrade at an accelerated rate compared to the rest of the remains, or; two, some minor modern disturbance occurred. Distinguishing between these two possibilities is extremely difficult, though worth noting considering that this represents the only physical observable damage.

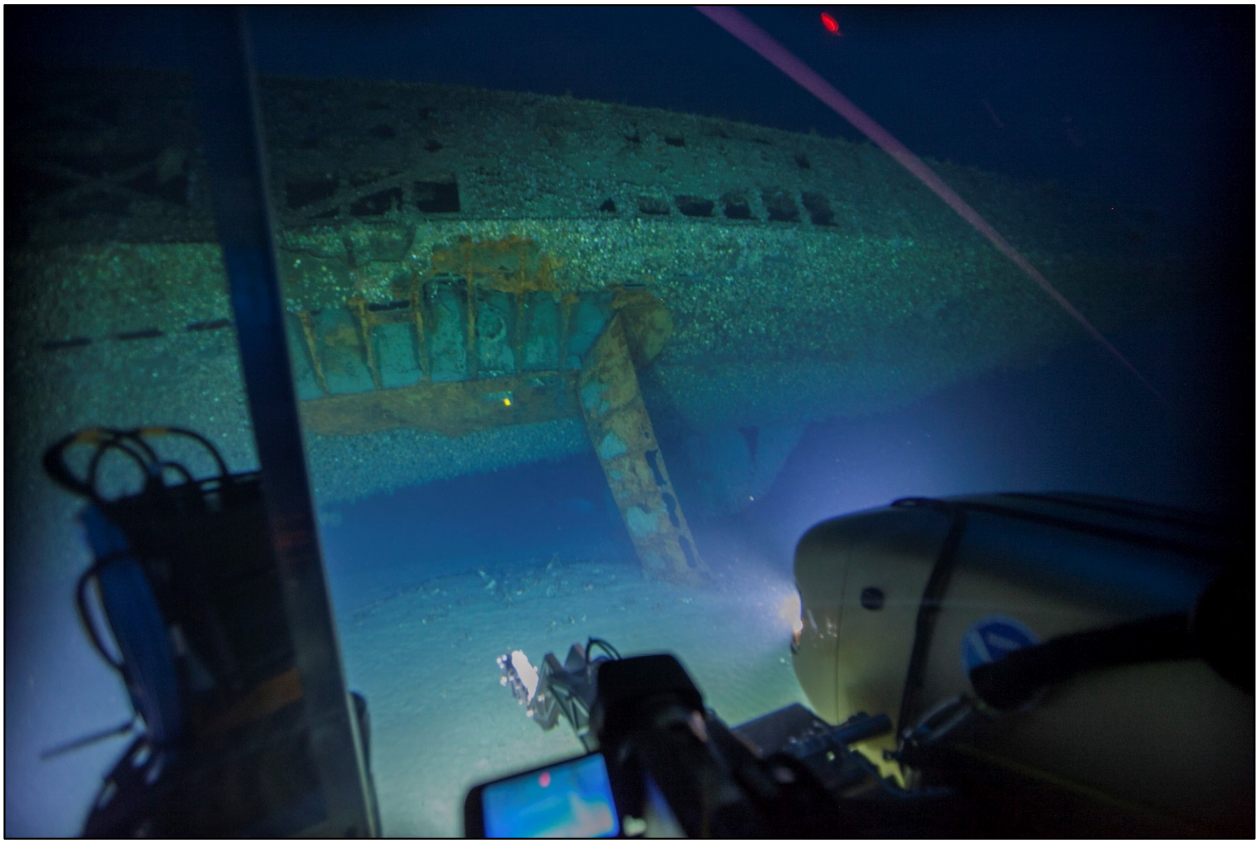


Figure 9-57 Area of damage to the outer hull fairing on the starboard side bow area.
Source: Robert Carmichael – Project Baseline

One particularly interesting feature is the orientation of the diving planes. While it is possible that the current orientation has been altered post depositionally due to mechanical degradation, it is likewise possible they remain in the position to which they were last set. The forward planes are oriented in a position to maneuver the vessel towards the surface (Figure 9-58). The forward edge of the plane is elevated above the trailing edge, such that with forward momentum the bow would push towards the surface. Additionally, the stern planes are the opposite - the forward edge is positioned lower than the trailing edge (Figure 9-59). With forward momentum this would have the effect of pushing the stern down. The net result of the plane orientation would have sharply pointed the bow towards the surface.

Typically while under attack a U-boat would dive as an escape tactic. The position of the planes seems to indicate that at some stage after the attack it became clear that the vessel was a loss and efforts were made on the part of the crew to surface or attempt to stabilize the sinking of their craft, despite the presence of a large convoy just above. This feature therefore tells a small bit of the story of the sinking of the vessel. There was a period of time after being attacked that the crew was aware of their destruction but still had time to make an effort towards getting to the surface or correcting an uncontrolled descent.

Further survey was also conducted by means of stereo-photogrammetry. Although a complete model of the site was not able to be generated due to weather restrictions, the photogrammetry survey was successful in creating a partial model of the vessel, particularly in areas that were not in the line of sight of the laser survey. The completed section focused on a view from the keel up the port side of the vessel (Figure 9-59). Because the vessel is lying on its starboard side, this view illustrates the contact area of the vessel and the seabed, as well as bottom portions of the starboard diving planes. Additionally, this data provides the best view of the keel/ballast keel assembly and the inlet valves for the main internal diving tank. The inlet valves are clearly in the open position (Figure 9-60). Available data was unable to determine the orientation of the outlet valves on top of the tanks. Additional survey of outlet valves may indicate if the vessel was actively flooding tanks or filling them with air at the time of loss.

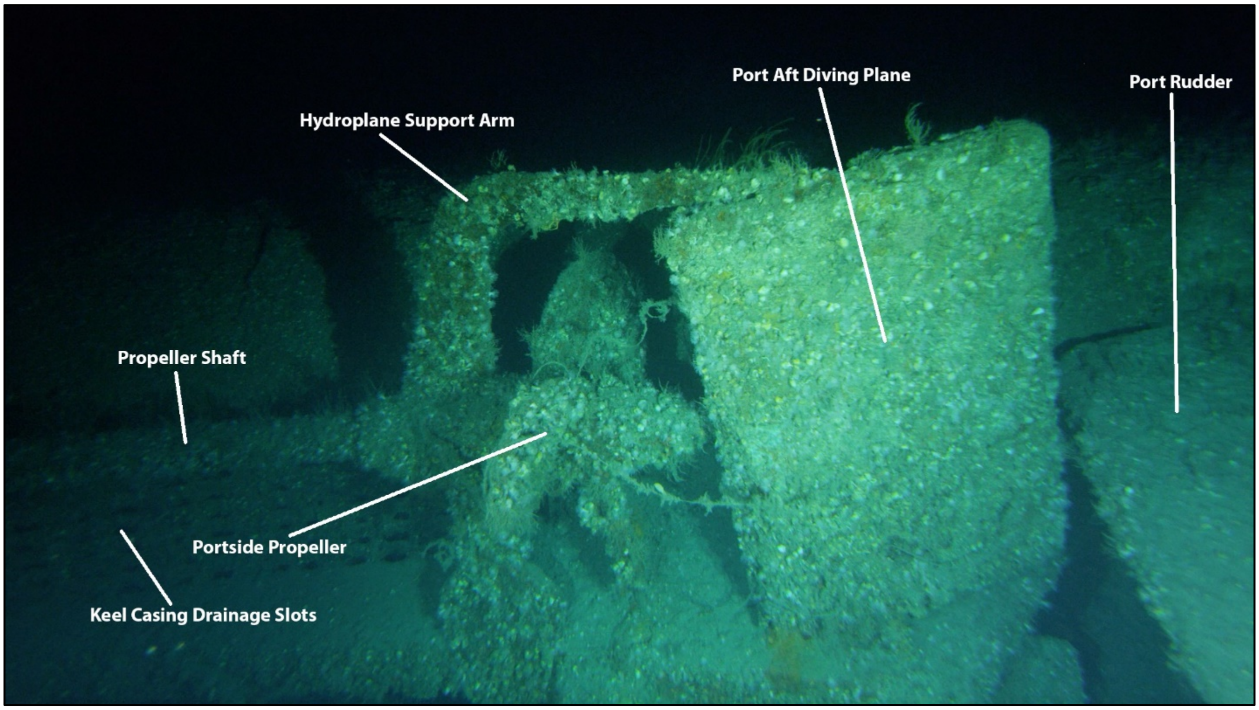


Figure 9-58 Port side propeller and diving plane assemblage.
Source: John McCord, UNC-CSI

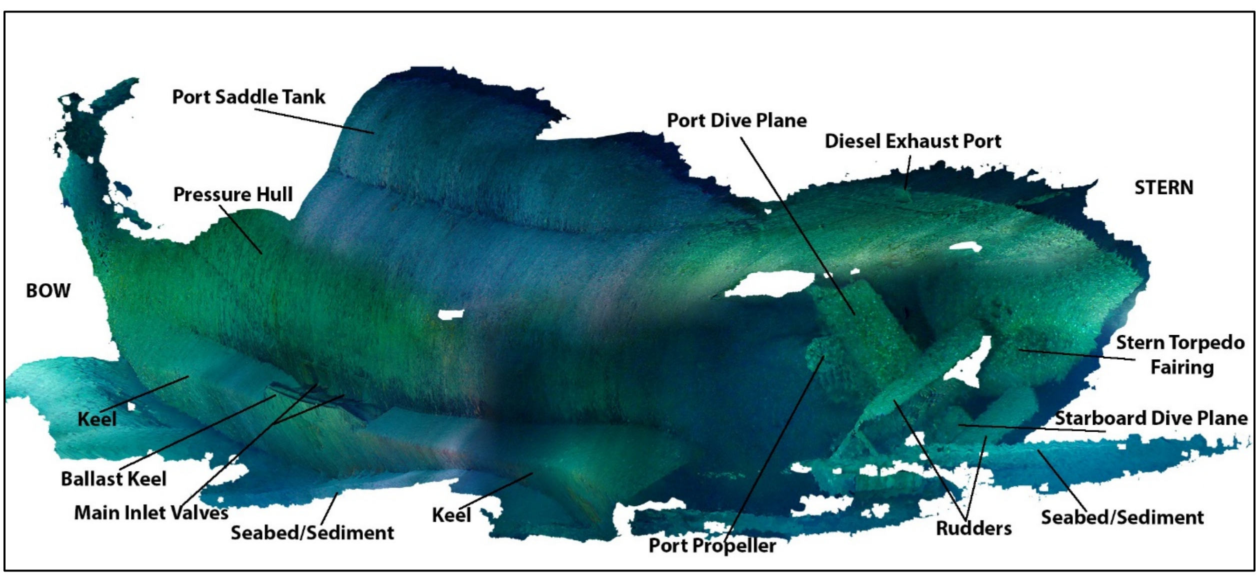


Figure 9-59 Isometric view of partial photogrammetry survey showing the stern and rudder assemblage.
Source: NOAA/BOEM – Images collected by William Hoffman

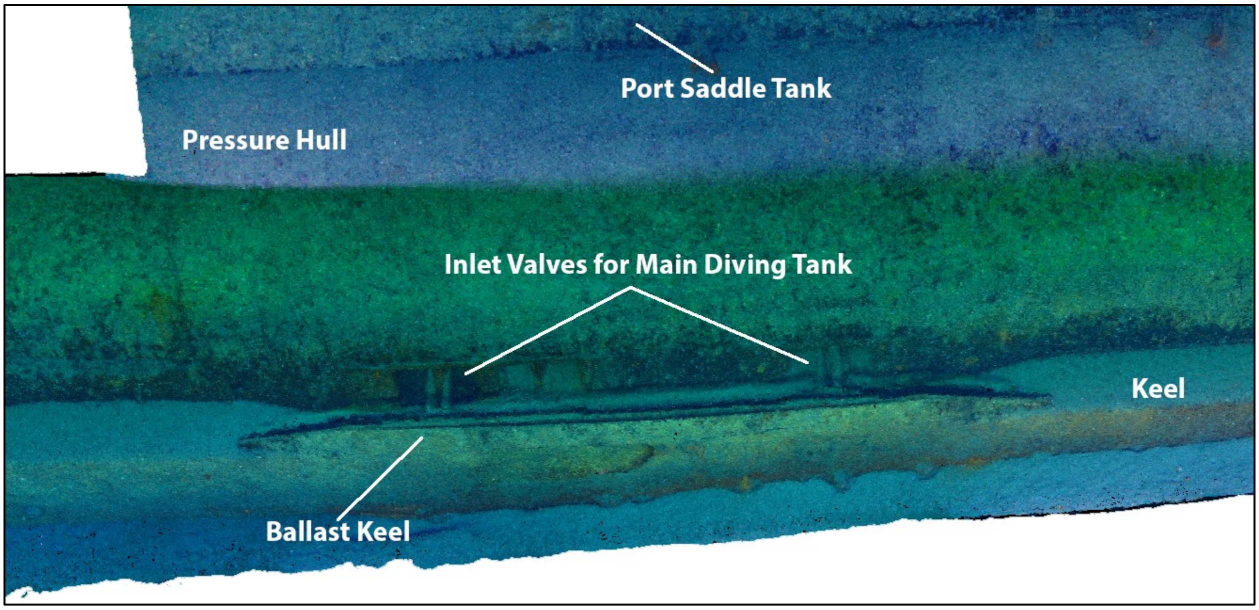


Figure 9-60 Detail view of the keel amidships showing the open inlet valves.
Source: NOAA/BOEM – Images Collected by William Hoffman

The planned survey of this site was terminated prematurely due to severe weather. The data that was successfully collected serves as a permanent record of the site and its disposition in 2016. Additional survey could possibly provide further insight into the loss. Whether the fatal blow was struck by the armed guard crew aboard *Unicoi*, or depth charge attack from scouting squadron VS-09, is currently unclear. Future research should focus on imaging the starboard side of the vessel to the degree possible and investigate means to acoustically profile the interior of the hull to determine of any significant air voids persist.

A great deal has been learned from this site with additional data, and it is clear the site is unique in the collection of wrecks off North Carolina. It is without a doubt the most intact Type VIIC U-boat currently known in U.S. waters and remains the only location of a convoy battle site with representative material remains of both sides of the conflict. Accordingly, on 8 December 2015, both U-*576* and *Bluefields* were listed on the NRHP as a single property due to their close proximity (reference number 15000864). The archaeological remains of U-*576* and *Bluefields* are significant at the national level under NRHP Criteria A and D for the year 1942. Both U-*576* and *Bluefields* are individually and collectively significant to Maritime History, Military and Archaeology – Historic as a result of their association with the Battle of the Atlantic off the United States East Coast and Gulf of Mexico (Marx and Hoyt 2015d).

9.4 U-*701*

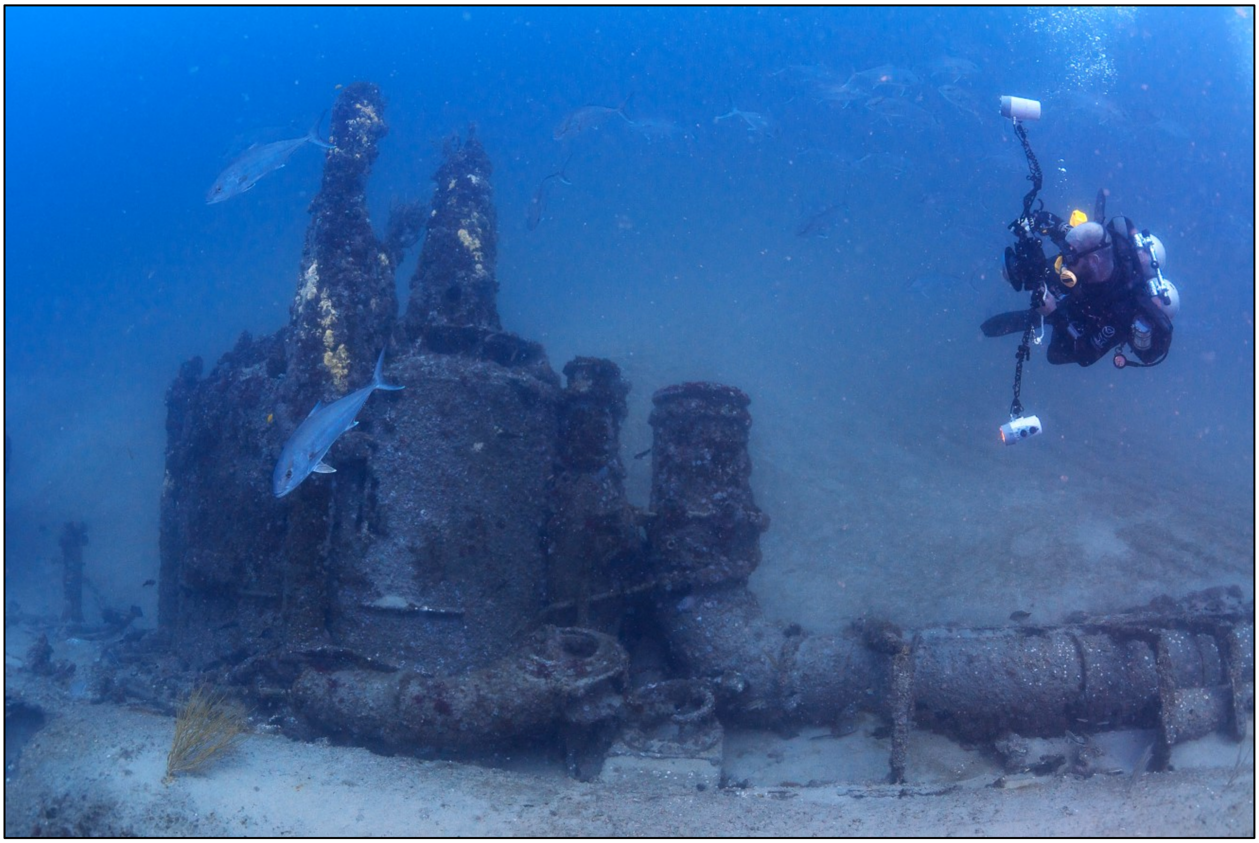


Figure 9-61 NOAA diver taking an image of the conning tower on U-*701*.
Source: NOAA

Table 9-4 Characteristics of U-*701*

Characteristics	U-*701*
Year of Build/Type/Hull #	1940/Military Type VIIC U-boat/760
Date Lost	7 July 1942
Position & Depth	@ 120 ft depth
Ship Characteristics	Displacement 761/865 tons (surfaced/submerged) Length: 67.1 m (220') Beam: 6.2 m (20') Draft: 4.8 m (15.7') Engines: 2,800 bhp/750 hp (2-shaft diesel/electric) Armament: 14 Torpedoes, 88-mm deck gun, 20-mm anti-aircraft
Cargo	n/a
Survivors	39 lost and 7 survivors
Owner	German Navy
Construction Details	Steel (Stl) hull, , Diesel/Electric Motor
Builder	H C Stulcken Sohn, Hamburg, Hamburg, Germany
Port of Registry/Flag	Germany
Sunk by	US Army Bomb. Sqdn. 396, Pilot 2Lt. Harry Kane
Data Collected	Still and video photography collection; site plan, high-resolution Reson multibeam survey; 3D video collection; listed on NRHP.

9.4.1 History

U-701 was the first U-boat built by the Stülcken Sohn shipyard in Hamburg, Germany (Table 9-4 above and Figure 9-61). Its keel was laid on 13 May 1940, and it was launched on 16 April 1941. The vessel was subsequently commissioned into the Kriegsmarine on 16 July 1941 (Figure 9-62). The conning tower of the U-*701* was decorated with a sea robin (Figure 9-63).

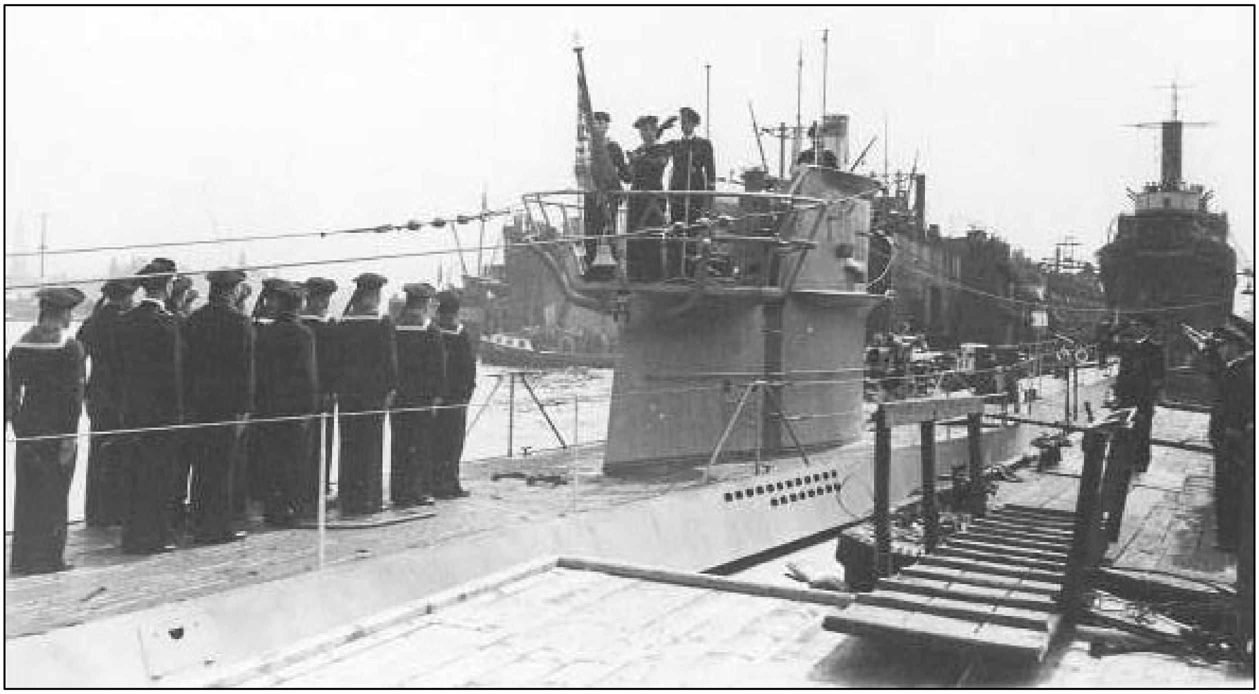


Figure 9-62 The U-*701* during the commission ceremony on 16 July 1941. Degen is standing on the conning tower saluting the flag.
Source: Dr. Günther Degen

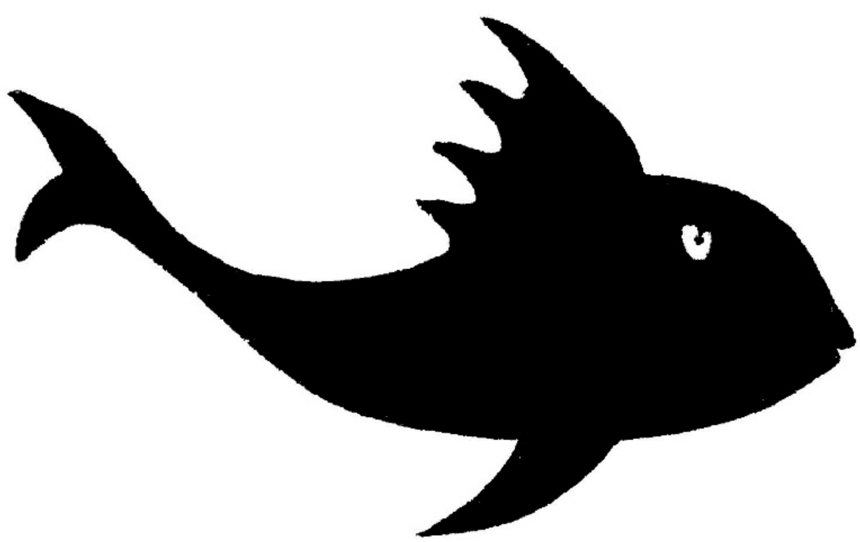


Figure 9-63. This emblem adorned the conning tower of U-*701*.
Source: Högel 1999:138

It was unusual for the construction of a U-boat to last nearly a year. In this case, the duration of construction was attributed to the fact that the yard had not yet produced a U-boat and was, subsequently, inefficient. As a result, there were persistent mechanical issues during and after the construction of *U-701*, enough to warrant a substantial refitting that further prolonged the completion of the U-boat. Most notably, the electrical wiring and the air and oil lines were improperly installed and had to be fixed (USONI 1942c:5; Wynn 1997:125).

Towards the end of the boat's construction, its future crew was ordered to Hamburg to oversee the completion of the vessel. This was done to familiarize the entire crew with each intricate detail of their U-boat. It was known as Baubelehrung, and was required of each crew taking command of a new U-boat. Baubelehrung on U-*701* began in May of 1941 (Busch and Röll 1999:53). After this, sea trials in the Baltic Sea took place under scrutiny of the U-Bootsabnahmekommission (U-boat Acceptance Commission). During these trials, more inadequacies of construction were exposed, at which point the vessel put into the Danzigwerft in Danzing. Evidently the yard was unsuited to carry out the necessary repairs and was ordered to report back to Stülcken Sohn shipyard for what would amount to an overhaul (USONI, 1942c:5).

Command of *U-701* was given to Kapitänleutnant Horst Degen of the Naval Class of 1933. Degen, was born in Münster, Westphalia on 19 July 1913 (Figure 9-64). He had served as the Second Watch Officer and the Torpedo and Radio Technical Officer on the destroyer *Z 10 Hans Lody* from September 1939 until June 1940. He transferred to the U-boat arm in July 1940, and by March 1941 Degen had completed the U-commanders course. Upon completion of the course, Degen was assigned to a U-boat for commanders training (Busch and Röll 1999:53). This he completed onboard *U-552*, commanded by Erich Topp (Figure 9-65). Topp went on to become one of the most famous U-boat skippers of the war, ranking fourth in overall tonnage sunk during the entire Battle of the Atlantic. Degen was heavily influenced by Topp's aggressive U-boat tactics and held Topp in high esteem stating that he had, "taught me all I know" (USONI 1942c:5).

Almost immediately upon his return, Kptlt. Degen reported to Hamburg to begin Baubelehrung and took command of U-*701* (Figure 9-66). The newly completed U-boat was attached to the third Flotilla, headquartered at La Rochelle, France. Due to ongoing repairs, the U-boat departed for its first war cruise directly from the shipyard in Kiel on 27 December 1941 (USONI 1942c:7).

In addition to being the first war cruise of U-*701*, the vessel was also taking part in the first deployment of U-boats into American waters. This cruise, as it turned out, was very difficult for the newly minted boat and crew. While outbound to their assigned operational area off Newfoundland, First Watch Officer Oberleutnant zur See Weinitschke was swept overboard and lost after going on deck in heavy weather without a safety belt (USONI 1942c:7). Continuing on, between 2 and 7 January, Kptlt. Degen found and attacked several ships, expending eleven torpedoes; only two found their target: British Baron Class freighter *Baron Erskine*. After the ship sank completely, Kptlt. Degen approached the lifeboat with survivors to inquire as to the name of the vessel, which was refused. Due to severe weather, Kptlt. Degen was also concerned that the lifeboats might be lost. He was right; no survivors of *Baron Erskine* were ever found (Gannon 1990:144).

Figure 9-64 Kptlt. Horst Degen.
Source: Dr. Günther Degen

Figure 9-65 Commander Erich Topp (second from left) and Horst Degen (far right) on the conning tower of the U-*552*.
Source: Dr. Günther Degen

The weather encountered during the rest of the Atlantic crossing was atrocious. Kptlt. Degen could not maintain an appropriate topside watch. After heavy seas caused a bridge gun to come loose, injuring his Second Watch Officers, Kptlt. Degen decided to run submerged. Because of this, he was not able to replenish his torpedo supply until calm weather would allow him to access the additional torpedoes stored outside of the pressure hull. After about 5 weeks of patrolling, U-*701* was recalled, and returned to St. Nazaire on 9 February 1942, having sunk only a single vessel. For this unimpressive patrol, Kptlt. Degen received harsh criticism from Admiral Döenitz. His expenditure of 11 torpedoes and only a single resultant sinking was thought to be excessive and rash. Likewise, he did not conduct what Döenitz believed to be an adequate man-overboard search when the First Watch Officer was lost (Blair 1996:143, 543).

After two weeks in St. Nazaire, U-*701* embarked on its second war patrol, departing 26 February. Döenitz initially planned to send U-*701* back to American waters, but was obliged to divert Kptlt. Degen in order to maintain a strong presence in the Northwest Approaches to England. In contrast to the previous patrol, Kptlt. Degen found much success during his second war patrol. From 6 through 11 March, Kptlt. Degen sank 3 confirmed ships (possibly a fourth as well, *Rononia*, but this is unconfirmed), expending just 7 torpedoes (USONI 1942c:8; Blair 1996:552; Wynn 1997:126).

In addition to the freighters, Kptlt. Degen also attacked and sunk two British antisubmarine trawlers. On 8 March, U-*701* sunk the warship HMS *Notts County* and 3 days later sank another vessel of the same class, HMS *Stella Cappella*. The remainder of the patrol was fruitless due to heavy weather, which prevented any further attacks. By 1 April, U-*701* made its way to Brest, completing a successful second patrol (USONI 1942c:8; Blair 1996:552; Wynn 1997:126). This patrol evidently redeemed Degen's command in the eyes of Döenitz, who subsequently referred to him as the 'Gallant Degen' (Taylor 1958:178).

The crew of U-*701* was granted more than a month of liberty while at Brest, and did not embark again until 19 May 1942. This patrol began with a transfer to Lorient, where they completed refueling and departed for their operational area on 20 May (Wynn 1997:126). This was to be by far the most successful patrol of the U-*701*, and it would also be its last.

This patrol was part of operational group *Hecht* (English: *Pike*). Five of the *Hecht* boats, including U-*701*, were diverted for special missions. This special operation represented possibly the most aggressive coordinated U-boat assault on the United States in the entire war. Three of the boats were assigned to mining ports along the East Coast: Delaware Bay, Boston Harbor, and the Chesapeake Bay. Meanwhile, two other U-boats landed Abwehr agents (German equivalent to a CIA operative) on United States soil in Long Island and in North Florida. These two groups of agents intended to meet in Cincinnati, Ohio and coordinate sabotage on shipyards and factories. The five boats diverted for these special missions were to rendevious in the Cape Hatteras area following completion of their respective tasks (Döenitz 1945:76; Blair 1996:602).

U-*701* was the boat assigned to mine the Chesapeake Bay area. On 12 June, Kptlt. Degen arrived off the entrance to the Chesapeake and proceeded to strategically lay 15 delayed action TMB mines (Figure 9-67). Cape Henry and Cape Charles lights were bright and visible, which assisted Kptlt. Degen in accurately fixing a position. Within 30 minutes, U-*701* had deposited all of its mines in 36 ft of water directly in the shipping channel (Hickam, Jr. 1989:246; Blair 1996:602; Wynn 1997:126).

This minefield was very productive, sinking 2 ships and severely damaging 3 more. On 15 June 1942, convoy KN109 from Key West to Norfolk came into contact with the active mine field. The first two ships hit were American tankers *Esso Augusta* and *Robert C. Tuttle* (Figure 9-68 and Figure 9-69). These ships were severely damaged, but were later returned to service. On the same day, the 448-ton British anti-submarine trawler, HMS *Kingston Ceylonite* struck another of Degen's mines and was destroyed. Additionally, four stack destroyer USS *Bainbridge* was slightly damaged when one of its own depth charges detonated a nearby mine. Following this chaos, the channel was closed until it could be properly swept. Once cleared, the channel was reopened. Unfortunately, the sweeps had not entirely cleared the area and a remaining mine struck and sunk American freighter *Santore* (Figure 9-70) (Hickam, Jr. 1989:256; Chewning 1994:95; Blair 1996:602; Wynn 1997:126).

Figure 9-66 The U-*701* at sea conducting training exercises.
Source: Dr. Günther Degen

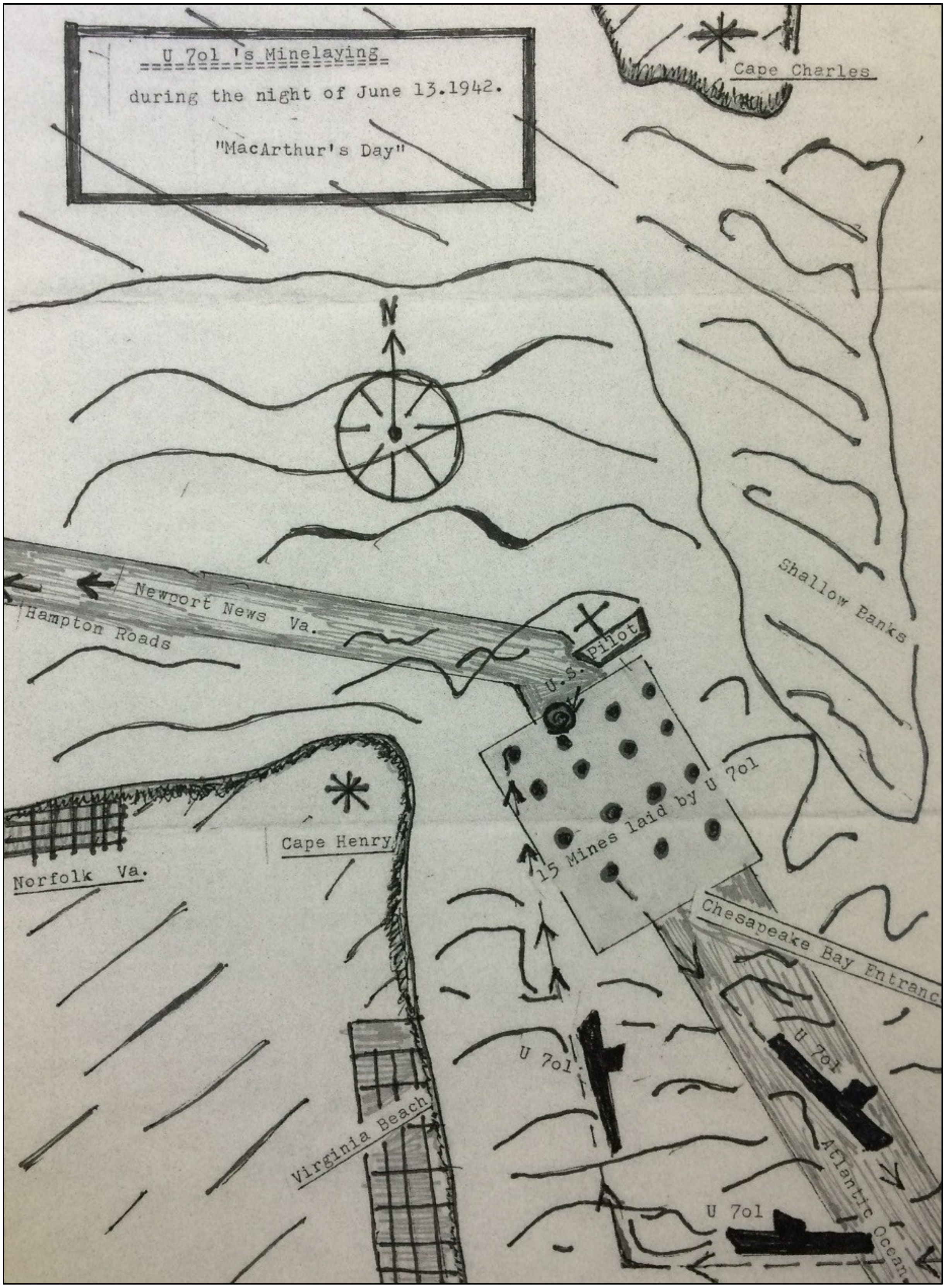


Figure 9-67 Hand drawn map by Horst Degen showing the distribution of mines he laid with U-*701*.
Source: Ed Caram Collection 2011

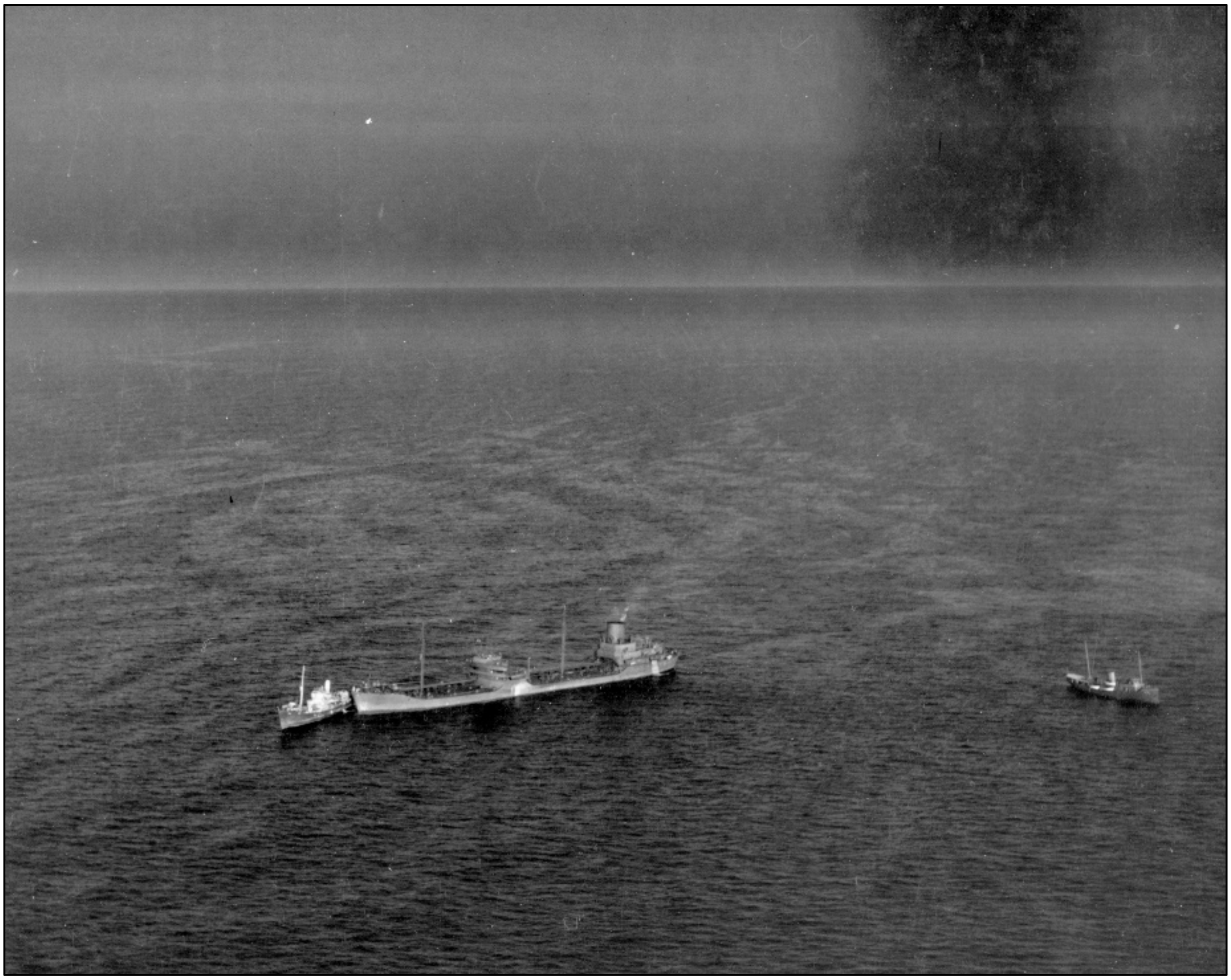


Figure 9-68 The *Esso Augusta* being towed in for repairs following detonation of one of U-*701*'s mines at the entrance to the Chesapeake Bay.
Source: NARA

U-*701*'s participation in the special mission was seen as a complete success in the eyes of Admiral Döenitz, who forwarded Kptlt. Degen a congratulatory radio message. In fact, of all the *Hecht* group boats assigned to the special mission, U-*701*, was the only one that achieved its goals. Furthermore, this was the only mining operation with appreciable success in United States waters in the entire war (Blair 1996:602).

Following the mining operation, Kptlt. Degen took U-*701* to waters off Cape Hatteras. For about a week U-*701* was again dogged with mechanical issues. Their ventilation system was functioning poorly and the boat was extremely hot in the warm gulf stream waters. Kptlt. Degen sighted some convoys and fired off two torpedoes which did not find targets, and on one occasion was depth charged by aircraft, which caused damage to gauges and the main periscope (Döenitz 1945:122).

On 19 June, U-*701* came into contact with a small US Navy patrol boat, USS *YP-389* (Figure 9-71). Kptlt. Degen had possibly encountered and avoided this same vessel a number of times over the preceding days, but when he inadvertently surfaced near *YP-389*, Degen decided to sink the vessel with surface gunfire. After a brutal exchange between the two vessels lasting over an hour, *YP-389* succumbed despite an impressive resilience for such a small craft (see Section 8.3, on USS *YP-389*; USONI 1942c:12; Döenitz 1945:135; Hickam, Jr. 1989:262; Blair 1996:606; Wynn 1997:126).

Then, another week of little activity. The crew of U-*701* spent most of their days bottomed to conserve fuel, surfacing only briefly to flush the heat and stench out of the boat. During this time, an extra vigilant watch was set to guard against patrolling American aircraft. On 26 June 1942, U-*701* torpedoed Norwegian freighter *Tamesis*. On the following day, Kptlt. Degen spotted British tanker *British Freedom* and sent one torpedo into its side. Both the *Tamesis* and the *British Freedom* were only damaged by the attack and were later returned to service (Wynn 1998:126).

For Kptlt. Degen and the crew of U-*701*, this had already been an exceptional patrol. But on the very next day, they encountered SS *William Rockefeller*. This was one of the largest tankers in the world at the time: a gargantuan 14,054 tons. Sinking the *William Rockefeller* would be a praiseworthy ending to this highly productive patrol. Kptlt. Degen fired one well-aimed torpedo at the tanker, resulting in severe damage that brought *William Rockefeller* to a halt. US Coast Guard boats and aircraft rendered assistance and facilitated its abandonment by the crew. After dark, Kptlt. Degen returned to the tanker's drifting hulk and fired one more torpedo to sink the ship (USONI 1942c:12; Hickam, Jr. 1989:262; Blair 1996:606; Wynn 1997:126).

Figure 9-69 Smoke billows from the side of *Robert C. Tuttle* after striking a sea mine laid in the approaches of the Chesapeake Bay by U-*701*.
Source: NARA

Figure 9-70 The SS *Santore* sinks in shallow water off the Virginia Capes after striking a mine planted by U-*701*.
Source: NARA

Thus far during the patrol, Kptlt. Degen was responsible for sinking 21,789 tons and damaging an additional 38,283 tons. Altogether, at 60,072 tons, this was the best single Type VII patrol (Blair 1996:608). Three of these 9 vessels were warships and one was the largest tanker sunk by a U-boat to date. Additionally, the success of the mining operation was highly regarded by Admiral Döenitz. U-*701*'s war patrol, however, was not over yet.

U-*701* continued patrolling off Cape Hatteras for over a week after sinking *William Rockefeller*. During the day they sat on the bottom, but came up occasionally to freshen the boat's air. On 7 July, while surfaced at around 1300 hours, First Watch Officer Konrad Junker failed to spot an Army Air Force Hudson approaching the U-boat. By the time he noticed the plane, it was too late. The Hudson, piloted by Second Lieutenant Harry Kane out of MCAS Cherry Point, North Carolina, accurately dropped three 325-pound depth charges (USONI 1942c:12; Hickam, Jr. 1989:262; Blair 1996:606; Wynn 1997:126).

As U-*701* attempted a crash dive, 2Lt. Kane's charges hit (Figure 9-72 and Figure 9-73). The damage was such that Kptlt. Degen could not blow the ballast tanks and surface. Instead, the crew had to bailout of U-*701* when it came to rest on the bottom. Two separate groups of survivors reached the surface. All but 7 of the crew escaped the boat. However, 2Lt. Kane was not able to offer assistance in his Hudson, except to radio a position and drop a smoke flare. The remaining crew of 36 drifted with the gulf stream for 49 hours. During that time all but 7 drowned. On 10 July, Navy blimp K-*8* located the survivors and called in a US Coast Guard sea plane, which recovered the 7 crew members, Kptlt. Degen included (USONI 1942c:12; Hoyt 1978:184; Hickam, Jr. 1989:262; Blair 1996:606; Wynn 1997:126).

Figure 9-71 The fishing trawler *Cohasset* at the Brooklyn Navy Yard preparing for conversion to *YP-389*.
Source: NARA

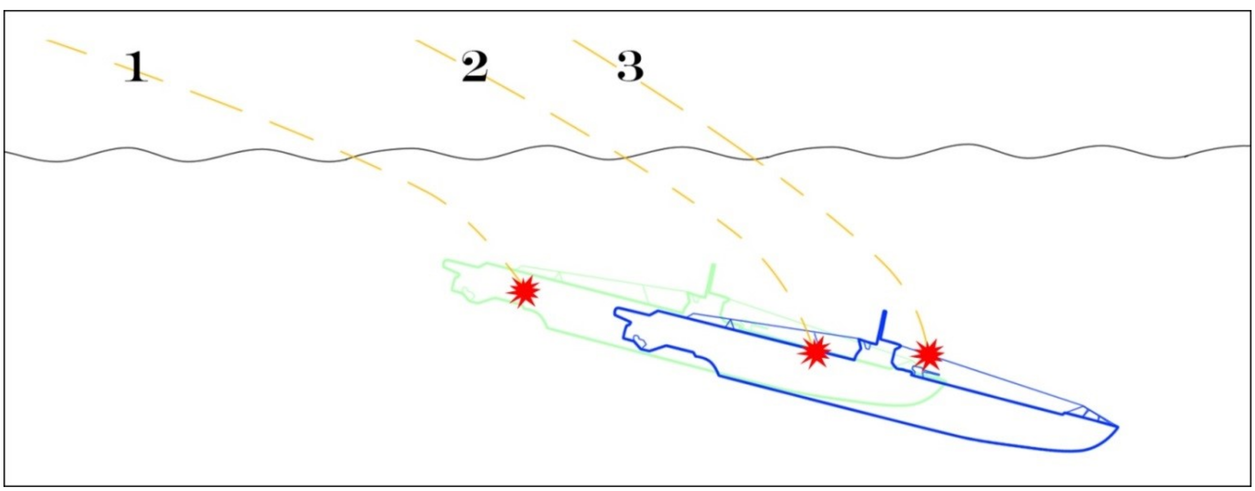


Figure 9-72 Analysis of 2Lt. Kane's attack on the U-*701*.
Source: USONI 1942c

Figure 9-73 Lt. Harry Kane, Jr. poses for a picture with his crew. He points to a location on a chart where he attacked the U-*701* off Cape Hatteras.

Source: NARA

Upon being rescued off Hatteras, the remaining U-boat crew were suffering heavily from exposure, dehydration, sunburn, and were covered in oil (Figure 9-74). After a short period of recovery, 2Lt. Harry Kane and the crew of his bomber wished to meet with Kptlt. Degen to apologize for not being able to render more immediate assistance to the U-boat's crew (Figure 9-75). Thus, the crew of U-*701* were taken as POWs, and they remained in various prison camps in the United States until the end of the war (Figure 9-76).

9.4.2 Archaeological Site Description

The remains of U-*701* were completely undisturbed for 47 years until discovered by sport divers in 1989 (Cook 2004; Nolan 2004). The vessel was located in approximately 110 ft of water surrounded by the shifting sands and currents where the Gulf Stream and Labrador current collide off of Cape Hatteras. After its discovery in 1989 by sport divers, the location of the U-boat was kept a secret from the public for many years. As a result, very few artifacts were looted during this time (Keatts and Farr 1994:115; Kozak 2004; Cook 2004; and Nolan 2004).

The site was discovered by another group of divers in 2004, following a hurricane; thereafter, recreational charter boats began regular service to the site (Cook 2004). Despite an outpouring of requests among the sport diving community to maintain the 'pristine' quality of U-*701*, the site was almost immediately subjected to looting (Cook 2004; Allegood 2004; Kozak 2004). Despite the years of looting that followed, by 2008 the site was still far more intact than the remains of both U-*85* and U-*352.* The disparity in archaeological site integrity among these three vessels—lost within months of each other, each resting in a similar oceanographic environment—is a testament to the potency of illegal looting and desecrating anthropogenic influences over site formation processes. In short, the large temporal gap between U-*701's* loss and discovery by the wider public, combined with its relative difficulty to access, appeared largely responsible for its higher state of preservation when compared to U-*85* and U-*352*.

U-*701* rests in an amazingly dynamic area characterized by dramatic shifts in water current, temperatures, salinity, and bottom geology. The vessel is periodically covered completly with sand and other times is nearly completely exposed. It is possible that any visit to U-*701* may find the vessel in any state between burial and exposure. Though alternation between inundation levels seems fairly normal, observations between 2008 and 2015 revealed that, at the very least, the conning tower and the 88-mm deck gun seemed consistently exposed. Major portions of the hull were buried when the team investigated in 2008, only to be completely scoured out in subsequent surveys (Figure 9-77).

The highly dynamic geological conditions surrounding the site are representative of its overall accessibility to divers. Visiting the site is difficult due to the array of variable and unpredictable conditions possible. Owing to its location with respect to transit times from proximate inlets (Oregon, Hatteras, and Ocracoke), traveling to U-*701* often takes much longer than visiting other vessel sites off Hatteras, and is also more prone to inclement weather. Once at the site, water temperature, current, and visibility also vary greatly, and in some cases may be too unsafe for recreational divers to attempt diving to the site. All other factors notwithstanding, one may enjoy ideal weather and water conditions only to visit the site and find most of it completely buried.

Figure 9-74 Survivors from U-*701* recovering in Norfolk, Virginia. Left, Obersteuermann Winter Kunert covered in oil. Right, Funkmaat Herbert Grotheer's face shows extreme sun burn.

Source: NARA

Figure 9-75 Harry Kane (seated left) and Horst Degen (seated right), meet shortly after Kane sunk U-*701*.
Source: NARA

In addition to the geographic and environmental difficulties, the site itself also poses some hazards, namely live, unexploded ordnance. When the vessel sank it still had two or three torpedoes onboard. These were most likely loaded into the tubes, ready for use. Depending on the condition of the bow and stern, and the variability of sediment, it may be possible to discern how many torpedoes were on the vessel, as well as their location. Additionally, depending on the amount of scour, it is possible that 20-mm and 88-mm shells are also arrayed around the site. Features observable on site that may contain munitions include the bow and stern external torpedo containers. These were watertight tubes, which contained spare torpedoes, located on the outside of the pressure hull beneath the outer hull fairing. It is likely however, given that U-*701* depleted most of its torpedoes operationally, that these external tubes would have been emptied, and the torpedoes transferred to the interior of the U-boat and loaded into firing position in the torpedo tubes. While this is the most likely scenario, it remains possible that these containers still hold the remains of torpedoes. The single external container at the stern is often exposed, as well as the port side container near the bow. The forward ready ammunition locker was also exposed just forward of the 88-mm deck gun. This watertight container was located outside the pressure hull with a 'clam shell' hatch accessible from the external deck level near the main deck gun. It would have contained various types of shells for the 88-mm gun. While a number of rounds were discharged from this weapon during U-*701*'s engagement with *YP-389*, it remains very likely additional rounds remain in this container.

Figure 9-76. The seven surviving crew members of U-*701* after being taken into United States custody. Top: left, Maschinenmaat Ludwig Vaupel; middle, Mechanikersegefreiter Werner Seldte; right, Obersteuermann Winter Kunert. Center: Horst Degen. Bottom: Mechanikers

Source: NARA

Figure 9-77 Scour exposed stern section of U-*701* in 2011.
Source: NOAA

Because of extant records, it is possible to compare the state of the site at its earliest discovery with its state today. By 2008, many features had been removed from the site that were documented in place prior to 2004. These included the sky periscope, the radio direction finding (RDF) loop, and the gun harnesses on the 88-mm deck gun, as well as some of the gun's smaller components. These features are believed to have been intentionally looted in 2004 (Cook 2004; Allegood 2004; Kozak 2004). The detailed archaeological site plan developed in 2008 is a comprehensive record of the state of the site at that time, and will aide in understanding impacts to the site moving forward, both natural and anthropogenic (Figure 9-78 through Figure 9-80).

As the site often has greater sediment cover and fewer human interactions over the years, the degree of preservation on this site is particularly evident in the remains of the outer hull fairing. Each Type VII U-boat was doubled hulled, containing a pressure vessel that was fitted externally with various components; exhaust trunking, ventilation, escape hatches, loading ports, external armament, and pressurized air flasks, etc (Figure 9-81). Though all of these components were essential to the boat's operation, they were not hydrodynamic as fitted to the pressure hull. As such, the entire vessel was encapsulated by a floodable outer hull fairing to protect and streamline these features. As it was not a pressure sensitive feature, the gauge of the steel was less robust and consequently this feature is often poorly preserved in other U-boat sites in similar depths.

When U-*701* was first investigated in the summer of 2008, a great deal of sand was covering the site, roughly up to the deck level (Figure 9-82). When the site was revisited in 2011 to collect 3D imagery, an enormous amount of sediment overburden had been removed to the point where the seabed undercut both the bow and stern sections. The forward diving planes were exposed at the bow, and at the stern both propellers, both rudders, and both diving planes were also exposed (Figure 9-83 through Figure 9-86).

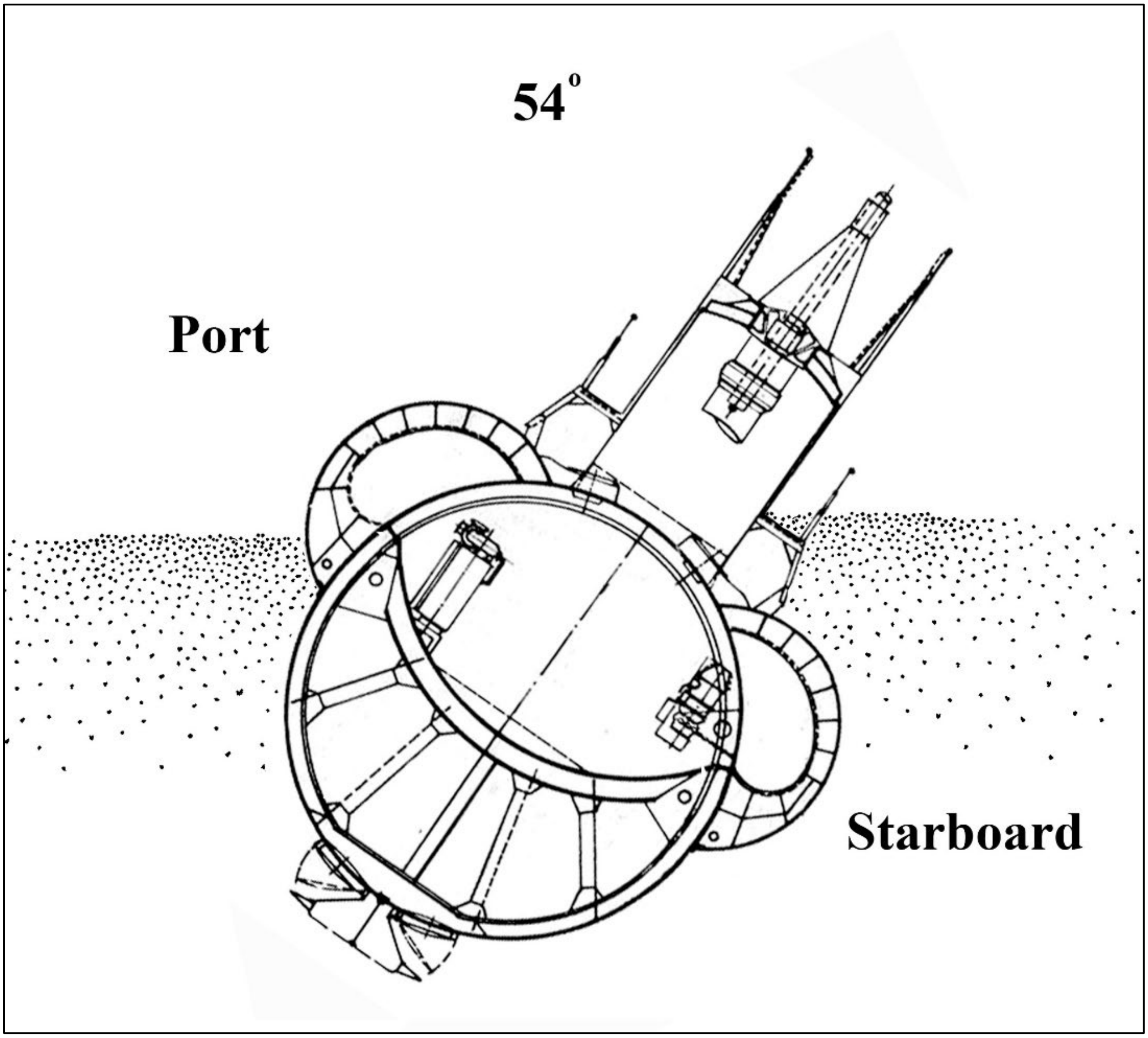


Figure 9-78. U-*701* angle of orientation to the sediment.
Source: NOAA

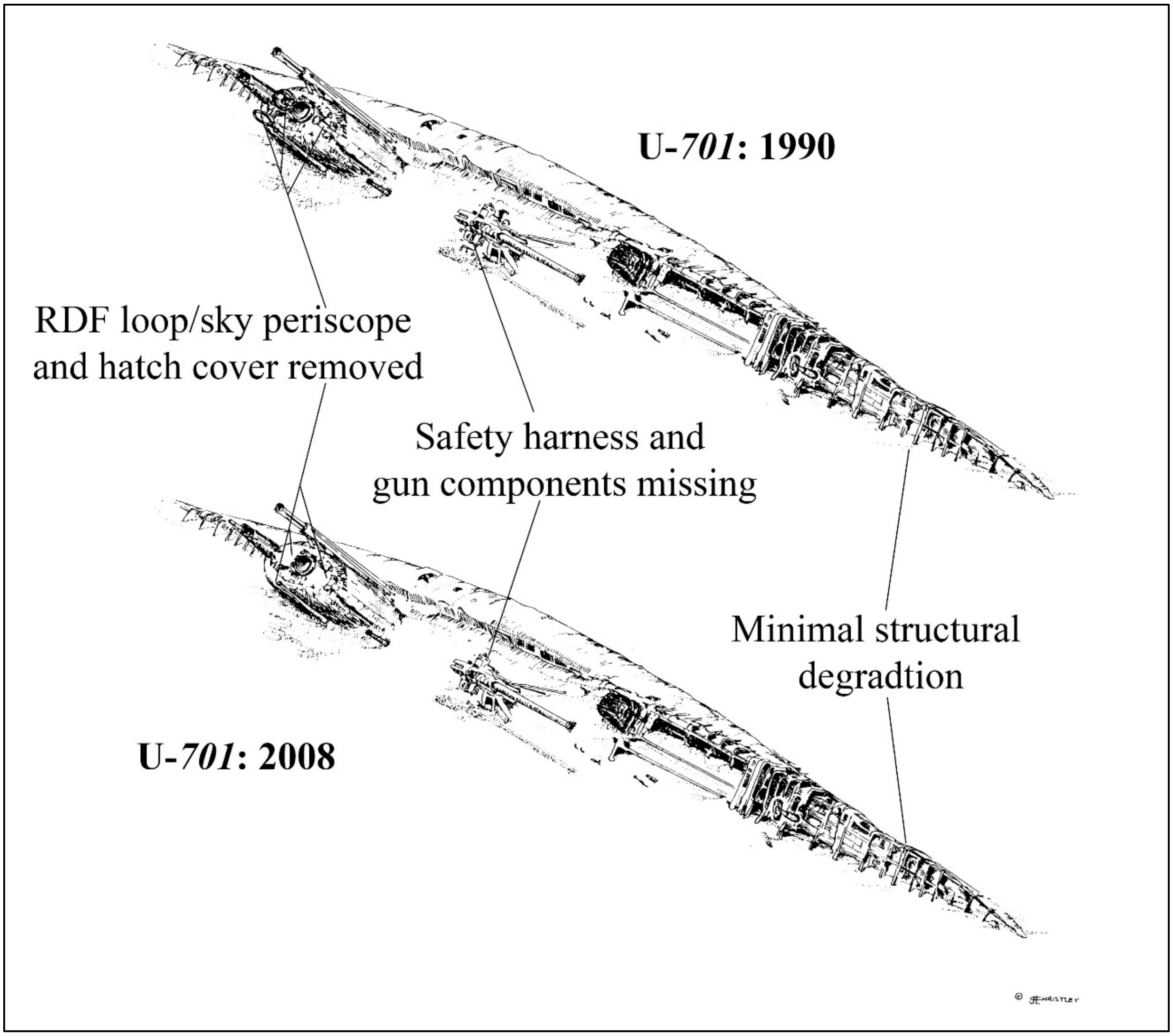


Figure 9-79 Artist's depiction of the U-*701* as drawn from video and still imagery in 1990 (top) and 2008 (bottom), illustrating one artist's interpretation of the site over an 18-year period.

Source: Artwork courtesy of James Christley

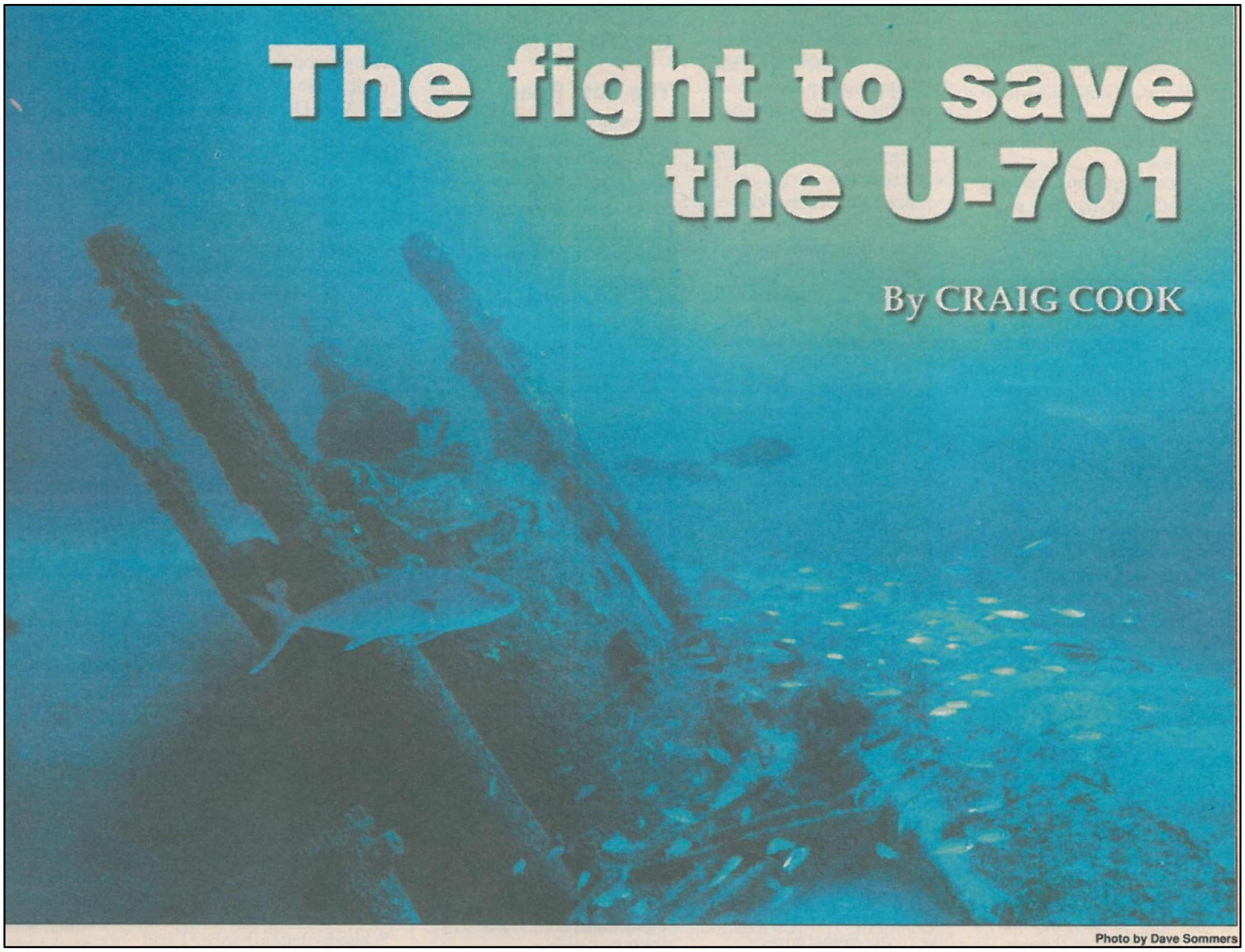


Figure 9-80 Image of the conning tower with RDF visible.
Source: Dave Sommers/Island Breeze

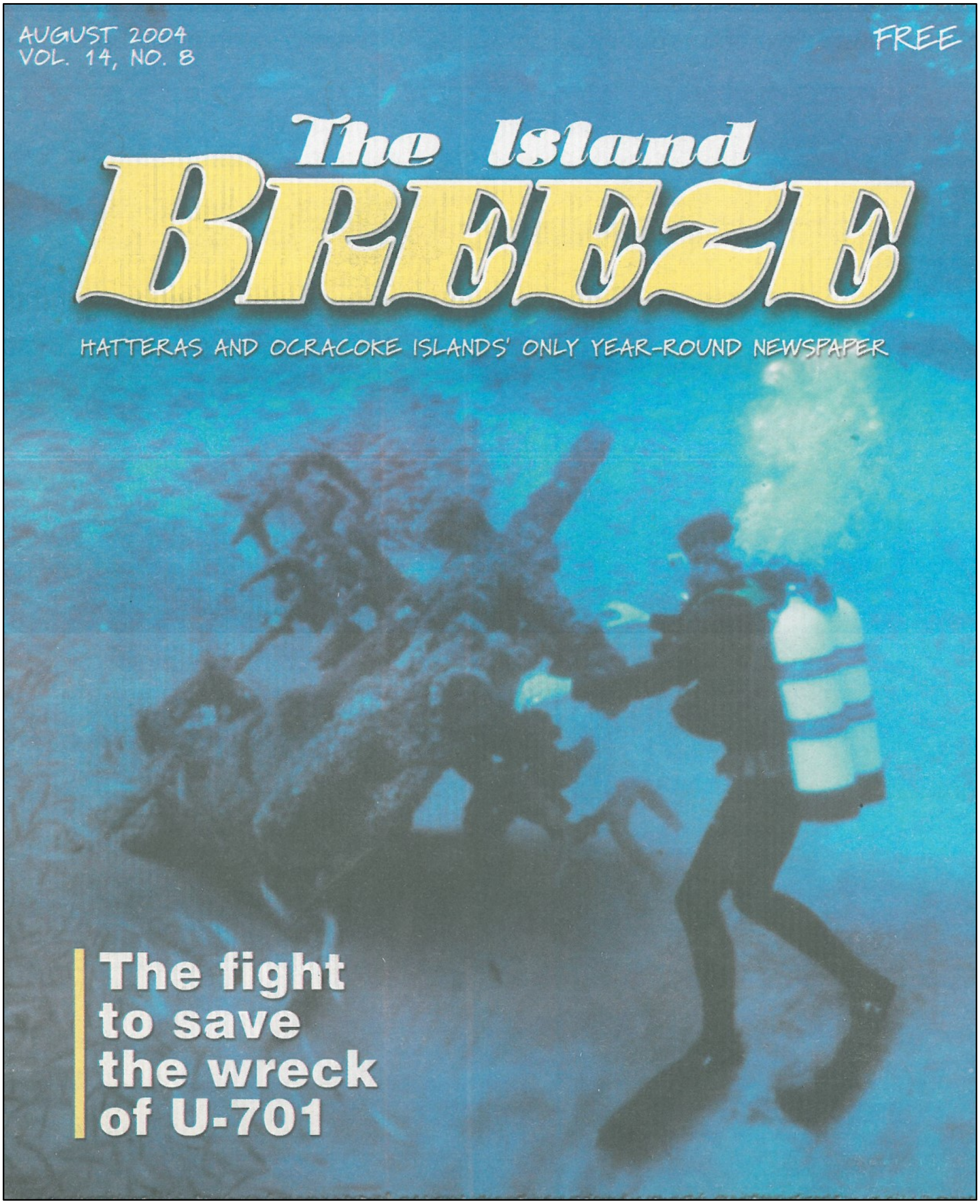


Figure 9-81 88-mm deck gun in 2004 with harnesses intact.
Source: Dave Sommers/Island Breeze

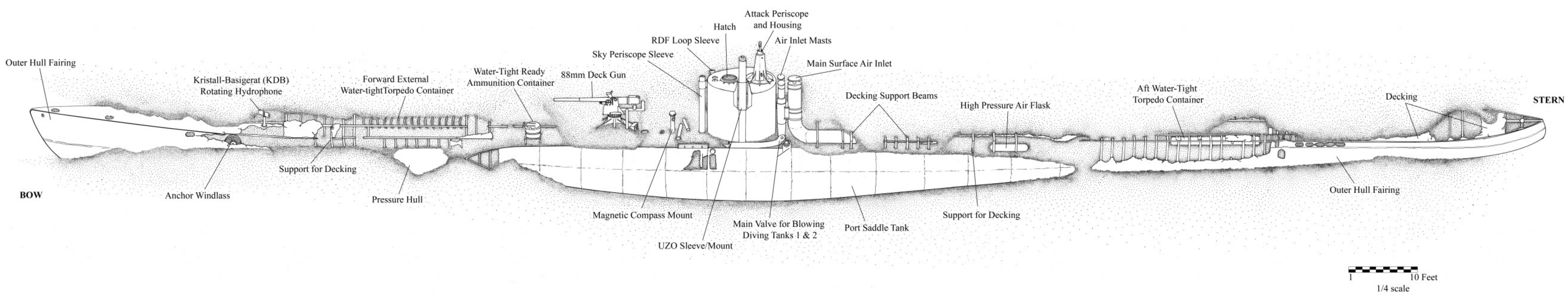


Figure 9-82 Finalized archaeological site plan of the U-*701* wreck site.
Source: NOAA

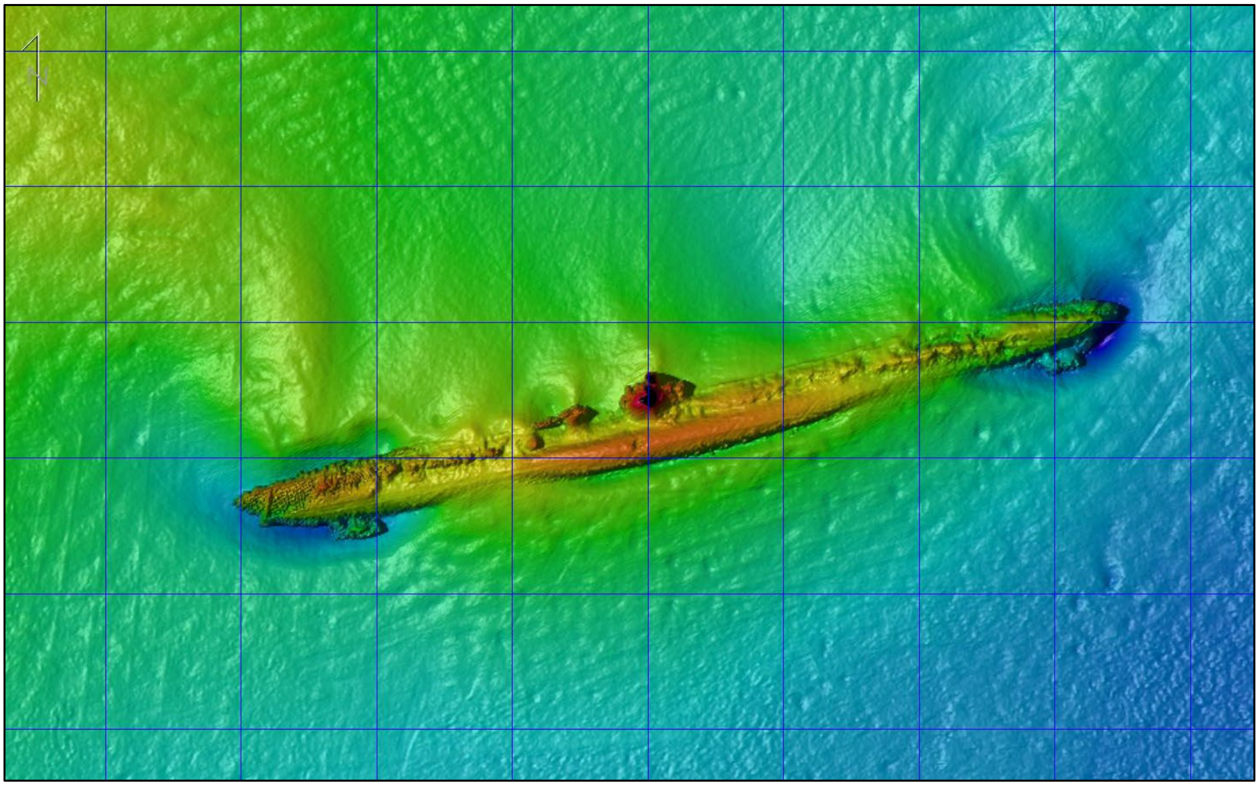


Figure 9-83 2011 Reson 8125 scaled multibeam survey of U-*701* wreck site.
Source: ADUS

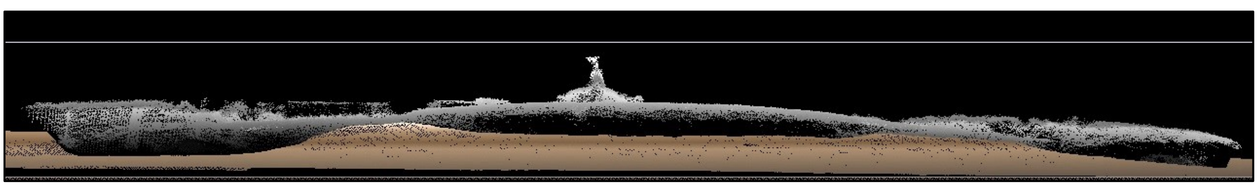


Figure 9-84 Profile view multibeam SONAR visualization of U-*701* wreck, 10-m grid.
Source: ADUS

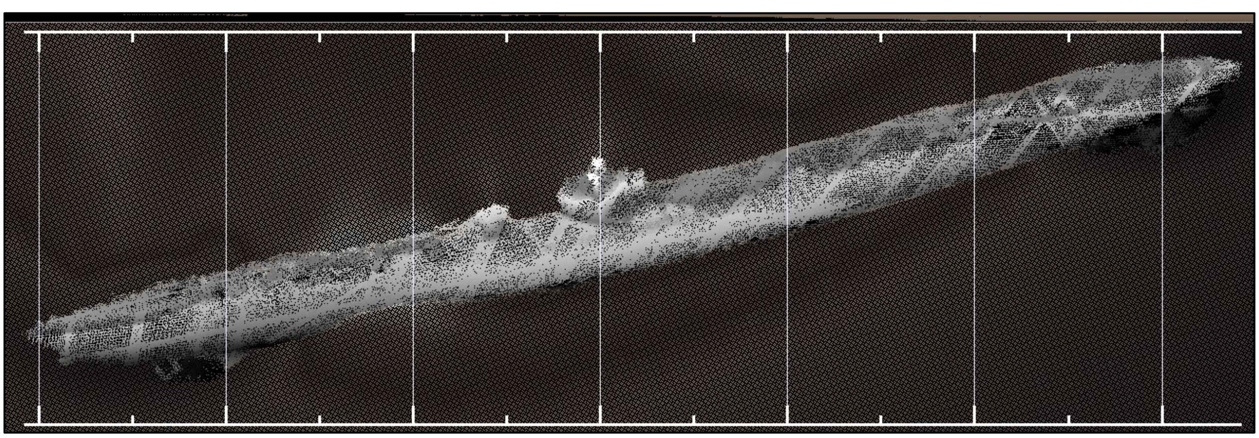


Figure 9-85 Plan view multibeam SONAR visualization of U-*701* wreck, 10-m grid.
Source: ADUS

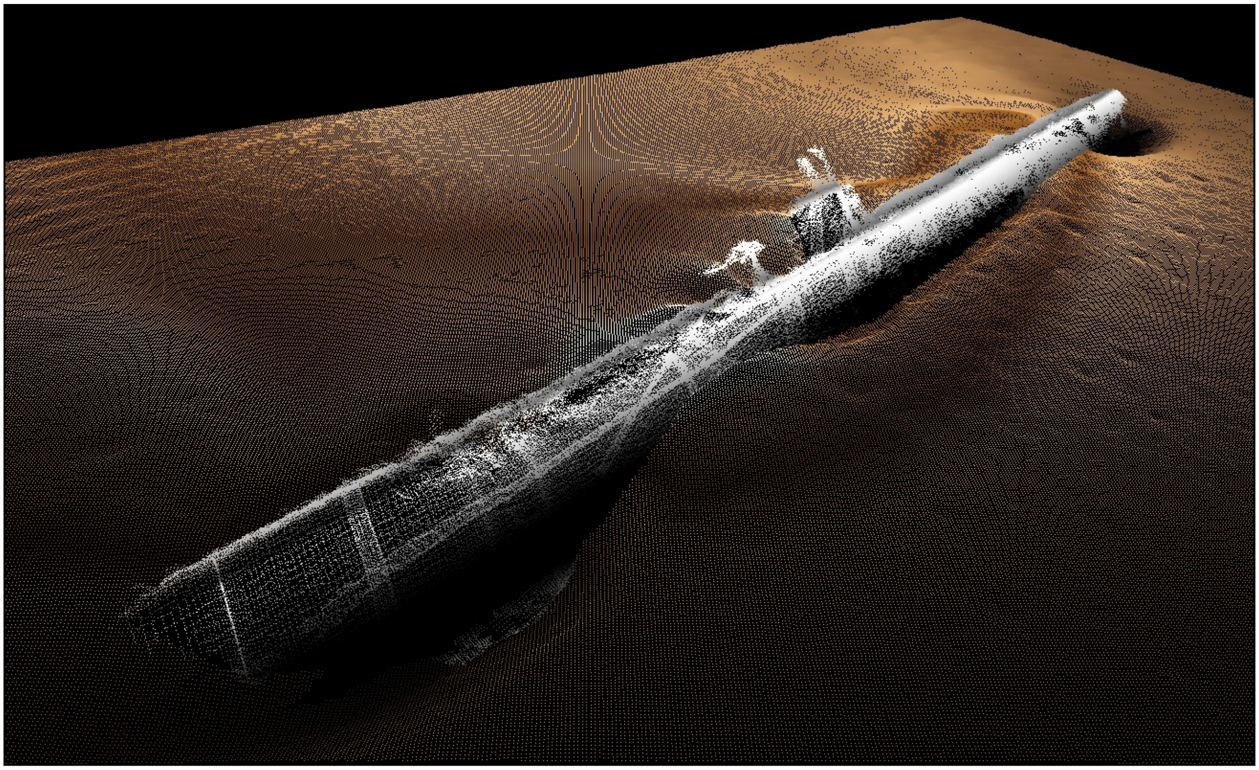


Figure 9-86 Isometric SONAR visualization of the U-*701* wreck site.
Source: ADUS

9.4.3 Description of Impact at the Site of the U-*701*

- The main hatch on the conning tower has been completely removed. There is clear evidence this was a result of human impact and occurred since 2004.
- The RDF loop has been removed most likely by means of hacksaw or oxygen lance. Due to marine growth, it is difficult to determine the method of removal; however, it is clear that it was removed deliberately since 2004.
- The main periscope or sky periscope and a section of its housing has been cut off and removed, likely by the same means as the RDF loop. This also occurred since 2004.
- 88-mm gun safety harnesses removed; known to be present prior to 2004.
- Various small components of the 88-mm deck gun have been removed.
- The 88-mm brass gunsight has been removed, though this occurred more than a decade ago.
- The head of the magnetic compass is missing. No indication as to when this was last known to be present. Given that the rest of the assembly remains intact, this indicates human impact.
- Location of 20-mm antiaircraft gun is unknown. Presumably as the conning tower fairing structure, which was made of the lighter hull fairing material, decayed to the point where it could no longer support the 20-mm gun. In this case, the gun may well be on site albeit completely obscured by sand. Alternatively, it may have been recovered at some unknown time by private individuals. In early data from the site, there is no representation of the gun. It is most likely that natural forces have resulted in the gun being buried, and is likely still within a 100-m radius of the site.
- The decking is completely gone. This is undoubtedly a natural process, as the deck material was wood and could not be expected to be preserved in this environment.
- Unlike the other U-boats in this study, the majority of U-*701*'s outer hull fairing is present and has a remarkably high degree of preservation. Though some sections do show evidence of

deterioration, it is possible that these areas coincide with damage incurred during the sinking event. This preservation is likely due to the sands that have been known to cover large portions of the site.

- The conning tower fairing is completely gone. This portion would have had a higher likelihood of exposure to the elements and it is believed to have been a natural process that caused the deterioration of this feature.

9.4.4 Features Believed to be Threatened at the Site

- The attack periscope. During the 2008 survey, the attack periscope was present and in good condition with intact glass. It protrudes approximately 1 ft out of the housing sleeve and could be easily removed with hand tools.
- The Kristalldrehbasisgerat (KDB, crystal rotating base) rotating hydrophone. This feature is exposed and accessible. It is also small enough to be recovered without specialized equipment. It should be noted that this is the only U-boat site in North Carolina where this feature is extant.
- Potentially internal components.
- The outer hull and pressure hull will continue to deteriorate at an as-of-yet unknown rate.
- The presence of human remains inside the hull is highly likely.

U-*701* is significant to American military, maritime history, and historic archaeology as it was the first U-boat sunk by the United States Army Air Force off the American East Coast during the Battle of the Atlantic. The U-boat still retains enough integrity to meet the NRHP Criteria A and D and be significant to the nation. U-*701* is a rare example of a Type VII-C German U-boat and its location off North Carolina makes it only one of a handful of its kind near the United States available for study. On 12 November 2015, U-*701* was listed on the NRHP (reference number 15000806) at the national level with the period of significance being the year 1942 (Marx and Hoyt 2015e).

10 Non-OCS Deepwater Sites

The Battle of the Atlantic took place over an expanse of hundreds of thousands of square miles. In looking at the ships lost in North Carolina waters, there are many that extend beyond any maritime border, far beyond the scope of this project's study area. But just because these sites are difficult to access does not imply that the story of their wrecking event is any less important. The following ships lost during the Battle of the Atlantic represent a group of vessels that collectively offer a compelling historical narrative – whether they be the cargo the ship was carrying or the wrecking event themselves – and are an essential component of the battlefield landscape of the region. However, it is believed that these sites are more than 150 miles offshore of North Carolina state waters. It is recommended that, if given proper time, equipment, and research design, these wreck sites should be identified and examined.

The practicality and expense of actually locating these sites was not possible within the scope of the present study; however including known information about them in this inventory provides a more holistic characterization of the resources, as well as a baseline of information if any undertaking in these waters were to be realized. The offshore sites listed herein are known to have been lost during the Battle of the Atlantic, but only basic information has been collected on them for the purposes of this study. This information is limited to the vessels' identity, the approximate position, cargo being carried, and the name of the attacking U-boat (Table 10-1). These offshore sites are as representative and significant as any other merchant vessel casualty associated with the Battle of the Atlantic. The location where these vessels were lost does not diminish their historical value, but does limit potential interpretive value due to complexity of access, thus relegating assessment at this time to simply cataloging the sites.

Historically, the study of such sites may have additional value beyond this inventory. For example, there are some observable differences in the types of cargoes being carried on the vessels that were lost far offshore. Inshore vessels on the OCS were three times as likely to be carrying oil rather than finished general cargo, war materiel, or other bulk commodities compared to vessels further offshore in this inventory. Near-shore vessels in the data show that 41% of merchant vessels were carrying a bulk oil product; this figure increases to 50% when including 4 vessels in service as tankers, but sailing in ballast at the time of loss. Conversely, only 14% of vessels in the offshore inventory were carrying bulk oil. Additional research into this topic may provide further insight to this, and other lines of inquiry.

Table 10-1 List of Vessels Located Offshore for which Little Data has been Collected for the Purposes of this Study

Name	Miles Offshore	Dead	Sunk	Cargo	Sunk By
Amerikaland	90	5	02/03/42	In ballast	U-*106*
Anna	400	0	06/03/42	1,739 tons of coal and two motor boats on deck	U-*404*
Arabutan	90	1	03/07/42	9,680 tons of coal and coke	U-*155*
Belgian Airman	90	1	04/14/42	Sorghum in bulk and dairy feed in bags	U-*857*
Blink	160	24	02/12/42	3,600 tons phosphate	U-*108*
Bris	400	5	04/21/42	Asphalt and flour	U-*201*
Ceiba	100	44	03/17/42	Bananas	U-*124*
City of Birmingham	250	9	07/01/42	2,400 tons general cargo	U-*202*
Clan Skene	300	9	05/10/42	2,006 tons of chrome ore	U-*333*
Derryheen	200	0	04/22/42	11,036 tons of general cargo, including nitrates and motor trucks	U-*201*
Koll	400	3	04/06/42	96,067 barrels diesel oil	U-*571*

Table 10-1 List of Vessels Located Offshore for which Little Data has been Collected for the Purposes of this Study

Name	Miles Offshore	Dead	Sunk	Cargo	Sunk By
Kollskegg	400	4	06/19/42	8,000 tons crude; 6,300 tons fuel oil	U-*754*
Lady Hawkins	150	251	01/19/42	2,908 tons of general cargo and 213 passengers	U-*66*
Leif	350	15	02/28/42	2,300 tons of general cargo (cement)	U-*653* (Gerhard Feiler)
Libertad	70	25	12/4/43	8,000 tons of sugar	U-*129*
Major Wheeler	150	35	02/06/42	4,611 tons sugar	U-*107*
Margaret	53	29	04/14/42	4,508 tons of sugar	U-*571*
Narraganset	450	49	03/25/42	14,000 tons petroleum	U-*105*
Oakmar	375	6	03/20/42	Manganese ore and burlap	U-*71*
Otho	200	32	04/03/42	4,400 tons of maganese ore, 1,300 tons of palm oil, and 750 tons of tin	U-*754*
San Jacinto	400	14	04/22/42	3,200 tons general cargo and passangers	U-*201*
Steelmaker	300	1	04/20/42	7,660 tons of war supplies	U-*654*
Svenør	350	8	03/27/42	11,410 tons furnace oil	U-*105*
Tolosa	100	22	02/09/42	In ballast	U-*108*
Ulysses	50	0	04/11/42	9,544 tons general cargo, passengers; 4,000 tons pig iron	U-*160*
Victolite	500	47	02/11/42	In ballast	U-*564*
West Ivis	130	45	01/26/42	General cargo	U-*125*
West Notus	420	4	06/01/42	7,400 tons flax seed	U-*404*

Source: Compiled from Lloyd's, Wynn, and Stick

10.1 Lady Hawkins

Whereas most of the vessels in this deep-water inventory tell a similar story, there is one site that warrants additional discussion. The sinking of RMS *Lady Hawkins* represents the single biggest loss of life of any vessel off North Carolina during the Battle of the Atlantic, a fact more significant considering that a large majority of those lost were civilian passengers (Figure 10-1).

Among the very first wave of five U-boats sent to the United States was the veteran commander Richard Zapp in U-*66*. This was Zapp's fourth war patrol and first foray into U.S. waters. On 18 January 1942, Zapp scored the first successful sinking off North Carolina in WWII, putting two torpedoes into the tanker *Allan Jackson*. The very next day Zapp and his Type IX U-*66* came upon a Canadian passenger ship approximately 180 miles off Cape Hatteras (Hickam, Jr. 1989:13; Gannon 1990:247; Blair 1996:466).

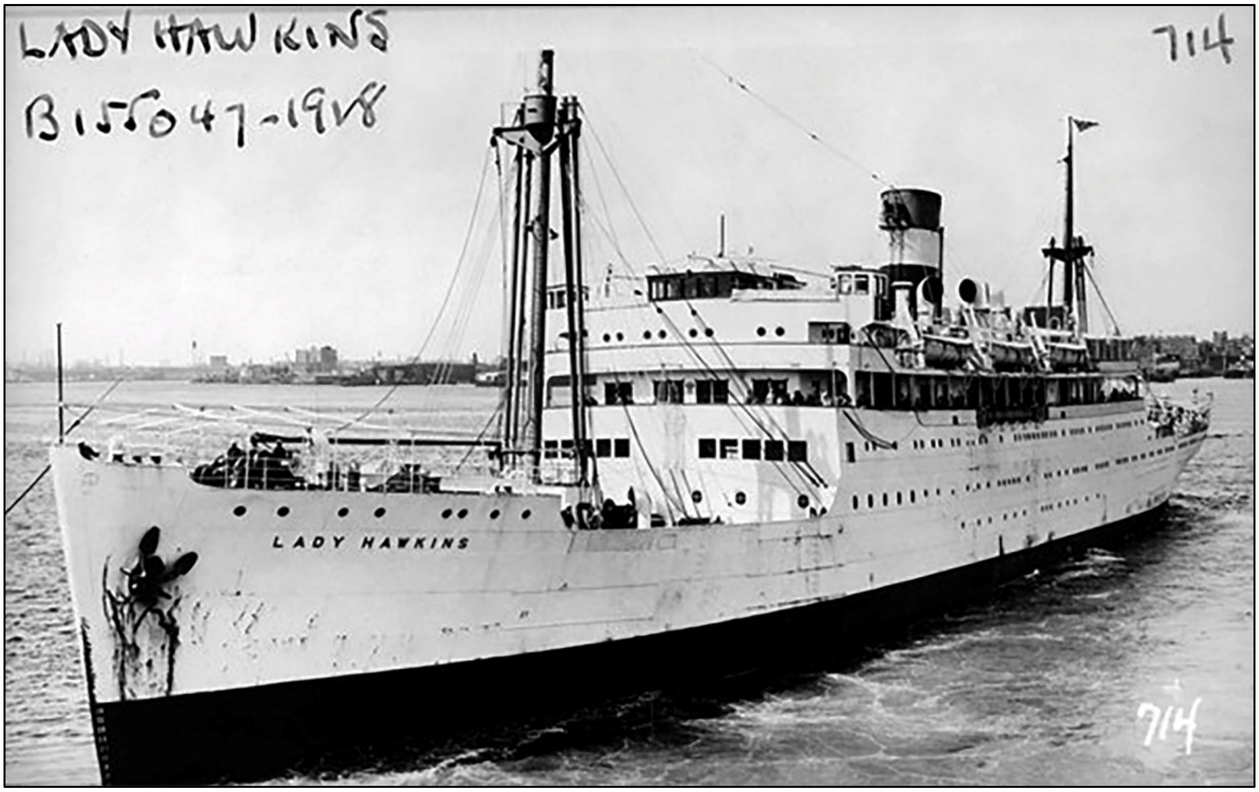


Figure 10-1 RMS *Lady Hawkins*.
Source: Steamship Historical Society of America

RMS *Lady Hawkins* was built in 1928 by Cammell Laird and Company in Birkenhead, UK. *Lady Hawkins* was 419.5 ft long, 59.1 ft abeam, and had a depth of 28.2 ft. Designed as a passenger vessel, the ship had 3 decks with twin screws and oil-fired steam turbines. On the night of 19 January 1942 off Hatteras, *Lady Hawkins* was southbound out of Montreal carrying general cargo and 321 passengers and crew (Blair 1996 reports 312 total crew and 250 deaths; Gannon 1990 reports 321 [212 passengers and 109 crew]; Hickam, Jr. 1989 reports 300 passengers and 96 survivors; Contemporary NYT reports 70 survivors and 251 lost [the reliable accounting seems to be a total of 321 passengers, 251 of which were lost and 70 survived] (*New York Times* 1942h:3; Lloyd's Register of Shipping 1942; Hickam, Jr. 1989:14; Gannon 1990:247; Blair 1996:466).

Making way at 14 kts, suddenly two bright searchlights illuminated the *Lady Hawkins*. U-*66* sought to identify the vessel prior to executing an attack. Zapp, satisfied the vessel was a fair target, sped ahead of *Lady Hawkins* and launched two torpedoes from his stern tubes. Both torpedoes found their target, striking *Lady Hawkins* with such force, the immediate list of the vessel threw some passengers overboard and made it exceedingly difficult for those remaining to access the lifeboats (*New York Times* 1942h:3; Gannon 1990:247).

In the chaos, passengers and crew scrambled to get a spot in the lifeboats, two of which had been destroyed in the attack. Ultimately, three lifeboats were successful in being launched and getting away from the sinking hulk, but were heavily overloaded and under provisioned. One lifeboat, manned by Chief Officer Percy Kelly, had 76 people aboard a boat designed for 63. The frightened passengers were forced to row away from panicked survivors still in the water for fear of being swamped (*New York Times* 1942h:3, 1942i:10).

The three escaping boats, one of which carried the Captain, remained together initially but gradually drifted apart. Aboard Officer Kelly's boat, a rotation of standing and sleeping passengers was instituted to accommodate space and rationing of scant supplies began. Each passenger was given a half of a biscuit and a few ounces of water each day, along with a capful of condensed milk. Men also swapped out bailing duties to keep water out of the boat. The conditions were appalling in mid January. Despite being in the Gulf Stream, the nights were cold and over the course of 5 days, 5 of the passengers died of exposure and were buried at sea. Aboard the lifeboat was a 2-year old girl named Janet Johnson whose high spirits and jovial nature brightened the mood such that other survivors would later credit her for getting them through (*New York Times* 1942h:3, 1942i:10).

Being so far offshore, the survivors were in a lightly traversed sea-lane and were very relieved on the fifth day when *Coamo* passed nearby. Officer Kelly sent up flares and *Coamo* came to the rescue of the 71 remaining survivors (Figure 10-2). The survivors were weak and cold and one would later die in hospital in Puerto Rico. The other two lifeboats were never seen again. Hawkins later reflected on the sinking of *Lady Hawkins* as a story of '…bravery and discipline, tears and laughter, alternate hope and despair and, above all, a tale of real human courage (*New York Times* 1942h:3, 1942i:10).

Figure 10-2 Survivors from *Lady Hawkins* safe in Puerto Rico.
Source: *New York Times, 26 February* 1942

11 Remote Sensing Discoveries and Unidentified Sites

11.1 Introduction

While the primary focus of this study was to investigate material remains associated with the Battle of the Atlantic and WWII, the nature of the study was such that non-associated sites were surveyed and/or located in the course of searching for specific vessels sunken on the OCS. In most cases, due to the focused research scope of the project, once a site was determined not to be associated with WWII, the data were processed and kept for potential future inquiry, but no further attention was paid. As a result, numerous remote sensing anomalies were identified and the majority of these targets remain uncharacterized. In some instances, the level of resolution in the survey data was such that the target could be confidently categorized as a shipwreck or human-made object, while in other cases the survey data merely indicated an anomaly that was potentially cultural, but also possibly a natural feature. In these cases, more detailed survey would be required to determine the presence or absence of submerged cultural materials.

Despite the unknown nature of these data, the report of results would not be complete without inclusion of this information. Likewise, it remains possible that some of the targets are indeed associated with the Battle of the Atlantic, but too little data, both archaeological and historical, has been amassed to make a proper determination. The results from targets such as these are included in this section.

11.2 Wide-Area Low-Resolution Targets

The largest dataset of unknown targets was amassed during surveys conducted in the 2011 field season. These surveys were primarily aimed at locating the sites of *Bluefields* and U-*576* and were, consequently, focused on an offshore tract of the continental shelf break south of Diamond Shoals. Over 45 individual anomalies were identified as having potential to yield cultural material. Only a handful of the targets were later assessed at a higher level of resolution. The potential for these targets to represent man made objects is high, although large-scale modern era shipwrecks are unlikely to have been overlooked in this survey. Materials not associated with a ship or smaller older vessel remains that have been substantially reduced (wood deterioration) are more likely to be represented in this dataset.

As this survey was intended to cover large swaths of the seafloor with low or medium resolution sonar imagery, individual sonar targets were not well defined within the dataset. Instead, the workflow was planned to first cover the largest area possible at lower resolution, develop a series of targets, then collect detailed, target-specific data with a higher resolution system. Thus, preliminary target identification was based upon a series of evaluation criteria to identify anomalous features within the dataset. These included acoustic reflectivity (hard, bright returns), relief off bottom, the geometry of the object—linear features, round features, vessel-shaped features—and difference from the bottom geology. Individually, the targets had varying combinations of these properties; those displaying all in a higher degree were ultimately selected for detailed evaluation.

Table 11-1 Select Evaluation Criteria for 47 Anomalies Observed during Wide-Area Survey

Day	Run	Reflect	Scour	Shadow	Length-m	Iso.	Seabed	Passes	Range-m	File ID
3-Jun	1	High	None	None	5	Y	Sand	1	37	6030101
3-Jun	1	Medium	None	Yes	93	Y	Sand	2	188	6030102
3-Jun	1	Low	None	Yes	55	Y	Sand	1	190	6030103
3-Jun	1	Low	None	None	16	Y	Sand	1	483	6030104

Table 11-1 Select Evaluation Criteria for 47 Anomalies Observed during Wide-Area Survey

Day	Run	Reflect	Scour	Shadow	Length-m	Iso.	Seabed	Passes	Range-m	File ID
4-Jun	1	High	None	None	9	Y	Sand	1	304	6040101
4-Jun	1	High	None	None	14	Y	Sand	1	395	6040102
4-Jun	1	High	None	Yes	18	Y	Sand	1	0	6040103
4-Jun	1	High	None	None	9	N	Sand	1	101	6040104
4-Jun	1	Medium	None	Yes	23	Y	Sand	1	127	6040105
4-Jun	1	High	None	None	7	Y	Sand	1	326	6040106
4-Jun	1	High	Yes	Yes	58	N	Mixed	1	365	6040107
4-Jun	1	High	None	Yes	52	Y	Mixed	1	285	6040108
7-Jun	1	Medium	Yes	Yes	89	Y	Sand	1	217	6070101
7-Jun	1	High	Yes	Yes	111	Y	Sand	2	445	6070102
7-Jun	1	High	None	None	150	Y	Sand	1	352	6070103
7-Jun	2	Medium	None	Yes	103	Y	Sand	1	140	6070201
7-Jun	2	Medium	None	Yes	22	Y	Sand	1	328	6070202
7-Jun	2	Medium	None	Yes	43	N	Sand	2	100	6070203
7-Jun	2	High	None	None	53	Y	Sand	1	0	6070204
7-Jun	2	Low	None	None	170	Y	Sand	1	56	6070205
7-Jun	2	Medium	Yes	Yes	150	Y	Sand	1	0	6070206
7-Jun	2	Medium	Yes	Yes	55	Y	Sand	2	476	6070207
7-Jun	2	Medium	Yes	Yes	30	Y	Rock	1	230	6070208
7-Jun	2	Medium	None	Yes	45	N	Sand	1	350	6070209
7-Jun	2	High	None	Yes	105	N	Rock	1	80	6070210
7-Jun	2	High	None	Yes	86	N	Rock	1	151	6070211
7-Jun	2	High	None	Yes	48	N	Rock	1	154	6070212
7-Jun	2	Medium	None	Yes	105	N	Rock	1	255	6070213
7-Jun	2	Medium	None	Yes	46	N	Rock	1	220	6070214
7-Jun	2	High	Yes	Yes	110	N	Rock	1	235	6070215
7-Jun	2	High	None	Yes	16	N	Rock	1	116	6070216
7-Jun	2	Medium	None	Yes	94	N	Mixed	1	194	6070217
8-Jun	1	High	Yes	Yes	49	Y	Mixed	1	55	6080101
8-Jun	1	High	None	Yes	95	N	Rock	1	266	6080102
8-Jun	1	High	None	Yes	52	N	Rock	1	213	6080103
8-Jun	1	High	Yes	Yes	27	N	Mixed	1	235	6080104
8-Jun	1	High	Yes	Yes	67	N	Rock	1	235	6080105
8-Jun	1	High	Yes	Yes	80	N	Rock	1	386	6080106
8-Jun	1	High	None	Yes	48	N	Rock	1	400	6080107
8-Jun	1	High	Yes	Yes	78	Y	Rock	1	146	6080108
8-Jun	1	High	Yes	Yes	37	Y	Sand	1	199	6080109
8-Jun	1	High	Yes	Yes	70	Y	Sand	1	250	6080110
9-Jun	1	High	None	None	18	Y	Sand	1	138	6090101
9-Jun	1	High	Yes	None	40	Y	Sand	1	182	6090102
9-Jun	1	High	Yes	None	81	Y	Sand	2	0	6090103
9-Jun	1	Medium	Yes	Yes	76	Y	Sand	1	207	6090104

Source: NOAA, based on interpreted UT:ARL dataset
Note: Thumbnail tiles (see Table 11-2) are organized numerically in rows byfile name.

Table 11-2 Exported Geo-Rectified Anomalies Identified during Wide Area Survey

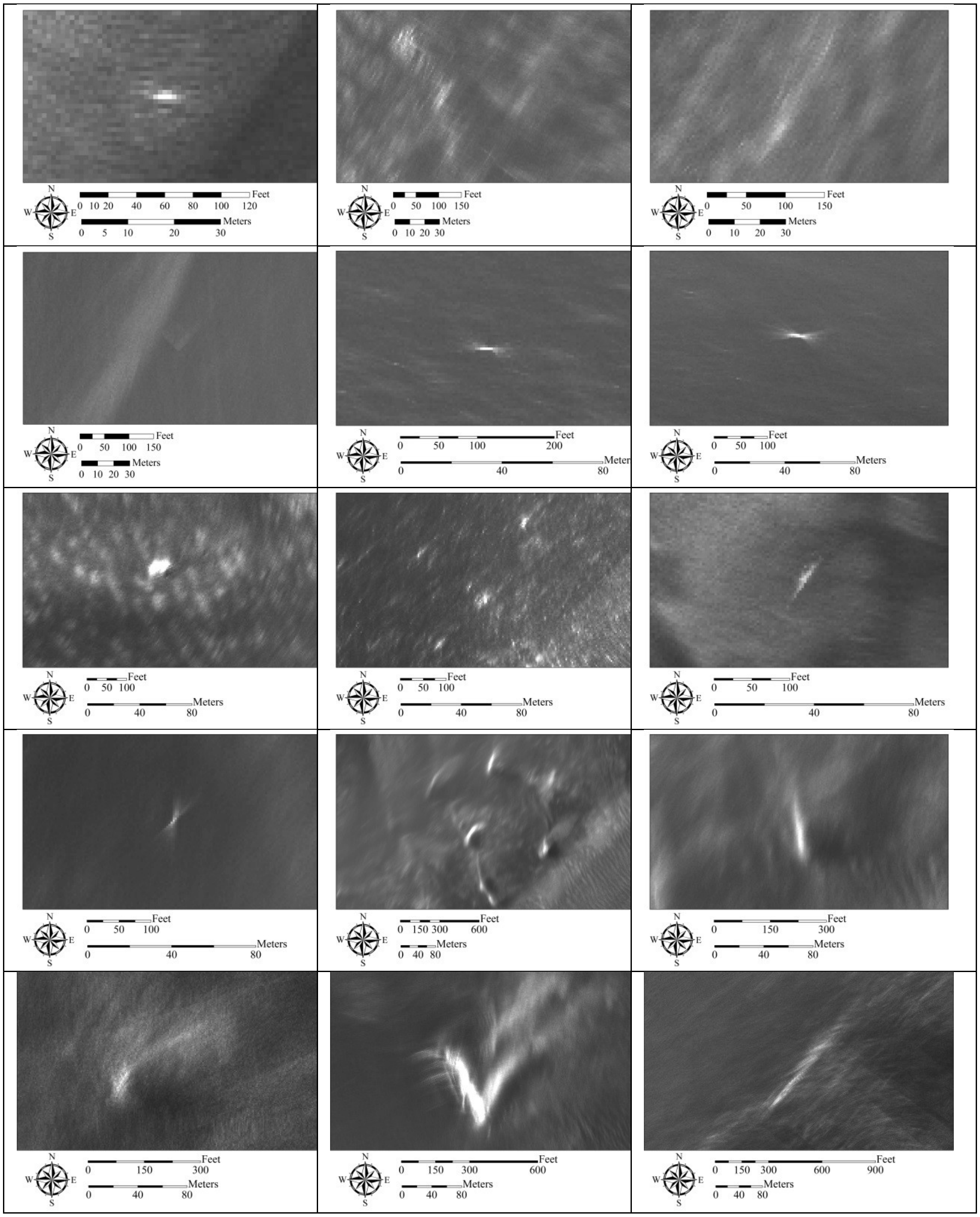


Table 11-2 Exported Geo-Rectified Anomalies Identified during Wide Area Survey

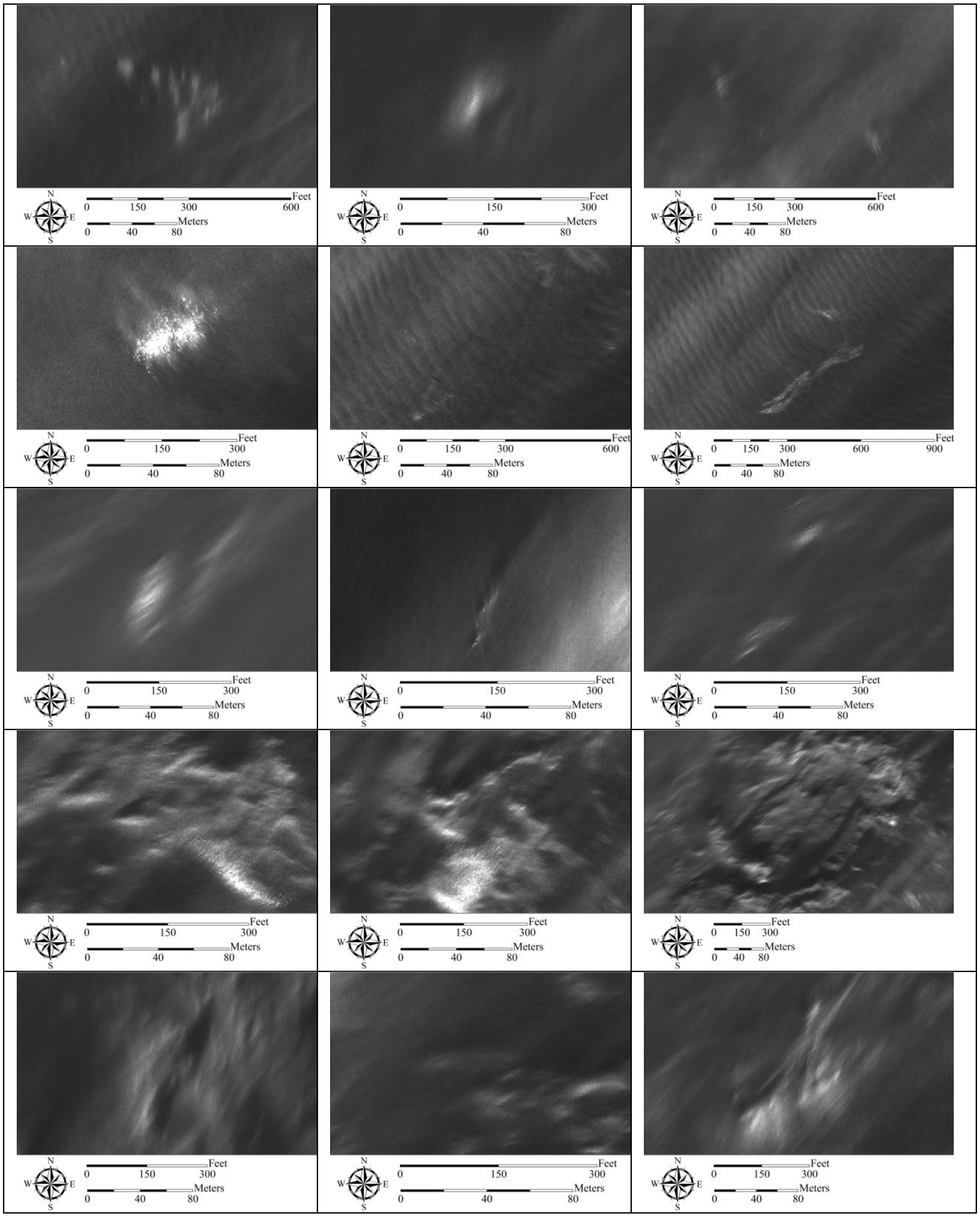


Table 11-2 Exported Geo-Rectified Anomalies Identified during Wide Area Survey

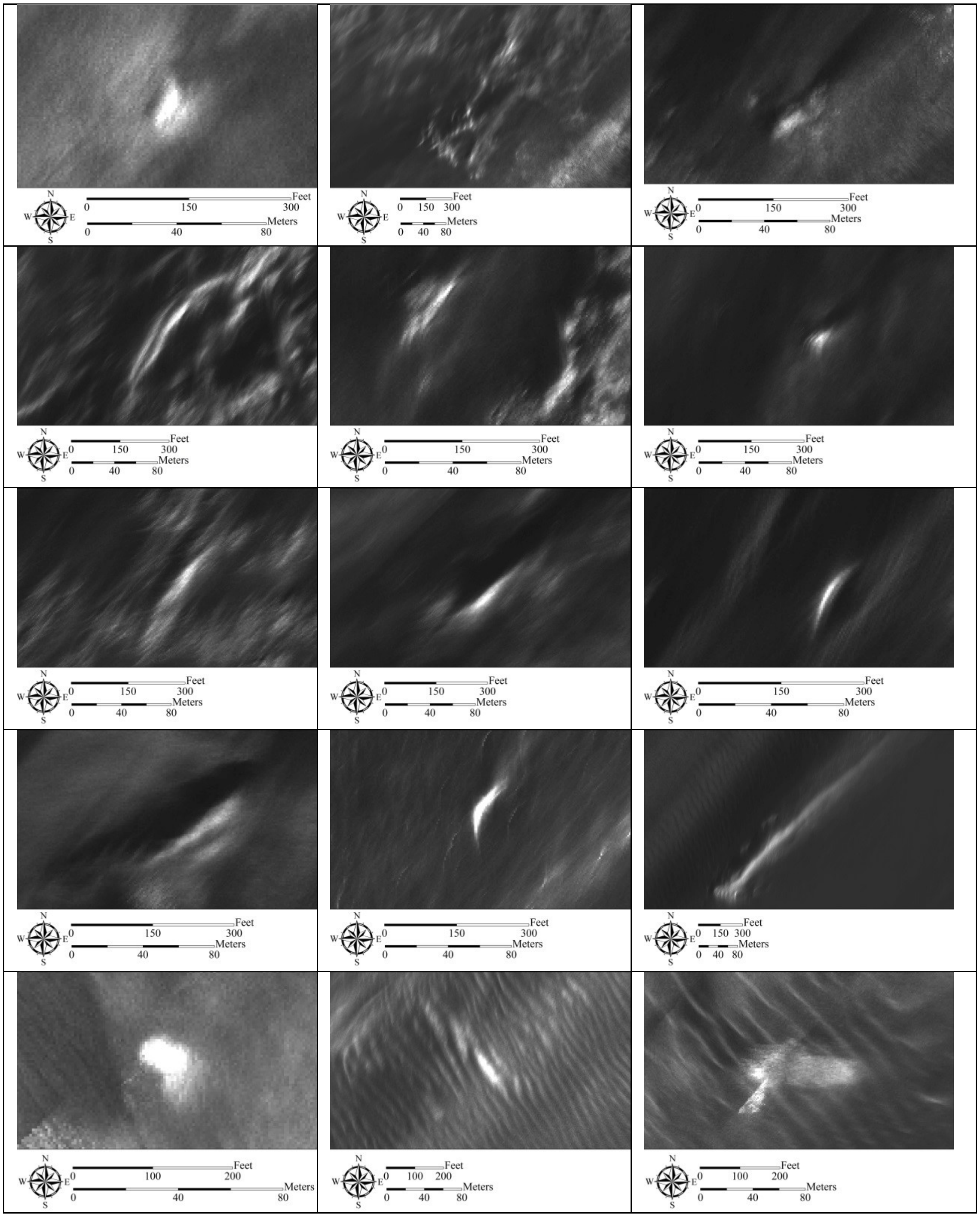
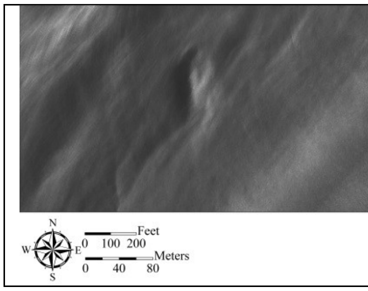


Table 11-2 Exported Geo-Rectified Anomalies Identified during Wide Area Survey



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Source: ARL:UT – NOAA

11.3 Targeted Higher Resolution Results

Further survey focused exclusively on obtaining higher resolution imagery of priority acoustic anomalies identified from the wide-area search. Of the 45 targets generated in 2011, one was imaged immediately following the wide-area survey in 2011, and 8 more priority targets were evaluated in 2012. These were imaged at two resolution scales via an SRI Bluefin AUV. A medium-resolution reconnaissance survey was completed, which would provide the requisite data needed to plan a closer pass. The benefits of this approach were two-fold. First, in many cases the medium-resolution data set was sufficient to determine whether or not a second high-resolution pass was necessary. Second, in the event the medium-resolution image produced a target of further interest, the data could be used to program the AUV to approach the object much closer without concern over entanglement hazards associated with the potential high relief of a shipwreck site. This would, in turn, yield much better final results and reduce risk to the AUV.

11.3.1 Target 1-1

Target 1-1 had been imaged in 2011 with the medium-resolution Delta P multibeam aboard SRI's Bluefin AUV (Figure 11-1; see also Chapter 3: Methodological Approaches). As such, it was the first priority. As this was the first dive of the field season, the AUV system required calibration for positioning and a few test dives to ensure the system was achieving bottom lock and tracking appropriately. Target 1-1 rested in approximately 470 ft of water, oriented in roughly an east-west position. The resulting data collected clearly confirmed the remains of a sunken ship (Figure 11-2).

The vessel's bow appeared to have a higher degree of damage evident and less structural integrity. This suggested the possibility that bow damage was either the cause of the sinking (i.e. collision) or the result of the sinking (i.e. the vessel sunk by the bow and collided with the seabed). The vessel appeared broken amidships with the stern section exhibiting a higher degree of structural integrity (Figure 11-3 through Figure 11-5). The remains of what appeared to be a deckhouse or superstructure were clearly defined and may help in the eventual identification of the site.

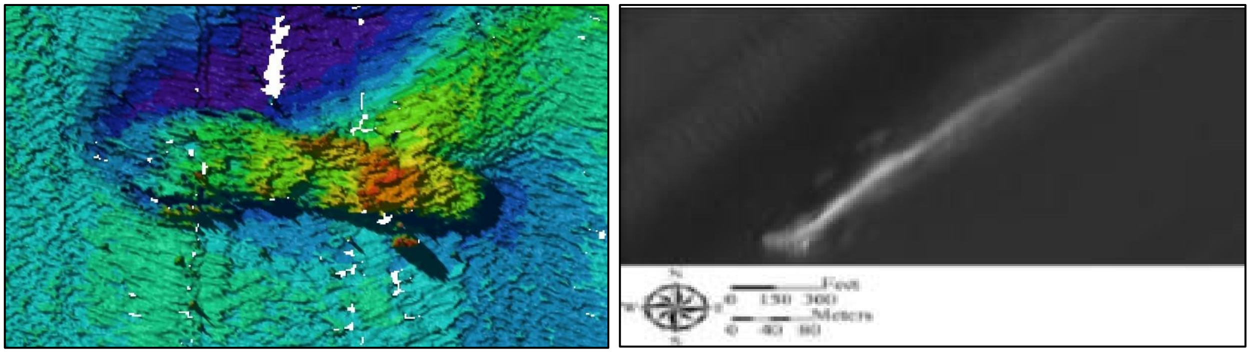

Figure 11-1 2011 Delta P (left) and ARL:UT (right) images of Target 1-1.
Source: NOAA/SRI/ARL:UT

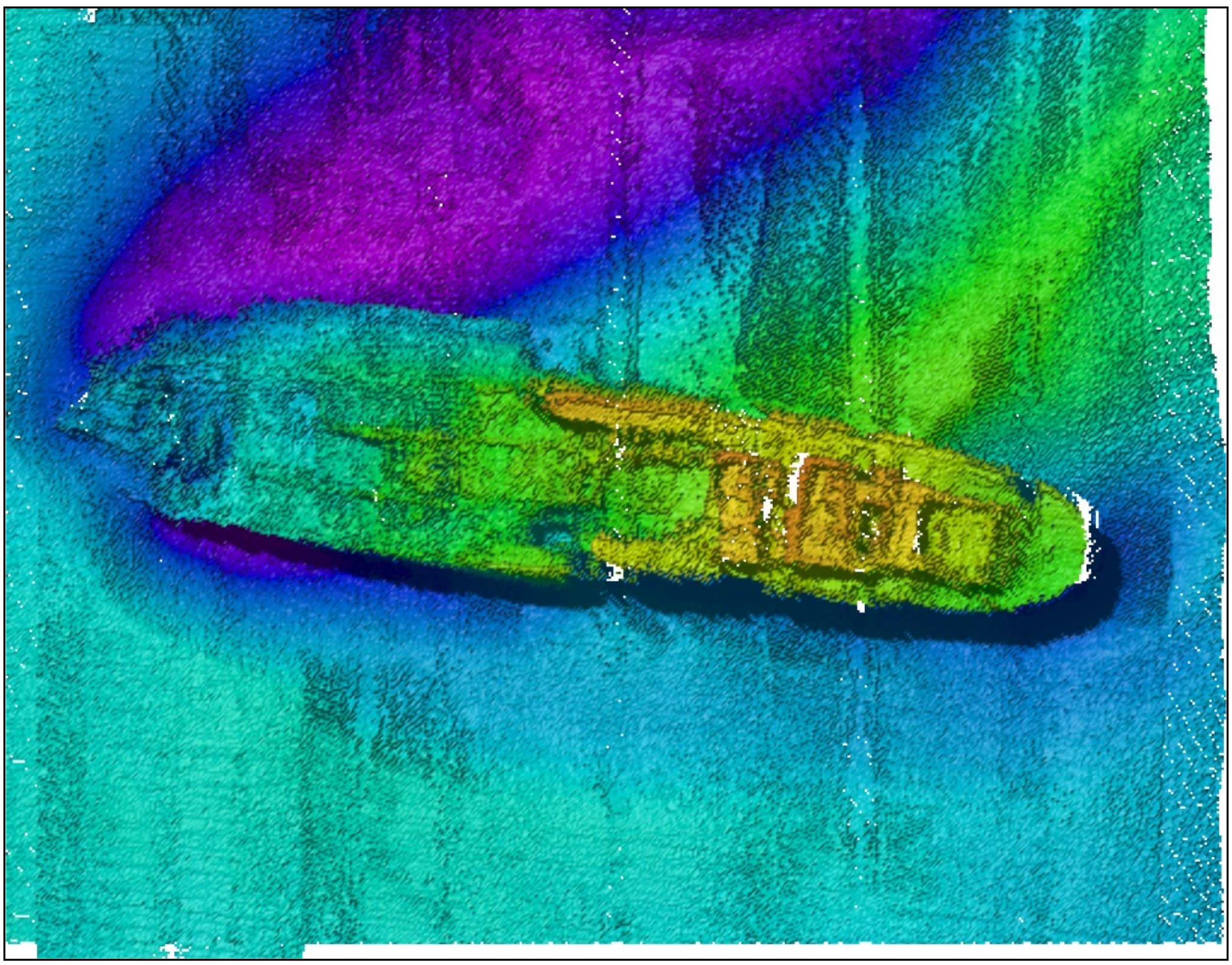

Figure 11-2 Target 1-1 Blueview multibeam SONAR results.
Source: NOAA/SRI

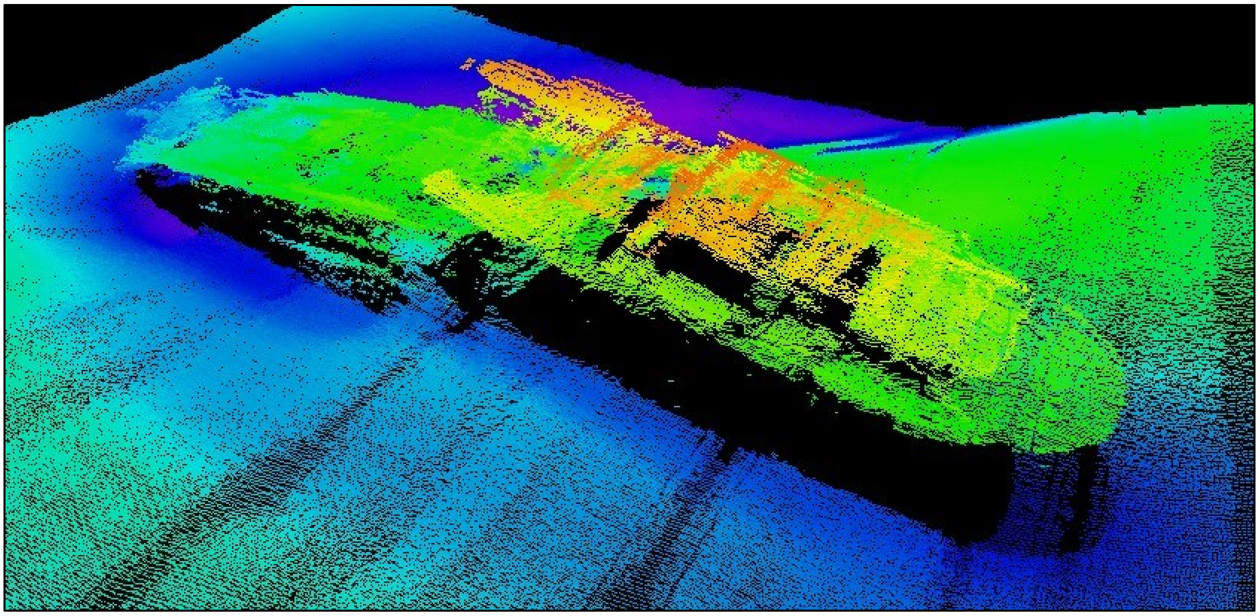

Figure 11-3 Processed 3D visualization of Target 1-1 port quarter.
Source: NOAA/SRI

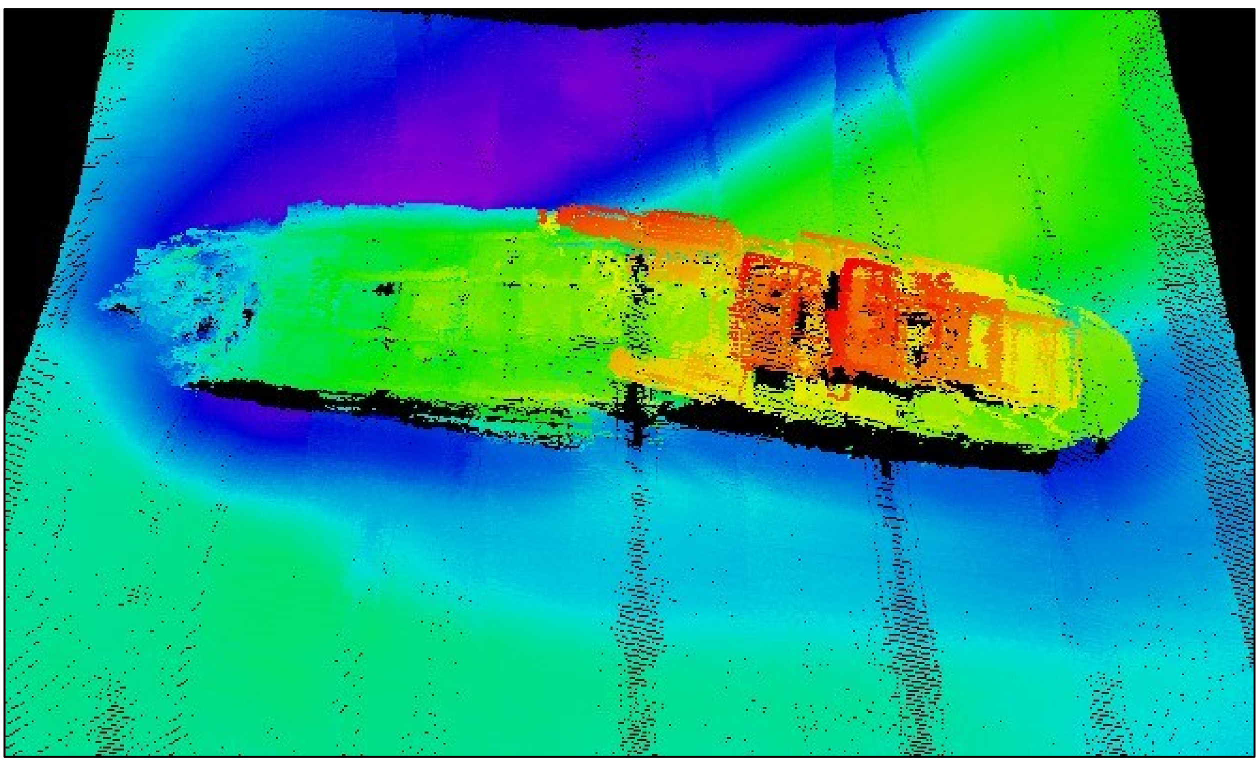

Figure 11-4 Processed 3D Visualization of Target 1-1 port side [North-up].
Source: NOAA/SRI

Via 3D viewing software, a fair degree of interpretation is possible. The vessel appears largely intact. It is not scattered like many vessels, likely due to the water depth. Some of the superstructure is still evident towards the eastern side of the target. It appears as though the vessel is oriented with the bow to the west, as the easterly portion clearly exhibits a well-defined fantail characteristic of a stern (Figure 11-5).

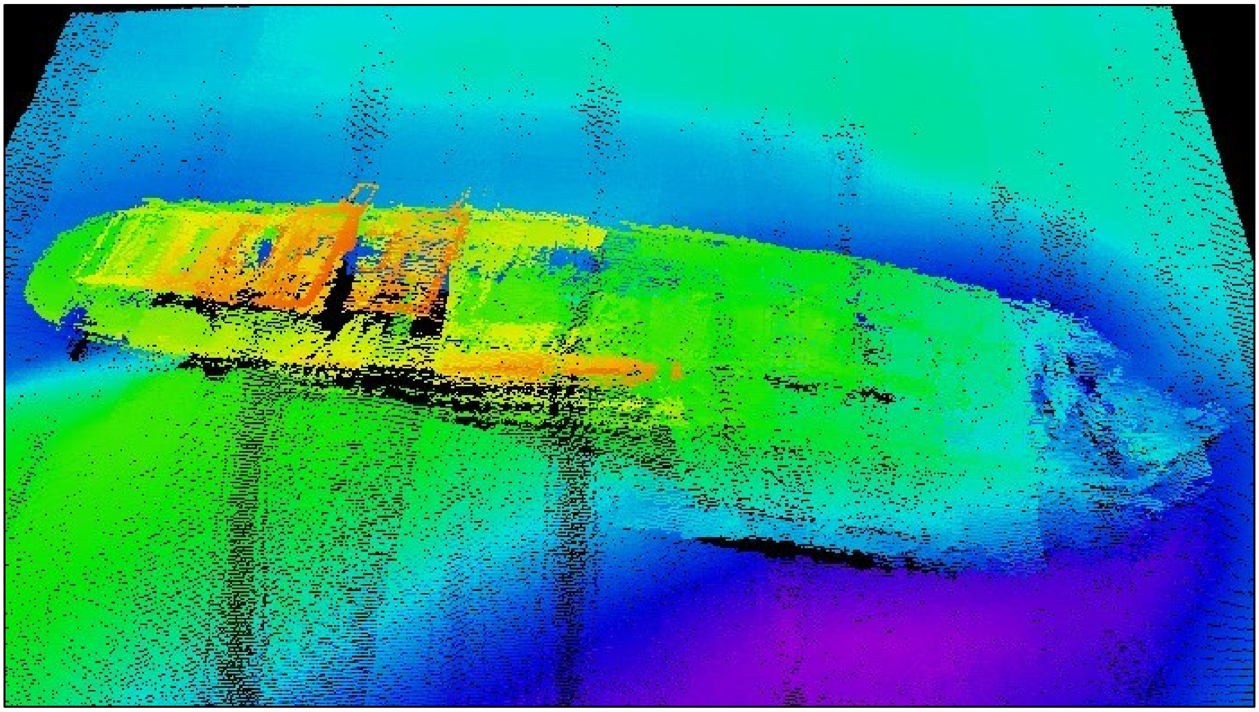

Figure 11-5 Processed 3D Visualization of Target 1-1 starboard side [south-facing].
Source: NOAA/SRI

Target 1-1 measured approximately 220 ft long and 43 ft abeam. The available database of vessel losses in the region contained no craft with those approximate dimensions. Further research will be needed to identify this vessel. It is believed, given the location of the vessel and the dimensions, that a viable candidate pool can be generated. Recommendations for future research on this site would include an ROV-based HD video survey to collect diagnostic data. In the interim, a robust review of vessels lost in this region off North Carolina must be undertaken and compared to this data set.

Target 1-1 was selected for higher resolution imaging as a possible candidate for the remains of Nicaraguan freighter *Bluefields*. This was due to its approximate size and the fact that it was located well within the pre-determined search area designed to locate the vessel and U-*576.* The apparent superstructure aft, however, was not consistent with historical imagery of *Bluefields*, and once the actual location of the KS-520 sites was determined, the identity status of this site became completely unknown. This acoustic imagery is the only known data collected on this target, and it is likely that visual and photographic survey would yield additional information that may make it possible to establish the identity of the site. Currently, of the sites known to have been lost in this area during the Second World War, there are no known ‘missing’ sites that have these general dimensions.

11.3.2 Target 2-1

The remaining high-priority targets identified during the 2011 field season were imaged the following year with the Delta-P sonar system operated by SRI. Target 2-1 revealed a structure consistent with the remains of a historic vessel (Figure 11-6). The surrounding area featured a fairly homogenous geological substrate, thus the anomaly’s vertical relief and characteristic length-to-width ratio was indicative of a cultural object. The site was approximately 300 ft long and 40 ft wide. Given the dimensions, location, and surrounding geology, it is believed the remains are cultural and not natural. This site was resurveyed in 2018 and is likely to be the remains of *Ljubica Matkovic* (see Section 7.28).

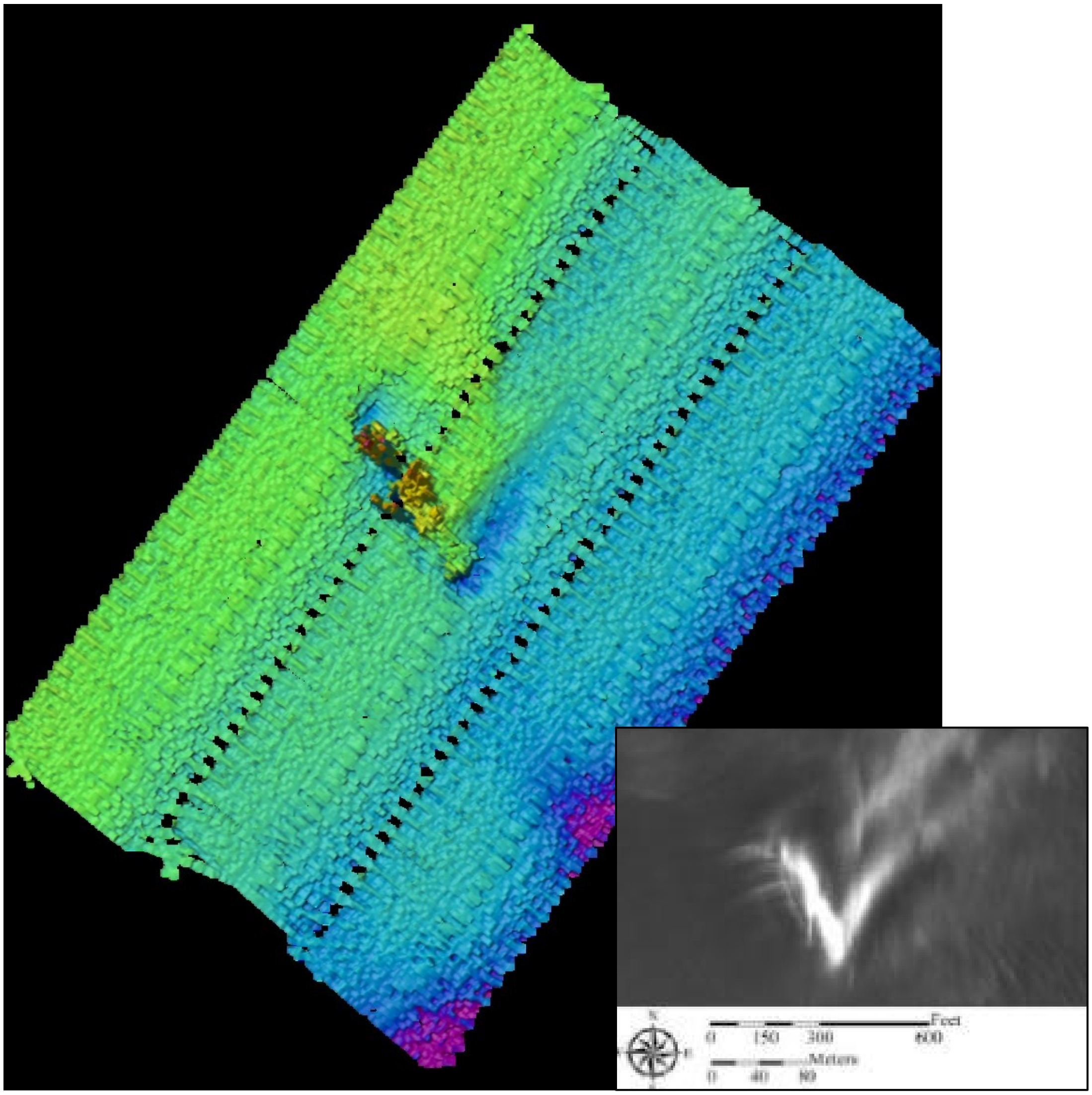

Figure 11-6 Target 2-1 Delta P survey results (left). 2011 ARL:UT data for Target 2-1 (right).
Source: NOAA/SRI/ARL:UT

11.3.3 Target 3-1

Target 3-1 was identified as two distinct features that appeared proximate to each other in a linear orientation (Figure 11-7). This site was successfully re-surveyed with the medium resolution Delta-P sonar. The greater detail of the Delta-P systems resulted in this target being interpreted as likely geological. The features were irregular and seemed to cover a larger area than would be likely for a historic vessel site. As such it was determined that further site investigation with higher resolution imagery was unnecessary.

11.3.4 Target 4-1

The Delta-P survey of Target 4-1 verified that the object emitting a hard acoustic return in the wide-area survey had little, if any, vertical relief. A similar acoustic return was not observed with the Delta-P system. Within the sonar mosaic was small area of increased relief, but this was interpreted as likely geological (Figure 11-8). The possibility remained that the anomaly observed during the 2011 survey resulted from an embedded object; thus further investigation would benefit from parity with magnetic remote sensing.

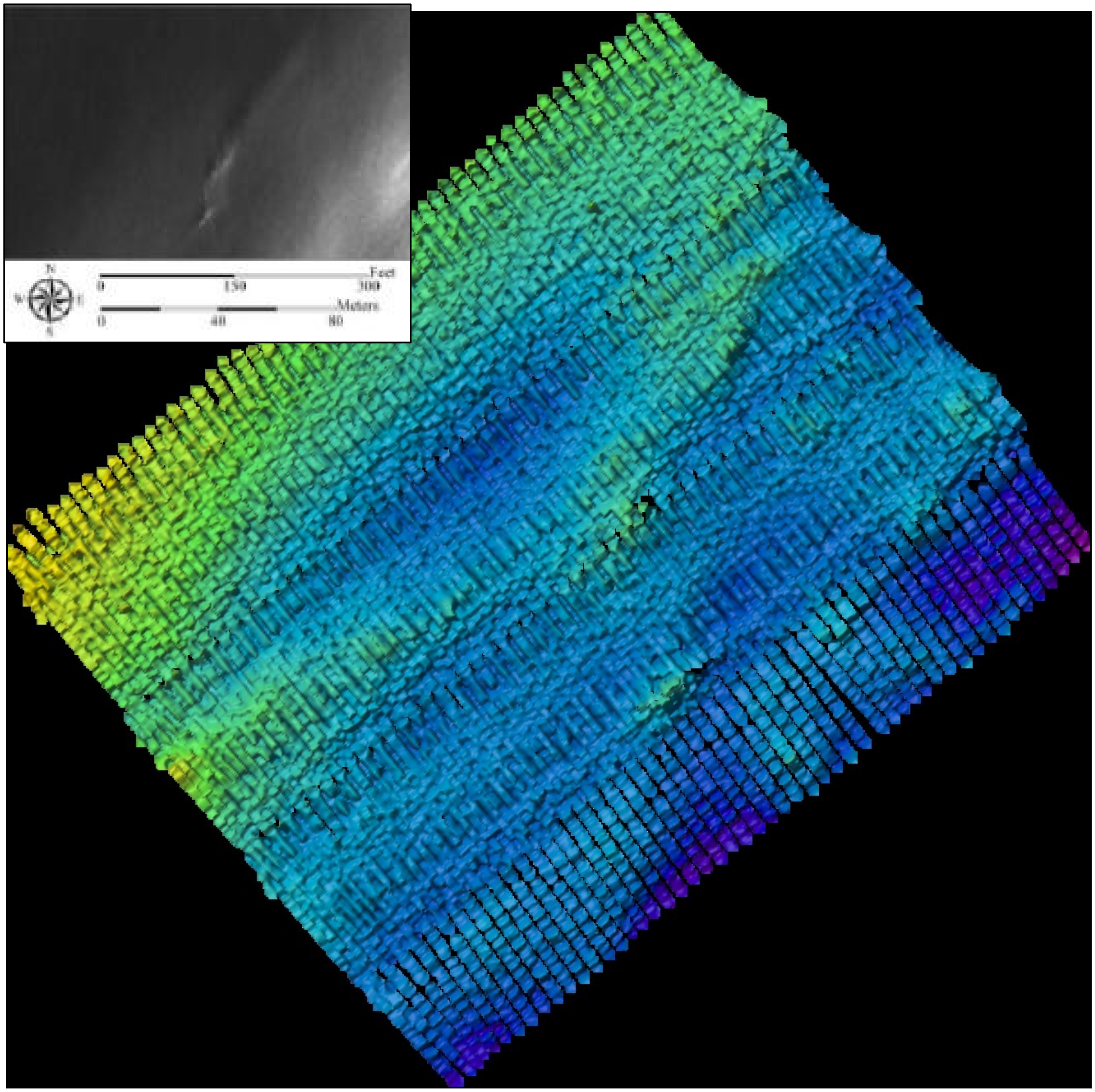

Figure 11-7 Target 3-1 Delta P survey results (left). 2011 ARL:UT data for Target 3-1 (right).
Source: NOAA/SRI/ARL:UT

11.3.5 Target 5-1

Though the acoustic data collected on Target 5-1 and 4-1 via the ARL:UT dataset appeared very similar, the results of further survey via Delta-P produced vastly different results. While the ARL: UT data on Target 5-1 appeared oblong and well-defined, the resultant Delta-P instead revealed a large, amorphous area consistent with geological features (Figure 11-9). This site was most likely an area of natural hard bottom substrate.

11.3.6 Target 6-1

The survey results of Target 6-1 appeared devoid of any notable features (Figure 11-10). The interpretation of the ARL:UT showed a large multi-component feature but the higher resolution Delta-P survey produced a flat, featureless seabed. It is possible that the image collected in 2011 was acoustic noise (i.e. school of fish) or the features have potentially been covered by shifting sand requiring magnetic data to further assess the presence of cultural remains.

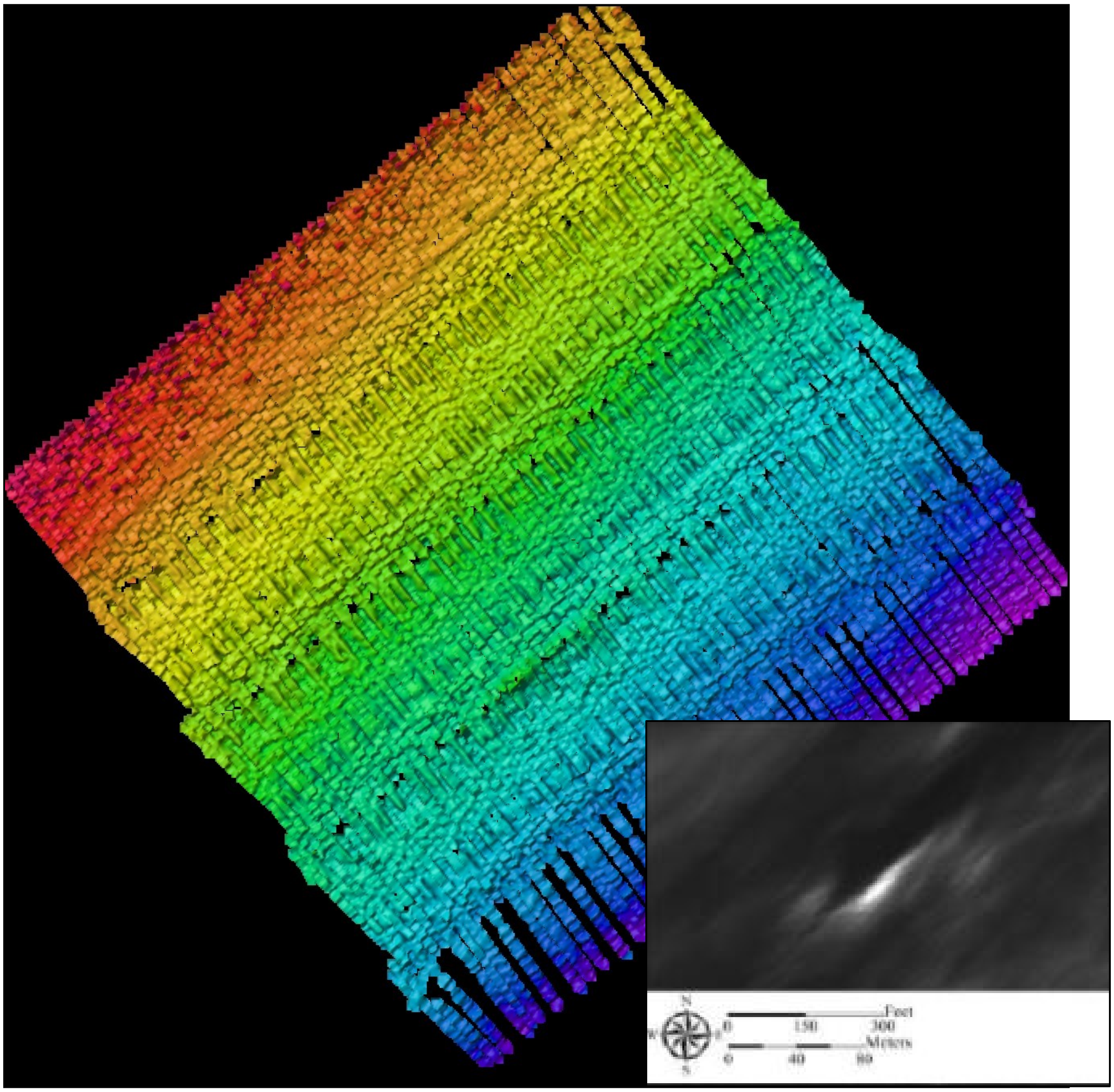

Figure 11-8 Target 4-1 Delta P survey results (left). 2011 ARL:UT data for Target 4-1 (right).
Source: NOAA/SRI/ARL:UT

11.3.7 Target 7-1

Survey results for Target 7-1 likewise revealed geological features. The site had been initially identified in the ARL:UT dataset due to its prominent appearance on the edge of two overlapping survey lines

(Figure 11-11). The Delta-P survey, however, revealed an anomalous feature characteristic of hard bottom.

11.3.8 Target 8-1

The final survey target from the ARL:UT dataset was Target 8-1. This anomaly appeared in both a 2009 NOAA survey of the site from a hull-mounted multibeam as well as the ARL:UT survey. As such, a more detailed site survey was completed with the Delta-P (Figure 11-12). The site exhibited clearly defined vertical relief and was causing a distinct scour in the surrounding sand. Based upon the additional sonar data, however, it was not possible to discern whether the object was natural or cultural. A higher resolution acoustic survey in conjunction with a magnetic remote sensing should be considered for any future research at this site.

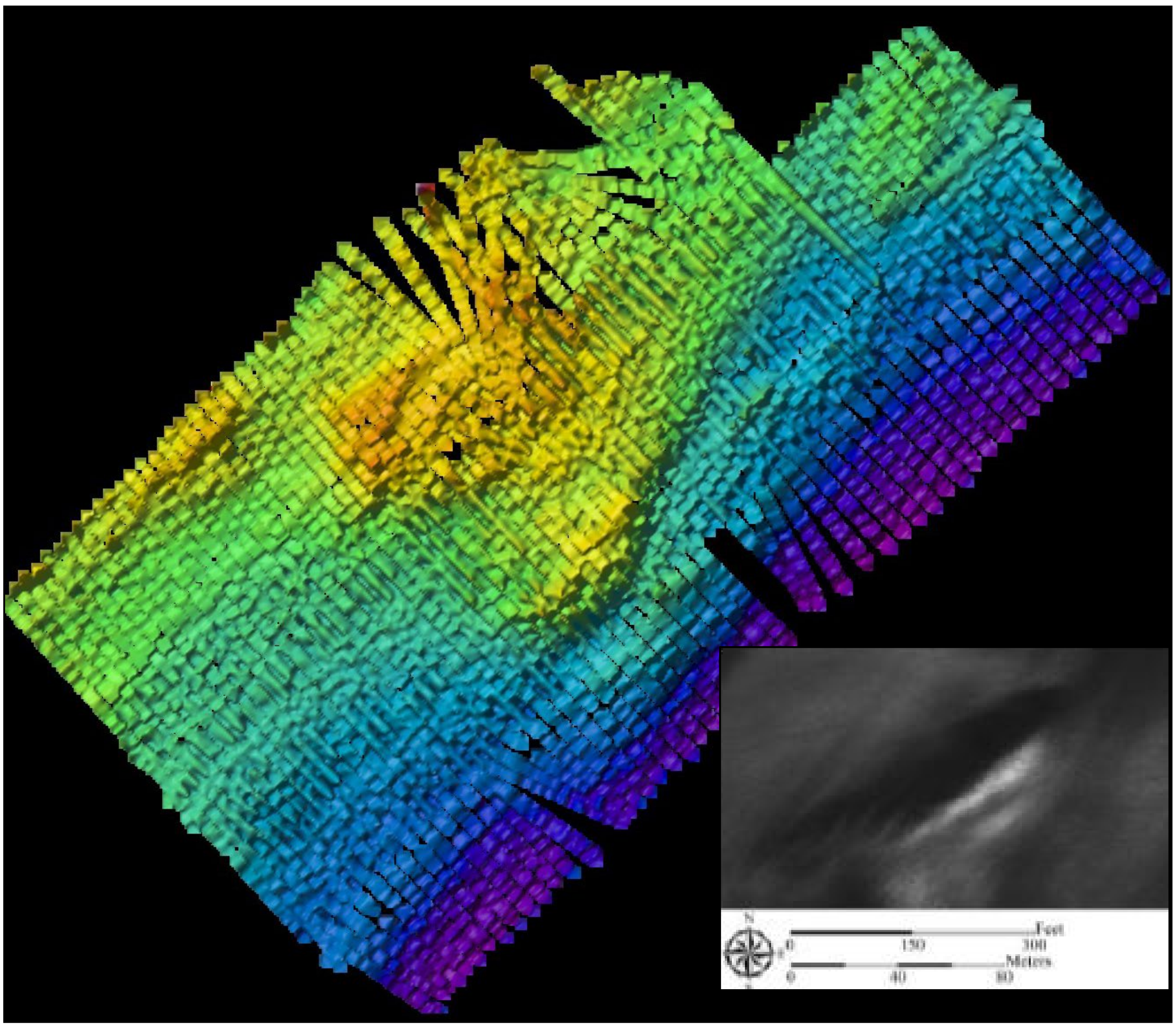

Figure 11-9 Target 5-1 Delta P survey results (left). 2011 ARL:UT data for Target 5-1 (right).
Source: NOAA/SRI/ARL:UT

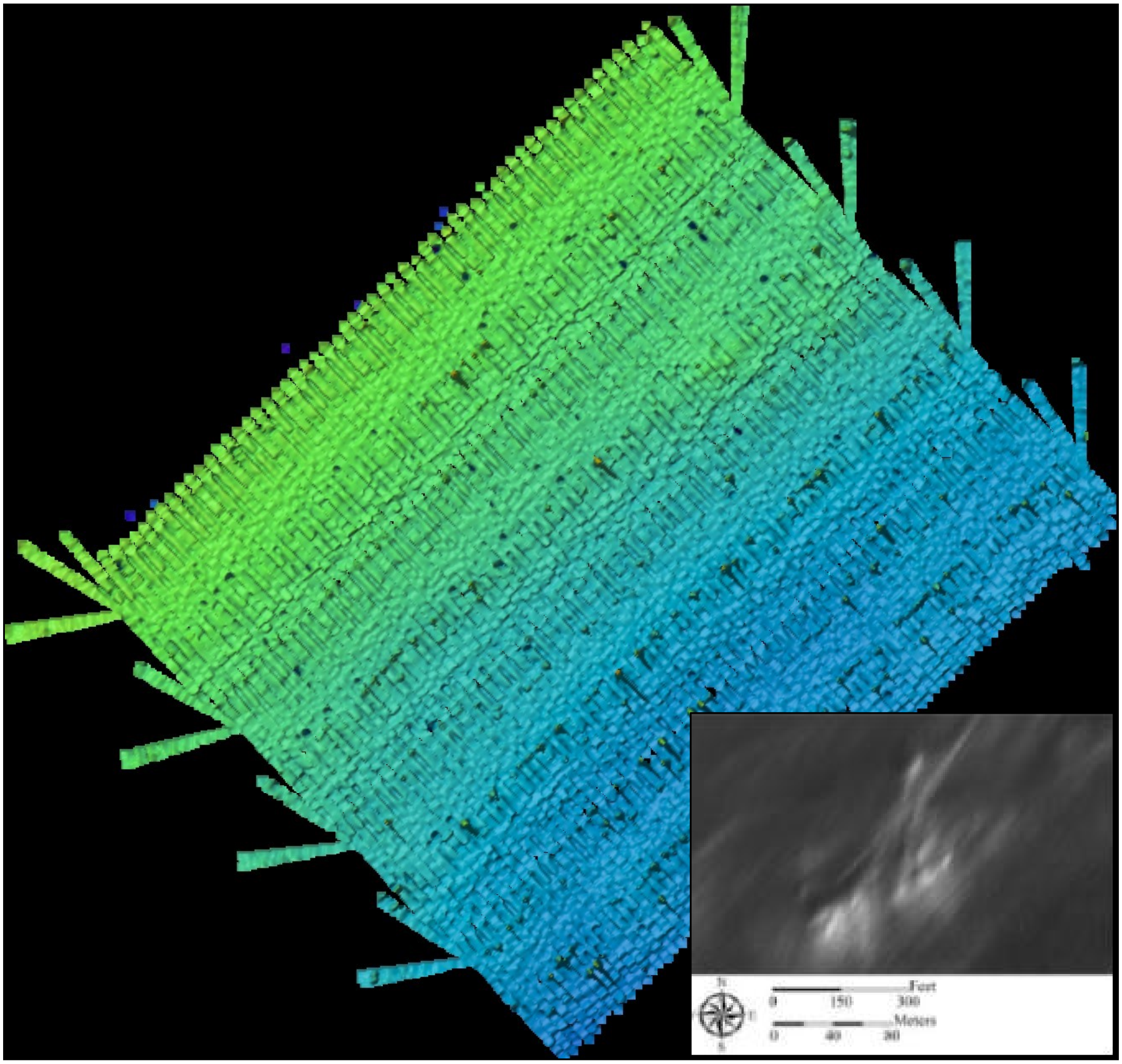

Figure 11-10 Target 6-1 Delta P survey results (left). 2011 ARL: UT data for Target 6-1 (right).
Source: NOAA/SRI/ARL:UT

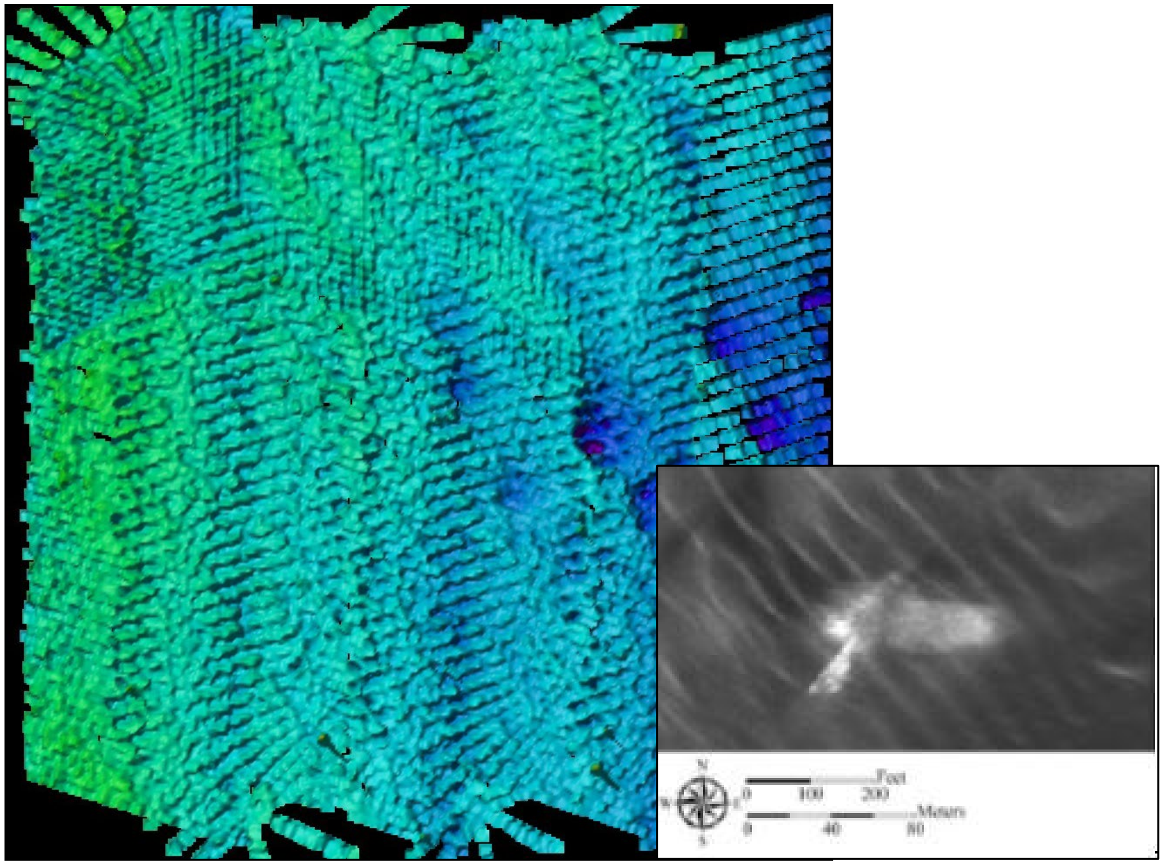

Figure 11-11 Target 7-1 Delta P survey results (left). 2011 ARL:UT data for Target 7-1 (right).
Source: NOAA/SRI/ARL:UT

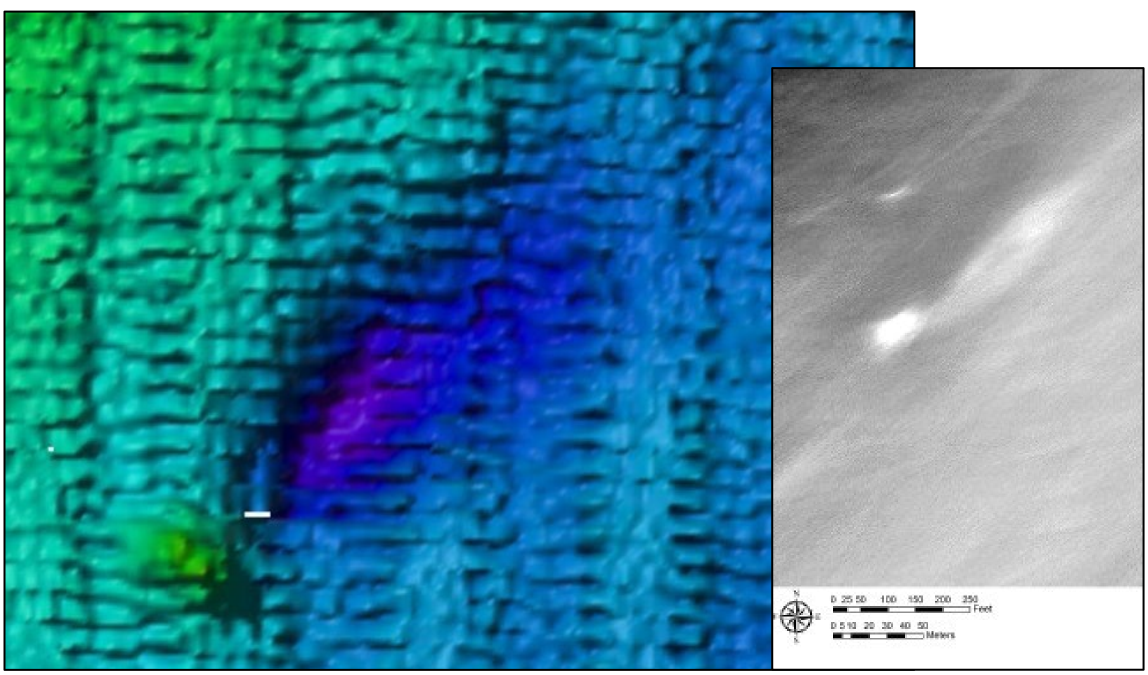

Figure 11-12 Target 8-1 Delta P survey results (left) and ARL:UT data (right).
Source: NOAA/SRI/ARL:UT

11.4 Additional Unknown Targets

Beyond systematic survey operations pursuant to the KS-520 research design, the researchers also investigated site locations provided by anecdotal information from the local fishing and recreational diving community. Some of these targets were surveyed in detail to determine their possible association with WWII.

Local diver Ken Clayton provided the first target in this category. It was presented as a potential location for U-*576*, and given the position and size of the target, it appeared a plausible possibility. The target was surveyed by the hydrographic mapping system onboard NOAA R/V *Nancy Foster* in 2009 and the results of the initial survey were a very promising target consistent with a historic vessel; but the level of detail was too low to determine whether or not the site was actually a U-boat (Figure 11-13). Subsequent ROV operations were utilized to ground truth the target (Figure 11-14).

Ultimately, it was determined that the target in question was not a U-boat, but was instead the remains of a much older vessel. The site had what appeared to be a single propeller and steam machinery, but the hull was made of wood with some evidence of copper sheathing. Following a brief dive on the target, it was determined that this material likely represents a late nineteenth or earlier twentieth century merchant vessel. Further site investigation would be required to make additional observations.

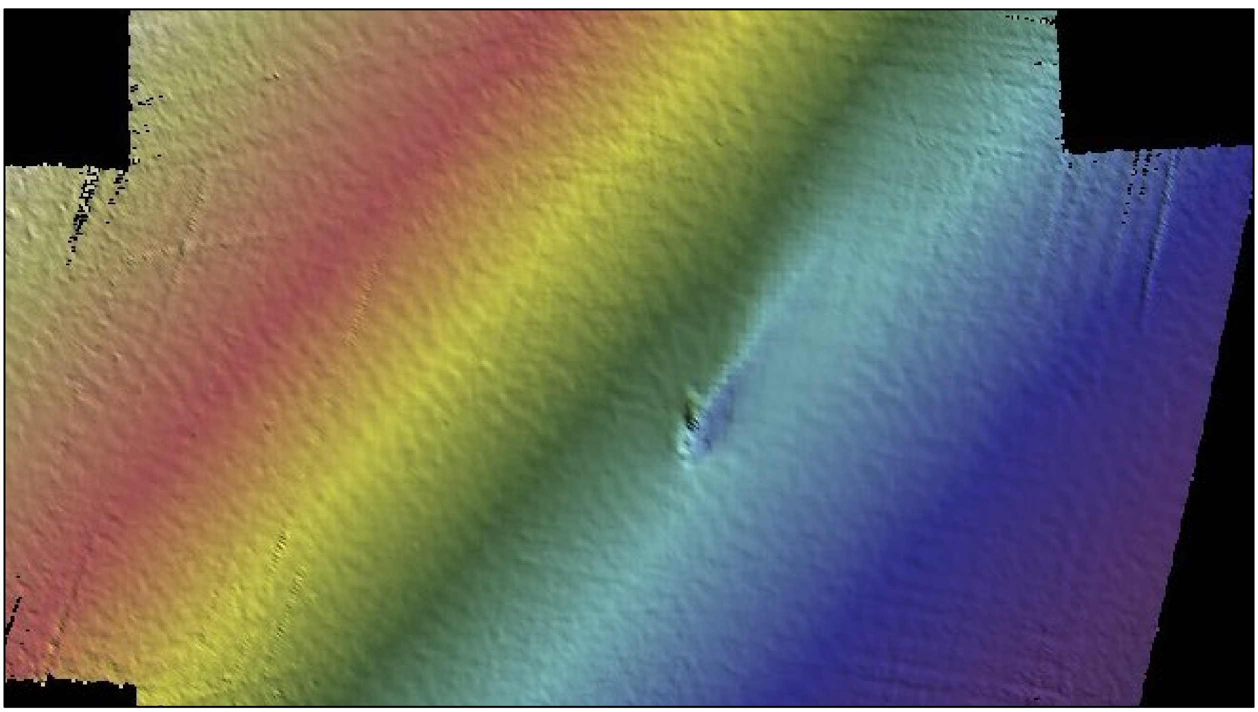

Figure 11-13 Location of target provided by local diver. Rather than a WWII era submarine, the survey depicts the location of unidentified 19th century wreck site.
Source: NOAA

Figure 11-14 Screen capture from ROV dive on unknown 19th century vessel remains showing copper sheathing.
Source: NOAA/UNCW

Next, in 2012, following some information obtained from local fisherman, a strong magnetic anomaly was recorded in 140 ft of water off the eastern tip of Diamond Shoals. The anomaly suggested the remains of a large ferrous object, confirming the fisherman's report of a possible shipwreck at that location. Local knowledge postulated these remains as the site of lost freighter *Venore*, a 550-ft ore carrier lost concurrently with *Empire Gem* following a 24 January attack by *U-66*. The site was in an area of extremely variable conditions on the edge of the shoals. Widely fluctuating current and visibility complicated both sonar and diving operations. Thermoclines and currents complicated the positioning of towed remote sensing equipment, dramatically reducing the quality of acoustic data recorded from numerous attempts at deploying a sidescan sonar. Complete remote sensing documentation was further compounded by the fact that the site itself was broken and oriented in two, perpendicular sections. This orientation prohibited gaining a complete high-resolution (900 kHz) sonar image within a single pass; however, this was achieved with the wider swath capability of the 500 kHz frequency sonar (Figure 11-16 and Figure 11-17).

The results of the sonar survey revealed the remains of a vessel completely broken into two large intact sections that appeared keel-up. Given the relatively shallow water depth of 140 ft, the vessel's condition suggested that the ship sunk very quickly. Comparable sites, such as *Naeco* and *Tamaupilas*, that also broke into two sections within identical water depths, sunk much slower and their respective sections came to rest much greater distances apart.

The georeferenced sonar data yielded measurements that revealed a cumulative length of the sections of approximately 360 ft long with approximately a 50-ft beam. This immediately excluded the theory of the remains belonging to *Venore* due to the vast discrepancy in vessel size. *Venore* was 550 ft long and over 70 ft abeam.

Subsequent diving operations on the site collected additional archaeological data used to determine if the vessel was associated with WWII. First, it was confirmed that the entirety of the vessel's remains were contained within the two extant sections; there was no additional structure or debris in the vicinity. The site was broken amidships where the bottom of a boiler was located. Its offset position suggested that an additional adjacent boiler likely occupied the space opposite the vessel's centerline, but this area was heavily buried in sediment. Also, a cellular-style hull was observed underneath the boilers indicating water ballast amidships. At the stern, a large single propeller remained, as did the ship's rudder.

Historical research utilizing the field data strongly suggested the remains did not belong to *Venore*, but were much more likely the remains of WWI casuality *Merak*. Subsequent diving operations conducted in 2015 further bolstered the theory of the vessel being *Merak* (see *Olympic* for further discussion).

Another site was also visited based upon reports from local fisherman (Figure 11-15). Here, a vessel located in approximately 230 ft of water east of Diamond Shoals was imaged via sidescan sonar. The site's dimensions were approximately 230 ft long and 27 ft abeam. The image suggested a heavily deteriorated site with three distinct components of relief. The engine or machinery appeared at amidships. The acoustic data suggested a wreck of a vintage earlier than WWII, perhaps a wooden or composite vessel. Further investigation is needed to aid in the identification of this site. A particular focus should be on photographic documentation using either ROV or divers.

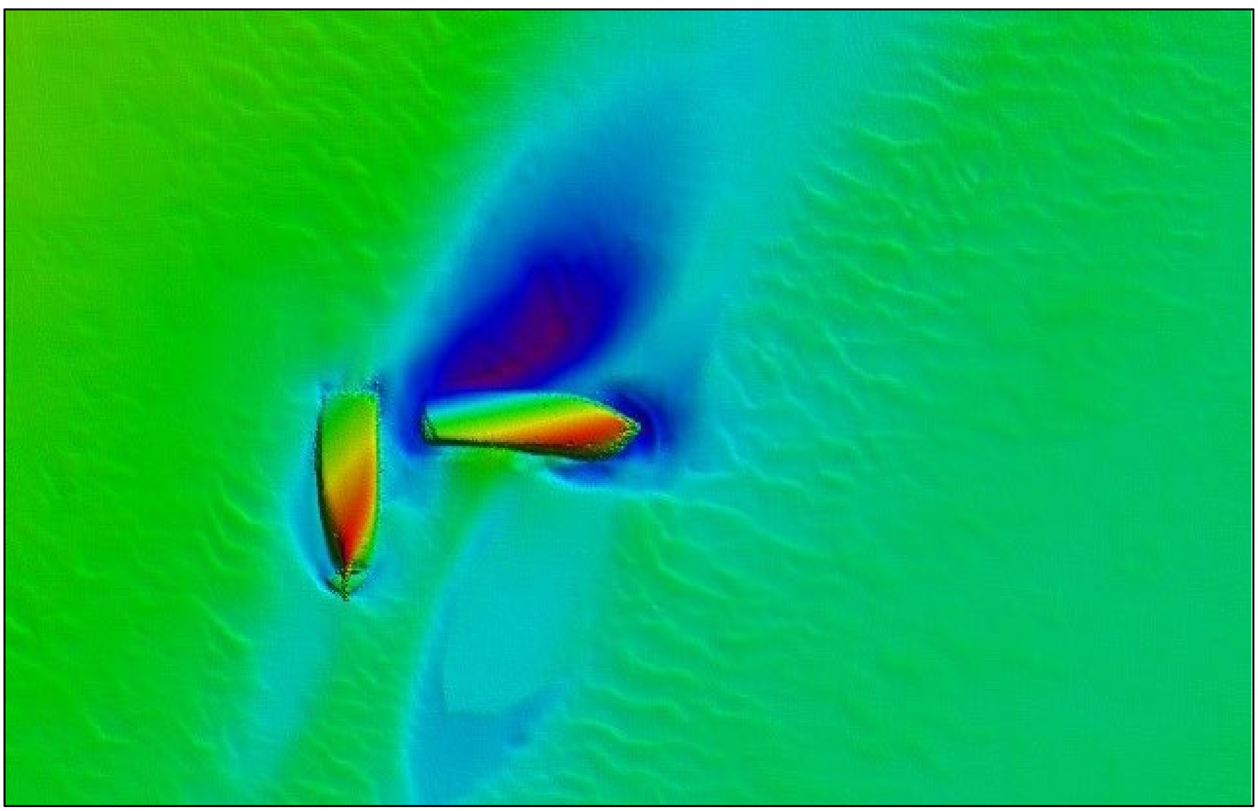

Figure 11-15 400 kHz multibeam image at 0.25-m resolution from Reson 7125 in 2016.
Source: NOAA R/V *Nancy Foster*

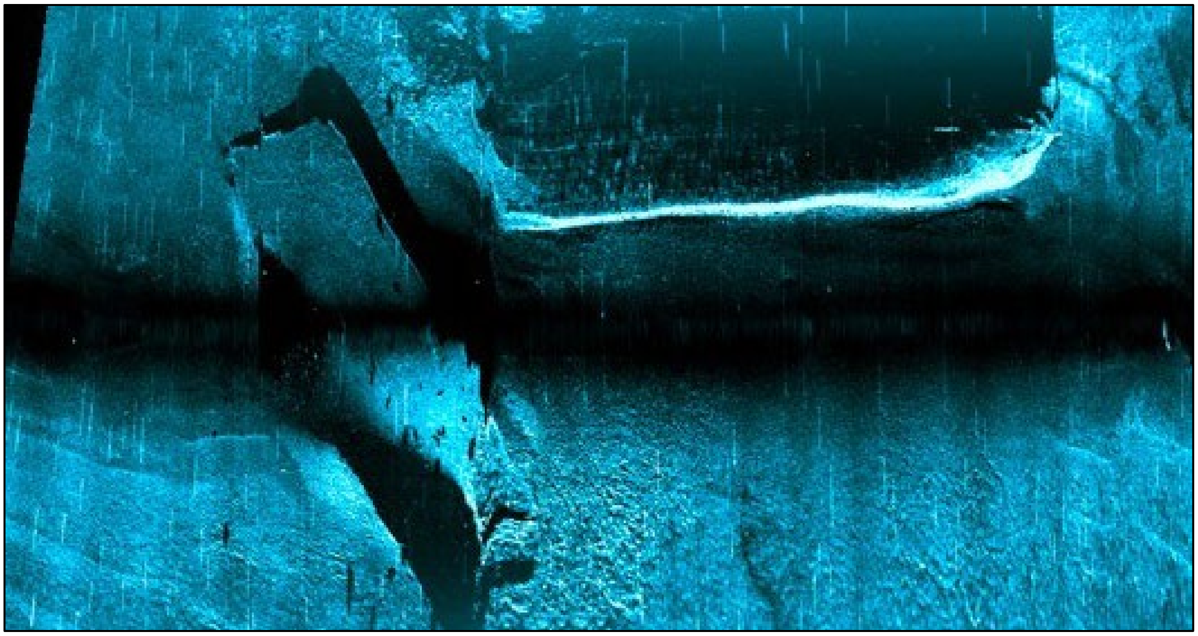

Figure 11-16 High-frequency sonar image of an unidentified site near Diamond Shoals.
Source: NOAA

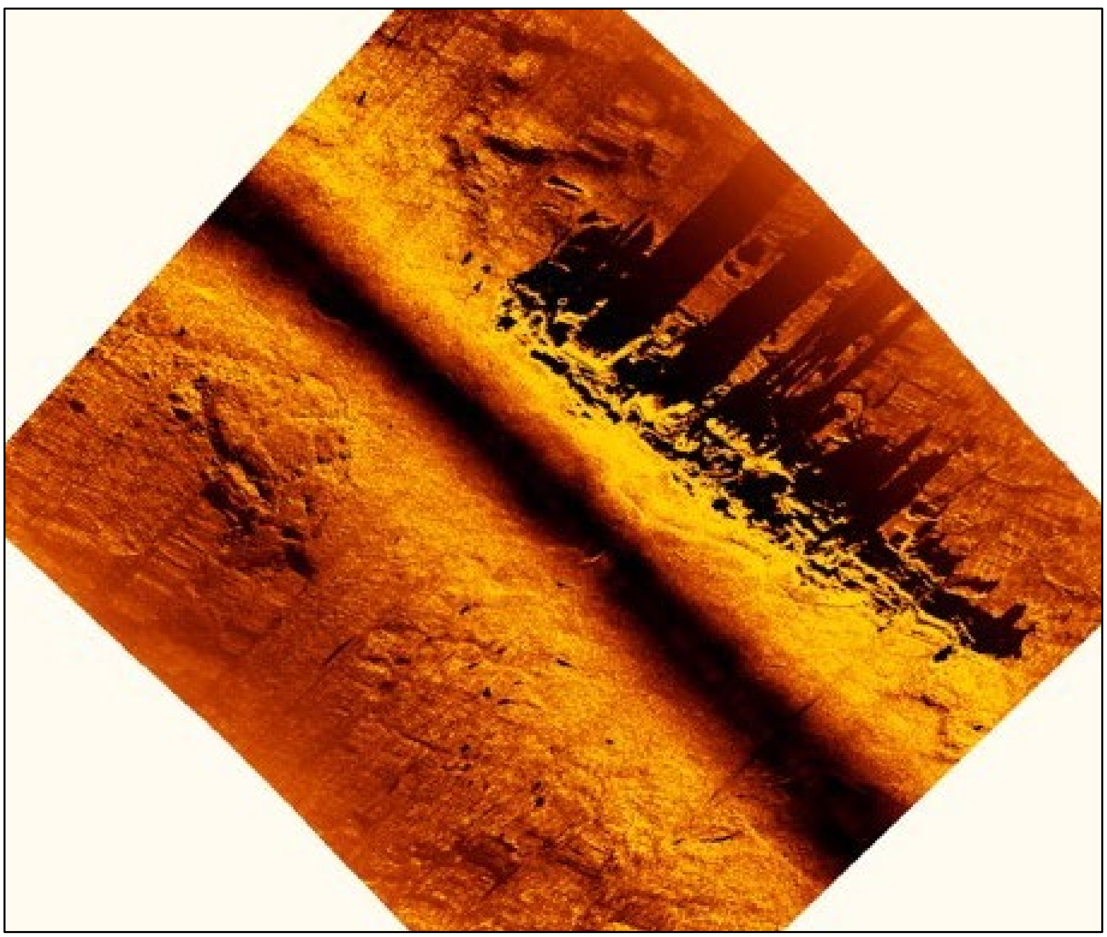

Figure 11-17 Low-frequency sonar image of the deepwater unknown target.
Source: NOAA

12 Conclusions and Recommendations

12.1 Conclusions

Over the course of 9 years of fieldwork, this survey project and resource inventory successfully collected an enormous amount of data on WWII shipwreck sites and their corresponding historical activity off North Carolina. Varying levels of documentation and survey were conducted on 40 individual sites associated with the Battle of the Atlantic, which has been collated in the previous results sections. Nearly 140 square miles of seabed were mapped and assessed for potential cultural materials. During these surveys, three previously unidentified sites (*YP-389*, *Bluefields* and U-*576*) were located and positively identified, adding new understanding to the Battle of the Atlantic. Likewise, these surveys located a number of targets that are still unidentified and may be historically significant. Forty-seven anomalies were located that presented possible signatures of man-made materials. Currently, three of these features are certain to be the remains of unidentified shipwrecks. Further detailed surveys of unidentified anomalies may lead to additional discoveries, though not necessarily sites of WWII.

During the course of survey preparation, or during individual research activities nested within this broader study effort, historical information was accessed from worldwide primary source repositories. The US NARA was extensively accessed, as well as collections from the Mariners' Museum and Park, Steamship Historical Society of America, and shipbuilder's archives, in addition to an array of secondary source materials and correspondence with researchers and familial decedents of these activities. Used throughout this study, this list of sources can be perused in this document's bibliography, with primary source materials also being curated as a project collection at Monitor National Marine Sanctuary.

The research collected during this study directly supported the development, nomination, and successful listing of 11 sites to the NRHP (U-*85*; U-*352*; U-*701*; U-*576*; *Bluefields*; *Empire Gem*; *Lancing*; *E.M. Clark*; *Dixie Arrow*; HMT *Bedfordshire*; and USS YP-*389*). Beyond just individual site listings, a multiple property designation was also approved for 'WWII Shipwrecks along the East Coast and Gulf of Mexico' (Marx and Delgado 2013e). Finally, many of the successes and discoveries made in the course of this study received global media coverage, increasing public awareness regarding this aspect of WWII history on the American Coast.

The approach during these surveys was first and foremost designed predominantly for baseline characterization and significance assessments for compliance with the NHPA as it relates to both BOEM and NOAA interests and mandates in the area. Concurrently, strategic partnerships with academic institutions such as ECU and the UNC-CSI allowed for more in-depth scholarly inquiry into various aspects of the Battle of the Atlantic (Wagner 2010; Bright 2012; Sanchagrin 2012; Sassorossi 2015; Davis 2015; Freitas 2017). Additionally, a report resulting from an ABPP grant was completed focusing on KS-520 convoy actions, and submitted to the NPS (Bright et al. 2012). Beyond published reports, portions of this survey's data were regularly delivered to professional academic and public audiences via presentations at academic conferences such as the Society for Historical Archaeology's Annual Conference on Historical and Underwater Archaeology.

This study and associated data serve as a compendium of North Carolina-specific Battle of the Atlantic research. This synthesis report is a basis for additional analysis and research on the part of the primary research team and partners as well as broader future historical or archaeological research efforts.

Consequently, there may be additional programmatic rationale for further work on these sites, beyond the immediate NHPA compliance recommendations driving the present study. At present, Monitor National Marine Sanctuary is considering expanding sanctuary boundaries to include additional maritime heritage resources in this area. While potential boundaries remain uncertain, all currently proposed models include areas that contain a significant portion of Battle of the Atlantic related shipwrecks. As such, data collected during this study will aid in the development of compliance documents for National Environmental Protection Act (NEPA) review of an expanded sanctuary. If new sanctuary boundaries are indeed established, NOAA and ONMS will have an interest in conducting further detailed surveys under NHPA Section 110 compliance, as well as for public outreach, education, interpretation, monitoring, and protection of the sites. Consequently, specific recommendations for those purposes are difficult to determine as such needs are as yet undefined. MNMS has also signed a Memorandum of Agreement (MOA) with the United Kingdom for the management of HMT *Bedfordshire*, and is in the process of drafting similar agreements with the Federal Republic of Germany with regards to the U-boat sites.

Like NOAA, BOEM will also likely have need of further details on select sites in the future. As renewable energy and mineral extraction developments grow on the East Coast of the United States, BOEM may have additional compliance obligations within potential lease blocks or study areas. The data collated in this document can serve as a solid foundation for follow on site-specific analysis to meet emerging needs.

Because of the varied nature of ownership and applicable laws in place for these resources, this chapter on conclusions and recommendations was structured to delineate vessels into appropriate categories. Separating vessels between military assets and merchant ships is further divided in this section to reflect nationality as well as location in relation to the OCS, both which trigger different potential management approaches and necessitate different recommendations. This section is structured to reflect those distinctions and bin vessels into appropriate recommendation categories.

12.1.1 Allied Military Assets

United States military vessels in this collection constitute only a few positively identified targets, USS YP-*389*, USCGCs *Jackson* and *Bedloe*, and a Navy contracted support tug, *Keshena*. There are additional targets that have not been located and are believed to be in excess of 100 nautical miles offshore. Activities undertaken by NOAA and BOEM related to these vessels have, and should continue to be in coordination with appropriate federal resource managers; i.e. US Navy assets are coordinated through the Naval History and Heritage Command (NHHC) and work on US Coast Guard vessels is coordinated via the US Coast Guard Historian's Office. Specific guidance for merchant vessels sailing under the War Shipping Administration or those that carried United States Naval Armed Guard crew is not available. While the Sunken Military Craft Act may encompass armed or commissioned merchant vessels, such interpretation of the Act remains unclear. For the purposes of these recommendations, all merchant vessels are placed in the same category.

Two Allied warships, HMT *Bedfordshire* and HMT *Senateur Duhamel*, are included in this inventory. Both are British flagged and remain the property of the United Kingdom. Monitor National Marine Sanctuary has an active MOA with Great Britain for management and interpretation of the *Bedfordshire* wreck site. The wreck site of HMT *Bedfordshire* has been frequently dived by recreational divers. As such, it represents a significant economic cultural resource. HMT *Bedfordshire* rests south of Cape Hatteras, off Cape Lookout in the more inviting Gulf Stream waters which attract sport divers worldwide. Many stakeholders, therefore, have vested interests in this site. Human remains have been reported among the HMT *Bedfordshire's* site and the government of Great Britain considers it to be a war grave. Also, there are several pieces of unexploded ordinance (UXO) in the form of undetonated depth charges located near the stern of the vessel. They are not armed, but may pose a risk to visitors at the site. Future survey efforts must take this potential hazard into consideration.

Additional research on the site may identify contributing factors to degradation allowing for informed management approaches. As the wreck of HMT *Bedfordshire* has been thoroughly documented, continued observance of any changes should be monitored periodically to track changes to the site over time. This is an iconic site for the Battle of the Atlantic in United States waters and it is recommended, to the extent possible and in keeping with the MOA between Great Britain and MNMS, to conduct ongoing monitoring in at least 5-year intervals to compare to baseline data compiled in this study.

The site of YP-*389* is unique amid the battlefield landscape off North Carolina's coast, representing the sole United States Military vessel lost to enemy action off North Carolina during the Battle of the Atlantic. Though additional warships were lost in the area, those remaining United States Military assets in this region are believed to be very far offshore and in a depth of water that rendered them outside the scope of the present study. While YP-*389* has had a determination of eligibility (DOE) for the NRHP, detailed documentation of the site's remains are needed to better inventory the extant material culture.

The first ROV-based site survey in 2009 utilized now-obsolete imaging technology. Standard definition video recorded to magnetic tape (VHS) produced low quality imagery, resulting in a subpar photomosaic. Seven years later, utilizing advancements in high-resolution underwater imaging systems captured far greater archaeological detail when a collaborative team of divers visited the site. The resulting photogrammetric models and image inventory revealed an incredible degree of preservation not seen in the 2009 dataset.

Though YP-*389* rests in deep water, it is accessible to advanced technical divers. In fact, the divers deployed at the site in 2016 were the first to do so since its discovery. In addition to noting an incredible state of preservation, they also observed a greater preponderance of extant portable artifacts and material culture than is normally seen on comparable Battle of the Atlantic sites that have been subject to extensive looting. Artifacts ranged in size from the munitions for the 3-inch deck gun, to ports holes, and an estimated thousands of rounds of small arms ammunition. A similar amount of surface portable artifacts is atypical upon most WWII sites frequently visited by sport divers. Many of these small pieces are highly susceptible to disturbance. As NHHC and NOAA consider future management of this site, it should be a priority to develop a comprehensive artifact inventory of material culture remains.

12.1.2 German Military Assets

Working through the State Department, NOAA has taken the lead in coordination with the Federal Republic of Germany as it relates to the research conducted in this study. Each phase of the study consisted of prior notification and approval through the German Embassy and subsequent reports to the same once operations concluded. Ultimately, any future management approaches and research relating to the four German vessels documented during this study should continue to work through these channels as each historic property has been repeatedly and expressly recognized as sovereign property of Germany.

U-*85* is one of only 24 Type VII-B German U-boats ever built. It is certainly the only example of a Type VII-B in United States waters. It may also be the only example of a VII-B in waters accessible for traditional archaeological survey. The one possible exception is *U-74* near Cartagena, Spain (Niestlé 1998:40). As such, it has high historical value as a unique representative of a sub-class in the evolution of German submersible technology.

Unfortunately, most of U-*85's* material remains were looted over the course of several decades. This U-boat was visited by US Navy divers just a day after its sinking, and in the 1960s, was re-discovered by sport divers, after which it has been regularly visited. Virtually all external portable artifacts were looted by divers, and the inside of the boat was indiscriminately dredged of nearly all of its contents. These activities severely and irreversibly diminished the type of archaeological research possible on this site, due to the absence of material cultural remains and disruption of provenience during salvage activities.

There are, however, sections of U-*85* that may yield archaeological information. Despite the widespread degradation of the site due to wanton looting, the hull itself still has archaeological and historical significance due to such a small representation of extant Type VIIB U-boats worldwide. Additionally, the site retains historic and economic significance for its role in the Battle of the Atlantic, as expressed via Criteria A of the NRHP guidelines (Marx and Hoyt 2015b).

The story of *U-85* is important to American history because it was the first enemy submarine sunk by a US Navy warship in the Second World War. Additionally, the sinking of *U-85* was the first German U-boat lost in United States waters during the war (Döenitz 1959:28). Initial documentation was conducted in 2008, and subsequent visits to the site thereafter captured high-resolution acoustic imagery; this site has been successfully listed on the NRHP (Marx and Hoyt 2015b).

Of the four U-boats in this study, *U-352* had the least eventful operational career. Due in large part to its location, U-*352* is the most frequently visited U-boat off North Carolina. As such, it represents one of the most significant economic cultural resources investigated in this study. This is not to belittle the economic importance of the other sites in this study, but it is an important consideration regarding multi-stakeholder interest in *U-352's* remains. The site's longevity as a viable and enjoyable scuba diving site is crucial to the area's charter vessel businesses; such viability remains only as long as these sites are protected from looting and desecration. Further assessments should include all stakeholder positions and educate and re-norm the activity of "souvenir hunting" into what it really is: illegal looting, ensuring this site remains a resource for the economy of the diving community in the future.

U-*576* is an exceptional resource with unique attributes. The level of preservation on this site encompasses the most well preserved example of a Type VIIC U-boat in United States waters, and perhaps beyond. Despite being the most common submarine type of the war, few examples of this type still remain. Only a single preserved example remains as a museum ship, U-*995*, located outside of Kiel, Germany. In addition to the remarkable site integrity, the significance of this site is enhanced by its relationship, both historically and spatially, to *Bluefields*, just 250 m away. Together these sites represent the only remains of a convoy battle in United States waters with merchant vessel and U-boat resting in a single location. The remains of U-*576* and *Bluefields* were successfully listed on the NRHP (Marx and Hoyt 2015d).

Due to the water depth at both sites, there is a somewhat lower risk of human impacts, but this risk is not nonexistent. Particularly because each site is so pristine and virtually unchanged structurally from their loss in 1942, they are consequently more vulnerable to degrading impacts from an archaeological and heritage perspective. Potential human impacts, therefore, could include damage due to fouled fishing gear or any other system whereby lines, nets, anchors, etc. are dragged across either vessel's remains. Currently this site is under consideration for inclusion in expanded boundaries of the Monitor National Marine Sanctuary.

Despite the status of high-resolution imagery collected for each vessel, U-*576* still has historical and archaeological information to gather. Further research based on mutlibeam imagery collected during the search for U-*576*, reveals several small targets a few thousand meters to the south of the site, which may represent debris from the initial surface battle. A follow-up archaeological study to the initial battlefield survey of the sites (see Bright et al. 2102; Bright 2012) would likely reveal additional information regarding the sequencing of events during the battle and the relationship to the immediate landscape features.

U-*701* is by far the most operationally successful of any U-boat lost off North Carolina's coast during the war. It also participated in one of the most aggressive U-boat assaults on the United States, during which it completed a successful (in terms of Allied vessel damage inflicted) patrol of any U-boat of its class in American waters. On it's final patrol, U-*701* conducted the only successful mining of a major United States port in the war. This resulted in the loss or damage of five ships in the approaches to the Chesapeake Bay. U-*701* was also responsible for one of the longest surface engagements with a US Navy vessel that resulted in the loss of YP-*389* and six of its crew. U-*701* was also the first enemy submarine sunk by an aircraft without the assistance of surface vessels. The historic achievement was conducted by the Army Air Force operating out of MCAS Cherry Point, North Carolina.

In addition to its history, U-*701* is the most intact and least-disturbed representation of a Type VIIC U-boat in an accessible water depth in this inventory. There are hundreds of these vessels on the seabed world-wide, but very few within conventional diving depths. Of the known Type VIIC sites, U-*701* has been protected by obscurity until recently. As such, only minimal interference with the site's integrity has occurred, which has seen the looting of external artifacts: radio equipment, gun harnesses, periscopes, and hatch covers. It is unknown if the interior of the vessel has been accessed. Out of the U-boats located in shallow waters, this site has the highest degree of preservation and consequently a larger potential for damage.

While the obligations of the NHPA have been met for all known German military assets in the region, it is possible that further study or periodic monitoring could lead to the development of management approaches that would potentially mitigate further damage or loss of historical and archaeological information.

These are iconic sites for the Battle of the Atlantic in United States waters. It is recommended, to the extent possible, to conduct ongoing monitoring, in at least 5-year intervals to compare to baseline data compiled in this study. It is recommended that these sites are revisited periodically to continue to understand site degradation and develop potential mitigation approaches, particularly as they are under consideration for inclusion in the expanded boundaries of the MNMS.

Potential for future study at these sites is very high. Further historical analysis and site documentation is likely to continue to add additional detail to the understanding of the Battle of the Atlantic. Practical studies relating to site formation and corrosion should also be considered. The circumstances of the loss of these four vessels present a compelling practical laboratory setting. Four nearly identical vessels in material and structure were sunk in very close temporal proximity in four distinctive environments: Temperate (U-*85*), subtropical (U-*352*), a mixing zone of the two (U-*701*), and deep water on the edge of the photic zone (U-*576*). Consideration of follow-on studies should be considered to the extent practicable.

Finally, all of the U-boat sites in this study have had a very thorough documentation of the external hull remains. However, due to the nature of these sites as war graves, researchers in this study did not penetrate the hull by any means. As such, the interior spaces, where a higher degree of preserved material culture likely remains, were not assessed. In the future, if non-invasive and culturally respectful methods are identified, interior survey would be beneficial to create a baseline inventory of internal material remains. Where looting and desecration of war graves cannot be prevented effectively – despite the illegality of such actions – securing and respectful repatriation of human remains must be considered. This is particularly the case on sites such as U-*85* and U-*352*, where it is known the interior portions of these sites are often accessed by individual sport divers. Regardless, not knowing what the accessible hull contains presents challenges to resource managers.

12.1.3 Merchant Vessels

By far the largest dataset in this inventory consists of merchant vessel losses. Unfortunately, this category of vessel also has the highest level of uncertainty relating to the applicability of various historic preservation laws. Nearly the entirety of the vessels in this inventory rest in federal waters and outside state jurisdiction and the application of the Abandoned Shipwreck Act of 1987. The sole exception is *Chilore*, which lies just two miles off Cape Henry in Virginia state waters. The remainder of this collection falls under admiralty law which can be complicated and may apply to each site individually in different ways depending on whether or not a vessel has been expressly abandoned or if an admiralty arrest has been filed. Admiralty law generally centers on a determination of ownership. With wartime losses, this can be difficult to determine. If a vessel is sailing under the direction or operating under the auspices of the War Shipping Administration, it is possible, though legally uncertain, if such a vessel would be considered military as it pertains to the Sunken Military Craft Act. If these vessels are not considered military in nature or ownership, then title would belong to the original owner, descendant, or legal entity that holds the original owner in its corporate lineage. However, if the vessel was declared a total loss, title to vessel or cargo would likely be transferred to an insurance company where it would either still be held, was sold, or officially abandoned. This question of ownership is further complicated by the fact that the wrecks in this inventory were registered to 11 different countries.

As a consequence to the complexity of ownership determination, these vessels are regarded by the public as unprotected and for all practical purposes that holds true. Admiralty law is meant to apply to physical property and was not designed as a law to manage heritage assets. Given the complexity of the legal landscape surrounding these sites, they are *de facto* in an unprotected state, and should be considered vulnerable to artifact removal and other potential degrading anthropogenic impacts.

The historical and preliminary field data collected at many of these sites do make many of them eligible for inclusion on the NRHP. Indeed, five of these sites have been successfully listed based on data from this study and a multiple property designation was accepted, thus potentially establishing eligibility for all the sites in the inventory. This provides for their consideration from Federal agencies with undertakings that may adversely affect them, but does not provide for additional site management or protection from individual impacts.

It is recommended that further research be conducted on identified sites and that additional nominations are made to the NRHP. Additionally, this battlescape and the wrecks contained within it are nationally significant, considering additional measures of protection, management and interpretation are recommended. As new management approaches emerge it is recommended that, to the degree feasible, these sites are monitored at regular intervals of 5 years to compare changes to baseline data and further tailor resource protection approaches to specific needs. Merchant vessels constitute the largest number of heritage resources in this collection and present a significant resource burden to manage. NOAA and BOEM should explore strategic partnerships with non-profit and avocational/volunteer organizations as well as academic programs to support the further study and survey of these resources.

12.1.4 Remote Sensing Discoveries and Unidentified Sites

In addition to the identified resources in this study, many unidentified vessels were also located. Many more sites may also be located within acoustic survey data that is not of sufficient resolution to distinguish between geologic or man-made objects. The largest collection of unknown targets was generated during the 2011 survey. Many of the 47 anomalies identified during that survey remain uninvestigated. Evaluating the acoustic anomalies identified during 2011 is highly recommended. An initial measure could involve magnetometer survey over each target to determine which of the 47 targets contain ferromagnetic materials (such as steel ship hulls or iron/steel components) and, therefore, more likely correspond to cultural materials. This, in turn, would allow a more effective prioritization of this large target list.

Several unidentified sites are clearly remains of shipwrecks. While it appears likely that the sites mentioned in this section do not represent WWII-related losses, they may nevertheless have historical significance in their own right. In each case, position accuracy is high allowing for easy re-location. Due to the fact they were imaged during a low-resolution wide-area survey, however, the level of detail within the resulting imagery is too low to make an adequate determination of a given site's identity or significance. Further site investigations would be required in order to make a determination of eligibility for the NRHP, as these remains could belong to vessels lost during WWI, or other historically significant time periods. Additional surveys should focus on collecting much higher resolution data of the sites as well as visual imagery in the form of still photography and video.

12.2 Resource Management Recommendations

In relation to current mandates, many of the sites in this study necessitate identical recommendations due to the similarity of their circumstances of loss and historical association. Therefore, recommendations are parsed into three broad categories with sub-categories and have been tabulated for quick references (**Error! Reference source not found.**). Recommendations relate only to current mandates as they apply to each individual site assessed during this study. This categorization serves the purpose of identifying future needs, which can be prioritized for use by BOEM and NOAA as well as other applicable Federal resource managers based on emerging programmatic needs and availability of funding.

12.2.1 Recommendation Category Descriptions

12.2.1.1 Category A: Undiscovered Sites

Vessels that fall in this category were indicated as lost in the area via historical records, but have not yet been located. These sites are believed to be located in accessible water depths on the OCS and, given a reasonable level of effort, have a high likelihood of being located and identified through future survey efforts. All sites in this category, until located and surveyed, should be considered to potentially contain extant human remains.

Remote sensing operations, depending on the scale of the area under investigation, can come with a high cost in effort and time. Not all vessels that fall in this category warrant an independent effort aimed at their location. Further in-depth historical analysis focusing on sources that could be used to develop search areas for these targets is recommended. Such studies will provide a better indication as to the feasibility and expense of searching for these sites and can be weighed against emerging needs of both BOEM and NOAA.

While all sites in this study meet a baseline level of significance as established through their association with the multiple property designation *World War II Shipwrecks along the East Coast and Gulf of Mexico* accepted by the NRHP (see Criteria A, association with events that made a significant contribution to the broad patterns of history), there remain varying degrees of additional significance amongst the collection (Marx and Delgado 2013e). Sites may be determined to have higher priority through greater degrees of correlation to the three other national register significance criteria, or a more specific, articulated description relating to Criteria A. These sites should be the focus of additional search efforts.

Finally, future renewable energy undertakings and/or mineral extraction in the area may necessitate further survey in the area off North Carolina. At a minimum, this inventory indicates the approximate locations of vessels in this category. In the event federal undertakings require additional survey in these areas, detailed remote sensing should be conducted to identify remains, recommend avoidance and potentially nominate additional sites to the NRHP. Likewise, ongoing developments and potential technological changes in the long-term are likely to reduce the cost and complexity of marine survey, while also increasing the level of detail achievable. While sites in this category may currently be assessed as impractical or prohibitively expensive, these factors should be reassessed as new approaches become available.

Sub Group 1a: Military vessels with unknown location (may have additional considerations and significance under the Sunken Military Craft Act).
Sub Group 2a: Merchant vessels with unknown location.
Sub Group 3a: Vessels that may have additional significance through historical narrative (first vessel lost, massive loss of life, etc.). Such additional considerations are identified in the 'notes' column of the table.

12.2.1.2 Category B: Undocumented/Under-Documented Sites (for the purposes of NRHP)

This category indicates sites that have locally accepted positive locations and identities, but were not assessed in detail during the course of this survey. Likewise, this category includes sites on which very limited data was collected (low-resolution acoustic imagery, not visited by divers, etc.). Positions of these targets are considered to be extremely accurate, but little detail beyond site location was recovered. Additionally, there are sites in this category that have known locations, but the identity of the vessel is uncertain. In these instances it is recommended, when feasible, to conduct additional survey with the goal of assigning positive identifications. Until completed, NRHP eligibility cannot be determined.

The reasons sites in this category were not documented in greater detail during this endeavor vary, but generally were determined by accessibility and cost. For instance, certain sites, while very accessible, were isolated from other clusters of targets. Mobilizing a survey expedition that would be able to collect data on a dozen sites in close proximity was far more viable than mobilizing in fewer, but multiple, far-reaching operating areas wherein only a single site may be accessed in each.

Consequently, there remain a small number of sites that are known but remain undocumented. Historical descriptions of these sites are included in this inventory, but it is recommended that the physical remains of these vessels be documented to a higher degree of detail, towards making a determination of eligibility for the NRHP. Data collected should focus on high-resolution remote sensing, photographic and video documentation, and diver-based observations. Such data should be adequate to determine eligibility and provide enough information to inform researchers if further site documentation is warranted.

Sub Group 1b: Sites on which no physical data was collected.

Sub Group 2b: Sites on which limited or low-resolution physical data was collected and additional survey is needed to make an eligibility determination.

Sub Group 3b: Sites that contain known shipwreck remains but have uncertain vessel identification.

12.2.1.3 Category C: Fully Evaluated Sites

Many sites in this study have been the focus of thorough documentation to generate robust baseline characterization, and some have had comprehensive documentation conducted over the course of several seasons of research (i.e. U-*352*). This category addresses sites on which survey can be considered complete, for the purposes of making a determination of significance and eligibility for the NRHP. Indeed eleven of the sites that fall in this category have already been accepted to the NRHP. The remaining sites that have not been nominated in this category have enough detailed site documentation amassed that no further fieldwork would be required to prepare a nomination package.

As time allows, these sites should be nominated to the NRHP. In addition to responsibilities under the NHPA, many of these sites are of interest to the MNMS as it considers boundary expansion. Further, more detailed work on particular sites may have value for education and outreach purposes or public engagement. Such work may include high-resolution modeling or detailed diver-generated site plans. While the benchmark for documentation under NHPA has been satisfied on these sites, some have the potential to yield additional information and may warrant finer detailed follow-on surveys.

Other programmatic needs may arise that require more detailed surveys. These sites may also be documented in further detail opportunistically through partnerships with special interest and avocational groups interested in site documentation. Finally, the level of detail already obtained on these sites makes them good controls for testing and evaluating new methods and tools for site assessments.

Sub Group 1c: Sites that have been successfully listed on the NRHP.

Sub Group 2c: Sites that have enough data collected and are eligible for the NRHP.

Table 12-1 Recommendation Categories for Battle of the Atlantic OCS Shipwrecks

Vessel Name	Status	Sub Category	Recommendation Category	Notes
Merchant Vessels				
Allan Jackson	unlocated	1a	A	First merchant vessel to be sunk in North Carolina waters during WWII
Ario	located	2c	C	
Ashkhabad	located	2c	C	Complete site plan collected.
Atlas	located	2c	C	
Australia	located	2c	C	Significant sediment transport that obscures large portions of the wreck episodically.
Bluefields	located	1c	C	Listed on NRHP.
British Splendour	located	2c	C	
Buarque	located	3b	B	Three sites have uncertain locations and identifications: *Buarque*, *Chenango* and *Equipoise*.
Byron Benson	located	2c	C	
Caribsea	located	2c	C	Complete site plan collected.
Cassimir	located	2b	B	
Chenango	located	3b	B	Three sites have uncertain locations and identifications: *Buarque*, *Chenango* and *Equipoise*.
Chilore	located	2c	C	
Ciltvaira	unlocated	3a	A	Has additional significance as it relates to the 'free Latvian Navy'.
City of Atlanta	located	2c	C	
City of New York	unlocated	2a	A	
Dixie Arrow	located	1c	C	Listed on NRHP.
E.M. Clark	located	1c	C	Listed on NRHP.
Empire Gem	located	1c	C	Listed on NRHP.
Empire Thrush	located	2b	B	

Table 12-1 Recommendation Categories for Battle of the Atlantic OCS Shipwrecks

Vessel Name	Status	Sub Category	Recommendation Category	Notes
Merchant Vessels				
Equipoise	located	3b	B	Three sites have uncertain locations and identifications: *Buarque*, *Chenango* and *Equipoise*.
Esso Nashville	located	2b	B	Only of portion of the vessel remains.
John D. Gill	located	2b	B	Positive ID and frequented by local divers.
Kassandra Louloudis	located	2c	C	
Lancing	located	1c	C	
Liberator	located	2c	C	
Ljubica Matkovic	unlocated	2a	A	
Malchace	located	2b	B	
Manuela	located	2c	C	
Marore	located	2b	B	
Naeco	located	2c	C	Broken into two disparate sections. Only the stern has been assessed by divers but both sections have been documented acoustically.
Nordal	unlocated	2a	A	Misidentified during Gentian survey.
Norvana	located	2c	C	
Olympic	unlocated	2a	A	
Panam	located	2b	B	
Papoose	located	2b	B	
Rio Blanco	unlocated	1b	A	
San Delfino	located	2c	C	Previously identified as 'Green Buoy Wreck' or the remains of a WWI shipwreck *Mirlo.*
Tamaulipas	located	2c	C	Broken into two disparate sections. Only the stern has been assessed by divers but both sections have been documented acoustically.
Venore	unlocated	2a	A	
W.E. Hutton	located	2c	C	
William Rockefeller	unlocated	3a	A	One of the largest tankers lost, sunk by U-*701.*
Allied Military Losses				
HMT *Bedfordshire*	located	1c	C	Listed on NRHP.
USS *Cythera* (PY 26)	unlocated	3a	A	Only instance of POWs being taken back to Germany from the East Coast.
USS *YP-389*	located	1c	C	Listed on NRHP.
Non-Combat Losses				
F.W. Abrams	located	2c	C	Sunk by the Hatteras minefield.
HMT Senateur Duhamel	located	2c	C	
Keshena	located	2c	C	Complete site plan collected.
Suloide	located	2c	C	
USCGC *Bedloe*	located	1b	B	Positive ID and frequented by local divers.
USCGC *Jackson*	located	1b	B	Positive ID and frequented by local divers.

Table 12-1 Recommendation Categories for Battle of the Atlantic OCS Shipwrecks

Vessel Name	Status	Sub Category	Recommendation Category	Notes
U-Boats				
U-*85*	located	1c	C	Listed on NRHP.
U-*352*	located	1c	C	Listed on NRHP.
U-*576*	located	1c	C	Listed on NRHP.
U-*701*	located	1c	C	Listed on NRHP.

12.2.2 Avoidance Area Recommendations

The 40 sites that were accessed and surveyed during this study were done so predominantly for Section 110 compliance with NHPA. As BOEM and NOAA consider further action relating to the sites, an understanding of their geographical distribution is essential to providing avoidance recommendations or inclusion in potential protected areas. Table 12-2 was developed as a quick reference guide for each target and can be utilized to make specific determinations as needed.

12.3 Data Sharing/Data Management Plan

A very large dataset has been generated as a result of this survey. Archaeological survey data including photographs, video, photomosaics, photogrammetry models, archaeological measurements and drawings, as well as remote sensing and bathymetrics data, including multibeam sonar, side scan sonar, magnetometry data, and laser surveys will all be archived and where appropriate be made publically accessible in accordance with the following:

- NOAA Administrative Order (NAO) 212-15,
- Public law 111-11 Section XII Ocean Exploration (see 33 USC 3403), and
- Section 304 of the National Historic Preservation Act.

All data will be kept on file at NOAA's Monitor National Marine Sanctuary, which can be contacted through https://www.monitor.noaa.gov whereby requests for specific data can be made by contacting the Sanctuary Superintendent. Additionally, all data collected under OER funded operations will be archived with the NOAA National Coastal Data Development Center (NCDDC) via https://www.ncddc.noaa.gov.

Table 12-2 As-built Compared to Observed Dimensions of Each Vessel Visited During this Survey and Total Area Coverage of Debris Fields

Vessel	Length As Built	Beam As Built	Observed Length	Observed Beam	Scatter Extent Length	Scatter Extent Beam	Overall Area (Sq. Ft)	Highest Relief Approx (Ft)
Ario	436	56.1	422.90	56.40	424.50	87.59	31,563.41	10
Ashkhabad	401	52.3	395.55	48.75	398.00	144.74	37,172.30	15
Atlas	430	58.20	421.73	56.47	442.20	108.30	44,728.29	25
Australia	509	70	532.16	49.80	537.60	136.90	51,419.74	15
Bluefields	250	43	244	43.2	289.15	50.50	14,602.52	40
British Splendour	441.2	59.7	419.55	58.28	419.55	125.72	33,277.65	15
Byron Benson	465.4	60.2	510.27	76.62	531.46	97.61	47,496.35	10
Caribsea	261	43	248	42.8	254.44	111.88	28,903.77	20
Chilore	549.6	72.2	566.36	96.46	581.73	116.15	75,073.20	5
Cassimir	390	54.2	352.68	53.75	437.6	70.4	37,644.13	20
City of Atlanta	377.5	49	410	46.92	425.25	104.36	29,868.40	15
Dixie Arrow	468.3	62.7	466.32	61.3	500.00	116.88	47,095.90	30
E.M. Clark	499.2	68.1	499	61	500.00	40.00	20,000.00	50
Empire Gem	463.2	61.2	402	55	515.00	210.00	108,150.00	30
Empire Thrush*	395.5	53	12	12	500.00	300.00	150,000.00	10
Esso Nashville (Bow)	445.4	64.2	52.4	24	215.00	110.52	22,645.88	15
F.W. Abrams	467.6	62.7	430	62	573.45	106.80	61,193.87	20
HMS Senateur Duhamel	192.3	31.1	179.81	31	209.54	73.16	15,337.19	15
HMT Bedfordshire	162.3	26.7	160	26	160.00	26.00	4,160.00	10
John D Gill	528.5	70.2	547.79	68.2	648	191.15	92,625.29	20
Kassandra Louloudis	400.1	52.3	382.51	52.75	396.93	108.38	34,751.79	15
Keshena	142	27.5	140	24	150.00	32.00	4,800.00	20
Lancing	470	57.2	468.8	53.96	494.30	82.40	38,642.88	30
Liberator	410	56	205.89	27.48	164.45	35.43	14,851.71	30
Malchace	338.8	48	306.75	35.5	359.43	80.49	30,464.48	25
Manuela	393.8	55.3	397.07	49.82	407.11	165.68	46,695.17	20
Marore	550.3	72.2	500	72	575.00	90.00	51,750.00	20
Naeco (Bow)	411.6	53.4	N/A	N/A	382.41	294.57	87,552.16	10
Naeco (Stern)	411.6	53.4	230.84	50.34	248.19	87.04	19,665.78	20
Norvana	253.4	43.8	273.63	40.22	302.78	76.53	19,433.53	15
Panam	438.7	57.2	438	60	440.00	60.00	26,400.00	35
Papoose	412	53.3	396.5	56	400.00	56.00	22,400.00	35
San Delfino	463	612.2	450	60	480.00	65.00	31,200.00	15
Suloide	338.1	48.2	318.5	45.42	340.05	71.42	23,376.88	10
Tamaulipas (Stern)	434.8	56.2	232.58	51.25	247.54	81.51	15,262.69	30
Tamaulipas (Bow)	434.8	56.2	193.34	55.18	198.24	60.73	11,185.34	25
U-*85*	220	20	141.14	14.69	147.26	22.38	2,582.64	25
U-*352*	220	20	194.97	14.16	209.29	20.91	4,196.12	25
U-*576*	220	20	218	20	225.00	20.00	4,500.00	35
U-*701*	220	20	218.77	14.14	219.98	18.45	4,413.00	20
USS YP-*389*	102.5	22.1	102	22	105.00	35.00	3,675.00	20
W.E. Hutton	435	56	412.12	55	590.06	100.84	59,506.43	30

* Note: Scatter Extent for Empire Thrush is estimated, only a single boiler is observable above the seabed. Source: NOAA

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