

# Understanding the WWII Aviation Cultural Landscape of Queensland and Australia

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## *Abstract*

This paper discusses the historical and other documentary sources used to compile and understand the historically significance list of potentially submerged wrecked aircraft in Queensland waters and how the historical information can be used to aid in preparation for fieldwork on aircraft by determining what occurred prior to, during and after the related wrecking event. As most of the wrecks date from WWII, they are all protected under Queensland and Australian legislation. WWII resulted in increased military aircraft activity along Queensland waters, with many Allied aircraft bases being located in Queensland, for operations in New Guinea and the Coral Sea. The research identified 121 potential aircraft wrecks from all eras, being an increase of 69 over the 52 currently in the Australasian Underwater Cultural Heritage Database (AUCHD); with 110 from the WWII era. An analysis of WWII era aircraft is conducted to understand the aviation cultural landscape. The research was in association with the Queensland Department of Environment and Science, with the aim of updating the AUCHD. The extensive historical and documentary research of an aircraft narrows the potential search area for future fieldwork and provides knowledge of the type of wrecking event and the cultural and environmental site formation processes that have acted on a wreck, such as salvage and wave action. Further research is needed to fully examine and determine the state, extent and assess the significance of the remaining wrecks currently identified. Many of the wrecks need to have their location confirmed or determine and to attempt to identify the cause of the crash, if possible and appropriate. Further research and fieldwork are needed on this constantly diminishing cultural heritage to protect and preserve it, such as understanding the environment and cultural factors. It is hoped that this paper can be used as a guide to others looking to undertake similar research into submerged aircraft wrecks in Australia.

Keywords: WWII; aircraft; submerged; maritime; cultural landscape

## INTRODUCTION

World War II (WWII) Allied activity in the Pacific resulted in many aircraft wrecks in Queensland waters for the period of 1940 to 1945. Many of these wrecking events were in remote locations leading to the aircraft and their stories fading from remembrance. The United States (US) mass-produced 295,959 military aircraft in support of WWII between 1940 and 1945 (Office of Statistical Control 1945:127). The increased Allied activity resulting from the expansion of Japanese forces into the Southwest Pacific during WWII and subsequently into New Guinea saw a rapid increase in military personnel and equipment into North Queensland in early 1942 (Gillison 1962:299, 470, 482). Australian and US airbases were established in Queensland to station frontline aircraft squadrons of the United States Army Air Force (USAAF), United States Navy (USN) and Royal Australian Air Force (RAAF) (DACA 1944-1944; 1944-1945; Dunn 2020d; RAAF Historical Section 1995) to support wartime activities against the Japanese forces in New Guinea and the Coral Sea (Gillison 1962; Odgers 1957). There were approximately 131 landing grounds used by the military during WWII in Queensland (DACA 1944-1944; 1944-1945). Of these airfields 17 were used as military bases, 46 as landing grounds and 59 were used as emergency landing grounds. There were a further five flying boat bases (Fig. 1). With an increase in aircraft activity came a resulting growth in aircraft crashes.

Though anecdotally it is known that there were many aircraft crashes in Queensland in WWII, only aircraft in Queensland waters are systematically recorded in the Australasian Underwater Cultural Heritage Database (AUCHD) (DAWECA 2020). There are currently 38 aircraft wrecks recorded in Queensland on the AUCHD that are known to have been lost during WWII. This paper discusses the desktop research that was undertaken in cooperation with the Queensland Department of Environment and Science to understand the submerged aviation cultural landscape and determine the correctness

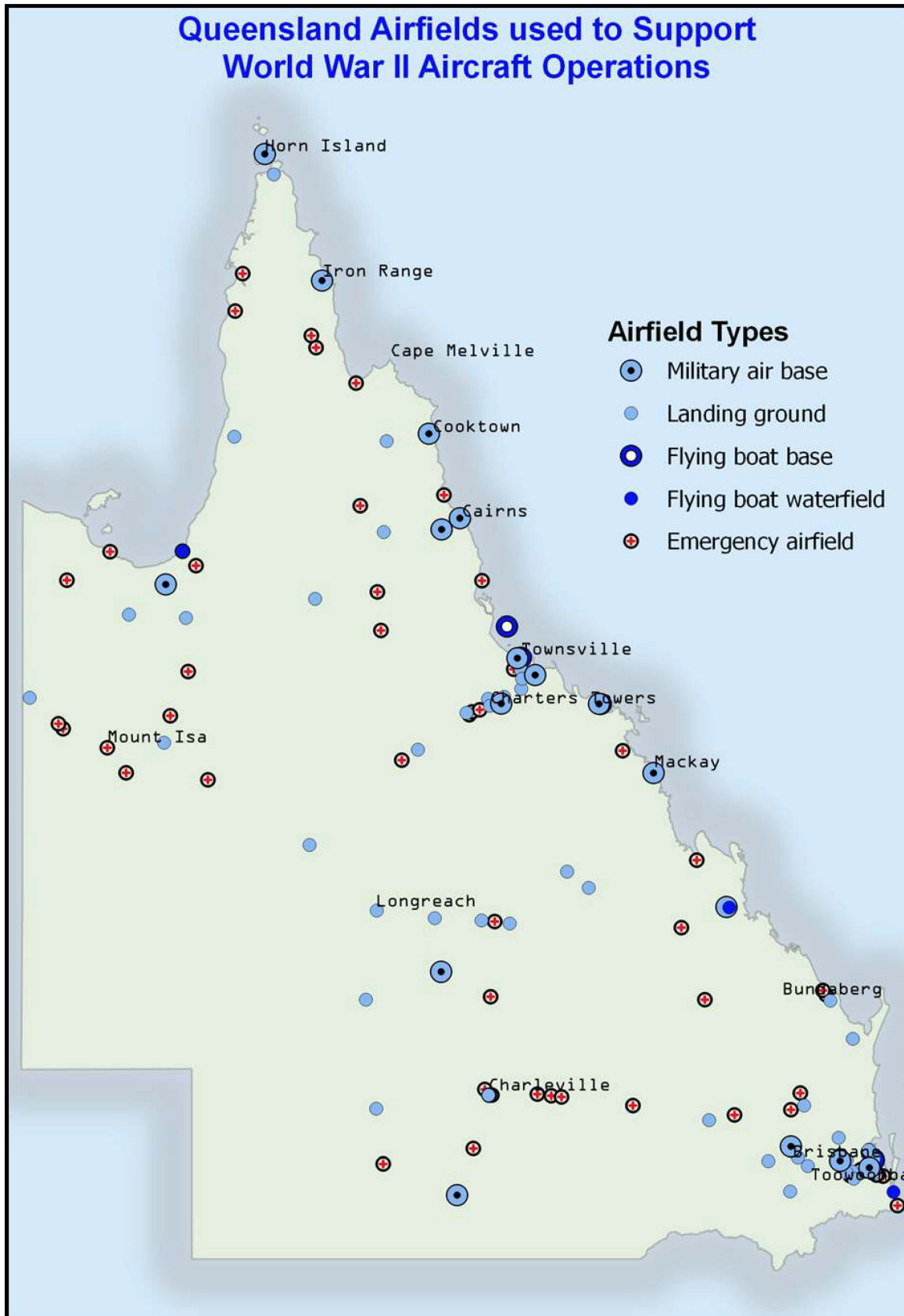


Fig. 1. Queensland airfields used to support WWII aircraft operations compiled from data contained in DACA (1944-1944; 1944-1945).

of the aircraft listed in the AUCHD and if there are any other aircraft wrecks that should be added to the AUCHD. Being listed and documented will assist with heritage protection of the wrecks using legislation and enforcement.

The desktop research was inclusive of all aircraft wrecks military, civilian and era, but removed any known not to be submerged wrecks, as they do not meet the criteria to be listed in the AUCHD. Submerged aircraft are automatically protected after being in the water for 75 years, whereas terrestrial wrecks require listing on the appropriate heritage register. As part of the research, an assessment was made of the wrecks to determine a priority for further research. It is hoped that this article can act as a guide for others considering researching aircraft wrecks, especially in Australia.

By conducting extensive historical and documentary research of an aircraft the potential location of the wreck can be narrowed. Any post-crash salvage could then be assessed and if any part of an aircraft might still be in situ. Further knowing the location can inform on an understanding of any environmental site formation processes that have impacted a wreck. As will be discussed, documentary research is important, but it is only the first step in understanding the aviation cultural landscape. There is much work that can be done and should be done on submerged WWII aircraft wrecks in Queensland waters that are legislatively protected but at risk as their locations are not identifiable as historically significant.

### *Aviation archaeology in Australia*

The study of aircraft wrecks whether submerged or on land has been contained within the umbrella term 'aviation archaeology' (Christian 2020; Ford 2006; Jung 2001; 2008; Leahy 2019; McCarthy 2004; Waterson 2005). Aviation archaeology has been defined by Spennemann (1998) as including aircraft wrecks and support structures, such as airfields (Ford 2006; Jung 2001). This expands the term aviation archaeology, which was first cited by Robertson (1983:17) in 1973 and used specifically to refer to the research and recovery of WWII aircraft wrecks. However, Robertson was largely concerned with the collection of artefacts and salvage of aircraft for restoration (Ford 2006:9). These practices are incompatible with the articles and principles of the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage (UNESCO 2017) and accepted heritage principles, which places a preference for the in situ preservation

and conservation of underwater cultural heritage. The work by people such as Robertson was only archaeology by name and not method.

The pioneering studies of submerged aircraft wrecks in the Pacific and Australia using accepted archaeological methods were conducted by Rodgers et al. (1998) in 1994 and later by McCarthy (1997), Jung (2000; 2001; 2004; 2007a; 2007b; 2008) and Ford (2006). Jung (2000; 2001; 2004; 2007a; 2007b and 2008) has dominated the study of aviation archaeology in Australia. However, this work has mainly focused on flying boats in Darwin and Broome, which he considered to naturally fit into both the maritime and aviation archaeology categories. Similarly, early work by McCarthy (1997) focused on sites in Broome and Rottneest Island, Western Australia, with Fix (2014:989-990) suggesting that the work by Jung and McCarthy advanced the field of aircraft archaeology in theory and methods. The work by Ford (2006) involving desktop research of historical records that identified and analysed 75 submerged aircraft wrecks in Victorian waters associated with WWII. This research did not involve any field component or the confirmation of any of the wrecks but has provided an important basis for further study of submerged archaeological aircraft wreck sites in Victoria. More recent work has been undertaken by Leahy (2019) on a terrestrial aircraft wreck site in Victoria, however, this was a limited study which only identified one aircraft.

No systematic work has been published for Queensland, however, research by Garrett et al. (2006) looked at the WWII landscape of Townsville and focused on an analysis of potential submerged aircraft wrecks in the region. Potential sites were compiled, and one was selected for field analysis. A field survey was conducted; however, the selected aircraft could not be located, and it was later determined from oral history that the wreck had been salvaged. What this work highlights is the importance of historical research before undertaking fieldwork.

The value of historical, archival, and archaeological research in identifying and understanding an aircraft wreck has been identified by many researchers (Ford 2006; Garrett et al. 2006; Jung 2000; 2001; Leahy 2018). For example, Jung (2000:109) was able to eliminate an aircraft that was suspected of being wrecked and submerged in Darwin Harbour. Through his detailed historical research using RAAF Operational Record Books, he found that the plane was recovered and flown again. This highlights the importance of detailed historical and archival research on the post-crash biography

of the aircraft to determine the accuracy of the location and archaeological potential of submerged aircraft wrecks. With an accurate understanding of the aircraft wrecks, the cultural landscape that exists can be examined and studied.

A better understanding of the whole system of submerged aircraft wrecks across a large landscape can be obtained by identifying and appreciating the whole cultural landscape including all the activity nodes, such as airbases, routes and conflict zones. The whole becomes more than the sum of its parts and the macro analysis can inform a social narrative about the individual and groups within the system (Anderton 2002:190). Cultural landscape research has been applied to many conflict studies related to WWII (e.g. Gheyle et al. 2016; Kilpatrick 2016; Passmore et al. 2017; Passmore and Harrison 2008; Passmore et al. 2014; Passmore et al. 2013; Reeves et al. 2016; Schofield 2001; van der Schriek 2020; van der Schriek and Beex 2017). The first step in understanding a landscape is know where the sites are located. However, just knowing the location of the sites will not lead to a detailed in-depth knowledge of the landscape. There will always be a need to ground-truth the information to confirm the presents of a site and to extract detail, to better understand what occurred (Spennemann 2012:106, 120).

#### *legislative protection of submerged aircraft wrecks*

In Queensland waters, all aircraft remains and associated artefacts that are older than 75 years are protected for coastal waters under section 91 of the Queensland Heritage Act 1992, and the remainder of the Australian Territorial Sea along the Queensland coast under section 16 of the Australian Commonwealth Underwater Cultural Heritage Act 2018 (UCHA). The Queensland legislation commenced in 2015 and the Australian Commonwealth legislation on 1 July 2019. As a result, all WWII underwater aircraft and associated artefacts have legislative protection.

To align with the UCHA 2018 legislation the AUCHD was established and is located on the Australian Department of Agriculture, Water and the Environment website (DAWECA 2020). To ensure the protection of the limited heritage that is WWII aircraft, further research of submerged aircraft wrecks needs to be undertaken in Australia and this information updated to the AUCHD. With a comprehensive list of known and possible submerged aircraft wreck sites in Queensland and an analysis

of the historical significance of each potential site, the sites can be ordered to determine a priority/significance list for survey and examination. Though Victoria has a comprehensive list of aircraft wrecks compiled (Ford 2006:9) this list is not reflected in the AUCHD (DAWECA 2020). The Northern Territory is the only jurisdiction with a comprehensive list of aircraft on the AUCHD with 117 entries (DAWECA 2020). Waterson (2005) argues that there is significant potential for submerged WWII aircraft wrecks research in Queensland, however, limited archaeological investigation has been done to date which is something this research seeks to start to remedy.

#### *Researching potential submerged aircraft wrecks in Queensland waters*

This research sought to survey all available documentary sources of information to identify known and potential aircraft wrecks within Queensland waters from any period, not just WWII. This was done to ensure they were listed on the AUCHD and to make sure of protection under the legislation and to further identify a baseline from which further fieldwork and research could be conducted. To identify the order for which further work should be conducted a priority list was determined based on clear criteria. This work was undertaken as an unpaid student placement within the Heritage Branch of the Queensland Department of Environment and Science and due to COVID-19 restrictions was largely undertaken independently and remotely from home, using mainly online resources.

#### **METHODS**

The first major activity in understanding the submerged aviation cultural landscape was to create an inventory of potential sunken aircraft wrecks in Queensland waters and then research, analyse, and prioritise the list. The steps taken were: (1) conduct a search of all available sources to obtain the details of as many potential aircraft wrecks as possible in Queensland waters; (2) research each possible aircraft wreck location for any information that could be obtained using all available sources to obtain sufficient details of the aircraft, the people involved and the wrecking event; (3) research reliable archival and historic information to decide if an aircraft wreck is a submerged aircraft wrecked in Queensland waters and meets the Australian or Queensland legislative criteria for underwater



cultural heritage protection; (4) remove any listing that was confirmed to be terrestrial/land-based aircraft wrecks (terrestrial aircraft are out of scope for this work); (5) remove any listing where it was confirmed the aircraft was recovered and no part may have remained, such as an aircraft making an emergency landing on a remote beach or reef and the aircraft being recorded as 100% salvaged and reused; (6) prioritise the wrecks to determine the aircraft wrecks that are classed as significant (e.g. especially if skeletal remain may be associated with the aircraft).

This research was aided by the numerous sources of information as listed in Table 1. The main primary source information for archived US military records can be accessed using the Fold3 website (Fold3 2021) and for Australian military records using the National Archives of Australia website (NAA 2021). The Fold3 site contains the USAAF Missing Air Crew Report (MACR) records along with many other military records. The NAA records contain Australian Government official records with the main types that are useful for WWII aircraft research listed in Table 2. The records contained on these two sites provide documentary source material that many of the other sites may be based on but are not referenced sources. Many of the records have been digitised which allows for quick access to the information. Concerning USAAF aircraft wrecks, information can generally be obtained from the MACR records, however, NAA does contain some details of USAAF missing aircraft within the A9845 Series.

Secondary sources that are useful for identifying aircraft or details related to an aircraft wreck or crash include the research by Musumeci (2014). Though unreferenced, his book contains useful information when compared against the websites and other historical research. Sources such as Musumeci (2014) and the information provided by websites, such as *Australia @ War* (Dunn 2020c) and *Pacific wrecks* (Pacific Wrecks 2020b) contain accounts obtained from family members, letters and photographs, which further details the human story behind the aircraft. One issue of note regarding many of the secondary source websites is that information related to an aircraft or incident will not be referenced to a primary source. This information then appears to be copied and referenced to the original website and repeated across many of the sites, which results in the unreferenced material being repeated across many sources giving the impression of reliability when the reliability is unable to be determined without reference to, or location of, a primary source.

Despite this, the secondary source websites listed in Table 1 can be a useful tool for identifying a serial number of a wrecked aircraft, as the date of loss may be cross-referenced with the aircraft type. With this information, official sources can be checked to find official primary source records.

The major sources used to compile the database are listed in Table 3. The entries already contained in the AUCHD were used as the beginning of the Queensland submerged aircraft wreck list. As the final aim is to add all the identified wrecks to the AUCHD, the headings from this database were used as the heading for the collection of data. Extra headings were added to enable the database to be filtered, analysed, and assessed.

The 1961 Aircraft Survey (Wing Commander Greg Williamson pers. comm. 2020) titled 'Details of crashed and missing aircraft in Australia' has 357 aircraft crashes both military and civilian from 1940 to 1960 listed. It is unknown who produced the list and for what purpose it was compiled. Some of the locations listed were based on where the aircraft had departed from in Australia, as they, for example, were headed for Papua New Guinea and never heard of again. Sometimes an aircraft may have been listed travelling between two Australian states with an unknown fate and the last location was based on where the aircraft had departed. To ensure all appropriate records were investigated, the place from which the aircraft left and the place the aircraft had planned to arrive were both listed and then all the records were filtered. Any record that had a possible connection with Queensland was added to a list to be further investigated.

The Great Barrier Reef Marine Cultural Heritage Database (Dennis 1993) contained 66 aircraft wrecks. This list was compared with the combined list of the 1961 Aircraft Survey and AUCHD and duplicates entries were noted, and any additional information added to the working database. As a result, an additional 8 aircraft were added to the working database. Any other aircraft identified from other sources were also added to the database.

All known aircraft from all periods fell into four categories: RAAF aircraft, USAAF (5th Air Force), other Military aircraft (Militaire Luchtvaart van het Koninklijk Nederlands-Indisch Leger [Royal Netherlands East Indies Army Air Force] – RNEIAAF, USN and Royal New Zealand Air Force – RNZAF) and civilian aircraft (Fig. 2). The category of aircraft dictated which available source material should be searched to obtain details of the aircraft incident.

Table 1. List of sources of information that can aid as a starting point for research into lost or wrecked aircraft in Queensland and in some cases internationally

Website	Type of information listed
ADF Serials < <a href="http://www.adf-gallery.com.au/raaf2.htm">http://www.adf-gallery.com.au/raaf2.htm</a> >.	Records related to Australian, New Zealand and Papua New Guinea Military aircraft.
ASN Aviation Safety Database < <a href="https://aviation-safety.net/database/dblist.php">https://aviation-safety.net/database/dblist.php</a> >.	Information related to airliner accidents and safety issues.
Australia @ War < <a href="https://www.ozatwar.com/">https://www.ozatwar.com/</a> >.	Information related to military crashes in Australia during WWII.
Australian Newspapers and Gazettes < <a href="https://trove.nla.gov.au/newspaper/">https://trove.nla.gov.au/newspaper/</a> >.	Contains information related reported crashes and subsequent investigations.
Aviation Archaeological Investigation & Research < <a href="https://www.aviationarchaeology.com/src/db.asp">https://www.aviationarchaeology.com/src/db.asp</a> >.	USAAF and USN accident reports, non-combat losses only.
Aviation safety investigations & reports < <a href="https://www.atsb.gov.au/publications/safety-investigation-reports/?mode=Aviation">https://www.atsb.gov.au/publications/safety-investigation-reports/?mode=Aviation</a> >.	Australian aviation investigations and reports related to aircraft crashes.
Fold3 < <a href="https://www.fold3.com/">https://www.fold3.com</a> >.	USAAF Missing Air Crew Reports (MACR) and other personnel records.
National Archives of Australia < <a href="https://recordsearch.naa.gov.au">https://recordsearch.naa.gov.au</a> >.	Official records related to aircraft employment, personnel files, maintenance records, crash investigation and other official records and correspondence related to Australia
Pacific Wrecks < <a href="https://pacificwrecks.com">https://pacificwrecks.com</a> >.	Information related to war in the Pacific.
USASC-USAAS-USAAC-USAAF-USAF Military Aircraft Serial Numbers--1908 to Present < <a href="http://www.joebaugh.com/usaf_serials/usafserials.html">http://www.joebaugh.com/usaf_serials/usafserials.html</a> >.	Records related to aircraft manufactured by the United States of America.

Table 2. List of National Archives of Australia records used to research aircraft crashes and other information related to Australian aircraft

Series	Title	Content dates
A2408	Subject Registration Booklets for Correspondence Files.	01/01/1922–31/12/1961
A9186	RAAF Unit History Sheets (Form A50) [Operations Record Books - Forms A50 and A51].	01/01/1925-
A9845	RAAF aircraft crash reports, single number series.	01/01/1925-31/12/1969
A10297	Aircraft status cards [RAAF form E/E88].	01/01/1930-01/12/1988
A705	Correspondence files.	01/01/1912-31/12/1988

Some NAA or MACR records were located by searching for the aircraft serial numbers or the name of an aircrew member or report/correspondence number referred to in other records. This is where the information recorded in some of the unreferenced

websites was useful, as they provided a starting point to search the official records.

Where an aircraft's crash location was not in water permanently or occasionally, such as in a mud flat or beach area, the aircraft was removed from the

Table 3. List of the major sources used to compile the database of known or potential submerged aircraft in Queensland waters

Source	Source type	Availability
Australasian Underwater Cultural Heritage Database (AUCHD) < <a href="https://dmzapp17p.ris.environment.gov.au/shipwreck/public/aircraft/search.do">https://dmzapp17p.ris.environment.gov.au/shipwreck/public/aircraft/search.do</a> >.	Web database	Publicly
The 1961 Aircraft Survey titled 'Details of crashed and missing aircraft in Australia'.	Spreadsheet	Restricted
The Great Barrier Reef Marine Park Cultural Heritage Database.	Database	Restricted
The Australian Transport Safety Bureau online database < <a href="https://www.atsb.gov.au/publications/safety-investigation-reports">https://www.atsb.gov.au/publications/safety-investigation-reports</a> >.	Web database	Publicly
The Aviation-Safety Network website < <a href="https://aviation-safety.net/database/dblist.php?Country=VH">https://aviation-safety.net/database/dblist.php?Country=VH</a> >.	Web database	Publicly
The Pacific Wrecks website < <a href="https://pacificwrecks.com/provinces/australia_queensland.html">https://pacificwrecks.com/provinces/australia_queensland.html</a> >.	Website	Publicly
ADF Serials < <a href="http://www.adf-gallery.com.au/raaf2.htm">http://www.adf-gallery.com.au/raaf2.htm</a> >.	Website	Publicly
USASC-USAAS-USAAC-USAAF-USAF Military Aircraft Serial Numbers--1908 to Present < <a href="http://www.joebaugher.com/usaf_serials/usafserials.html">http://www.joebaugher.com/usaf_serials/usafserials.html</a> >.	Website	Publicly
Australia @ War < <a href="https://www.ozatwar.com/">https://www.ozatwar.com/</a> >.	Website	Publicly
Australian Newspapers and Gazettes < <a href="https://trove.nla.gov.au/newspaper/">https://trove.nla.gov.au/newspaper/</a> >.	Website	Publicly
National Archives of Australia < <a href="https://recordsearch.naa.gov.au/">https://recordsearch.naa.gov.au/</a> >. A2408 Series - Subject Registration Booklets for Correspondence Files. A9186 Series - RAAF Unit History Sheets (Form A50) [Operations Record Books - Forms A50 and A51]. A9845 Series - RAAF aircraft crash reports, single number series. A10297 Series - Aircraft status cards [RAAF form E/E88]. A705 Series - Correspondence files.	Online archive	Publicly
Fold3 – USAAF Missing Air Crew Reports (MACR) < <a href="https://www.fold3.com/">https://www.fold3.com/</a> >.	Online archive	Publicly with subscription
Musumeci, M. D. 2014. Aircraft Crashes of Northern Queensland 1942-1945. Port Melbourne, Victoria: Trojan Press.	Book	Publicly

working database. Some of the NAA records have not currently been digitalised and further work would be required to obtain these records. Other wrecks were researched by obtaining details contained in newspaper reports. Where enough evidence could be obtained to determine that a wreck had occurred on land and not in a submerged water environment, or that the whole aircraft had been recovered and no parts remained submerged, the entry was removed from the database and the information noted in the working copy.

The final number of 121 potential aircraft wrecks (110 being WWII aircraft) was a combination of merged duplicates, the removal of appropriate

entries as discussed above and the addition of a few records where a wreck was recorded in the AUCHD as an aircraft suspected of having crashed in Queensland waters. There is also a known wreck site that had not been confirmed as a particular aircraft listed in the database and there may be others. AUCHD entry 11178, which is listed as the USAAF B-17F (Flying Fortress) Pluto (Serial No. 42-24384) lost in 1943. This aircraft is listed as having been located at 11.2°S and 142.8°E by Ben Cropp. Cropp's discovery is recorded in a TV documentary and the information presented as if the identification had been confirmed. This however has been disputed by Leahy (2018). So as a result, two entries were made,

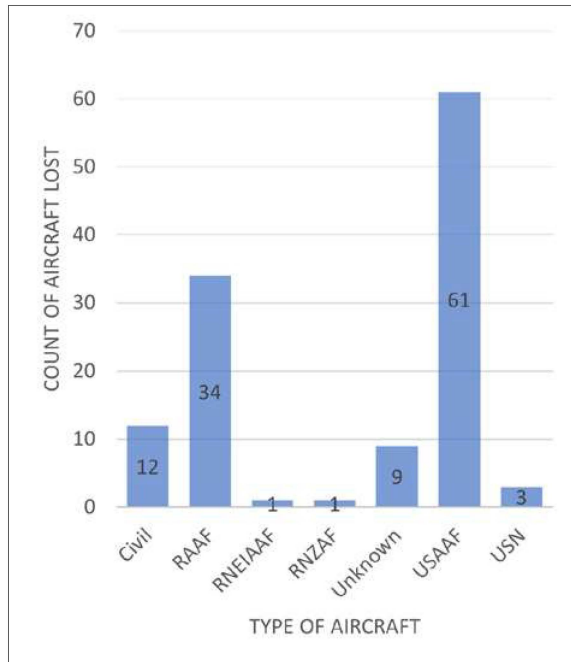


Fig. 2. Chart of the count of all known or potentially submerged aircraft wrecks in Queensland waters by aircraft operator.

one for an aircraft at the location and one for the missing 42-24384 at an unknown location.

The list of submerged aircraft wrecks was then categorised to determine the priority for further research. Table 4 lists the criteria for how the aircraft entries were prioritised. Based on the priority order established further research was conducted on the priority A aircraft listings. This further research was an in-depth look at the service history of the aircraft from squadron war diaries (NAA Series A9186) and the service history of the crew members and passengers of the aircraft, where possible. The intent was to then update the AUCHD with the obtained research information and references. This is currently being undertaken.

Of all the aircraft listed, 107 (88%) were military and the year of loss, where known, ranged from 1940 to 1995, with 90 known to be lost during WWII and further 20 aircraft currently have an unknown date of loss (Fig. 3). Of the 20 aircraft with an unknown date of loss, 17 are listed as military aircraft and of the known models, 14 are of WWII vintage. The following analysis will focus on the 110 aircraft that are known or could have been lost during WWII.

### *The cultural landscape of potential WWII submerged aircraft in Queensland*

There is a large range of aircraft model types represented among the 110 potential WWII submerged wrecks in Queensland waters. Most models only have one example listed (Fig. 4). The most recorded type of aircraft is a B-25 (Mitchell) bomber with 14 wrecks recorded, followed by 12 P-39 (Airacobra) fighters. This distribution of aircraft is reflective of the distribution of role types, with 51 of the 110 being bombers and 29 fighters, making 73% of the aircraft, combat aircraft. However, despite this fact, none of the recorded wrecks is known to have wrecked as a direct or indirect result of combat.

An analysis of the available data provided information for a cause of the crash for 42 of the potential WWII wrecks, with 68 having an unknown cause (Fig. 5). Of the known causes 33% (14) were weather-related, 26% (11) mechanical failure, 21% (9) pilot error and 12% (5) resulting from running out of fuel. Of the 68 crashes where a cause could not be determined 34% (23) had no location or details of the crash that is known as the aircraft was last seen leaving the point of departure. Of the remaining 45, four have official documentation related to the aircraft where it states that they were force landed, but no reason for this is listed. For the remainder, no reason can be determined at this point, but further research may uncover the cause. From the current data, no conclusions can be drawn between the known cause and the locations, but pilot experience may have been a factor as more crashes occurred in Queensland at the start of the conflict off the coast than later.

The largest number of aircraft (37) were lost in 1942 of which 21 were bombers while 20 aircraft were lost in 1943 with 7 fighters being the majority (Fig. 6). Despite the decrease in the number of crashes there were 103 deaths related to 1943 crashes compared with 84 related to 1942, with a total of 272 known deaths associated with known or potential submerged aircraft wrecks in Queensland waters that occurred during WWII. Some of the crashes resulted in large numbers of deaths linked to one aircraft crash, with one crash in 1943 resulting in 27 deaths. Crashes by bombers resulted in 123 deaths and military transports, 91 (Fig. 7). Of the military bombers B-25 (Mitchell) bombers had 39 related deaths and B-17 had 29. Most deaths related to military transport were associated with the C-47 with 59 from four crashes and 51 from two crashes with 27 and 24 deaths each.

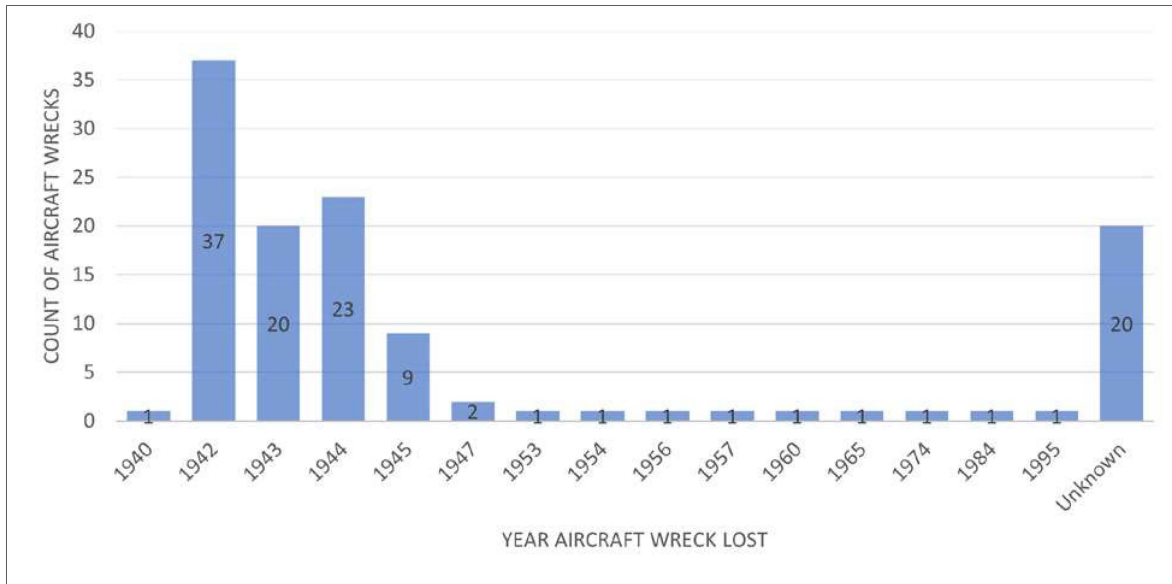


Fig. 3. Chart of the count of all known or potentially submerged aircraft wrecks in Queensland waters by year of loss.

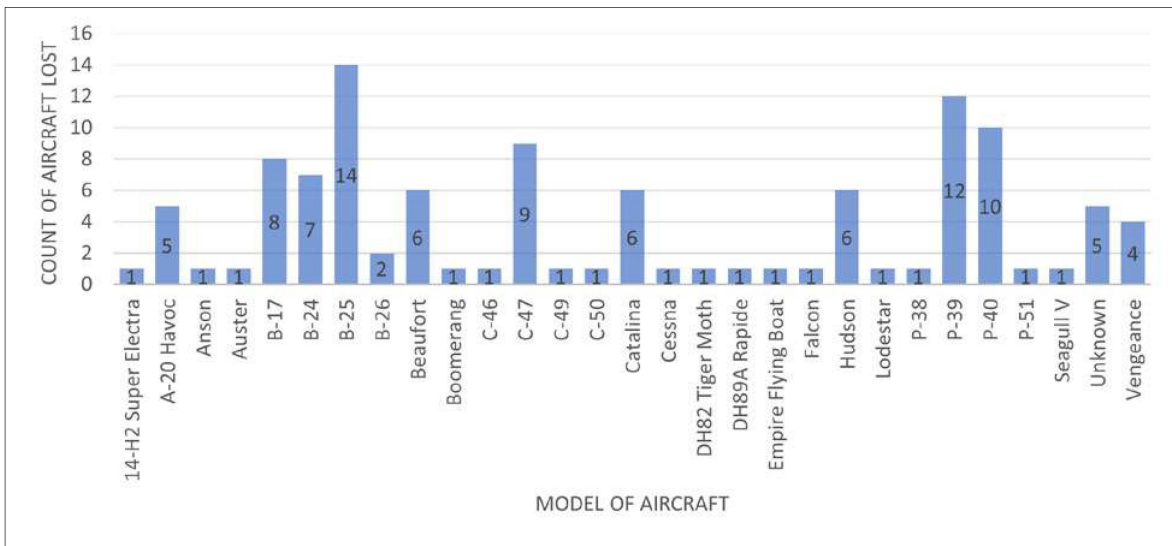


Fig. 4. Chart of the count of known or potentially submerged aircraft wrecks in Queensland waters that are known to have been or may have been lost during WWII by aircraft model.

After assessing the priority (see Table 4) of the aircraft wrecks recorded, four of the wrecks were considered priority A wrecks for further research and 21 priority B, which are the wrecks with known fatalities. The largest category was priority D wrecks with 41% (45) of the aircraft wrecks and being wrecks that are not related to known deaths and the location is known but not confirmed (see Table 4). From the currently available information, 36 crashes have a confirmed location, which is constituted by the research priority A, C and 24 of the priority D

crashes. Furthermore, 74 have a location that is not confirmed, which comprise the research priority B, E, F and 21 of the priority D wrecks. However, though most crashes do not have a confirmed location of the crash, 86 of the 110 wrecks do have a location recorded. Of these 86 potential wrecks, 50 have no known current evidence of the crash location being confirmed.

The majority of the aircraft wreck locations were concentrated in North Queensland as seen in Fig. 8. This concentration was most likely a result of having



Table 4. Criteria for each category of priority for further research for each known or potential submerged aircraft wreck in Queensland waters

Category	Criteria
Priority A	Where the crash relates to a death and confirmed wreckage.
Priority B	Where the crash relates to a death and a location is recorded.
Priority C	Where crash wreckage is confirmed but is not related or known to relate to a death.
Priority D	Where the crash location is recorded but not related or known to relate to a death.
Priority E	Where the crash relates to a death, but the location is unknown.
Priority F	Where the crash location is unknown, and it is unknown if the crash is related to a death.

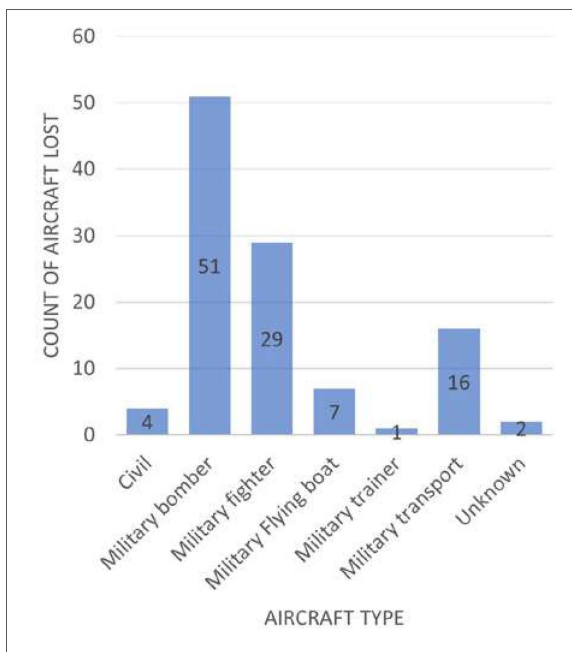


Fig. 5. Chart of the count of known or potentially submerged WWII aircraft wrecks in Queensland waters by the cause of the crash, where known.

a large number of the 17 military airfield bases, 46 landing grounds and five flying boat bases (DACA 1944-1944; 1944-1945) in Queensland (Fig. 1) in North Queensland. Even though the population in North Queensland is relatively small, this was where the aircraft activity was concentrated resulting from the proximity to the conflict zones, the major airfields, and the connecting transit zones.

Of the 110 WWII aircraft identified as in or potential in Queensland waters only two are known to have had extensive archaeological surveys conducted and have been further protected by having an area declared around the wrecks that prevents entry of any vessels and persons. The two wrecks protected are both RAAF Consolidated PBY-5 (Catalina) flying boats A24-24 and A24-25 that

were wrecked on 17 August 1943 and 28 February 1943 respectively. Both aircraft were deemed priority A for research (see Table 4).

The remaining two priorities A research aircraft are a RAAF Curtiss P-40E Kittyhawk A29-69 that crashed 27 April 1942 and a USAAF Boeing B-17E (Flying Fortress) 41-2497 that crashed 24 March 1944. To date, no archaeological survey has been conducted on these two aircraft, that have high cultural heritage significance and are related to known deaths and their locations are known and confirmed. Further, there is a rich history behind these aircraft and the persons known to have flown in them and are showcased below to highlight the digital information available from primary sources, which also provides an awareness of the research method and sources.

#### *RAAF Curtiss P-40E (Kittyhawk) A29-69 and Flying Officer Montague David Ellerton*

Flying Officer Montague David Ellerton (Service no. 568) born 1 March 1919 and enlisted into the RAAF on 4 September 1939 (DACA 1939-1948). He was given a short service commission and awarded his flying badge on 3 March 1940 graduating from No. 26 Course at Richmond Flying School (Fig. 9).

He proceeded overseas with No. 3 Squadron (Hurricanes) on 15 July 1940 and was promoted to Flying Officer on 3 September 1940. The unit travelled to the Middle East where he saw action in the Western Desert. He reported that on 2 April 1941, he and his wingman shot at an Italian Savoia-Marchetti SM.79, three engine bomber west of Benghazi, which was last seen trailing smoke and probably destroyed (DACA 1940-1945:96). On 5 April 1941, he destroyed two Junkers Ju87 (Stuka) dive bombers over the Barce Pass (DACA 1940-1945:132). He served in this theatre of war until August and then returned to Australia on 13 October 1941. He served initially as a staff pilot with

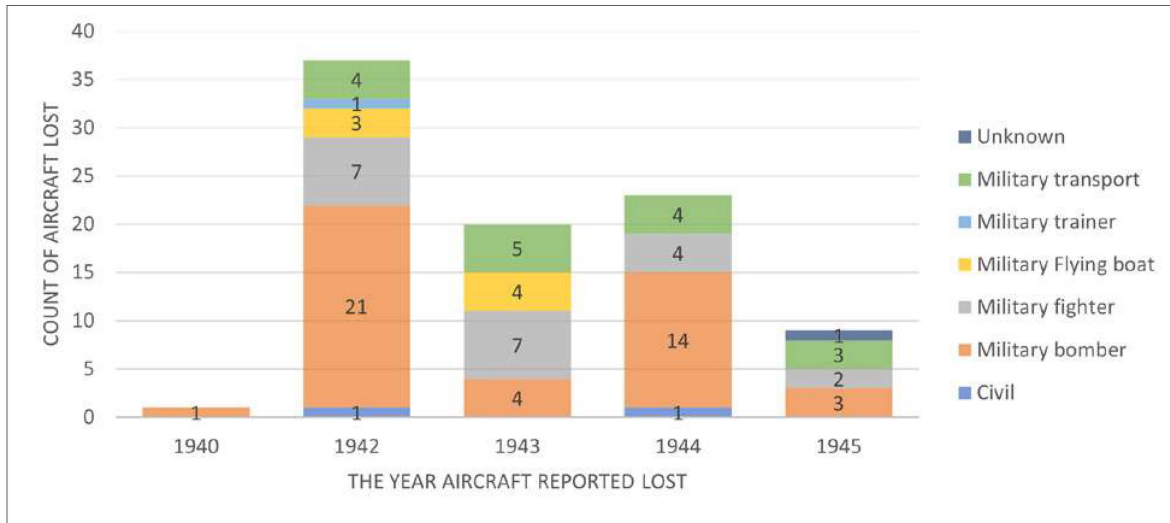


Fig. 6. Chart of the count of known or potentially submerged aircraft wrecks in Queensland waters that are known to have been or may have been lost during WWII by year reported lost and divided into aircraft type.

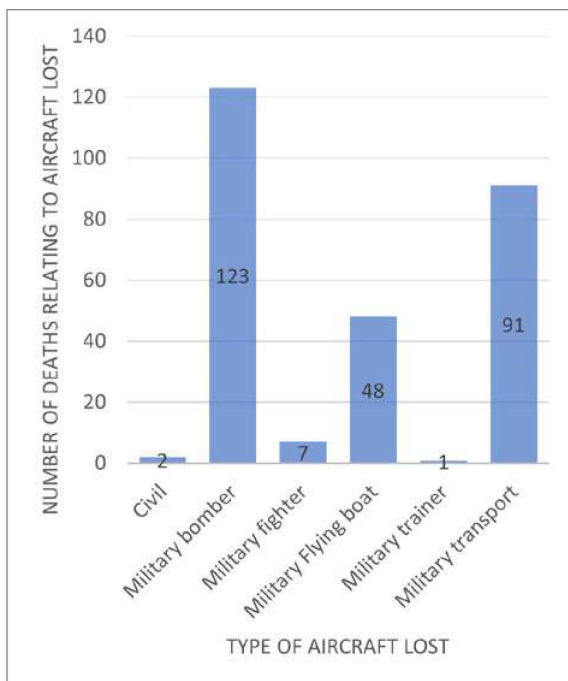


Fig. 7. Chart of the number of deaths related to known or potentially submerged aircraft wrecks in Queensland waters that are known to have been lost during WWII by type of aircraft.

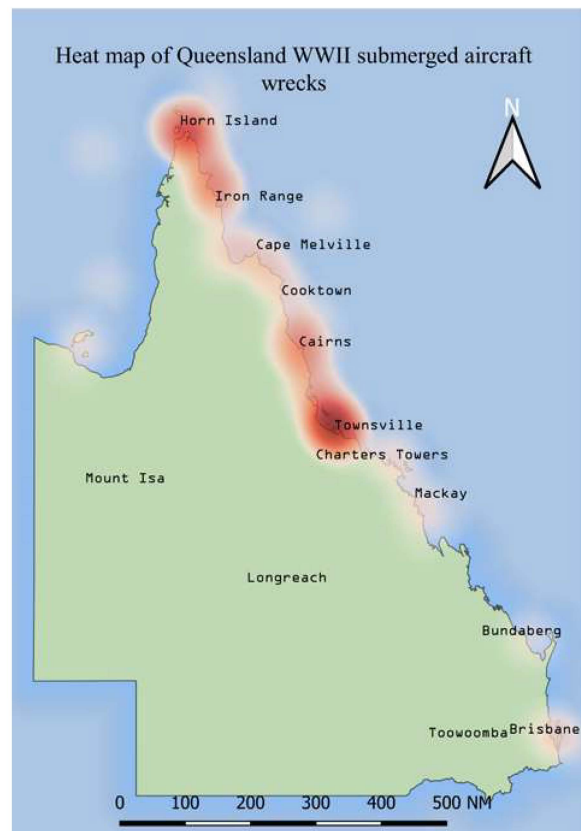


Fig. 8. Heat map of the Queensland known or suspected submerged WWII aircraft wrecks where a location is recorded.

No. 1 Service Flying Training School, Point Cook, from December to February 1942 (Pacific Victory Roll 2013).

He joined No. 75 Squadron (Kittyhawk) on 16 March 1942 and flew the following operations: 6 April 1942, Patrol Horn Island and 9 April 1942,

Horn Island to Port Moresby (DACA 1939-1948). At 10:50, 10 April 1942 while in a formation of seven Curtiss P40Es and flying A9-41 over Port





Fig. 9. Outdoor group portrait of No. 26 Course, RAAF graduating group located at Richmond Flying School, NSW in March 1940. Cadet Montague David Ellerton 568 is seated on the ground front row, first on the left (AWM 1940).

Moresby they intercepted seven enemy Nakajima B5N2 (Kate) type 97 carrier attack bombers and six Mitsubishi A6M (Zero) carrier-based fighters. He conducted a stern attack on the extreme port bomber of the formation finishing with a burst at short range. A Zero fired at long range to no effect and a trail of black smoke was observed from the enemy bomber (DACA 1942-1945:78). He flew a cover patrol on 12 April 1942. Flying A29-8 on 18 April 1942 he intercepted an unknown number of Zeros while in a formation of seven P40Es, nil losses and nil result were observed on the enemy (DACA 1942-1945:113).

The Curtiss P40E A29-69 was constructed as US serial no. 41-5550 and left Sacramento Air Depot on 17 December 1941, arriving via ship on SS Mormac Star on 22 February 1942, and was transferred to the RAAF as A29-69 (Birkett 2016:19). The P-40E was a US-built fighter and ground attack aircraft of which 820 were built (Dann 2007). A total of 13,738 of all P-40 variants were constructed (Office of Statistical Control 1945:114). The aircraft was originally issued to No. 76 Squadron on 1 April 1942 from No. 1

Aircraft Depot. No. 76 Squadron was formed on 14 March 1942. The aircraft was listed as unserviceable on 20 April 1942 and then reallocated on 25 April 1942 to No. 75 Squadron, which was short of aircraft due to losses defending Japanese attacks near Port Moresby (Fig. 10).

On 27 April 1942, Flying Officer Montague David Ellerton was ferrying A29-69 from Townsville to re-join 75 Squadron in Port Moresby. About 50 nm NW of Cooktown, he located USAAF Lt William McGovern whose Airacobra crashed the day before between Murdoch Point and Rocky Ledges Reef. The pilot attempted to land on the beach to aid the stranded pilot when one of his wings clipped a sand dune and the aircraft flipped over, landing on the beach at low tide. Flying Officer Ellerton was trapped and unable to get out of the aircraft and Lt McGovern was unable to free him and he was killed by the incoming tide (DACA 1942; Dunn 2020b).

The deceased pilot's nephew Tim Ellerton visited the wreck site in October 1999. At that time very little remained of the Kittyhawk, only the upside-down wing root and the left-hand undercarriage



Fig. 10. A P40 (Kittyhawk) operated by No. 75 Squadron RAAF at Milne Bay, Papua in September 1942 (AWM 1942).

extension struts, and some copper and brass hydraulic plumbing. According to him, the Allison V12 engine was taken back to Cooktown some years before. He stated that he recovered the struts and ram (before someone could souvenir them) and has removed 58 years' worth of barnacles, lime and rust encrustation. He reported that some of the larger mild steel nuts unscrewed readily, knuckle joints now articulate freely, and the ram even yielded a couple of cups full of hydraulic fluid (Dunn 2020b).

On 5 May 1942, it was reported that Flying Officer Ellerton was buried close to the aircraft with one wing of the plane used as a headstone (DACA 1942-1947:27). The record card for A29-69 (DACA 1942) stated that the aircraft was written off and there is no indication of salvage. However, as the pilot was trapped in the upside-down aircraft, some dismantling of the aircraft would have occurred to remove the pilot's body and remove a wing for use as a headstone.

The wreck of RAAF Curtiss P-40 (Kittyhawk) A29-69 (wrecked 27 April 1942) has been located and confirmed and is within Queensland coastal waters, on the beach visible at low tide between Murdoch Point and Rocky Ledges Reef. It is currently protected under s. 91 of the Queensland Heritage Act 1992 as it has been in Queensland coastal waters for 78 years and is listed on the AUCHD (#8050). The aircraft appears to have not been involved in any combat-related flights and was on its first operational flight when it crashed.

#### *USAAF Boeing B-17E (Flying Fortress) 41-2497*

The B-17E serial no. 41-2497 was manufactured in the Boeing factory in Seattle and delivered to the USAAF at McDill Airforce base on 26 January 1942 and on 17 February 1942, it was assigned to the 19th Bombardment Group, 30th Bombardment Squadron (30BS) in Java. The B-17E was a US-built long-range high altitude heavy bomber of which 512 were built. A total of 12,761 of all B-17 variants were constructed (Willmott 1980). It is claimed that there are currently only four complete B-17E known to exist, one that has combat service, two others that served during World War II and one that was for civilian use. There are only 46 complete B-17 of all variants still surviving (Wikipedia 2020). The aircraft was then transferred to the 7th Bombardment Group; then back to the 30th Bombardment Squadron and evacuated from Java to Australia.

The 30BS was stationed in Melbourne c. 5 March 1942; Cloncurry, c. 27 March 1942; Longreach,

c. 13 May 1942 and then Mareeba, c. 24 July-c. 10 November 1942. The 30BS saw combat in Southwest Pacific, 7 December 1941 to c. 16 November 1942; ground echelon fought with infantry units in Philippine Islands, c. 20 December 1941 to May 1942 and was awarded distinguished unit citations for Philippine Islands, 7 December 1941 to 10 May 1942; Philippines and Netherlands Indies, 1 January to 1 March 1942; Philippine Islands, 6 January to 8 March 1942; Papua, 23 July to c. 10 November 1942; New Britain, 7 to 12 August 1942 (Maurer 1982:148-149).

In late 1942, the aircraft was assigned to the 317th Troop Carrier Group, 46th Troop Carrier Squadron (46TCS). Nicknamed *Tojo's Nightmare* (Baugher 2020). The Squadron was stationed at Garbutt Field (Townsville) from 23 January 1943 and then Port Moresby, New Guinea from 1 October 1943. It was involved in paratrooper drops on Nadzab (New Guinea), Noemfoor, Tagaytay (Luzon), Corregidor, and Aparri (Luzon), as well as aerial transportation in the South, Southwest, and Western Pacific. The Squadron principally used C-47 Douglas Dakotas (Maurer 1982:205). During the B-17E's (serial no. 41-2497) service with the 46TCS, the squadron was awarded two Distinguished Unit Citations: Papua, January 1943 and New Guinea, 30 January to 1 February 1943 (Maurer 1982:205).

On 15 November 1942, the aircraft was nickname *Mac Mac* and carried one U.S. Army howitzer, a tractor, ammunition and an eight-man crew to 7-Mile Drome near Port Moresby from Australia (Fig. 11). After delivery, the cargo was divided between several C-47s and flown to the north coast of New Guinea for use at Buna, New Guinea (Pacific Wrecks 2020a).

On 24 March 1944, the aircraft took off from New Guinea, piloted by Captain William Compton with American and Australian personnel aboard for furlough in Australia. During the approach to land at Horn Island Airfield, the nose began to rise unexpectedly, causing a stall and a quarter turn flat spin from 250 feet before impacting the mangrove swamp into about 1.2 metres of seawater near the edge of Horn Island (Pacific Wrecks 2020a). The wreck of USAAF Boeing B-17E serial no. 41-2497 is confirmed within Queensland coastal waters, in the mangroves north of Horn Island airfield. It is currently protected under s. 91 of the Queensland Heritage Act 1992 as it has been in Queensland coastal waters for 76 years and is listed on the AUCHD (#8032).

Allied personnel on the island rushed to the crash site. One of the first at the scene was U. S.



Fig. 11. Boeing B-17E (41-2497), the men and the equipment which took part in the flight to move artillery into New Guinea (National Archives 1942).

Army Captain John D. Ewing plus Australian Army personnel from 34 Heavy Anti-Aircraft Battery and the 157th Light Anti-Aircraft Battery that rescued the crew. The rescuers cut a hole into the top of the bomber to allow the crew and passengers to escape. All but one person aboard sustained injuries and spent the night in the hospital. Two of the crew that were injured later died. Another aircraft transported the survivors to Garbutt Field near Townsville (Pacific Wrecks 2020a).

It is unknown what post-crash salvage was conducted on the aircraft. The Pacific Wrecks website (2020a) has images of the aircraft after the crash and an image showing what remains in 2000. Based on the images most of the aircraft appears to have been removed, but by whom and when this occurred is currently unknown.

***The need for further work including archaeological fieldwork to understand, protect and preserve the submerged aviation cultural heritage***

What the historical documentary research does is provide the best potential understanding of where the aircraft is located, what occurred to it during the wrecking event, what occurred to it after the event, such as salvage, and therefore what state it may be in. Further by knowing the location and state of the aircraft, a better understanding of the environmental site formation processes that may have affected the surviving structure. With this knowledge any field researcher will be armed with the best information to aid in effective fieldwork, that can save time and resources (Burke et al. 2017:29-32; Tuttle 2014:116). As the list of potential submerged aircraft requiring further work is large, a systematic criterion should be used to determine the priority order. As such, further research is needed to assess the significance of the remaining wrecks currently on the compiled database and any further wrecks identified in the

future. This work will need to include further analysis of official records to determine what salvage was conducted and if any physical investigation, such as a survey was completed to confirm the existence, extent, and state of each wreck.

As discussed above, primary source information can be used to identify an aircraft at a wreck site, but ultimately only a physical analysis of the remains of the aircraft can confirm the identity, if at all. A method of identifying an aircraft can be by use of images of the historical wrecked aircraft or investigation and observations during the fieldwork of the remaining physical artefacts of an aircraft, to identifying the specific model type, once the make and general model are known. During WWII different aircraft, such as the North American B-25 (Mitchell) bomber and Boeing B-17 (Flying Fortress) bomber, were produced in different models and types, as the war progressed, and lessons were learnt. For example, the B-25 was produced as a B-25, B-25A, B-25B, B-25C, B-25D, B-25G model but within these models, there were different types such as the B-25C, B-25C-1, B-25C-5. The B-25C had no external attachment points on the wings, were as the B-25C-1 did and was equipped with a 0.30 calibre gun in the nose, whereas the B-25C-5 had a 0.5 calibre flexible gun and a fixed one for the pilot (Wagner 1965). If these differences survive the initial crash and the underwater environment, they can be used as a key to help in the identification of an aircraft. More research is needed to understand what aspects and features of an aircraft are more likely to survive underwater.

Leahy (2019:6) argues that archaeological examination of a wreck site can provide information on the details of the broader conflict and complete gaps in the historical record, that might otherwise have been lost. Ford (2006:12) further notes that the investigation of aircraft wrecks by the US Army Central Identification Laboratory in Hawaii is mainly concerned with the recovery of the deceased, but does use archaeological methods to assess the cause of the crash and the impact on the involved personnel during and after the wrecking event. McCarthy (2004:83) further advocates that aircraft wreck sites are archaeological sites that can provide information about the people that flew the aircraft. To ensure the full historic story of the people related to an aircraft wreck is obtained, including before, during and after the wrecking event and to either confirm or challenge the historical facts related to an aircraft wreck, some level of examination and archaeological investigation of the physical evidence is required (Cooper 1994:136; Frka et al. 2020:180;

Holyoak 2001:259; Waterson 2005:4-5; Whitehead 2020:3).

The level of examination that should be carried out should be appropriate for the level of information that is required to be determined. This will have to be balanced by the available resources and significance of the wreck. There may be merit in adopting a systematic phased approach to the level of archaeological examination as proposed by Christian (2020:20). The phased aviation archaeology research (PAAR) methodology has five phases, namely: (I) historical survey, (IIa) general data survey, (IIb) detailed data survey, (IIIa) target excavation and (IIIb) full data recovery excavation (Christian 2020:20-21). The PAAR methodology is designed to be used by professionals and avocational groups to be a standardised methodology for a terrestrial environment but could be adapted for the maritime context (Christian 2020:25).

Beyond positively identifying a wreck as a particular aircraft using a serial number, an equally important challenge is to determine the details of the wrecking event or the events that led to the aircraft becoming a wreck. Aircraft wrecks can be understood in similar ways as shipwrecks as they are subject to similar formation processes. Martin (2014:47) argues site formation processes are needed to fully appreciate and understand a shipwreck site. Muckelroy (1978:158) was the first archaeologist to develop a process to interpret the site formation processes of a wreck which mainly concerned the environmental factors of shipwrecks. Gibbs (2006:16) further expanded this to include the cultural influences on a shipwreck. However, these approaches did not have a direct correlation with submerged aircraft wrecks as argued by Bell (2010:120) who adapted the processes to include aircraft wrecking events in her research. Though discussed by Bell (2010:124) her model does not integrate the cultural site formation processes associated with the wrecking event, that may influence the site formation, such as releasing of external fuel tanks, weapons or other items to lighten an aircraft; the alighting of the pilot, crew and passengers, the removal of objects, the opening of the hatches.

One factor discussed in all of these processes is salvage. The type of salvage, be it systematic or opportunistic, may be influenced heavily by the process of wrecking, the location (for instance in a surf zone) or remoteness of the event and the proximity to any settlements/community (Gibbs 2006:14). As with shipwrecks, if an aircraft wrecking event is near a settlement, opportunistic salvage



can and does occur (The Daily Mercury 1954). Due to the at times high speeds and more lightweight structures of aircraft the wrecking event can cause substantial disintegration of the aircraft, this is not always the case as the crew may be able to land the aircraft without loss of life and with minimal damage to the aircraft (Bell 2010:122). If this is achieved then factors such as whether the landing occurred on a long stretch of intertidal beach wheels up or down; on a shallow reef; in the open ocean in a large swell or flat sea will influence the wrecking or landing event. The success or otherwise of the 'landing' can then affect whether the aircraft disintegrates and loses a wing or the tail and then if it floats or sinks.

As discussed most of the aircraft wrecks in Queensland relate to WWII aircraft and though vast quantities of aircraft were produced for the war they were a valuable and not an unlimited resource. The value of spares was important, with dedicated repair and salvage units within the RAAF tasked with salvage of crashed aircraft (RAAF Historical Section 1995:viii). For RAAF aircraft the status cards (DACA 1939-1973) indicate whether an aircraft was salvaged completely, the percentage that was salvaged or if it was written off. An aircraft may have been written off because the location was unknown, the aircraft was unable to be salvaged or the parts were not usable. Salvage can additionally occur as the aircraft may pose a danger to people or navigation. It has been asserted that contemporaneous recovery is rare (Garrett et al. 2006:82) however examination of many RAAF aircraft status cards may tell another story.

The responsibility for USAAF salvage rested with the appropriate equipped maintenance unit. 3rd Echelon maintenance at subdepots was equipped with heavy equipment for salvage, however, they only had responsibility where it was beyond the less equipped 1st and 2nd Echelon maintenance units within combat units or squadrons (Office of Air Force History 1983:375, 388-389). The capacity and reach of USAAF units in Queensland are unknown and further investigation into available records and the presence of such units will need to be conducted before any conclusions can be made to that effect. The cost of producing a B-17 Flying Fortress (Heavy Bomber) in 1942 was US\$258,949, which is equivalent to US\$4,368,767 in 2021 corrected for inflation (Office of Statistical Control 1945:134). Given the costs involved, there would be an incentive to reuse airworthy parts where possible, which would also reduce pressure on supply chains.

From the information obtained from archival records and other sources, it is known that 25 of

the 121 aircraft wrecks have been subject to some recovery of the aircraft by military salvage crews. Furthermore, the methods used varied from the use of grappling hooks to recover submerged aircraft and bodies, while at other times divers were used. Where aircraft were recovered, some were later sold as war surplus. As time passed after WWII many of the aircraft wrecks have been subject to salvage by aircraft enthusiast, both terrestrial and maritime. Some aircraft wrecks have been recovered and 'restored', used for parts on other restorations, or have had parts removed as souvenirs. Examples include Airacobra's from Cape York being recovered by a group called the Cairns Aircraft Recovery Team with one aircraft going to Syd Beck's museum (a private business) and another being sold to a South Australian military aviation enthusiast (Clarke 2015; Dunn 2020a). With the passing of Beck, his family were offering the museum and items within for sale (Aussie hunter 2017). Other examples include wrecks, some of unknown heritage or significance, having parts souvenired including the removal of machine guns (4x4australia 2017; Cropp 2016) and the removal of other aircraft parts located on disused RAAF airfields (NQExplores 2012). Further, the recovery of a Spitfire at Crocodile Creek (StorytellerMedia 2016) is an example of a RAAF aircraft being recovered by an official RAAF group where the only focus was the recovery of the wreck without any archaeological consideration.

Bell (2010:1, 125) notes that the wrecking event of an aircraft is different from that of a shipwreck due to the potential high speed of impact and the aircraft's lightweight structures, which can result in substantially rapid disintegration of the aircraft before being submerged. Bell (2010:121) also notes that in a high energy environment (such as the surf zone) an aircraft is at major risk from physical disintegration, and a low energy environment, the main cause of deterioration is corrosion. Where some or all of a wrecked aircraft remains, it will then become susceptible to environmental factors beyond the other cultural factors list by Bell (2010:124). High energy environments may result from wrecks being present on beaches or shallow coral reefs or in the path of infrequent tropical cyclones. Where present in a low energy environment, biological and chemical effects affect the structure of the aircraft, however, as noted by Bell (2010:121) only limited research has been done on the long term effects of saltwater on aluminium alloy aircraft materials.

An understanding of aircraft materials is required to understand what the long-term effects may be of an aircraft's structure. An aircraft's ability to fly is

contingent on it developing enough lift to overcome gravity. To achieve this with heavy than air crafts, light materials are sort after. Aluminium has been used in powered aircraft since the beginning with the Wright Flyer having a cast aluminium alloy engine case with 8% copper (Polmear 2004:2; U.S. National Park Service 2017). During the early years, an aluminium-copper (Al-Cu) alloy known as duralumin (2017) was used, but stronger alloys made with the addition of magnesium (Mg) were developed for the aircraft industry prior to WWII (Polmear 2004:5). The alloy known as 2024 contained Al with 4.3% Cu, 1.5% Mg and 0.6 % Manganese (Mn). Aluminium alloys with about 5% Cu are classed as 2000 series and are known for their strength but have limited corrosion resistance (Greenwood and Earnshaw 1984:248).

Aluminium's general corrosion resistance is achieved as a result of the protection afforded by a thin layer of aluminium oxide ( $Al_2O_3$ ) that forms quickly and is inert (Greenwood and Earnshaw 1984:248). This effect is a contrast to iron oxide which does not protect any underlying metal. However as aircraft alloy is made with Cu and due to the grain structure of the metal formed by the hardening process, intergranular corrosion occurs when immersed in saltwater, with the Cu acting as a cathode and the Al structure becoming the sacrificial anode resulting in pitting (MacLeod 1983:2).

Much work has been done by MacLeod (1992, 1996, 2010) on the in situ conservation of iron shipwrecks and or stabilisation prior to recovery by the use of sacrificial anodes (Viduka 2017:86). There, however, has been little work done directed at the in situ preservation of aluminium aircraft wrecks. Salvage and preservation of aircraft from a saltwater environment depend on having sufficient resources and a treatment such as the one developed for aircraft alloy containing Al and Cu involving an ammonia-ammonium sulphate buffer in aerated deionized water, which removes corrosion products and stabilises the metal (Jung 2001:190; MacLeod 1983:1). This however is only effective when removing an aircraft from saltwater, which is not generally an option due to cost and where the wreck is a known grave.

A more reactive metal such as Mg may offer the ability to act as a sacrificial anode however this would require extensive laboratory experimentation to determine if it would have any effect and not be detrimental to the aircraft. Cathodic protection of Al is different from that of steel. With Al, there is a need to balance the cathodic reaction to ensure that the surface  $Al_2O_3$  layer is not disturbed which would

lead to increased destruction of the alloy beyond the pitting damage cause by the Cu (Nişancıoğlu 2007:5).

MacLeod (2006) has also done important in situ corrosion studies on submerged aircraft wrecks in Chuuk Lagoon, Federated States of Micronesia, which included a Kawanishi H8K (Emily) flying-boat, a Yokosuka D4Y Suisei (Judy) dive-bomber, and Mitsubishi A6M (Zeke or Zero) carrier-borne fighters in the cargo hold of *Fujikawa Maru*. Bell (2010:135) believes that further work is required on the corrosion potential of aircraft and MacLeod (2006:130, 135) also advocates for further conservation research for aircraft wrecks including laboratory work for the development of conservation methods for preservation of existing aircraft in situ.

Preservation of the remaining heritage from the natural environment is just one factor and needs to be balanced with protections from cultural factors such as salvage and souveniring. Ways of protecting the site, also include legislation, enforcement and education. One method to educate the public of cultural heritage is the use of interpretation signs. Interpretative signs could be used to explain the significance of a site as suggested by Jung (2001:191-193) and help persevere this diminishing heritage.

## CONCLUSION

This paper presents the results of desktop and archival research to produce a consolidated list of submerged, predominantly WWII, aircraft wrecks remaining or potentially remaining in Queensland waters. It provides a guide to where relevant historical information can be obtained to help identify potential aircraft wrecks and further where detailed information can be obtained to assist in understanding individual wrecks and the people that flew them. Those looking to undertake similar research into WWII aircraft wrecks in Australia can use it as a guide.

The research identified 121 potential aircraft wrecks, being an increase of 69 over the 52 currently in the AUCHD. Furthermore, some of the entries currently in the AUCHD have been identified as being on land and not submerged and will need to be removed. Most of the wrecks are located away from the populated areas of North Queensland. Being submerged in saltwater the aircraft are subject to corrosive forces that need to be further researched and understood. Further research is needed to understand the cultural influences affecting a wrecking event. Additional systematic salvage of



wrecks by military salvage units needs to better be understood, such as methods and priorities.

Further work and research will need to be conducted to fully examine and assess the significance of the remaining wrecks currently on the compiled database and any further wrecks identified in the future. Many of the wrecks and particularly the priority 'A' wrecks have cultural significance, and as 75 years has passed since the end of WWII, they are all protected by legislation. However, more needs to be done to determine the current state and extent of the remains of the aircraft and many of the wrecks need to have their location confirmed or determine. Additionally, research into the cause of each crash, where this is unknown would aid in understanding why so many aircraft from the WWII era crashed when compared with other times. Did factors such as experience, maintenance, production standards or tropical weather play a part, or was it the result of the sheer number of flights and aircraft? There are

only 11 recorded wrecks in Queensland waters since WWII, which is 11 in 76 years when compared with 110 in 5 years. There are clearly reasons behind these statistics and there is plenty of research that needs to be done. WWII aircraft wrecks are a diminishing cultural heritage and more needs to be done to identify, understand, protect and preserve them for the future. More needs to be done to further educate the public on the value of this cultural heritage that exists in Queensland waters and around the world concerning submerged aircraft wrecks that are unique to limited parts of the world.

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