Perceptions and Research Potential of Submerged WWII Aircraft as Archaeology and Beyond

by

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Preface

Abstract

At the moment, the majority of submerged aircraft knowledge comes from non-academic sources.

There is a lack of knowledge regarding submerged aircraft because historically speaking they had more of an economic value rather than academic. However, the need to interact with submerged aircraft due to an increase of sea activities such as diving and other commercial activity has left a gap in our understanding of this submerged heritage. Although the amount of academic research on submerged aircraft has vastly increased over the last ten years, there is still a larger body of knowledge made up of non-academic sources. And at times these non-academic sources are often overlooked by researchers, but may potentially have useful information for future studies of aircraft wrecks.

The main question this study tries to answer is how to properly examine these aircraft by analyzing legislation, media, and perceptions of submerged WW II aircraft in order to identify their archaeological potential. The perceptions and research potential of three submerged WW II aircraft studies will be used as case studies to examine this question and others pertaining to the study of submerged WW II aircraft.

The culmination of the study will result in recommendations for the management of the Black Jack Wreck.

Abstrakt

I øjeblikket kommer størstedelen af vores viden om flyvrag under vand fra ikke-akademiske kilder.

Der er en mangel på viden omkring flyvrag under vand, fordi historisk set, har de haft en mere økonomisk, end en akademisk værdi. Behovet for at interagere med sunkne fly, grundet en stigning i hav aktiviteter, såsom dykning og anden kommerciel aktivitet, har forårsaget at

forståelsen af denne undersøiske kulturarv er mangelfuld. Selv om mængden af akademisk forskning af flyvrag under vand er steget væsentligt de sidste ti år, stammer størstedelen stadig fra ikke-akademiske kilder.

Ofte overser forskere disse ikke-akademiske undersøgelser, på trods af at de potentielt kan have nyttige oplysninger til fremtidige studier af flyvrag.

Det primære spørgsmål, denne undersøgelse forsøger at besvare, er hvorledes man korrekt undersøger flyvrag, ved at analysere lovgivning, medier, og forståelsen af sunkne fly fra anden verdenskrig for at identificere deres arkæologiske potentiale. Forskningspotentialet samt forståelsen af undersøgelser af tre anden verdenskrigs flyvrag under vand, vil anvendes som casestudies til at undersøge dette og andre spørgsmål i studiet af flyvrag under vand fra anden verdenskrig.

Kulminationen af undersøgelsen vil resultere i et forslag til håndteringen af Black Jack Wreck.

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List of acronyms

BuNo: Bureau Number
DoMH: Department of Modern History Museum (Papua New Guinea)
EAA: Experimental Aircraft Association
EADS: European Aeronautical Defence and Space company
EH: English Heritage
MAP: Marine Protected Areas
MBCC: Michael Beetham Conservation Center
MOD: Ministry of Defense (United Kingdom)
NAS: Naval Air Station
NARA: National Archives and Records Administration
NHHC UAB: Naval History and Heritage Command Underwater Archaeological Branch
NPS: National Parks Service
NRI: National Research Institute of PNG
NOAA: National Oceanic and Atmospheric Administration
PNG: Papua New Guinea
RAF: Royal Air Force
SMCA: Sunken Military Craft Act
USAAF HRA: United States Army Air Force Historical Research Agency

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Chapter I:
Introduction

The thesis is concerned with the archaeological potential of submerged aircraft by analyzing maritime legislation, media, and case studies. The case studies focus on aircraft from World War II and are supported mainly by United Kingdom and United States organizations respectfully. Each case is a unique look at different sides of research currently going on and will build on each other in some way to culminate into a management plan for the Black Jack Wreck.

The subfield of aviation archaeology has been growing since the 1980's, but mostly with the same narrow historical standards of early archaeology. Although the subfield has matured since then, the full research potential of submerged aircraft as archaeological material is still not fully understood and should be explored further. There are a number of projects involving aircraft which have been done for monetary gains, but also those that are helping to move the subfield forward and reach a level of academic standard worthy of studying.

The intent of this research is to evaluate the subfield of submerged aviation archaeology through the lens of legislation, public perception of such heritage, and a need to continue research geared in protecting it for future generations. Although the case studies focus on the U.S. and UK, the far-reaching consequences of their policies and individuals often intersect those of other nations. This is due to the interconnectedness of shared systems of trade, transportation, humans, and ideas. Through an examination of these case studies in regards to their results, media, and legislation, identification of the archaeological potential of submerged military aircraft will be expressed.

This paper will follow a "Battlefield" and "Media" archaeological approach to investigate the research questions. An introduction of these methods will be addressing how they will help to examine the case studies that will be evaluated. Then an introduction to aviation and society over the ages to WW II will be reviewed to set the stage for the evaluation of the submerged WWII heritage.

1.1 Introduction to Approaches

Battlefield Archaeology deals with addressing a specific event in the past which is a persisting memory into the present (Carman 2005). A battlefield archaeological method would allow me to define archaeological objectives and research goals for each of the historical cultural resources that will be evaluated in the case studies.

Media archaeology has the potential to uncover those things that modernity has hidden, overwritten, made absent or obscured (Buchli 2002). By taking a media archaeological approach to the case studies, the aim is to analyze media sources such as news articles, blogs and historical reports to examine the archaeological potential of such sources and the way they can be useful in understanding how the information is and is not presented to worldwide audiences and also uncover what is not.

1.2 Introduction to Aviation and Society over the Ages

Aviation developed quite rapidly during times of war. Although, aviation in the form of lighter-than-air balloons has been used in warfare since 1794, it was not until WW I that heavier-than-air aircraft became common in warfare (Maclsaac 2015). From then on, the modern aircraft has had an increasing role in the way war was fought and political affairs developed. The centennial to the Second World War is coming in the next twenty-three years and before that time comes the field of aviation archaeology should be prepared to deal with its increasing transformation as a profession and responsibility to an expanding collection of cultural heritage.

The imitation of birds was the central idea in the earliest thoughts about achieving human flight. This is certainly apparent in the early Greek myth of Icarus and how he and his father fashioned wings fastened by wax to escape their prison. While ignoring his father's warnings, Icarus flew too close to the sun and fell to his doom. There are indeed several stories throughout time of attempts at flight with many ending in calamity. By the 1500's, the concept of achieving flight being achieved mechanically was extensively researched by Leonardo da Vinci.

It was not long after that the first successful human flight took place in Paris 1783 by way of balloon. Sir George Cayley was really the individual responsible for the eventual creation of the modern aircraft. In 1799, instead of relying on the concept of imitating birds he suggested a

fixed-wing aircraft design, which would allow an aircraft to achieve lift and combat drag effectively (Anderson 2005: 6). The first mechanically operated flight following the concepts of Cayley, was accomplished by the Wright brothers' Wright Flyer 1 in 1903 and quite literally would soon open up the skies to everyone. After the end of WW II, the general public was finally able to enjoy all the benefits of flight.

The attraction of flight continues to be of great appeal to individuals around the world and can be seen by the number of people that attend air shows of historic planes and museums like the National Air and Space Museum in the United States. More than eight million people visit this establishment every year making it the most visited museum in the United States. The largest air show in the world is held in Oshkosh, Wisconsin every year by the Experimental Aircraft Association (EAA) to showcase new aviation technology and witness representations and sometimes originals of aircraft from the past. Every year the weeklong celebration of flight and aircraft draws around 500,000 people from more than 60 countries (EAA 2015).

The potential for aircraft to be used as weapons of war became quite apparent after WW I and several countries began to build up their aviation industries. With the onset of WW II, the advancement of aircraft capabilities came to include strategic bombing, reconnaissance, transport, electronic warfare, weather reconnaissance, flying lifeboats, and mobile flying artillery (Fox 2014).

1.3 World War II and Aviation

From 1939 to 1945 the world was once again in a conflict involving the world's major powers due to the instability created in Europe during the First World War. Germany and Japan began to expand their armed forces at a rapid pace during the 1930's (Uziel 2006; Tokarev 2014). To the Soviets, aviation exemplified its potential ability to master new industrial capacities which would place it as one of the world's most advanced developing nations. In the 1930's the Soviet Union had the largest and most capable heavy bomber force of any nation which was made up of the TB-3 (Jasinski and Mizin 2004: 216). Development also came with assistance from German sources in exchange for facilities in Russia where the Luftwaffe would train in Secret (Mondey 1978). Prior to WW II, Japan was still new to the aviation industry.

By 1939 the armies and air forces of Germany and Japan far exceeded those of the United States. Both countries soon started to invade its neighbors and expand their territories without much opposition. Germany had also made a pact with Soviet Russia late 1939 to split Poland between themselves. Weary from the last war, other world powers tried to avoid confrontation with Germany for as long as possible. It was not until Germany invaded Poland that Britain and France declared war on Germany (Bailey 1979).

After the defeat of Poland by German and Soviet forces, Germany had shifted its focus on its western neighbors eventually occupying Denmark, Netherlands, Belgium and France. In 1941, Germany had invaded Soviet Russia breaking their nonaggression pact leading to their expansion to slow down now that its forces were split fighting on two borders. Once Germany became enemies of Russia, it received large supplies of fighters from Britain and the U.S. allowing the Soviets to produce the Ilyushin I1-2 Styrmovik aircraft. This aircraft was heavily armored to withstand fire from German ground troops. Japan effectively managed to bring the United States into the war in December 1941by attacking Pearl Harbor (Harvey 1999; Tokarev 2014).

During this same time the U.S. Air Forces consisted of an Army Air Force, Navy Air Force, and Coast Guard. In an agreement with Britain, the U.S. had established that while Britain would focus on building short range aircraft, it would focus on producing long-range bombers and fighter craft. In its arsenal the U.S. relied on the P-38 Lightning, P-51 mustang, the B-17 flying fortress and B-24 Liberators (Mondey 1978).

Aside from the negative impacts of war, it is a time when technological advancements happen at a fast pace. This can be readily seen in the advancement of aircraft during World War II. Aircraft have risen from the first heavier-than-air machine, the Wright Flyer I on 17 December 1903 to jet engine powered aircraft by the end of the war (Bednarek 2001).

The involvement of aircraft during World War II far outnumbered those of WWI effectively changing the dynamic of the battlefield. A battlefield can be described within a "fixed spatial and temporal area" previous to WWII (Anderton 2001:265). The world was now the battlefield with fighting taking place on land, sea, and the air. In this war, the boundaries of static and mobile forces often blurred with one another.

1.4 Battlefield Archaeology

Battlefield Archaeology deals with addressing a specific event in the past which is a persisting memory into the present (Carman 2005). World War II can be seen as such a past event since the memories of it may certainly still be recalled today.

The archaeological study of battlefields was borne out of historical archaeology. The reasons it did not enter mainstream archaeological studies until the 1980's can be attributed to critics of the field suggesting that it had too strong a focus on the historical narrative and a lack of archaeological potential (Scott and McFeaters 2010). While earlier versions of the field were mostly concerned with comparing topographical features of the present to represent the features of events in the past, it did not take into account the rate at which the landscape can change over time (Carman 2005: 216).

Much like other emerging archaeological perspectives, battlefield archaeology started to gain popularity in mainstream archaeology in 1980 with the study of the Little Bighorn site. In this study, through the analysis of historical and archaeological data the troop movements of the Sioux and Cheyenne Native American tribes were able to be determined (Scott, Fox and Connor 1989; Fox and Allan 1993). It was the first major examination of cultural material left behind from armed conflict that demonstrated the potential information which might be retrieved by such sites (Freeman 2001: 2).

One of the other problems of battlefield archaeology was that a battlefield is often considered a 'historic place', rather than an 'archaeological site' (Carman 2005: 217). Now battlefields are subject to a range of various management styles by heritage agencies, which set the definition of a particular place or object of interest.

The idea that separating the attachment to the agendas of military history of the material objects being studied was proposed by John Carman and goes a long way in being able to provide a fresh view of historic resources (Carman 2005: 221). By doing so, it means to approach historic cultural resources with a clear archaeological objective and defined research goals. Aviation archaeology can benefit from the perspective of battlefield studies in this respect.

One of the first attempts looking at aviation wreck sites as whole sites rather than as a single wreck was conducted by Gould. His studies of the Battle of Britain and the Spanish

Armada allowed him to observe that sites with higher archaeological content would be in deeper water while those in shallower locations would be in more danger of disturbance (Gould 1983: 139). During times of conflict, wrecks in shallower waters would be scavenged or recovered due to the necessity of reusing the material. In contrast, with the advancement of diving and salvaging equipment there is today, aircraft and other maritime cultural heritage once safe in the oceans depths is now more accessible.

1.5 Media Archaeology

Media archaeology is another young form of archaeology that has come about recently. The goal of media archaeology is to enable us to view past, present and future as interrelated, as well as helping to construct alternative histories of the media (Parika 2012:161).

This form of archaeology came out of a tradition of historical media studies, which largely focused on the analysis of various forms of media and media technologies to form historical narratives (Huhtamo 1997: 222). In time, archaeologist began to see the need to evaluate the relationship between media and their archaeological work, how it is represented and can be presented to large audiences, and the potential to find archaeological viable information (Britain and Clack 2007:14).

The media has been an increasingly valuable tool for archaeologists to help share their findings with a larger audience, but Harrison argues that there is too much reliance on what he considers the highly partial and unstable nature of virtual material from the internet which influence the process of contemporary reportage, and by extension, history making. Harrison suggest that an 'archaeology of now' could provide a motivation to explore marginal and subaltern viewpoints and alternate contemporary histories. By focusing on contemporary material evidence as well as analyzing and excavation of virtual material culture, can reveal micro-histories of dominant narratives from the internet (Harrison 210:329).

1.6 Objectives

The aims of this study are to examine the field of submerged aircraft archaeology through the effects of legislation and the different entities that help to mold it as a growing subdivision of maritime archaeology. This study is theoretically based since it does not incorporate fieldwork; as such there are four aims this study considers. Here are the principal objectives/questions:

- To examine the sub-discipline of submerged aircraft in its beginnings until today
- To analyze the effects of legislation and media on military aircraft wrecks
- What are the benefits to conducting regional specific searches of potentially submerged aircraft?
- To identify the archaeological potential of submerged WW II aircraft

This study is theoretical in nature for a few reasons. First of all, an exploration will be conducted of three completely different aircraft projects not only in terms of what their final objectives were, but also of the legislation and management decisions that affected the wrecks. The case studies chosen for this paper are from the UK and U.S. Secondly, the scope of this study is largely to provide a point of departure for future studies into the progressively growing subfield of submerged aviation archaeology.

To that effect, aircraft wreck sites have not always been observed for their research potential and significance, but more for their monetary prospect (Hoffman 2011). One of the major perspectives of museums is to have rare historical aircraft available for the public's enjoyment, which may affect the way the general public views aviation archaeology and archaeology overall. Museums such as the Royal Air Museum in Britain are one of the few that have begun to have display their archaeologically recovered aircraft wrecks in their final resting condition rather than completely restored.

1.7 Methods/Research materials

Imposed Research Conditions:

All research will be conducted desk based research and possibly some hands on conservation and field work from the Naval Yard in Washington DC will be included. Constant contact with RAF staff by email has been integral to remaining updated on the progress of the Dornier project. During the three months as an intern with NHHC UAB, I have been able to observe the management plans of a number of aircraft wrecks, conduct archival research, and conduct a side-scan survey to locate aircraft located in the Chesapeake Bay and Potomac River. A database of the submerged aircraft in the two previously mentioned bodies of water was started as part of the internship duties. One of the case studies involves an archaeological project recently done by NHHC UAB. A wide variety of literature including published and unpublished work including journals, news, and popular periodicals relating to aviation archaeology was reviewed.

Literature to provide background information on the timeframe and the scope of the study was reviewed. Literature on the case studies were gathered from recent projects on aircraft wrecks, which include media sources. Legislative literature was used to provide clarity to the intricacy of wreck sites. Some of the original research and field work done for the NAS PAX River survey done in 2015 by myself as part NHHC UAB is unpublished at this point in time so certain details have been left out.

1.8 Limitations

Due to the nature of this study, there are certain limitations that must be stated. First off, much archival research on the Black Jack Wreck during my internship in Washington D.C was not able to be investigated. Since it is a USSAF aircraft, the primary sources would be found at the United States Army Air Force Historical Research Agency, which is located in Maxwell Air Force Base, Alabama.

One of the limitations of conducting large scale archival research would be there is also the possibility that much of the historical record of the USN and possibly the USSAF from WW II has been destroyed as expressed by (Hattendorf 2003:33). The second, is that archival research is extremely time consuming due to the organization of many of the source materials. Doing it for a few specific aircraft would not be much of a problem.

Data analysis was limited by the use of secondary sources, but this was also one of the aims of the study. Data and conclusions were based on the interpretation of the overall information collected for each of the case studies. For the Dornier case study this means that data on the media section was limited to a discussion of articles chosen. A statistical review of the articles based on the country of origins could have revealed a better understanding of how the lifting of a German aircraft was seen around the world.

The environmental analysis of the Papua New Guinea area surrounding the Black Jack was limited to a lack of systematic documentation of marine processes such as current information, acidification of the water, and sea level.

Finally, due to the nature of the study there is a bias to focus on mostly the aircraft of the U.S. and not mention the high potential for Japanese wrecks as well, specifically in the Black Jack case study. It will be acknowledged in the management plan to an extent.

1.9 Outline

Aircraft can be found all over the world and in every type of environment, but what is being done for those that are submerged? Seeing aircraft as archaeological materials has surely been done in the past, yet it is often overlooked by the academic community. It is not until recently that submerged aircraft are receiving more attention. One possible reason is that as people have more access to the depths of the sea due to recreational activities and improved diving equipment, therefore problems start to arise and have to be dealt with in some way. Another reason is due to the fact that the monetary potential for submerged aircraft was a driving factor of salvaging without an academic goal. Probably the most important being that many of the aircraft being disturbed are of military origin; which may contain sensitive material such as unexploded ammunition and human remains. The main problem today is being able to locate these submerged aircraft effectively in order to take appropriate action today and in the future. The other problem is how to manage them once they are found and become exposed to the general public.

Chapter two will provide an outline of the field of WWII archaeology, those of the submerged aircraft archaeological subdivision and how it has progressed through time. Another section will serve to illustrate the similarities of maritime and aviation archaeology progression into mainstream archaeology. The differences between aviation archaeology and aviation salvage must be described as well. Although the theme of this chapter is similar to discussions in other archaeological papers, it is important to re-examine it in today's context. The field has certainly matured over the years, so reviewing its progression over time by adapting a more modern approach should be informative.

In Chapter three, legislation affecting the protection of submerged aircraft in general and those that affect the planes in the case studies will be reviewed. Each case study is managed by a different group and thus looking at the legislation of each of their corresponding cases will help to determine the status and protection set to them. An understanding of the laws will help the reader to reflect on the difficulties of the field and the sensitive nature of such heritage in response to global changes.

In Chapter four, an analyses of the archaeological potential or lack thereof from the three case studies dealing with aircraft projects will be assessed. The case studies will also highlight what has been done recently and what is currently being done in submerged aviation archaeology. The first case is of a recent survey done by the Naval History and Heritage Command (NHHC UAB) to locate submerged aircraft from WWII in the Chesapeake Bay. The point of it will be to identify and evaluate the resources available to research submerged US Naval aircraft and ways to develop a process for other studies to consider. The second case is an example of a WW II German aircraft that was raised from the English Channel by the RAF Museum in 2013. The third case involves a submerged U.S. bomber submerged in the coastal waters of Papua New Guinea, which has not been the focus of any major studies, but does get several visits as a tourist attraction.

Chapter five will discuss the case studies as a whole. Each case study is a unique investigation with its own goals and sets of challenges. By looking at a set of diverse cases, it will also allow the reader to grasp the variety of current projects and understand the continued interest in the subject. Most importantly the archaeological potential will be assessed and primary research questions answered in terms of each case study. It will also include a recommendations for the precursor to the management plan of the Black Jack wreck and the other aircraft of the coastal waters of the PNG.

Chapter six will attempt to draw some conclusions regarding the information gathered from each case study.

Chapter II:

Archaeological Literature Review

This chapter will briefly cover literature involving archaeology of the recent past and the development of submerged aircraft studies. Although the archaeological study of sunken aircraft is fairly recent, it has been developing quickly. There are a number of archaeological papers that have come out in the last twelve years that will also be discussed. The theme of the papers varies from the archaeology of the recent past, history of submerged aircraft archeology, conservation of aircraft, site formation of aircraft, and tourism around submerged aircraft.

1.1 Archaeology of the Recent Past and Modern Warfare

Studying the recent past archaeologically might not have been seen as necessary because of the vast amount of documentary source material available to us now. Military aircraft of the 20th century might seem represented through source material and is a well-defined and understood phenomenon. Holyoak writes, "As with many other aspects of archaeological or historical study, closer analysis suggests otherwise" (Holyoak 2001: 259).

There are several approaches to documenting and extracting useful information from sites and Moshenka discusses his perspective on how to do this and why is it may be constructive. He advocates for a site-based approach to historical archaeological studies. He argues that excavations can serve as a meeting place were personal narratives can help to challenge and contribute to the understanding of such historical sites. The author mentions that while on an excavation of an aircraft wreck in London he learned a few things. First, the excavation acted as a catalyst for the memories of locals to be represented along with the material culture. Secondly, the site turned from a site of memory into a discourse of memory and history, which was created by the high level of public engagement. And lastly, that such events can be used to record oral histories in a unique environment (Moshenka 2007: 93). The author concludes that while it is useful to include oral history into archeological projects, that it can only work if the findings can be communicated back to the community effectively. His article also addresses the difficulties of working with such oral information and how it can be used to provide new information to the archaeological studies of the recent past.

Hattendorf's main point is that the U.S. Navy as a whole has made limited progress in using its maritime history as a resource and tool with which to broaden their outlook to deal with present and future problems. Due to the lack of historical understanding in the Navy, it creates an inability to make relevant policy and management decisions. Although he speaks about the Navy as a whole, the problems he mentions can be seen in the management of its heritage. It comes back to the way certain heritage is perceived. His paper discusses the way the Navy has maintained their historical records and how it helps and or hinders the way researchers gather information.

"…the result of neglecting their historical obligation is that the nation has no permanent record of their operations for the benefit of professionals today or of the future" (Hattendorf 2003: 33).

For too long the Navy as a whole has viewed history as "someone else's problem." As a result, much of our historical record over the past fifty years has been destroyed… (Hattendorf 2003: 33). This will definitely be a problem for research in the future when people look back onto our present time.

A paper by Gribble, Scott- Ireton, and Parhm discusses how historic shipwrecks are perceived to be either risk or resources from the viewpoint of cultural heritage managers. Based on how historic shipwrecks are labeled, management actions may compromise the archaeological integrity and value of such sites. Gribble argues that wrecks themselves are neither risk or resources, but are labeled as such by the involved parties, "…indirectly by the perceptions they create and perpetuate and directly in the actions or interventions…"which affect the sites under review (Gribble, Scott-Ireton, and Parhm 2009: 17). The danger with describing a wreck as a resource rather than an archaeological site is due to the commercial connotation it implies and allows a wreck to be perceived by the public more as a monetary object to be exploited. Scott-Ireton suggest that it is the responsibility of the archaeologist to work toward getting the public to change from perceiving historic wrecks as "resources" and instill the idea of wrecks as unique and irreplaceable parts of our common past (Gribble, Scott-Ireton, and Parhm 2009: 19).

The lack of funding in maritime archaeology is described as one of the main issues with trying to change the perception of wrecks as a risk or resource. Parhm acknowledges that even though the UK has been able to see historic wrecks as culturally valuable and in need of protection with laws such as the Protection of Wrecks Act, the inadequate founding of research projects leads to insufficient public engagement and interest (Gribble, Scott-Ireton, and Parhm 2009: 24).

The authors end by discussing some of the challenges faced by those managing a site. Wrecks in deep water that have intact hull structures present a risk to divers that visit them with the intention of entering its interior. Ensuring diver access to historic wrecks while maintaining the integrity of the site and diver safety is an issue submerged cultural resource managers have to deal with.

In order for there to be any real value into studying the recent past the research must be able to alter the understanding of society of the time period. Belford writes that this is the feeling in the academic community and that while the potential of researching some aspects of 20th

century life might change the view of the past, it does make a substantial social one (Belford 2014: 12). If the local community regards a particular historic object as valuable and will help in the understanding of their own collective past, it is worth researching with all the tools available including those of archaeology.

1.2 Aviation Archaeology Versus Aviation Salvage

Schwarz and Fix discuss the challenges with the preservation, ethics, and research potential of recovering sunken aircraft. Due to the perception that rebuilding significant aircraft structures rather than preserving the majority of recovered planes results in a public expecting to see an aircraft that is aesthetically pleasing or functioning. Having this approach to recovered wrecks highlights the potential loss of historical information and consequences of historic aircraft restoration (Schwarz and Fix 2010).

McCarthy argues that the decision to lift a submerged aircraft should never be a simple matter of having the necessary equipment such as slings and lift bags and the fact that intact aircraft have been recovered in the past because the action would certainly disturb the archaeological context of artifacts within the surrounding the aircraft and in turn lead to a rapid increase of corrosion and degradation of the structural and other components of the remains (McCarthy 2004:84).

Since the cost of conservation of submerged artifacts is quite high and the treatments for a varied amount of aluminum alloys is not well understood, working groups can be established to assess the condition and preservation needs of particular aircraft (Schwarz and Fix 2010). The authors conclude that there are many unresolved issues in determining the best approaches toward the preservation of sunken historic aircraft and that the number of these craft are rapidly diminishing as a result of the current attitude towards them. A reasonable national standard of preservation has to be accepted and enforced in order to deal with these issues (Schwarz and Fix 2010).

1.3 Submerged Aircraft Archaeology and its Start

Articles from (Wills 1996; Schwarz and Fix 2010; Gribble, Scott-Ireton, Parham 2009, and Ford 2006; English Heritage 2002) discuss the initial reasons for recovering submerged aircraft as coming from the perceptions of individuals and groups during time of war and

progressed to how they are currently viewed. To make it clear, during and after WW II, submerged aircraft have been viewed as valuable material to scavenge. The reuse of such material during these times decreased the available aircraft wreckages on land, so a growing demand for submerged wrecks rose due to their potential for reuse and exhibition. As time passed, collectors began to salvage historical wrecks to restore for either display or sell. The search for missing aircrew also prompted early searches of sunken aircraft, but as some of the authors point out, these searches were primarily concerned with the recovery of the crew rather than the investigation of the craft (Eames 1999; Holland and Mann 1996; Moore et al. 2002).

English Heritage wrote a detailed paper in 2002 concerning the early start of aircraft studies, and highlights the potential of different cases to produce interesting archaeological information. Several aircraft wrecks are from a period that many can still recall from a past not far from memory. The value is best said by the English Heritage report, " … crash sites have significance for remembrance, commemoration, their cultural value as historic artifacts and the information they contain about both the circumstances of the loss and the aircraft itself" (English Heritage 2002). One of the main concerns and reasons English Heritage started to pay more attention to aircraft wrecks is due to the fact that the actual number downed aircraft during WW II alone has yet to be determined and it is estimated that over ten thousand allied and enemy aircraft were wrecked around England. The potential to come across missing service men is of particular importance. English Heritage has also found it necessary to look at these sites more closely since the increase in commercial activity puts them and their contents in danger of being disturbed (English Heritage 2002).

Capelotti uses the term "aeronautical archaeology" to replace "aviation archaeology" to show that the field has a lot more material to incorporate. He discusses how the study of aircraft can no longer be constrained to just the study of the material remains of all aspects of humanity's interaction with the air via the medium of flight including airfields and other support structures, but must include spacecraft and its technologies (Capelotti 2003). For example, the Naval History and Heritage Command's Underwater Archaeology Branch (NHHC UAB) aside from being responsible for over 3,000 ship and 14,000 aircraft wrecks distributed world-wide, includes materials missing from the space shuttle and its associated components (NHHC UAB 2014).

1.4 Submerged Aircraft Studies in the past twelve years

The work of McCarthy has shown that aircraft in deep water had levels of preservation with rich artifact repositories including original fabric (McCarthy 2004:88). Also much like shipwrecks, aircraft have the potential to reflect life on board and adaptation for the individual and as a group based on the material assemblage. The view of in situ preservation is the favored choice of conservation method at the time and it is well established as that in the laws and regulations of submerged aircraft.

Research into the special marine environments is done a lot more often these days in order to understand the effects on the aircraft that are in it, but also to find a more conducive environment in which aircraft the aircraft could be preserved. This is particularly important for those aircraft and even shipwrecks that may not be able to be left undisturbed by either commercial enterprises or research projects.

The work of McLeod, Adams, Hallarn, and Degringny for example have come to be particularly important in understanding how to protect the variety of alloys from corroding and how the environment have affected them. McLeod's corrosion studies were published in 2006 with the overall conclusion that further work in developing a unifying corrosion-model to predict the lifetime of the submerged aircraft he studied in a protected lagoon environment (MacLeod 2006:135).

Julie Ford tries to analyze 75 submerged aircraft wrecks found around Victoria, Australia from World War II. Her concern is the potential of locating and surveying these sites to determine the growth of the aviation industry in Australia during WW II. She highlights the differences and uniqueness between wrecks involved in combat and those from training facilities (Ford 2006).

Anthony Burgess discusses the role of underwater aviation archaeology and its value within maritime archaeology by studying underwater aircraft heritage from WWII in the waters of Malta. He also reviews the competing demands upon the underwater aviation heritage and the value placed on them by those interested in it. The Maltese archipelago and surrounding waters contain a conglomerate of WWII aircraft heritage from different nationalities which make it a particularly interesting area of study archaeologically (Burgess 2013).

Jennifer McKinnon offers perspective into the effects on tourism on submerged aircraft and WW II sites in general from the Commonwealth of the Northern Marina Islands (CNMI). In the Pacific Islands diving heritage tourism is a growing industry and with it illustrates the challenges of managing such sites. Some of the impacts she discusses include looting and collecting, vandalism, the act of memorialization, anchor and mooring damage, and moving artifacts. Her paper, "Memorialization, Graffiti and Artifact Movement: A Case Study of Cultural Impacts on WWII Underwater Cultural Heritage in the Commonwealth of the Northern Mariana Islands," addresses these issues to improve management of submerged sites by reviewing the attitudes and behaviors or those that are visiting these sites (McKinnon 2015).

James Pruitt has done a study focusing on the site formation process of a PB2Y flying boat in Tangpag, Saipan. He discusses how studying site formation processes of aircraft can yield information that can potentially lead to archaeologist being able to ask broader cultural and socio- historical question (Pruitt 2015: 170).

Conclusion

This review has only touched upon a few of the individuals and groups that have committed themselves to investigating submerged aircraft. It also demonstrates some of the varied topics that such investigations have produced. Archaeological research focusing on submerged aircraft is becoming more available and accessible allowing the field to mature. There are also several unanswered questions and challenges that researchers in this field have acknowledged and from this, the necessity to further study the elements of site formation studies, cultural resource management, and interpretation of submerged aircraft wreck sites.

Chapter III:

Legislative Review

Often aircraft wrecks have little in common with the country they rest in, belong to the heritage of other countries, and brought into the local orbit by happenstance.

-(Spenneman 1998)

Legislation is one of the many tools archaeologists use to help protect cultural heritage. Each country has its own legislation, policies, and protections for archaeological material. A

review of the legislation of UNESCO, United Kingdom, the United States, and Papua New Guinea to see how it affects the type of material that is considered archaeological and specifically at the influence to submerged aircraft.

In the world of submerged aircraft, legislation is constantly developing and being revised today as interactions with aircraft and aircraft sites increase. Some countries have either revised their older heritage legislation to include aircraft or made completely new policies specific to aircraft and other sunken heritage itself.

This paper will also try to focus on just those policies and laws that may directly impact the submerged aircraft in my case studies. There is a vast amount of legislation for each of these organizations which alone could be a part of its own study and is beyond this paper.

1.1 UNESCO Legislation

The 2001 UNESCO convention was developed to address the concerns of the mostly unchecked and unprotected recovery of cultural heritage in international waters. Many countries did not condone treasure hunting on submerged archaeological sites outside their territorial sea and as Koschtial mentions, even if a concerned site lies not far from the coast, the treasure hunter only has to obey the laws of his or her own country (Koschtial 2008:64). At its core it is an international treaty between States focusing on the protection of submerged archaeological sites. One of its objectives is to provide a common standard for the protection of such heritage regardless of monetary value or benchmarks for the significance of sites in question and implies that consideration has to be given to a site as a whole and to its research and protection before any plans call for a disturbance.

Those States that do adopt it pledge to ban the destruction of submerged heritage for commercial reasons and take on an application of archaeological standards if sites are to be intervened on. It also encourages States to prohibit the disturbance of heritage regardless of location and to inform its State of their finds; States then inform other States in order to foster cooperation for the protection. Although the 2001 convention is not specific to submerged aircraft, it does protect them as cultural heritage and advocates for in situ preservation as the mode of conservation (UNESCO n.d: 24).

1.2 United Kingdom Legislation

In response to discoveries of several crash sites by marine development and Aggregate Levy Sustainability Fund (ALSF) projects, English Heritage (EH) saw that many archaeologist and those in marine industry did not fully understand how to deal with aircraft when found (Wessex 2008). This section will review the Military Remains Act of 1986.

Military Remains Act of 1986

The United Kingdom claims control over all military aircraft crash sites in its land, territorial waters, or British aircraft in international waters through the Protection of the Military Remains Act of 1986. Unless the Ministry of Defense authorizes permissions, under this act it is an offense to tamper with, damage, move, or unearth any items at such sites (Wessex 2008). The UK defines a known loss as an aircraft that has been designated as having been destroyed or abandoned, regardless of whether or not the site of the crash is known (Wessex 2008).

Similar to the U.S., there is a process to go through for any type of activity to take place on military aircraft sites. One of the first steps is to get a license from the Joint Casualty and Compassionate Centre (JCCC) that allows the recovery or excavation of a military crash site in the UK (English Heritage 2002). The license itself covers any military aircraft crash site whether it was in service of the British, German, U.S. or other nation's armed forces.

The license procedure is quite lengthy itself as the requirements depend on the type of work wanting to be done and where the crash site is located. The application includes a detailed research report of the aircraft along with the items intended to be recovered, its location and fate of the crew. The license application needs to be turned in completed at least 3 months before the project is set to commence (English Heritage 2002).

1.3 United States Legislation

There are three main organizations that deal with the submerged heritage and its protections and legislation in the United States including the Naval History and Heritage Command (NHHC UAB), National Oceanic and Atmospheric Administration (NOAA), and the National Parks Service (NPS). In this section, a look at certain polices and regulations of these three organizations use to protect sunken heritage within their respective spheres of jurisdiction. Most of the legislation will be those that each of these associations use and build upon to guide their own specific policies and management procedures. There are other policies that deal with

submerged heritage, but do not necessarily apply to the conditions of this study. The Sunken Military Craft Act of 2001, The National Historic Preservation Act of 1966, the National Marine Sanctuaries Act of 1972, and the Abandoned Shipwreck Act of 1987 will be reviewed.

In the U.S. the responsibility of certain heritage falls to the respective States and local governments to manage. Although these organizations have their own policies and regulations to protect submerged heritage, they also collaborate with each other due to the shared responsibility of certain heritage that may be the jurisdiction of multiple parties.

Sunken Military Craft Act

Much like Britain, the U.S. has developed legislation and guidelines dealing specifically with its submerged aircraft. The U.S. Navy enacted the Sunken Military Craft Act on 24 October 2004.

The purpose of the SMCA is to preserve and protect sunken military craft from unauthorized disturbance. It protects all U.S. government and foreign sunken military craft that lie in U.S. waters. Also, any Naval craft remain the property of the U.S. regardless of location and passage of time and may not be disturbed without permission from the U.S. Navy. It has a customary international section that also establishes that such a vessel remains the property of the sovereign to which it belonged to at the time of sinking unless formally abandoned or transferred to another party (NHHC UAB 2014).

Aside from the above general protection, it establishes a number of task and guidelines for dealing with sunken military craft. The different sections of the policy include a permitting process for certain work to be done on a site or with associated objects, provides penalties and assessments of actions that have disturbed military craft, and encourages international cooperation. A military craft is defined as any sunken vessel owned or operated by a government on military non-commercial service when sunk (NHHC UAB 2014). It also includes any spacecraft, its cargo, equipment, and personal effects of crew within the government owned craft.

National Park Service

The NPS has developed a number of polices regarding sunken heritage and two of the more important ones involves the National Historic Preservation Act of 1966 and the Abandoned Shipwreck Act of 1987.

The National Historic Preservation Act of 1966

The National Historic Preservation Act of 1966 does a few significant things to provide protection. First, it allows any site or object significant for American history, archaeology, engineering and culture of 50 years of age or older to be included in the National Register of Historic Places (NPS 2009). Once on the register, it requires federal agencies to itself implement or assist states, territories, local governments, and Indian tribes in implementing a comprehensive historic preservation program for the heritage in mind. It also provides the authority to withhold confidential information to protect properties (McManamon 2000).

Abandoned Shipwreck Act of 1987

The Abandoned Shipwreck Act is a set of guidelines to manage shipwrecks and other cultural resources in waters under a States or Federal agencies ownership or control. The guidelines allow for certain activities to take place on shipwrecks, which include a way to establish identity of the wreck, ownership, research, recreational diving, commercial interest, international cooperation with interested parties, and education of maritime history. Although these guidelines are not mandatory for management agencies to follow entirely, they are encouraged to adapt them to fit the protection needs of their respective cultural heritage (NPS 2009).

National Marine Sanctuaries Act of 1972

An interesting tool for the several organizations that manage submerged cultural heritage is the use of Marine Protected Areas (MPA). As part of the National Marine Sanctuaries Act of 1972, these MAP's have been established by federal, state, territorial, and local governments to protect natural and cultural resources. MPA's can be established to protect a single ship, aircraft or other cultural artifacts within the sea floor and also to preserve natural heritage for conservation purposes (NOAA 2015). The purpose of the MPA system is to strengthen the protection of cultural heritage by allowing for coordination among several regional MPA centers to identify areas within or outside of MPA's that might need additional protection and lead to more sustainable methods of management, research, and education (NOAA 2015).

1.4 Legislation of Papua New Guinea

The Black Jack wreck lies off the coast of Papua New Guinea, so this section will cover the main laws that might affect the management of this site aside from the U.S. legislation. The only applicable pieces of legislation in relation to this study being reviewed will be the National Museum and Art Gallery Act 1992, the National Cultural Property (Preservation) Act, and the War Surplus Act of 1952. There are other laws that are specific to historic maritime heritage such as the War Cemeteries Act of 1986, but do not apply to this specific wreck.

National Museum and Art Gallery Act 1992

These two regulations go hand in hand to provide a more complete understanding of what is protected and who is responsible. The National Museum and Art Gallery Act allows Papua New Guinea to recognize the importance of its cultural heritage and enact laws to protect it. It also assigns the PNG Museum and Art Gallery as the national entity responsible for preserving the countries heritage and enforce the legislative measures (Esso 2010: 18).

National Cultural Property (Preservation) Act 1965

The National Cultural Property (Preservation) Act indicates that all historic and maritime sites must be reported to the PNG National Museum and Art Gallery. It allows the National Museum to investigate any activity on sites associated with WW II and considers them as national cultural property. Lastly, the PNG National Museum and Art Gallery must ensure that illegal damage or destruction of cultural heritage is permitted (Esso 2010: 18; Goldman et al. 2009: 459).

War Surplus Act of 1952

The War Surplus Act protects all material from WW II and other times of defense for the period between 1939 and 1952. The materials include any plane, shipwreck, vehicle or machine such as unexploded ordinance and can be located in internal waters, territorial seas or underground. It stipulates that all war-related materials become property of the state. It also requires that upon discovery of such a site, it has to be reported to the curator of DoMH which is part of the PNG National Museum and Art Gallery. The DoMH is responsible for the administration of the modern period material specifically those of WW II, and updates a register of military sites and collections

Conclusion

Although all three countries which are part of this study contain legislation that includes aircraft protection in mind, it is not always clear how the said heritage is to be protected, studied, or ultimately responsible. For example, between U.S. and PNG legislation there are what could be conflicting points of ownership or responsibility. In the case of a U.S. aircraft sunk off the coast of PNG, the SMCA states that regardless of time elapsed or location a U.S. military craft will remain property of the U.S.; at the same time the National Cultural Property Act states that any historic maritime sites are national cultural property of PNG. Of course when all the parties are collaborating in an effort to protect certain heritage, much of these types of conflicts are usually resolved.

Not all countries subscribe to the UNESCO 2001 convention because they have their own legislation that follows a similar frame work. There still needs to be more effort in part of countries and organizations to adopt consistent practices and guidelines which are conducive to international cooperation on the protection heritage of international importance because it is not just one countries heritage, it is shared heritage.

These pieces of legislation are just some of the few that are helping to not only protect cultural heritage, but allow research and enjoyment for all those wanting to interact and learn about the past. Now the question remains how do countries and those groups responsible for the protection of submerged heritage enforce and utilize these polices to study and protect those resources. In the next chapters, the focus shifts to the aircraft studies with a portion of the discussion on how these legislative guidelines have affected the management and protection of submerged aircraft.

Chapter IV:

Case Studies

This chapter will cover three archaeological aircraft studies with completely different end goals. During the analysis of these three cases, the aim is to examine the work that has been done and highlight the archaeological potential of each aircraft study or aircraft being examined. Since all three cases are different from one another, each has to be individually reviewed on its own terms because the potential information that can be found will be different as well. The first two cases will be used in part as support for the creation of a management plan of the third case.

1. NAS Patuxent River Survey

The NAS Patuxent River survey is currently an ongoing project for the Underwater Archaeology Branch of the Naval History & Heritage Command (NHHC UAB). This section will go over the objectives of the project and current standing. The second part of this section will mostly consist of evaluating the research gathered for the development of the survey, which consist of archival research of several individual aircraft and the Naval base itself. The purpose of this is to demonstrate the archaeological potential of the research itself and how it can be used in enhancing the NHHC UAB's current aircraft database and future survey projects. The major focus of the case study is to determine the type of information that will be useful for conducting further archaeological surveys and supplementing a database that will benefit the Navy's ongoing mission of protecting its submerged heritage and allowing it to fill in the missing gaps in its records.

1.1 Objective of Survey

The main objective of the project as a whole is to fill in the gaps of NHHC UAB's aircraft database. At the moment there is a lack of data on the amount of sunken aircraft for the Chesapeake Bay and Patuxent River. Field work took place on 19-25 August 2015 and at the time of this paper, the side-scan sonar data acquired is being reviewed and interpreted. The survey from the summer 2015 served as a starting point to assess the potential of aircraft remains in the area and assist with planning for more comprehensive surveying in the future. Three 1940's aircraft wrecks from NAS Patuxent were selected to be the intended targets for the survey due to them not being fully recovered at the time of the crash. The aircraft were selected based on archival research and their locations derived from the interpretation of the original accident reports. The database itself is to be a comprehensive list of all the potential aircraft wrecks that may be found sunk within the Chesapeake Bay and surrounding waters.

1.2 History of Naval Air Station Patuxent River (NAS Pax River)

To understand the importance of the survey, a review will be done of the history of Naval Air Station Patuxent River and its role during WW II. A more inclusive history of the base, its facilities, what was tested and specifics on the targets surveyed will be found on "Naval Air Station Patuxent River Aircraft Survey Patuxent River, Maryland" by Schwarz and Ortiz once it

is completed and published (Schwarz and Ortiz 2015). This paper is still being prepared, so this thesis will try not to reveal too much about the survey and focus on the research potential of the pre-survey research and the need for updating aircraft databases as explained in the introduction. The next four paragraphs will cover only the relevant aspects of the base history to understand the context of the survey, why it was done and how it relates to the other overall study of this paper.

Naval Air Station Patuxent River was a major aircraft testing facility during WW II. At the convergence of the Patuxent River and Chesapeake Bay, the Secretary of the Nay selected this area as the site of the base due to its proximity to Washington DC and other nearby airbases, its 6,400 acres of land, nine miles of waterfront, and isolation from the public (Coletta 1985: 427). Because of increasing tension in the war in Europe, the base was considered the country's most necessary air station.

Before NAS Patuxent was built, testing and building of new and active aircraft in the U.S. east coast took place in several air stations, which made those task difficult, slow, and inefficient especially during war time. Each air station tested or built different aspects of new and active aircraft. For example, NAS Anacostia tested aircraft performance, general characteristics, gun instillations, and radio; NAS Dahlgren tested spins, dives and bombing; NAS Norfolk focused on rough water and accelerated service test; Washington Navy Yard tested seaplane catapulting; and Naval Aircraft Factory tested deck landings (NAS Pax 1945; Coletta 1985:427).

When finally established, Naval Air Station operations, from those mentioned above, moved to NAS Patuxent by 1 April 1943. The base not only tested American aircraft, but routinely experimented on other allied and enemy vessels in order to find out their strengths and weaknesses (Shettle 1995). Among the aircraft being evaluated were the Spitfire, Mosquito, P-51 mustang, P-38 lightning and a Japanese Zero (Johnson 2012; Coletta 1985:426; Drew n.d). The varieties of aircraft added to the Navy's inventory during WW II created a lot of opportunity for development of new technology, but it also meant that a high operational accident rate exploded in the 1940s and 1950s (Drew n.d:11).

Over time accident rates declined so the way records are kept at the archives changed as well to reflect this change. It is reflected on the accident reports and the Navy Yards Archives aircraft database and will be explained in the next few sections.

1.3 Archival Research

The proximity of the base to several bodies of water, other Naval Air Stations, and areas designated for training suggest where the majority of aircraft wrecks have the potential to be found. Together with the archival records, can a comprehensive database be made to account for all the aircraft losses in the Chesapeake Bay and surrounding waters, if so, how can it lead to better understanding of WW II aviation in the US Navy.

1.31 Aviation command History Reports

The aviation command history reports are annual reports submitted by the several naval aviation commands. They cover the periods between 1941 to the present. The exception being between 1953 to 1957 when the Navy did not follow its reporting requirements and thus no histories from those periods exist (NHHC 2015). Many of these are currently being digitized and some of the newer reports are classified to the general public because of the sensitive information within them.

For the NAS Pax River survey and database, The command histories between the periods 1941 to 1960's were reviewed. These command histories detail daily activities within each of the test centers of the base including the aircraft they were using, and the type of experiments done to them. The major challenge in reviewing the histories for NAS Pax River was that they did not contain information specifically related to aircraft crashes, which would help to indicate the number of potential wrecks submerged in nearby waters. Each Naval command reported roughly the same information, but those such as NAS Deland included aircraft accident statistics, so another way to determine aircraft losses specifically for NAS Pax River had to be determined.

Where the histories were particularly useful was in the descriptions of particular events such as the Joint Fighter Conference held in 16-23 October 1944, where captured enemy aircraft were evaluated by ally nation pilots as well as pilots from several U.S military branches (Drew n.d: 8).

1.32 Aircraft Accident Summaries/Aircraft Mishap Investigation Reports

The aircraft accident reports are a record of operational losses. The Navy Yard Archives contain the summaries of these reports on microfilm, while the longer versions are found at the National Archives in Maryland. Each of these resources has its own challenges for the researcher.

Reports prior to July 1955 are declassified and releasable to the public, any later reports are only attainable by permission through the Freedom of Information Act (FOIA) (NHHC 2015).

Challenges of the survey and database:

- Accident Reports on Microfilm at Navy Yard
- Accident Reports [Long Version] at National Archives Maryland

This resource is what a researcher wants to obtain because of the information contained in it. These reports contain information pertaining to a particular aircraft's accident, crew, recommendation to avoid accident in future and location of accident. To find the information of a certain aircraft, the type of aircraft and date of the accident usually is what is needed for the search. Without that information, it is nearly impossible to locate individual reports.

For future underwater surveys to continue to be useful, probably the most important information that is needed is the location of the aircraft itself. An aircraft location must be verified through the examination of the archival records. Usually the exact location information in these types of reports is extremely vague and leaves much to be interpreted. For example, 'lost two miles north of Pax River' is as clear a location that will be recorded. This was the main challenge with these resource during research of the aircraft for the survey.

1.33 Accident Report summaries on Microfilm at Navy Yard, Washington DC

The microfilm records at the Navy Yard are summaries of the full length accident reports that are held at the National Archives. These accident summaries cover any incident with an aircraft whether on the ground or air which results in damage to the plane or crew. Because NHHC UAB is located at the Navy Yard as well, this is the logical first stop in finding the location of aircraft for survey and updating the aircraft database. Due to the high operational accident rate between the 1940s and 1950s finding a particular aircraft the type, year and 'Bureau Number' (BuNo) was needed. Each microfilm role contained several hundreds of these summaries, which can be cumbersome to go through when doing a search on multiple aircraft, but is necessary in order to have candidates for surveys. As flight test became safer and operational accident rates lowered, to find a particular aircraft all that is needed is the year of the accident and type of aircraft. What is meant is that records are now kept organized in the

archives by year because with lower accident rates, all the accidents fit on the same microfilm tape; making the need to separate them by type no longer necessary.

1.34 National Archives and Records-2 Maryland

This National Archive in Maryland contains the original Navy full length Accident Reports, Deck Logs, history of bases, and photographs of aircraft. A total of 24 boxes can be checked out at a time. Knowing what exact box is needed is helpful to retrieve the relevant records more quickly. There can be multiple boxes for a certain year of an aircraft type so at times they need to be checked out to find what is needed. Many of the accident reports were not organized chronologically in their files like they are supposed to. Files can be hundreds of pages each coupled with them being unorganized can make the search for a particular aircraft much more time consuming than it should be.

1.35 Accident Reports [Full length]

The accident records at the National Archives are the full length reports and usually contain further details of an accident and the aircraft. The problem with these records is that many of them did not offer any more information that may be used in locating the final resting place of an aircraft. The other challenge is that the although the reports are organized in boxes according to type and year of accident, they were completely unorganized in files containing hundreds of reports. This made it especially difficult and time consuming to locate reports for particular aircraft. Also found was that many of the accident reports were not organized chronologically in their files like they are supposed to. Files can be hundreds of pages each coupled with them being unorganized can make the search for a particular aircraft much more time consuming than it should be.

1.36 Deck Logs

Locating aircraft locations and other information of accidents can also be found from the Deck Logs from Naval ships. The deck logs are important for the compilation of the aircraft database because not all the sunk aircraft came from testing at a Naval Base such as NAS Pax River. These deck logs can have a bit different information about an accident than the actual accident reports. Deck logs contain information of what activities went on throughout a 24hour period onboard the vessel. Sometimes they would contain the location of the vessel that day and of other vessels nearby. What was observed was that sometimes there was a separate log for

detailing the position information of just the vessel that coincided with the deck log. With this information a researcher can figure out where a carrier was when a particular aircraft was involved in an accident. Usually the deck logs would have for example, FJ1 fell off of starboard side of carrier at 1600 hours, and along with this the deck logs have the position of the ship at that time even if the coordinates were not given in the accident report.

1.37 Aircraft Incident Database

The Navy Yard's archives have a digital database containing all aircraft incidents for multiple Naval bases. For aircraft incidents associated with NAS Patuxent between the years 1952-1969, approximately 608 were identified. This particular digital list contains thousands of records, but it is able to be filtered to find specific information, in this case those incidents with the above criteria. There is no equivalent database for aircraft prior to 1952. There is one for those after 1969, but are considered classified and cannot be accessed without prior permission from the Naval Safety Center (NHHC 2015).

A step by step approach is the best way to examine this database especially given a limited time and place to do this research. From these 608 incidents, determining how many were involved in severe and/or fatal accidents was the first step. The database itself only contains information relating to its operating location, date of incident, the aircrafts identification number and type/model of the aircraft.

Second, the type of incident had to be extrapolated from another paper database also found in the Navy Yard Archives. In order to narrow the down the list, the alpha incidents had to be identified. Alpha incidents are those that concern severe damage to the aircraft or fatal and are designated by identifiers such as "A B" or "A AA" and other variations, but most contain at least one "A" to signify damage to aircraft and more than one "A" to signify fatal accident. Once the paper list was reviewed, the list was narrowed to 71 alpha cases. Unfortunately, my internship ended before the next step could be taken.

The next step would be to search for the accident reports for these seventy-one aircraft to determine if they remain submerged in Chesapeake Bay or if they were able to be recovered at the time of the wreck.

One has to look at each of these resources together in order to interpret the location of a submerged aircraft as accurately as possible and make a survey worthwhile. There are instances where either the accident reports and deck logs will have different information on the same aircraft. The difference in information can be useful in locating a particular aircraft or give more details of its accident.

For the creation of the database itself, looking at the deck logs before looking at the accident reports has a great advantage. The deck logs are a lot simpler to go through because they are extremely organized by vessel and year and the files separated chronologically, making searches of particular aircraft simple and quick. As a comparison, it took four hours to verify information of about fifteen aircraft accidents in the accident reports, while it only took one hour and a half to verify information on fifty-three aircraft incidents through the deck logs. The remaining eighteen aircraft from the original list were not in the deck logs because they were serving on base and not in one of the carriers.

1.4 Conclusion

While there have been attempts to make a database of aircraft wrecks for the Chesapeake Bay by NHHC UAB and NAS Patuxent Cultural Resources Project Manager (CRMP) in the past, it is with the continuation of survey projects such as this one that the current NHHC aircraft database will be updated. The importance of conducting surveys such as the NAS Pax River survey is to allow the location of missing aircraft to be confirmed and update the database accurately to manage, protect, and preserve them more effectively. Aircraft wrecks can contain human remains, hazardous material, and unexploded ordnance, which may be sensitive to human and natural disturbance.

Building database based on a regional model would be an extremely helpful tool to archaeologist working in areas of high underwater activity. Since it is based on U.S. military aircraft, it can be held by the NHHC UAB and made accessible to those people or organizations permitted to work on or near these wrecks. As we move to the next two cases, there will be discussion chapter on how doing this research type of research may be useful on the management of the Black Jack Wreck and others found in the PNG.

2. Dornier Do-17 Project

The Dornier wreck was raised from the English Chanel on 10 June 2013 and currently in the conservation process undergoing cleaning and cataloging. The Do 17 Z flying pencil is the only known, substantially intact aircraft of its kind.

This project has been using new techniques in the lifting of the craft, conservation, and display. the phases of the project will be reviewed to show what has been learned so far and determine potential avenues of study. Out of the three studies examined by this paper, this one deals with the challenges of lifting a submerged aircraft and later conserving it. The second focus will be on reviewing the article and media coverage because there is currently no published academic literature on the project or wreck and determine if any new archaeological information can be obtained from those sources. The perception of submerged aircraft will be explored as well from the analysis of all the information coming from the RAF Museum and the other media sources together.

Background

First, the early aviation history of Germany and Britain, the Battle of Britain and the circumstance in which the Dornier of this discussion became submerged in the English Channel will be reviewed. Looking at both sides of aviation development and priorities into the onset of WW II will help to put into perspective the relationships between the aircraft, the sea, and heritage potential in the waters around Europe.

2.1 German Aviation WW II

The Luftwaffe was authorized as the third German military service on 26 February 1935. Military aviation was prohibited in Germany as one of the stipulations of the Versailles Treaty, so the training of the new Nazi air force had to be built up in secret (Fox 2014:53). A German civilian airline would be the means for pilots of the new military force to achieve the flight training needed for the upcoming war (Ray 2015). The program was set up around aircraft that could be built quickly instead of focusing on technological advancement capable of dealing with a probable UK enemy (Barley 2004: 390).

The early German Luftwaffe was made up of biplanes such as the Ardo Ar 68 and the Heinkel He 51 (Harvey 2012: 30). It was also comprised of a naval air force, but the Luftwaffe's leadership had reduced it as it was not seen an important sector for the fight against Britain

(Neiztel 2003: 455). The German forces gained many victories in the early years of the war in part due to the Blitzkrieg technique. This technique made use of their Stuka short range dive-bombers that allowed their ground forces to penetrate enemy defenses.

2.2 British Aviation

During the interwar period the RAF focused on developing its aviation industry centering on strategic bombing with the idea that the enemy's will would shatter once its economic and industrial infrastructure would collapse from the bombings effects (Barley 2004: 389).

It was not until the late 1930's that aircraft production shifted to fit the increasing advancement of aircraft technologies such as radar and capable monoplane fighters. Britain had developed a fully integrated air defense system with detection capabilities, ground control procedures and fighter capabilities (Fox 2014).

2.3 Brief History of the Battle of Britain

The Battle of Britain is an accumulation of air battles fought by the German Air Force (Luftwaffe) and the RAF over the summer and autumn of 1940. Today various types of evidence of the battles can found on the seafloor of Britain's coastal waters. Over 400 of the 17 Z model were made by the Luftwaffe during the Battle of Britain, for bombing and reconnaissance duties. Between August and November 1940, nearly 200 of this type were destroyed during various operations (Townsend 2003:43). The Battle of Britain was the first major military battle fought entirely in the air. Fighting took place between July and October 1940. Germany had planned to take over air superiority over the English Channel so that it can eventually invade Britain.

At the start of the battles the RAF had a force of 700 front-line fighters and close to 300 in reserve (Townsend 2003: 42). Although outnumbering the English forces by 2:1 at this same point in time, the German force went into the battle with a few major disadvantages.

First of all, Britain had its early detection system that allowed it to detect incoming air attacks. With Germany attacking its aviation industry first, Britain was not able to respond effectively (Harvey 2012:42; Barley 2004:398; Fox 2014).

Once Germany continued its bombing campaign on Britain, it suddenly diverted from its attack of the RAF sector stations to bombing London. This allowed the RAF to rejuvenate its air forces and prepare the British offensive in the Battle of Britain (Barley 2004: 398).

The German's were sending at least three fighter craft for every bomber that crossed the English Channel. The objective of the German force was to dominate British air space, but it did not have a proper plan to carry it out in the end (Harvey 2012: 43; Neitzel 2003).

The second disadvantage for the German Luftwaffe was that its forces were more suited for supporting ground troops so its tactics were ill suited for breaking the British defenses.

The Battle of Britain marked the turning point of dominance of the air by the western powers and a decline for the Luftwaffe. By 15 September 1940 the German forces suffered a major defeat at the hands of RAF defense. From then on the Germans changed tactics once again due to their severe loses and scraped the plan to invade England all together (Townsend 2003; Bailey 1979).

2.4 Description of events leading to its loss

This particular Dornier Do 17 Flying pencil is a medium bomber and operated out of a base in Belgium. The craft got its name from the silhouette it creates while flying overhead which makes it look like a pencil. Its mission was to perform a bombing raid to the RAF airbase in Britain. The crew was made of four German soldiers and a squad of nine other Dorniers.

After leaving the Belgium airstrip for a mission with its squad, they were intercepted by RAF fighters near the Thames Estuary. It was forced to make an emergency landing in the Goodwin Sands after it was shoot at with quadruple machine guns by the RAF Boulton Paul Defiants of 264 Squadron. Its mission was to perform a bombing raid to the RAF airbase in Britain and another source says it was to lure RAF fighters into a German fighter trap. Only a few of the other bombers managed to make it back to France. The emergency landing ended up in two casualties and two survivors. The dead washed up ashore in Holland and the south coast of England were they still remain buried. The two survivors were picked up by an unknown source and remained prisoners of war in Britain and later in Canada before returning to their families in 1946.

The aircraft remained submerged and covered in the English Channel from then until a fisherman snagged it on its nets. He reported it to a sports diver, which later made a formal report to Wessex Archaeology. Wessex then reported it to English Heritage and in 2010, the Port of London and Wessex Archaeology confirmed the presence of the aircraft with the use of side-scan sonar. Wessex was the one to do the geophysical survey of the wreck area and participate in the identification of the aircraft because they had been in the works of preparing the survey of the area for English Heritage already (Ingason and Scott 2014). With the support of the RAF Museum, Wessex Archaeology sent a dive team to the site to confirm the aircraft was indeed a Dornier.

In their 2008 study "Aircraft Crash Sites at Sea," Wessex had listed that there were no Dornier Do 17 survivors anywhere in the world and now they get to build upon their previous data which demonstrated the potential to find hundreds of World War II wrecks in the UK coast and how they add to our understanding of the war and aviation history.

2.5 Management and Details of the Aircraft

Although it was sponsored by multiple interested groups, such as the United Kingdom Ministry of Defense, Wessex Archaeology, Seatech, The National Heritage Memorial Fund (NHMF), EADS, 328 Support services, Society of friends of the RAF Museum, Wargaming.net, RedLoop Design, London Port Authority, Private donors, BBC News, the Dornier project was headed by The RAF Museum.

Aims and objectives of the Sponsors:

-Exhibition of rare artifact
- Investigate new conservation methods
-Collect information for future studies of preservation
-Digital and Virtual display
-Educate public of historical significance
-Highlight the bravery of those that fought from both sides of the war

Site Name:

The official site name is the Dornier Do 17 Z Flying Pencil. The name given to the future exhibition will be titled “The Great War in the Air,” in preparation for the transformation of the

Air Force Museum and International Progamme marking the Centenary of the Royal Air Force in 2018.

Dornier Do 17Z Specifications:

The Dornier was a medium range bomber. Its construction consisted of all metal with flush-riveted aluminum alloy skin over aluminum alloy ribs, stringers and semi-circular frames. The wings were built up on two open section girder spars that ran through the fuselage. The spars and wing root fittings were of chromium-molybdenum steel while the flanges were made of light-alloy extrusion. Fuel and oil tanks were placed within the wings between the two spars. Fuselage constructed in 3 sections: the cockpit; center-section; and rear portion. Each section was joined to the next by about 25 bolts mounted through flanges. Flying controls comprised hollow steel tubes, rods and fittings. Rudders and other control surfaces were fabric covered on an aluminum alloy frame (Pirday 2013).

Size:
Length: 52ft (15.8m), Wingspan: 59ft (18m), Weight: 5 tones
Propulsion:
Twin Engines: Bramo Fafnir 323P air-cooled
9 cylinder
Radial engines rated at 1,000hp
Material:
Aluminum, aluminum alloy skin and ribs,
The spars and wing root fittings were of chromium-molybdenum steel
Flanges were made of light-alloy extrusion
Cargo:
Up to 7x7.92 mm MG 15 machine guns and 2,000lbs max bomb load

2.6 Project Phases

Pre-recovery:

After having been confirmed it was a Dornier Do 17 in 2010, plans were being made by RAF Museum to salvage it. It was to be salvaged because it represents the only intact aircraft of its type in the world. Only 1700 of these craft were built for the purpose of acting as one of the main medium bombers for the Battle of Britain and early Blitz period (Wessex 2008: 158). Most bombers shot down during the Battle of Britain were sent to smelters to be turned into RAF aircraft (Wessex 2008; Dye 2013a). RAF museum also wants to commemorate the young airmen from both sides of the war with the display of this plane.

The decision to salvage it would allow the RAF to test new conservation techniques with use of hydration tunnels. Because it is not a war grave site RAF Museum was able to receive permission to salvage the craft.

At Time of Recovery:

The approximate location for the site was 16 meters below the coastal waters of Goodwin Sands in the English Channel, Britain. The craft was covered by a layer of sediment, which helped shield it from the high currents and further degradation. The first attempt at lifting was 2 June 2010, but winds picked up too much to lift it safely. The aircraft was lifted on the second attempt on 10 June 2013.

During Salvage:

Most of the aircraft was intact and has not been heavily disturbed by human presence. One of the guns is missing due to a previous unauthorized sports diver taking it (Dye 2013b). There is a debris field of parts surrounding the wreck. Initially the plan to lift the craft involved a full cradle frame to be built around it. This plane soon changed in favor of a cable system that would identify the strongest parts of the airframe and attach the cables to them in order to lift it all at once.

Once lifted out of the water, the craft had to be subjected to a Health and Safety check meant to ensure the recovered items were safe to work on. During inspection, a magazine from the MG15 machine gun was x-rayed by the EOD team and found to be empty (Priday 2013). It was determined that there were no hazardous materials and water treatments began to keep the metal from rapidly oxidizing in the open air.

For the travel to Cosford, a gel was applied to the aircraft to prevent oxygen to reach the surfaces and then covered by tarps to prevent the rain to wash off the gel. Its next stop would be the hydration tunnels at Cosford (Dye 2013b).

Hydration Tunnels:

Like shipwrecks, many aircraft artifacts are placed in tanks to go through desalination process. The hydration tunnels were to serve as an alternative to the tank method. Two tunnels measuring 20m in length and 3.5m in height were built with thirty-six moisture spray nozzles on

the ceiling as well as a floor system of tubes with directional nozzles would serve to hydrate the surfaces of the aircraft and desalinate as well (Hudson 2013).

The 2nd tunnel that holds the fuselage, the spray nozzles are set much higher and have directional flow to cover the whole outside of the fuselage. A second set of tubes with nozzles will be fed all the way through the fuselage to the tip of the tailpipe to keep it from corroding from the inside out (Hudson 2013).

The tunnels serve to replace large tanks having to be built to immerse the craft and all of its components. Also other advantages include, a control of the timing of the hydration system, turn it on and off and check it at any time that staff need to do so. Water used in the hydration tunnels drains in the floor and goes through special filters so that it can be re-circulated back into the hydration chambers as to not waste water. Water is checked for proper ph values so that it can gently wash off any salts and chemicals that have accreted to the airframe over time without damaging paintwork or other components within the structures.

The hydration tunnels are an original idea and first time used for conserving an aircraft out of water. The conservation process is estimated to take 2-3 years and can be viewed by the public throughout this process. Hydration tunnel tours made available as well because this is a side of the archaeological process the public rarely has a chance to witness up close.

Interactive Display:

While the aircraft is going through the conservation process, an interactive display will be available to the public. A new education center will allow the dismantle of information of the Dornier in situ during the conservation process for engineering, chemistry and conservation students around the world that are unable to visit it in person. And with the use of a phone app people will also be able to see a full 3d model of the aircraft to appear in different landmarks around the world.

The overall exhibition will focus on the story of its conservation and for visitors to realize the significance as the only surviving example in the world. Hydration tunnel tours made available as well.

Currently 2016:

The aircraft undergoing conservation at RAF museum Cosford according to the last blog entry on 4 June 2015. Although the RAF museum blog has not been updated since late 2014, contact with Darren Priday, manager of the Michael Beetham Conservation Center (MBCC) at RAF Cosford has been insightful. In a series of emails starting on 25 December 2015, Priday explained that due to bad winter weather this 2015-2016, keeping stable environmental conditions in the MBCC has led to conservators placing tarpaulins over the largest parts of the wreck and also the use of de-humidifiers. There is currently no target date set for the aircraft to come out of conservation and into physical display.

When it finishes the conservation process, the next step will be to put it back together with minimal alterations so that it is displayed the way it was found and not a complete reconstruction. By leaving it as is will allow archaeological investigation of bullet holes, shrapnel damage, spent magazines, personal items. In the email exchange with Priday and one of Peter Dye's blog post, they both expressed the possibility that if the aircraft were to be restored to a large extent it would lose most if not all of its archaeological value and destroy the very object they have worked to preserve (Dye 2014).

2.7 Media Interest

With a simple Google search several news articles are available. Most of the sources are from UK sources, but a few German articles are also available. A deeper look at the search results reveals hundreds of links from small and large news and media outlets from countries all over the world, such as Israel, France, the U.S, Russia, China and many others. This paper will look at eleven sources to illustrate the varied information of each media resource.

The first section looks at the information of ten news articles found online. After reviewing many of these links trying to find any articles with information which is not presented by the others, the ten chosen were from news and media outlets from a mix of countries such as the UK, Germany, Israel, and the U.S. A large majority are UK based sources so further work has to be made to represent the perceptions of the numerous countries that were also part of the world and had something to say. And the second section will look at the information presented by the RAF blog itself. The last section is a look at one of the sponsors which is a video game company called *Wargaming* and how they are contributing to the project.

2.71 News Articles

There is no surprise that all the articles report their information in different ways to appeal to their readers. The reporting of the Dornier's salvage and story have remained mostly consistent and largely unaffected by personal opinions having to do with hidden agendas or politics by the writers. On the other hand, each article does provide a few details the others do not, which help create a bigger picture if put together.

Some of the sources cover the days before the salvage such as *The Mirror, The Times of Israel, and Flying Magazine. The Mirror* article details how the aircraft looks underwater from sonar pictures as well how much RAF managed to raise for the project before the lift. The author, Euan Stretch, also gives the specifics of the aircraft along with an explanation of how it crashed. One interesting fact in this article is that he mentions how the last working model was scrapped by the Finish Air Force in 1952 (Stretch 2013). Also that few survived because many were scrapped for their highly sought after aluminum airframes, which were reused for a variety of building materials (Silva 2013; Stretch 2013).

The article presented by *The Times Israel*, talks about the plan to bring up the aircraft which is the same in most articles. This article is unique from the others in that this one mentions that the German government was aware of the recovery operation (Times of Israel 2013). No further details were mentioned on that aspect. A further inquiry of what the German reaction was to the lifting and what they think of their heritage of this time period today would be helpful in providing an open discourse for countries to look at their heritage in a different way.

The next set of articles written by *The BBC* and *The Independent* have a better description of the lifting itself and the challenges during this phase of the project.

The *BBC* has about five articles touching on different elements of the Dornier project. With video footage of the actual lifting, the BBC has included an element to the story that not many people get to see in these types of projects. It has a good description of the salvage operation as it was happening, which none of the other articles have. *BBC* correspondent describes how the lifting project was in the works for three years before it was raised in order to work out the details and the funds to conserve it afterwards (Higham 2013.)

The Independent offers a description of why the first lift operation failed and when the next try will happen. The original plan to lift the craft involved building a metal frame around it to lift it all at once, but strong currents and high winds did not allow that to work. The plan was redesigned to allow lifting equipment to be attached to the strongest parts of the airframe allowing it to be lifted in a single attempt set for 10 June 2013 when the weather improves. The article goes on to give a glimpse of the revenue acquired to salvage and preserve it alongside some of the NHMF's artifacts. The NHMF granted RAF £345,000 for the salvage and joins other cultural objects such as the HMS Caroline and the last surviving submarine of the second world war at a cost of £300 million (Halfpenny 2010).

A third set includes articles by *War History Online, The Telegraph*, and *The Express Star* inform on the next phase of the project, which was the progress of the conservation and eventual display.

The most up to date news article found was by, *The Telegraph* from 5 June 2015. The plan is to make it look like it was in its prime as it did during the Battle of Britain. It also describes the story of the particular aircraft during its mission up until it crashed in the channel (Harley 2015). Other than the aircraft's personal history, there is no new information about its current status and how much is ready for the next stage of conservation.

A release on the next stage of conservation work was reported by *War History Online* on 2 October 2014 and the *Express Star* on 8 November 2014 respectfully. Both articles report identical material of the conservation efforts. Although the information is a bit older than that of the previous news article, they provide a look on the progress of the conservation efforts of the museum. The citric acid based solution has shown that it has helped neutralize the corrosion in the aluminum aircraft structure. The second phase involves removing the fuselage from the hydration tunnels were the acid treatment was taking place to be washed down and moved into the conservation center. Technicians will now have greater access to the frame structure to prepare it for piecing back together at a later date (War History Online 2014; Express & Star 2014).

One thing that all the news sources have in common is that they show their fascination of this era of history and the link the aircraft has, to a not so distant past full of memories and

mysteries alike. Although the news articles were a mix of international sources a more statistical approach to the varying news origins could reveal more information on the general perception of the Battle of Britain and aviation archaeology in general.

2.72 RAF Blog and other social Media

The RAF Museum informed the public every step of the project with an active blog. With different staff members contributing their opinions about the progress it is easy to see why people remained supportive of this project. On Facebook, links to relevant articles and pictures of the aircraft can be found. The blog itself has information not found in any of the articles anything from the goals of the overall project to the ways it is being treated, discussions with the different parties involved such as the divers, archaeologist, conservators, and news outlets.

For example, the post from 27 February 2014 discuss what happens to the small artifacts such as those that are perceived to be most at risk from the poly-tunnels. Each one is individually assessed and recorded, given a number and treatment proposal. All artifacts are photographed in detail before any work is started in order to highlight their condition before and after conservation. After being numbered and photographed they are recorded on a spreadsheet with relevant info and hazards are noted.

Rule that they follow: The tools used are softer than the material being conserved. Minimizes the damage that delicate artifacts and only deposit material is removed. They call it the "pick and Flick" method in order to remove deposit layer by layer. Then, parts that are still not formally identifiable are described as much as possible until they can be examined more closely.

In order to conserve the distinguishing features of artifacts such as original paint or carbon deposits, all treatment decisions are discussed in detail before any action is taken. When a particular artifact is particularly delicate and to prevent further corrosion, some materials must be removed from them.

The information on the blog is interesting to read and informative to those interested in the subject and easily accessible to the public. Although the blog itself has not been updated in the last six months, it is a good source for further research.

2.73 Wargaming

Wargiming is one of the sponsors creating displays for the Dornier exhibit. They focus on creating historically accurate vehicles for their games by surveying planes, tanks, warships, original photos and blueprints. The Battle of Britain is seen as a pivotal battle and they wanted to include it in their games collection. This company has worked with several museums such as the USS Iowa and USS Yorktown on similar projects.

For the Dornier, they created a mobile app called Apparitions, in conjunction with RAF and Red Loop. The app allows people to see a full-seized version of the plane at locations around the world. Locations include Poland, Netherlands, Brazil, Canada.

They also funded the creation of the Dornier 17 website at the RAF museum in order for people to read about the recovery, conservation, and exhibition of the plane. Also on their game website, worldofwarplanes.com, they have great videos of the Dornier project including the dive footage, lifting of the craft, plans for the exhibits and more.

One of the problems they wished to address was to figure out how museums can better engage with young people. It is essential for museums to speak digital to this new generation because young people today live in a digital world (Spaight 2014).

2.8 Conclusion

The recovery of the Dornier was only possible because it was not a war grave. The information found through media sources is varied and countries from around the world reported on the recovery of the Dornier.

Wessex's 2008 study demonstrated the value of performing a large scale survey with the aim of better understanding the archaeological footprint of WW II aircraft in UK waters. The identification of the Dornier provides the possibility that many of the unique aircraft seen in WW II may still be found intact on the sea floor.

The Dornier still has a fairly long process to go through to be ready for physical display, but in the mean time the techniques being used to conserve, exhibit, and study the aircraft can be learned from. Raising this aircraft completely gives rise for others around UK waters to be found and verified.

The use of the hydration tunnels as an alternative to big tanks was interesting because it allowed for a few things which would not be as easy with other large objects using the tank method. First, was that conservators were able to have access to any part of the aircraft to adjust the hydration and desalination levels, as well as work directly on it. Secondly, it allowed for the public to see the conservation process up close.

An examination of the bullet holes on the aircraft and use of armament will allow researchers to build and add a unique personal story of the Battle of Britain. The presentation of the aircraft in the virtual medium in the form of a game, phone app, and interactive display will also be a way to reach a wider audience. Catering to a generation of young people growing up in a highly digital world is something more museums are starting to do today by using these alternative mediums to present information. The Dornier project would be a god way to see how much more interest and participation there is to learn about the past.

3.Black Jack Wreck

Unlike the other two case studies, the Black Jack wreck has not been the focus of serious archaeological study. It is however a popular tourist destination for the more experienced dive community because it is considered to be one of the best aircraft wrecks in PNG according to dive enthusiast and the tourist companies mentioned in this section. In 2014, as part of a class assignment I researched this wreck and others like it. It was reveled that submerged military aircraft are a highly sought out historical resource not only by archaeologist, but aircraft enthusiast. Aircraft enthusiast can be individuals, museums, and organizations that either benefit from submerged aircrafts for their recreational or monetary value. A number of archaeologist discus this topic in more detail in the following research papers (Burgess 2013; Wills 1996; Schwarz and Fix 2010; Pruitt 2015). The purpose of discussing this wreck in the thesis is to provide a look at a wreck with no prior archaeological studies and see if information available from internet can yield a bass for its archaeological potential and how it can benefit from archaeological study.

3.1 The Pacific Theater

During World War II both the United States and Japan were fighting for control for territories in the Pacific. Hundreds of military vessels, aircraft and water vessels from both sides can be found in and around islands of the Pacific. The Pacific Ocean was the scene of some of

the largest air battles in history. Having control of the pacific islands was strategically important for military operations at the time.

With Japan taking control of much of the Pacific Islands after the first World War, allied and U.S. forces started to build in the Pacific as well. The U.S. was brought into the war on 7 December 1941, when Japan attacked Pearl Harbor (Eames 1999; Harvey 1999).

In 1942 the allies' lost a battle in the Philippines and Australia was left as the last defensive stronghold in the Pacific. Australia and U.S. forces begun to rapidly build airbases from Australia to New Guinea in order to launch air and amphibious attacks against Japanese occupied territories (Pearson 2005:28).

One of the first major offensives for allied forces was the capturing of Rabaul in New Britain with the use of fighter and bomber squadrons. The Japanese strategy was to capture Port Moresby by air, but soon changed to a land advance due to their defeat at the Battle of Coral Sea (Pearson 2005:42; Dater 1950:194). By 11 September 1942, Japanese forces had taken the north of Papua New Guinea and advancing towards Port Moresby, while Allied forces were struggling to build adequate defenses due to the difficulty of the terrain, climate, and lack of resources.

By 1943, Allied forces began to effectively push back Japanese forces with a strategy involving regular bombings, land invasion, and finally construction of airbases (Pearson 2005). With the capture of Rabaul the U.S. implemented its island hopping strategy to isolate Japanese forces along the way and take back the Pacific pushing towards Japan.

Point Moresby was the direct link between Papua and Australia and was strategically important for communication and shipping between the Indian Ocean and the Pacific Ocean. Allowing the Japanese to have control of Port Moresby would have meant that it also would have had the ability to intercept any allied build up in Australia (Goldman et al. 2009).

Importance of B-17 in Pacific

Participating in mostly night raids, they were quite effective in the Battle of Bismarck Sea in attacking Japanese transports and again in the Battle of Midway against invading ships (Johnsen and Boyne 2000). The Japanese acknowledged the resilience of the plane because of the heavy assaults they were able to endure.

Although the early F-models had a distinct disadvantage in being tail heavy, which left it off balance when fully loaded and leaving it open to attack when confronted with Japanese fighters. Later modifications corrected the problem and increased the bomb capacity and adding a front turret to some giving it a multiple role of fighter as well as bomber (Boeing 2015). Where it excelled in the Pacific and Europe was in its ability to protect the crew from heavy fire due to having a strong undercarriage. After the war, like many other planes, they were scrapped for reuse of the metal, a few in the domestic sector for firefighting and crop spraying, or simply dumped in the ocean.

3.2 B-17F Specifics

This particular model was developed with improved defensive armament and 3,405 were produced. Although the outside appearance remained relatively constant after the E-model, the B-17F itself had over four hundred modifications throughout its production (Boeing 2015). The U.S. Army was the main branch of the U.S. armed forces to use the B-17 in the Pacific, it is not to say that the U.S. Navy and Coast Guard forces did not adapt their own variations of the aircraft. In smaller scale use the Navy and Coast Guard designated the B-17 as the "PB-1" modified mainly for maritime surveillance and air-sea rescue missions (Boeing 2015).

The vast variability in the F-model alone shows the potential wealth of construction and technological information which can be gained from aircraft. Due to the fact that only a few B-17's survive today in museums and air shows, the Black Jack represents a special cultural artifact. The B-17's were one of the most mass produced planes during WWII because of their durability in combat.

Model: B-17F
Dimensions:
Wing span: 103ft. 9in (31.6m)
Length: 74ft. 8.9 in (22.8m)
Height: 19ft. 2.4 in (5.9m)
Wing area: 1420 sq ft (132 sq m)
Wight:
Loaded: 40,260lb (18,261 kg)
Performance:
Max Speed: 325 mph (523 km/h)
Cruise speed: 160 mph (257 km/h)
Service Ceiling: 30,000 ft (9.144 m)

Normal range: 2,000 miles (3,219 km) with 6,000 lb (2722 kg) bomb load @ 220 mph (352 km/h) @25,000 ft (7,625 m)
Powerplant:
Four 1,200 hp (895 kW) Wright R-18820-97 Cyclones: 9 cyl. Air-cooled single –row radial engines with GE Type B-2 turbo-superchargers
Armament:
Thirteen 50-cal. Machine guns, a max of 17,600 lb of bombs

3.3 History of the Black Jack

The Black Jack is a B-17F Flying Fortress built in a factory in Seattle, Washington and operated out of Port Moresby Airstrip. Also known as "Jackson Drome" was one of the primary airfields operated by allied units during the start of the Japanese bombing campaign (Pearson 2005; Pacific Wrecks 2015).

The Black Jack got its name from the combination of its serial number 41-245**21** which ended in 21, and a reference to the common card game of "Black Jack" as it is synonymous with the number 21.

This aircraft was part of the 5th Air force and the 43rd bomb group, performing bombing raids on Japanese ships and airstrips around the pacific islands (Silcock 2011). The submerged craft was identified by the retrieval of the radio call plate from the instrument panel. This particular aircraft was credited with sinking the Japanese destroyer Hayahio during a night raid in 1942 (Dive World n.d; Silcock 2011). It has been involved in several air battles that have given the aircraft a popular identity amongst airplane enthusiast.

Cause of accident:

The aircraft was ditched in 12th July 1943. During a return flight from a night raid of the Rabaul airstrip controlled by Japan, the Black Jack was ditched off Boga Boga village of Papua New Guinea and sunk to 50 meters depth (AHOM 2014; Silcock 2011; Halstead n.d).

The flight was troubled by problems with the right wing engines as it was headed to its mission destination. On the way back they ran into a storm as they neared the cost of New Guinea that caused the two right engines to fail and unable to stay on course for Port Moresby Pacific Wrecks 2015; Taylan 2009; Silcock 2011).

Since the plane was low on fuel the pilot decided to ditch the aircraft on a shallow reef, but the craft overshot and landed over deep water. Three of the ten crew members were injured upon impact, but they all managed to exit the craft before it began to sink. Local villagers from Boga Boga assisted the crew in getting back to shore. A RAF seaplane was notified of the ditching and rescued the injured men and two days later the rest of the crew was recovered as well. After two weeks of leave the uninjured crew returned to combat (Pacific Wrecks 2015).

Current Condition:

The approximate location for the site is 50 meters below the coastal waters of Boga Boga, a village in the Milne Bay province of Papua New Guinea. The aircraft was left there and remained undisturbed until 1986 when WW II enthusiast Rodney Pearce went on a search of a different plane and found the Black Jack instead (Pacific Wrecks 2015). To identify it Pearce entered the wreck and found the Radio Call Plate which had the serial number of the plane. Pearce's dive partner described the inside of the plane as having dangling control wires (Silcock 2011).

The front of the nose is damaged either because of the crash into the water or when it hit the sea floor as it sank. It is covered by marine concretions, but remains mostly exposed to the open sea. There is no way of telling how the salt water has affected the composition of the metal on the aircraft over the years until those studies are done.

Tourism:

The site is open to dives year-round so it is constantly being toured by three main diving companies Niugini Diving, Tufi Dive Resort, and Golden Dawn Diving. There is a permanent guideline that starts at a shallow fringing reef near Boga Boga and extends toward the tail section of the aircraft (Niugini 2001; Silcock 2011). The waters are generally between 26-29°C (79-84°F) and visibility exceeding 30m making PNG a popular diving area.

Divers report experiencing a strong current that sweeps along the slope of the guideline and feel it strongest towards the front of the wreck. It is possible that this current has kept the wreck from being completely buried by sediment.

While only experienced divers are allowed to visit the site of the wreck because of the depth, it does not escape the disturbance of humans. Divers are allowed to enter the wreck, but because of the ten-minute time limit they are advised to only peer through the cockpit windows.

3.4 Environmental Characteristics of PNG

Climate:

Papua New Guinea experiences the lowest barometric pressures of any island in the Pacific during the months of November to April. This leads to monsoonal air flows from Southeast Asia that cause rainfall throughout the year. The dry season is from May to October, but it is only noticeable in the west region by Port Moresby (PCCSP 2011).

Water health:

Acidification of the waters has been increasing in PNG's waters and will likely be a threat to coral reef ecosystems (PCCSP 2011). The oceans become acidic due to the absorption of high levels carbon dioxide by the oceans. The effect it will have on cultural heritage such as the Black Jack will have to be studied closer if it is to remain a dive attraction for future divers.

Sea level is also increasing at a rate of about 7mm per year because of global warming. It is also the case that ocean currents are not well understood in the regions around the Pacific Islands according to NOAA due to the relationship between large-scale ocean circulation and regional climate and circulation (Ganachaud et al. 2007).

Flora and Fauna:

Papua New Guinea houses a rich biological diversity. It is within the Coral Triangle which has the most species rich marine life in the world. It also has rich mangrove swamps and rainforest. The waters around Papua New Guinea host a variety of marine life including reef fish, reef sharks, coral reefs, and manta rays. The seabed is characterized by coral reefs and soft sand. The coast exhibits, beaches and sedimentary rock.

3.5 Hazards to Site

It is likely that projects such as the Liquefied Natural Gas Project and growing shipping industry will have an effect on submerged heritage around PNG in the future. The paper on the

LNG project addresses the potential impacting of several archaeologically significant heritages near Port Moresby and makes recommendations on how to deal with the various forms of heritage in the area of the proposed project (Goldman et al. 2009).

As mentioned in the tourism section, divers are also a threat potentially disturbing the aircraft because there is a lack of data on the physical integrity of the wreck. The other threat comes from unexploded ordnance being found near the aircraft. Rod Pearce had found ammunition and firearms when he first explored the aircraft (Taylan 2009). None of the sources say what was taken from the plane except an oxygen bottle that floated to the surface after it became loose during the Pearce's group explored the wreck; so it may still be possible to find some unexploded ordnance. It is unlikely that there are any bombs on board because for this particular aircraft, it managed to drop all its bombs on Rabaul Airfield during its final mission.

3.6 Archaeological Value

Many aircrafts crashed around PNG during WW II due to a combination of being shot down in combat, becoming lost in extreme weather, or running out of fuel. Several wrecks have been documented by interest groups such as the Pacific Wreck Database and the Department of Modern History of the PNG National Museum and Art Gallery, but no archaeological studies have been done as previously mentioned. Due to the fact that only a few B-17's survive today in museums and air shows, the Black Jack represents a special cultural artifact. The B-17's were one of the most mass produced planes of WWII because of their durability in combat.

Due to its depth, it is a well preserved submerged aircraft and almost entirely intact. While this type of aircraft is not very unique in the pacific region, few have been archaeologically examined and fewer are as intact as the Black Jack. Individually, it is a Nationally important site to PNG and the U.S. for the contribution of the aircraft as well as the crew in its support of the Allied offensive on the Japanese which was crucial for the retaking of the Pacific.

One unique feature to this particular aircraft was the added turret to the nose upon request its first pilot then Captain Kenneth McCullar (Silcock 2011). The front nose turret would allow the Black Jack to attack Japanese fighters head on as while performing its bombing activities.

Environmentally, there is also no way of telling how the salt water and acidity has affected the composition of the metal on the aircraft over the years until those studies are done.

3.7 Conclusion

Much of the information on the actual aircraft was derived from nonacademic sources such as blogs from dive and aircraft enthusiast and dive tour companies. They were used because the fact remains that information for hundreds of aircraft wrecks can only be found through these types of mediums at the moment. Archaeologist often find out about sunken wrecks that are in danger of disturbance or just really popular with the dive community by looking at these sources. In the case of the Black Jack and other PNG wrecks, many are written and posted about, but without proper documentation people tend to take matters into their own hands to find out as much as they can. This has the tendency to lead to disturbance and further damage down the line.

There is a lot of academic work that has to be done in order to better understand these types of wrecks and inform people why they should be protected and investigated in a responsible fashion. In the discussion that follows this will be expanded on.

Chapter V:

General Discussion and Recommendations

The objective in analyzing the above three studies has been to ultimately create a hypothetical management plan for the Black Jack Wreck. This section will discuss the purpose of each study and how they have helped shape the management plan of the wreck.

1.1

NAS Pax River Survey:

One of the main objectives of this survey was to supplement the Navy's aircraft database for the Chesapeake Bay region. By evaluating the historical sources available to researchers, this paper has determined that the various materials have to be examined together in order to get the most information out of them. The better the information that can be extracted, the better the

chances of finding submerged aircraft wrecks to set up surveys around to verify their location. The next step would be to add them to the database and thus allowing military aircraft to be better managed and protected.

The benefit to having a database that is constantly updated and accessible to those conducting approved work is that it would allow licensing officials a means of knowing what can be expected in areas where sea activities or research are proposed. The database should be updated every time new information is found. The Wessex 2008 report is a great example to follow and if reports as detailed as that one can be produced regionally throughout the U.S. and even other countries by the appropriate organization whether it be NHHC UAB, NOAA, NPS, EH, the National Museum and Art Gallery of PNG or anyone else.

For the Black Jack Wreck and those of the coast of Papua New Guinea, doing extensive desk based research similar to the NAS Pax River study is needed to get a reliable means of creating this database. The Black Jack Wreck specifically still needs this research to be done for it since most of the information came from second hand accounts and non-academic sources. It would be interesting to confirm the information of these sources through the primary sources. And with a better historical insight into the battles around Papua New Guinea a better process for assessing aircraft wreck hot spots to later be surveyed.

Dornier Project:

The purpose for the recovery of the Dornier wreck was to add it to the RAF's Museum "Battle of Britain" collection which includes other unique aircraft of that war. The aircraft represents the only known survivor of its kind in the world today. The recovery itself is a testament to the difficulty in lifting such large and fragile objects intact from the ocean safely. Since its recovery, it has allowed new conservation and exhibit techniques to be tested.

The way archaeological data is collected, compacted, interpreted, and dismantled has a correlation with the materiality of media (Brittian and Clark 2007). This can be seen on archaeological excavations today. The media surrounding the Dornier Do 17 wreck can be seen as an example of this. The information itself is a reflection of alternative viewpoints on the subject of submerged aircraft. By evaluating the various media sources it was found that

although having similar information in the coverage of the project, that the difference in information reveals a reflection of the viewpoints of the writer and the public that comment on it.

The RAF museum has been largely successful in implementing their current research and conservation methods allowing the aircraft to reveal some of its secrets and the potential wealth of information that can be obtained.

The hydration tunnels improved the way desalination was administered and allowed the public to experience a side of the conservation process not always available to witness. Conservation has revealed bullet holes and personal items which can now undergo further investigation and answer questions relating to the process of deterioration from the English Chanel, to the unique features of this particular aircraft, and details about the crew of the aircraft.

At the moment one of the main challenges faced by the RAF museum is being able to provide a stable environment for the aircraft to await the next stages of conservation.

Like the Dornier, the Black Jack is a fairly intact aircraft and it is also not a war grave. Since it is a U.S. military craft the SMCA stipulates that since it is in no extreme danger, every effort should be made to preserve it in situ. At this point in time the Black Jack would benefit more from the use of virtual mediums to identify archaeological information rather than recovering it. 3D reconstructions of submerged heritage have been shown to be a valuable asset to archaeological projects. A virtual exhibit may also be a possibility to reach a worldwide audience and help promote in situ preservation.

Black Jack Wreck:

The Black Jack has not been studied archaeologically yet and it is one of the reasons that it was chosen for this study. Much of what is known about the aircraft, its current state and value comes from non-academic sources. One of the aims is to see how to use these sources to build a plan for its management that would be beneficial not only to the tourist industry, but to the protection and study of this important wreck.

A second reason is that there is a lack of quality data concerning positions and losses of submerged aircraft heritage for Papua New Guinea. As discussed in the last chapter, the coast off of PNG was the battlefield of significant air battles and the potential of finding sunken wrecks is significant. With the increase of commercial activity and the popular dive tourist industry, PNG

archaeologist are only scratching the surface of what is potentially in the water when conducting cultural heritage assessments because these assessments are limited to areas of the activity.

Although not in extreme danger of commercial activity due to its depth, diver disturbance can still be an issue. Based on the second hand sources, artifacts were brought up from it at one time. It needs to be assessed for hazardous material since it was a bomber and that armament was reported during its discovery.

The Black Jack played a significant role in the battles of the Pacific, which makes it a unique representation of aviation and Pacific Island history. With over 400 modifications of the B-17F model there is much to learn about the construction and individual touches added by those that operated it. Because of its depth its contents and the aircraft itself have a high level of preservation. The repository of artifacts inside the craft have the potential to reveal the life on board and adaptation made from the crew.

1.2 Recommendations

At the moment the NHHC UAB, USAAF HRA, or the DoMH do not have an accurate account of their wrecked aircraft resources still submerged off the coast of Papua New Guinea. Many of the known aircraft are part of the tourist industry which lack a regulated management plan to keep them protected from careless disturbance. Also many of the aircraft being discovered are by aviation enthusiast, which was the case with the Black Jack wreck. Although commercial activity has also been prompting archaeologist in the PNG to assess the potential of disturbing not only aircraft wrecks, but an array of cultural heritage, as seen in the PNG LNG reports from Goldman et al and Esso Highlands which were mentioned during the legislative chapter on Papua New Guinea.

Because of the lack of quality data concerning the locations and losses of USAF, USN, and Japanese wrecks around the waters of PNG, it is likely that many may be war graves. It would be necessary for further surveys to be undertaken with side-scan sonar and magnetometers, which will benefit the management of WW II and other culturally significant heritage for the National Museum. A similar search method taken for the NAS survey could prove useful in confirming the locations of missing aircraft around Papua New Guinea and provide the U.S. and PNG National Museum and Art Gallery a much needed update to their aircraft databases to

protect them in future developmental projects and tourist visits. There are also Japanese wrecks in these waters so cooperation with their government would be essential as well.

The DoMH and the National Museum and Art Gallery of PNG can better cooperate with the dive industry there to develop a structured plan for monitoring its many aircraft wrecks. The monitoring would allow the responsible archaeologist or organization to keep their database updated.

Chapter VI:

Conclusion

As seen throughout this paper, the use of primary, secondary, and legislative material was gathered to analyze the potential to extract relevant information to produce archaeologically viable management recommendations that can evolve into a full management plan for the Black Jack Wreck and other WWII aircraft heritage in the coastal waters of Papua New Guinea.

This thesis has demonstrated that in order to complement the growing base of knowledge of sunken aviation resources around the world, research into various contemporary and historical sources will be necessary. Continuing the updating of aircraft databases of those organizations involved in protecting submerged heritage would allow further sunken military aircraft to be found and protected for future generations of researchers and the public.

As the researchers mentioned throughout this study have documented, the assumption that aircraft construction and history is well understood and thus no archaeological information can be obtained is wrong. As is the case in Ford's paper and the actual NAS Pax River survey (not the case study) demonstrate that many sunken aircraft wrecks associated with training and experimentation military facilities yield aircraft unique in construction and capability. And this was demonstrate in the analysis of the Dornier aircraft and Black Jack wreck. It is also simple to see that those aircraft which were mass produced came with hundreds of variations in order to fit the conditions of their operations, environments, and test their limitations. Nutley suggest that those people or groups that have been dealing with crash sites for recording, recovery and burial

have been waiting for the archaeological community to catch up and realize the important information that can be gained from such sites (Nutley 2006: 101).

We must remember that the overall goal of archaeology is to investigate the stories of the past through the objects we study and by doing so learn where we as societies and individuals are and where we are headed. This study addressed the potential archaeological information that can be gathered from legislation and several forms of media in order to look at submerged aircraft and associated sites with a perspective based on varying ideas of the importance of sunken aircraft.

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Appendix A:

Hypothetical Black Jack Management and PNG Submerged Aircraft Heritage Plan

Figure 1Front view of the Black Jack from B17BlackJack.com

While the Black Jack Wreck is not in extreme danger of commercial and other human activities at the moment due to its depth, there are still legitimate concerns to its safety as a regularly visited cultural artifact. This aircraft represents only a handful of B-17 Flying Fortresses in the world today, if not one of the only ones still around which played an important role in the Allied offensive of the Pacific Battlefield during WW II.

This is a hypothetical proposal based on this thesis's objectives for the management of the Black Jack B-17 aircraft wreck and other submerged aircraft in the coast of Papua New Guinea. A number of recommendations discussed in chapter five of the thesis will be integrated into the management plan.

Background

World War II opened the door to major air activity and also resulted in the wreck of planes in all types of environments including on land, mountains, and under water. Most of these planes were wrecked due to combat or training during the war. It is no surprise that the Pacific Ocean is full of submerged aircraft from both the United States and Japan.

Black Jack is a B-17F Flying Fortress and operated out of Port Moresby airstrip. The craft got its name from a reference to a card game and its serial number, 41245**21** which ended in 21, the same as Black Jack.

During a return flight from a night raid of the Rabaul airstrip controlled by Japan, the Black Jack was ditched off the coast of Boga Boga village of Papua New Guinea and sunk to 50 meters depth (AHOM 2014, Indo Pacific 2014, Silcock 2011; Halstead n.d).

The flight was troubled by problems with the right wing engines as it was headed to its mission destination. On the way back they ran into a storm as they neared the cost of New Guinea that caused two engines to fail and unable to stay on course for Port Moresby.

Since the plane was low on fuel the pilot decided to ditch the aircraft on a shallow reef, but the craft overshot and landed over deep water. Three of the ten crew members were injured upon impact, but they had just enough time to exit the craft before it began to sink. Local villagers from Boga Boga assisted the crew in getting back to shore.

The aircraft was left there and remained undisturbed until 1986 when WW II aircraft enthusiast Rodney Pearce went on a search of a different plane and found the Black Jack (Pacific Wrecks n.d).

Importance of aircraft wrecks

Several aircraft wrecks are from a period that many can still recall from a past not far from memory. The value is best said by the English Heritage website, " … crash sites have significance for remembrance, commemoration, their cultural value as historic artifacts and the information they contain about both the circumstances of the loss and the aircraft itself" (English Heritage 2002).

Advancements in technologies for aircraft during WW II also transferred over to water craft and vice versa so in that respect they are similar. Certain ships such as aircraft carriers were given shape due a need to store aircraft. Terminology is another parallel that marine and air craft share to a large extent. Just like ships have rudders, hulls, propellers, ribs, etc, so do aircraft.

The Black Jack was part of the 5th Air force and the 43rd bomb group, performing bombing raids on Japanese ships and airstrips around the pacific islands (Silcock 2011). The submerged craft was identified by the retrieval of the radio call plate from the instrument panel. This particular aircraft was credited with sinking the Japanese destroyer Hayahio during a night raid in 1942 (Dive World n.d; Silcock 2011). It has been involved in several air battles that have given the aircraft a popular identity amongst airplane enthusiast.

The Black Jack B-17F Management Plan

General Project Information

Project Sponsor:

United States Army Air Force Historical Research Agency, Naval History and Heritage Command Underwater Archaeology Branch, National Museum and Art Gallery of Papua New Guinea, Department of Modern History Museum PNG, Tufi Dive Resort, Golden Dawn Diving, and Pacific Wrecks.

Accomplished by:

Agustin Ortiz

Approved authorities:

USAAF HRA, NHHC UAB, NRI, National Museum and Art Gallery of PNG, DoMH, Japanese Government Authority on Maritime Heritage

Site Name, Registration Number:

The official site name is the Black Jack B-17 Flying Fortress.

Site Location:

The approximate location for the site is 50 meters below the coastal waters of Boga Boga, a village in the Milne Bay province of Papua New Guinea.

Co-ordinates:

Not available until verified by proper authority

Coastal Geology:

The aircraft wreck lies between 50 to 55 meters below the seabed. The seabed is characterized by coral reefs and soft sand. The coast exhibits, beaches, sedimentary rock.

Figure 2. Map of its trajectory and landing place B17BlackJack.com

Climate:

Hot, tropical climate at sea level. The rainy season is between December and March due to the northwest monsoon. Papua New Guinea experiences the lowest barometric pressures of any island in the Pacific during the months of November to April. This leads to monsoonal air flows from Southeast Asia that cause rainfall throughout the year. The dry season is from May to October, but it is only noticeable in the west region by Port Moresby (PCCSP 2011).

Flora and Fauna:

Papua New Guinea houses a rich biological diversity. It is within the Coral Triangle which has the most species rich marine life in the world. It also has rich mangrove swamps and rainforest. The waters around Papua New Guinea host a variety of marine life including reef fish, reef sharks, coral reefs, and manta rays.

Figure 3. Black Jack as it lies on the seabed. Dive World.com

Human impact:

Underwater tourism makes up a substantial part of the local economy. Diving on wrecks around Papua New Guinea is common. There are currently three main diving companies providing tours to the Black Jack Wreck including Tufi Dive Resort, Golden Dawn Diving, and Pacific Wrecks. There is a permanent guideline that starts at a shallow fringing reef near Boga Boga and extends toward the tail section of the aircraft (Niugini 2001; Silcock 2011). The waters are generally between 26-29°C (79-84°F) and visibility exceeding 30m making PNG a popular diving area. Divers report experiencing a strong current that sweeps along the slope of the guideline and feel it strongest towards the front of the wreck. It is possible that this current has kept the wreck from being completely buried by sediment as seen in figure two above.

While only experienced divers are allowed to visit the site of the wreck because of the depth, it does not escape the disturbance of humans. Divers are allowed to enter the wreck, but because of the ten-minute time limit they are advised to only peer through the cockpit windows.

Depth:

At 50 meters depth

Owner of Terrain:

Papua New Guinea

Reported by:

Rodney Pearce, a wreck diver whom re-discovered the plane in 1986 while on a dive with two other WW II aircraft enthusiasts and diver.

Periods of Research:

The wrecks historical background has been pieced together from various secondary sources, official naval documents such as aircraft accident reports and base histories are not currently used in this analysis due to time and mobility constraints as mentioned in the Black Jack case study in chapter four. Many of the historical information pertaining to this wreck has to be verified by detailed archival research.

Site Definition:

It is a Flying Fortress Bomber aircraft built in a factory in Seattle, Washington during WW II by the Boeing company (Boeing 2015). It is currently submerged at 50 meters depth off the coast of a small village in Papua New Guinea. It represents a significant historical artifact that has remained fairly intact and is has been largely exposed to the open sea.

Deposition of archives:

Due to the nature of the research, archival research on the Black Jack was not able to be gathered at this time. The archival information of this aircraft may be found in the USAAF HRA's archive in Maxwell Air Force Base, Alabama or the Department of Modern History's Museum in Papua New Guinea. For the other wrecks, archival research might also entail visits to NARA II in Maryland, the NHHC archives in Washington D.C., and the appropriate Japanese equivalent for their archives.

Legal Status:

The Black Jack falls under both U.S. and Papua New Guinea legislation. For the U.S. the Sunken Military Craft Act, the National Historic Preservation Act of 1966 and the Abandoned shipwreck Act of 1987. Under PNG, the wreck is protected by the National Cultural Property Act of 1965 and the War Surplus Act of 1952. These and other legislation that may be useful in providing ways to better protect submerged aircraft are discussed in detail in chapter three.

The Black Jack itself is property of the United States as stipulated by the SMCA, but it can also be recognized as national cultural property of Papua New Guinea according to the PNG National Cultural Property Act. This can be mitigated when meeting for discussion. There is a lot of room for collaboration between the parties involved.

Recognized Threats:

For the majority of sunken wrecks including the Black Jack, the main threat comes from sports divers visiting these sites and potentially disturbing them. The second comes from commercial activities such as the Liquefied Natural Gas Project, which have the potential to disturb aircraft and other significant cultural heritage in their proposed areas of development. Third is the environment, there is a lack of data on marine processes such as currents, salinity, acidification, and marine organisms.

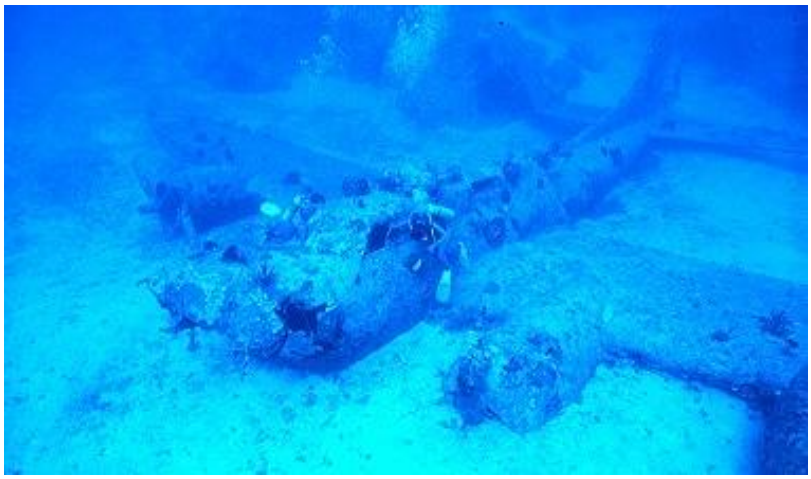

Figure 4:Divers on the Black Jack: Tufidive.com

Date of re-assessment:

The site is open to dives year-round so it is constantly being monitored by three main diving companies Niugini Diving, Tufi Dive Resort, and Golden Dawn Diving. It would be an asset to have an archaeological monitor and consult regularly, possibly monthly, with the companies so that sites such as this are well managed and educational at the same time. Archaeological monitoring can be sponsored by U.S. archaeologist, but would be more feasible if archaeologist from the DoMH or the National Museum and Art Gallery administer it. Collaboration and maintenance of an aircraft database would make sharing information on aircraft conditions a great way to recognize potential risk/threats to the cultural heritage.

Introduction

Previous studies:

Today Papua New Guinea is an area where there is a substantial amount of wrecks and other maritime related sites, and although a large portion are from WW II and official property of the governments of their respective countries, they are protected by laws such as the National Historic Preservation Act of 1966 and Sunken Military Craft Act. No archaeological studies have been conducted on the Black Jack Wreck as of yet. A historical account of the life of the craft and the people that have flown on it have been recorded, but the official documents are not readily available for the public and must be verified through detailed archival research.

Historical Context:

During World War II both the United States and Japan were fighting for control for territories in the Pacific. The Pacific Ocean was the scene of some of the largest air battles in history. Hundreds of military vessels, aircraft and water vessels from both sides can be found in and around islands of the Pacific. Having control of the pacific islands was strategically important for military operations at the time.

By 1943, Allied forces began to effectively push back Japanese forces with a strategy involving regular bombings, land invasion, and finally construction of airbases (Pearson 2005). With the capture of Rabaul the U.S. implemented its island hopping strategy to isolate Japanese forces along the way and take back the Pacific pushing towards Japan.

Point Moresby was the direct link between Papua and Australia and was strategically important for communication and shipping between the Indian Ocean and the Pacific Ocean. Allowing the Japanese to have control of Port Moresby would have meant that it also would have had the ability to intercept any allied build up in Australia (Goldman et al. 2009).

Assessment of Potential:

Description of research objectives:

The Main objectives would be to recommend strategies to:

-research the locations and conditions of aircraft through archival and geophysical survey

- create a detailed database to better manage submerged military aircraft and mitigate risk/threats

-allow legislation to provide varying protection to significant military sunken aircraft

-assess the potential of aircraft for archaeological study in situ

Reference working standards

Secretary of Interior's Standards for Historic Preservation Projects (NHHC)
2001 UNESCO Convention on Underwater Cultural Heritage (UCH) Protection, particularly its Annex.
Nautical Archaeological Society

Research Objectives:

To:

- Conduct Large scale archival and historic research the aircraft that operated and sunk in the Coastal Waters of PNG
- Non-disturbance surveys
-Determine the state of the shipwreck preservation once every 4 months

- Archaeological Potential of sites like this one
- Test ways to better protect metals from corroding

Expected Results:

-Presentations to the general public through exhibitions and presentations to promote maritime archaeology and applicable laws.
-Creation of detailed military aircraft Database
-Build communications and foster cooperation to keep sites protected
-Provide protection and management to a greater number of wrecks

Aims and wishes of the Sponsor:

-Non-intrusive methods
- Investigate site formation process
-Collect information for future studies of preservation
-Keep diving potential a priority
-Educate public of historical significance and how to dive responsibly on military wrecks

Evaluations in between:

Periodic monitoring of the area would be ideal. Once every four months the condition would be assessed.

Working Procedures

Research Methods:

The first major step, would be to conduct extensive archival research at the appropriate research facilities. The better the information that can be extracted, the better the chances of finding submerged aircraft wrecks to set up surveys around to verify their location.

The next step would be to add them to the database and thus allowing military aircraft to be better managed and protected. The benefit to having a database that is constantly updated and accessible to those conducting approved work is that it would allow licensing officials a means of knowing what can be expected in areas where sea activities or research are proposed. The database should be updated every time new information is found.

The Wessex 2008 report, "Aircraft Crash Sites at Sea: A Scoping Study," is a great example to follow and if reports as detailed as that one can be produced regionally throughout the U.S. and even other countries by the appropriate organization whether it be NHHC UAB, NOAA, NPS, EH, the National Museum and Art Gallery of PNG or anyone else. And with a better historical insight into the battles around Papua New Guinea, a better process for assessing aircraft wreck hot spots to later be surveyed.

Imposed Work Conditions for the Black Jack and Database:

Due to the depth any dives taken will be have to be decompression dives. Each diver will have at most one dive during a monitoring session which was determined to be every four months in the beginning of this plan. Length of time underwater will depend on depth of the site. Dive teams will need to be made up of at least four divers, one supervisor, one standby diver, and two divers. With one dive per monitoring session set every four months, it should be feasible to perform small assessments of the wrecks condition. All four must have kept up with their physicals and first aid. Divers have the right to refuse diving if they do not feel comfortable in a certain situation.

Facilities for re-compression would have to be available if this is to be done. Alternatively, because the depth exceeds 30 meters the use of an ROV would be an more likely candidate to do the checks on the site, which would minimize the need for several divers.

The database would have to be held by a central authority so that it can be updated frequently. The DoMH is the likely authority that should manage it.

Modus Operandi:

Non-intrusive methods are to be the only means of accomplishing task. If any loose line or trash is on the site automatically clean it up if possible.

Natural Sciences, applied sciences and other research:

Water acidity, salinity, wood samples, corrosion rates and biological surveys will be integrated into the project to promote interdisciplinary research and communication. It is possible to integrate a study of tourism as well and its effects on this site and others in Papua New Guinea.

Research Results:

Environmental Research:

The environment will be evaluated by specialist to keep the records updated.

Physical Condition:

The wreck is completely exposed to the open water. Many of the movable components such as the guns are still movable (Pacific Wrecks 2015). The front of the plane , the nose, is one of the most damaged parts of the craft. Currents and other marine process are not fully understood for the waters around Papua New Guinea at the moment. Research on these processes would greatly benefit the region as a whole and researchers of a varieties of backgrounds.

Figure 5:View of front and starboard side of the Black Jack: Image by Don Silcock (Silcock 2011).

Finds visible on surface:

The site is visible from at least the 15 meter mark while descending towards the wreck.

Completeness:

It is mostly intact since it is close to 50 meters below the sea. Also the way the pilot landed the plane allowed it to take minimal damage upon ditching it.

Stratigraphy intact:

Stratigraphy was not examined since the wreck is on top of the sea bed.

Stability of Natural environment:

The wreck is not severely affected by currents or wave action, but currents can get strong around the nose of the plane. More study on the process near the aircraft should be conducted as well. It also sits near a ridge, which drops down to depths past 100 meters in some areas.

State of preservation:

The preservation condition of the craft is known to be in very good condition, despite the frequent tourist activity every year.

Organic wreck parts:

According to divers such as Rodney Peirce, many of the individual remains of the crew have not been recovered, so it is likely that at 50meters depth organic material may still be found inside.

Metal Wreck Parts:

The entire frame of the wreck is metal. They show signs of corrosion and a bit of corral growth.

Cultural-historic and archaeological data

Identification

Cultural Context:

The Black Jack played a significant role in the battles of the pacific, which makes it a unique representation of aviation and Pacific Island history. With over 400 modifications of the B-17F model there is much to learn about the construction and individual touches added by those that operated it. Because of its depth its contents and the aircraft itself have a high level of preservation. The repository of artifacts inside the craft have the potential to reveal the life on board and adaptation made from the crew.

Century:

Mid 20th century based on historical accounts.

Exact dating:

The aircraft was ditched in 12th July 1943.

Function:

A bomber craft to take out Japanese naval craft and airfields in the Pacific and doubled as a fighter when needed due to its unique front turret, which was uncommon for the F-model.

Type:

B-17F model

Operating area:

Port Moresby and the Pacific islands

Propulsion:

Four 1,200 hp radial engines

Size:

About 74 feet in length, 19 feet in height, with a 74- foot wing span

Material:

Aluminum, with metal fastenings

Cargo:

Bombs and thirteen 50 caliber machine guns

Risk Assessment

Natural impact:

Currents can get strong due to monsoon activity, wave action, biological, high winds. Temperature of the water stays around 24 to 28 degrees Celsius (PCCSP 2011).

Human impact:

Entanglement inside craft. Breaking of objects carelessly due to curiosity or narcosis. Depth is over 30 meters so time and air consumption has to be monitored carefully. Ammunition was said to be onboard and posses a potential hazard to divers.

Cultural valuation of the Black Jack Wreck

Visible

Visible as a landscape element:

The site is part of the marine environment and a part of the tourism industry for the locals. Proper guidance can be used to teach recreational divers and student divers about underwater archaeology. It can also be incorporated as a bioenvironment given the condition of the wreck.

Visible as exposition element:

The wreck has performed well as a tourist attraction without it taking much disturbance damage from visitors. This still needs to be verified by archaeological monitors.

Memory value:

The wreck is still recent enough that certain individuals can still recall accounts of the war in the areas. The intact nature of the wreck helps people get a better visualization of the cultural object.

Historic Value:

The B-17 Flying Fortress was an important aircraft in helping the United States to fight in the Pacific. The story of the crew are still fresh in the minds of living individuals and present a closer historical narrative. Information gained from the wreck can be valuable for preservation efforts in the future. It is one of few B-17s still surviving today and maybe the only one with as much combat time during WWII.

Structural Integrity

Presence of craft construction:

The mode of construction can be easily determined from records from the Boeing company. It can also be observed from diving on it itself.

Completeness of the wreck parts

Most of the aircraft is intact and has not been heavily disturbed by human presence.

Stratigraphical conditions

Not assessed during the non-disturbance survey.

State of preservation

Wreck parts

Metal

Most of the wreck is constructed of metal and is covered in light coral growth and also corroding.

Artifacts

Quality of archaeological information

Representative value

So far it is the one of the best preserved submerged aircraft in the world, due to its depth. The State of preservation can be explored over time. The individual crew artifacts would be an irreplaceable cache of information on what it was like on board and what they valued the most.

Regional

While this type of aircraft is not very unique in the pacific region, few have been archaeologically examined and fewer are as intact as the Black Jack.

Significance of information

Geographical significance

During World War II both the United States and Japan were fighting for control for territories in the Pacific. Hundreds of military vessels, aircraft and water vessels from both sides can be found in and around islands of the Pacific. Having control of the pacific islands was strategically important for military operations at the time.

Historical or archaeological significance

The Black Jack B-17 wreck is one of the most well preserved submerged military aircraft in Papua New Guinea. Since it is such good condition it is one of the most famous and popular wrecks in Papua New Guinea. The Black Jack was part of the 5th Air force and the 43rd bomb group, performing bombing raids on Japanese ships and airstrips around the pacific islands (Niugini 2001). The submerged craft was identified by the retrieval of the radio call plate from the instrument panel. This particular aircraft was credited with sinking the Japanese destroyer Hayahio during a night raid in 1942. It has been involved in several air battles that have given the aircraft a reputation of being a warrior. All the crew that was on board escaped during the emergency landing. Three were injured, but they all managed to get to safety with the help of the local inhabitants.

Archaeologically, it is significant to the understanding of B-17F construction, individual crew adaptations, holds a repository of crew members individual artifacts.

Conclusion

Because aircraft and marine vessels share a common medium it is important that maritime archaeologist know what to do in the likely hood that they run into them. Improving the databases on submerged craft would help researchers do more comprehensive and detailed reports that can lead to significant historical and archaeological findings. The potential information that may be gathered from wrecks like the Black Jack will have a significant impact on the understanding of submerged aircraft and the wider social cultural history of the region.

Site management

Site management agenda

Safeguarding

Legal

The Black Jack Wreck is located inside the waters of Boga Boga village, New Guinea so it is protected by War Surplus Act and protected from disturbance with the National Cultural Property Act. The United States also grants this wreck a number of protections. It is protected and owned by the United States Army Air Force (USAAF). The USAAF is obligated by the National Historic Preservation Act to protect its historical properties, which included aircraft wrecks. The SMCA is geared with aircraft in mind and allows the craft to be studied through a permitting process.

Physical

The entire wreck is still intact on the seafloor mostly undisturbed.

Monitoring

Monitoring will be an essential activity in order to maintain the wreck protected from looting if found. Monitoring should be carried out in cooperation with locals, dive companies and the DoMH or the National Museum and Art Gallery. The monitoring should include observations about the state of preservation, marine life, and climate. Monitoring can be done by responsible divers and ROV operators in direct conjunction and cooperation with an archaeologist or archaeological organization. Monitoring of this type should be done once every four months or later determined by the initial assessment of the site.

Visualizing

Once analyzed:

- A site plan will be produced.
- Posters for the general public will be produced.
- Presentation of the project's results will be shared at international conferences.
- A press day, with international media coverage
- Digital photo and video records of the site will be taken for the Participants and contributors website.
- other promotional materials.