5. SUBMERGED SECOND WORLD WAR SITES IN CHUUK, GUAM, POHNPEI AND YAP

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GOOD PRACTICE

Taking a locally inclusive approach to the development of bilateral and multilateral agreements to cooperatively manage UCH sites

It is important to recognize that not every Pacific nation or nation state, or even individual island, will view the WWII shipwrecks as UCH having the same values or significance. It can depend on a number of issues, such as the level of impact of the war on local people and their islands, the continued impact of foreign interests, and the local political and social environments. It is also well known that communities with limited resources can have less regard for preserving heritage sites as they struggle to survive, and particularly when their own indigenous cultural heritage has been destroyed and/or is being marginalized. It is therefore important to take a locally inclusive approach to the management of sites, and to manage them in context with the broader cultural heritage of the nation/state/islands. The natural heritage of the sites should also be included as an important attribute in the value of the sites. Local people are the most important site managers, and they should be supported by foreigners or those with a vested interest. The UCH sites in Chuuk are in need of cooperative management, involving the Governments of Japan, US, Chuuk and the FSM, in a similar manner to that used in managing the seventeenth and eighteenth century Dutch shipwrecks in Australia, through the Australian and Netherlands Committee on Old Dutch Shipwrecks (ANCODS).

Introduction

This chapter is primarily focused on the submerged WWII sites in Chuuk Lagoon (formerly Truk Lagoon), which represents the largest number of sites in Micronesia (in addition to those in Palau). Other significant sites in Micronesia including Pohnpei, Yap and Guam are addressed briefly.

The main objective of this chapter is to consolidate the current knowledge of the submerged WWII sites in Chuuk Lagoon, taking into account some 'new' sites that have been investigated, and others that are alluded to in historic documents. A number of submerged WWII sites have also been investigated in regard to their condition and corrosion, and their health as artificial reefs. Another issue that raises questions about the future of the sites is the oil that has been leaking from some of them. Oil and gasoline have leaked from the ships since the day they were sunk. Evidence from modern shipwrecks and faulty oil wells in other parts of the world show considerable ecological damage, bringing into sharp focus the possible consequences of oil leaking in Chuuk Lagoon.

Pohnpei and Yap

The Pohnpei and Yap sites both had Japanese bases and airstrips and were regularly bombed by US aircraft (Pohnpei by naval bombardment as well), but do not contain significant shipwrecks that are sought after by divers. Some Japanese aircraft remains can be found on both islands, and a number of aircraft are known to exist in deep water off the Yapese reef flat but are not regularly dived. In Ulithi Atoll, an outer island of Yap, the remains of USS *Mississinewa* can be found. The vessel was carrying 3.78 million gallons of oil when the Japanese sank it on 20 November 1944. In April 2001, sport divers located the shipwreck and shortly after oil began to leak into the lagoon. From January to March 2003, the US Navy recovered 1.95 million gallons from the vessel. The oil was sent to Singapore, where it was sold and reused. The shipwreck is located in 30–40 m of water and it is unknown if it continues to be visited by sport divers.

Guam

The island of Guam saw considerable action during the war and contains a number of WWII-related UCH. It is also the only place in Micronesia that contains the WWI shipwreck, SMS *Cormoran*, a German raider that was scuttled by its crew on 7 April 1917 after spending nearly three years interned by the US Government (Ward, 1970). It lays adjacent to and in contact with a Japanese WWII shipwreck *Tokai Maru*.

Site databases and surveys of Guam's UCH, and in particular WWII-related UCH, have been carried out by the US NPS Submerged Resources Center from 1983 until 1989 (Carrell, 1991; Jeffery and Moran, 2007; Jeffery and Drew, 2007). In the desktop survey conducted in 2007, a total of 118 UCH sites were identified by Jeffery and Moran (2007) and these sites have been added to Guam's Historical Preservation Office (HPO) GIS database of all Guam's cultural heritage sites. A total of 24 UCH sites were identified from WWI and WWII. The Japanese WWII shipwrecks *Tokai Maru* and *Aratama Maru*; the WWI ship SMS *Cormoran*, an American Amtrac, and a Japanese midget submarine (on display at the NPS War in the Pacific National Historic Park Guam Visitor Center) are listed on the US National Register of Historic Places.

The desktop and site investigations of 2007 acted as a catalyst for the implementation of four maritime archaeology field schools funded by the Guam Preservation Trust (GPT) from 2009 to 2012, in which a number of WWII-related UCH were surveyed, with one outcome being the US National Register listing of the Amtrac (Jeffery, 2012). Surveys included other shipwrecks, aircraft remains and areas of dumped materials such as the 'Seabee Junkyard'. This latter site spreads over an area of 1 hectares in 12 m of water in Apra Harbor and includes tractors, an Amtrac, pontoon outboard propulsion units, vehicles, large pipes and construction materials. It is a very popular recreational dive site that can be dived under many weather conditions and a number of historical, site and management issues have been discussed for this site by Jeffery and Applegate Palmer (2017). The 'Seabee Junkyard' is one of many sites that have come about from dumping of war materials, including the dumping of munitions, of which some are very popular dive sites. Anecdotal information suggests a large quantity of munitions have been recovered from the sea, including phosphorus bombs. According to Eyerman (1945), Guam became 'the greatest forward port area in the world ten months after its reoccupation' and when it came time to demobilize, the large quantity of machinery and munitions gathered in Guam were dumped at sea.

With the significant economic benefit that is reported to be gained by the scuba diving industry in Guam – over US$56 million in 2015 is attributed to the scuba diving tourism industry (P. Laguaña, personal communication, 2017)[8]– there would seem a need to secure the management and promotion of the value of WWII-related UCH sites in Guam. The GPT continues to financially support maritime archaeology through the implementation of capacity building programs, which provides a significant link to the Guam community. This is complemented with the

[8] Pilar Laguaña, Director of Global Marketing, Guam Visitors Bureau

employment of an Assistant Professor to teach maritime archaeology at the University of Guam from 2015. However, current legislation does not encourage protection of sites but rather financial reward for those who recover historical objects '…provide[s] for the fair compensation to the permittee in terms of a percentage of the reasonable cash value of the objects recovered or a fair share of the objects recovered….'[9] This needs to change so that all Guam's UCH is seen as cultural heritage material to be protected and promoted for the benefit of all of the Guam community.

Chuuk Lagoon

Chuuk Lagoon is well known amongst shipwreck diving enthusiasts, Japanese war survivors, and US military historians. The 50+ shipwrecks, many retaining considerable integrity, located in a lagoon of warm, clear water have become a diver's paradise and are advertised as such through numerous websites, publications and films. They are also the final resting place for about 4,000 Japanese war dead. The shipwrecks also contain many munitions, including torpedoes, sea mines, thousands of small calibre ammunition, and many larger calibre artillery shells of various size. To the US, the shipwrecks are important historic sites associated with the US pushing back the Japanese military on their way to finalizing the War in the Pacific in 1945. They are a major economic resource to many Chuukese through dive tourism, dynamite fishing and artefact souveniring which causes much conflict in UCH management. These conflicts are a result of the different cultural values and uses of the sites in addition to past colonialism and neo colonialism issues (Jeffery, 2007).

Although the Chuuk State of Federated States of Micronesia (FSM) has specific legislation to protect and manage submerged WWII sites since 1971, and additional support from the US NPS Historic Preservation Fund, site management has not been effective. This is not surprising given the ever-changing issues associated with the sites but it is indicative of how site management should be more dynamic and capable. Some suggestions on how this could be implemented are summarized in the conclusion.

[9] *21 GCA Real Property: Chapter 76 Historical Objects and Sites, Section 76306.*

Figure 5-1. The largest vessel sunk in Chuuk Lagoon, the 11,600-ton *Heian Maru* was drafted from NYK line, shown here passing under the Lions Gate Bridge, Vancouver in 1930. ©Captain Nozaki, NYK Museum

During WWII, Chuuk was a strategic advance base for supplying Japanese ships, aircraft, stores and military personnel for the Japanese south-east expansion as well as a major communication centre for the region.[10] It was a vital base outside of the Japanese homeland and the US Navy considered Chuuk the 'strongest naval base in the Pacific with the exception of Pearl Harbor' (United States Strategic Bombing Survey (USSBS), 1947).

On 17–18 February 1944, the US attacked Chuuk with aircraft launched from a fleet of four carriers. Supported by about 70 ships, they sank over 50 Japanese ships, destroyed over 300 aircraft and many of the land military facilities including five airfields. A total of 1,250 aircraft attacks were flown, followed on 30 April and 1 May 1944 with a further 2,200 aircraft attacks from the same naval fleet (Carrell, 1991; USSBS, 1947). In conjunction with the continual bombing of the base from B-24 and B-29 aircraft with over 6,000 tons of bombs, the Chuuk base was taken out of the war, without any amphibious assault and major loss of American life. As a comparison, the Japanese attack on Pearl Harbor launched over 350 aircraft which sank or damaged 21 vessels, destroying 75 per cent of US aircraft, and killing over 2,500 Americans. The US promoted the bombing of Chuuk as a payback for the Japanese bombing of Pearl Harbor[11]. The US air raids killed and injured over 5,000 Japanese (about 4,000 in the ships) and 123 Chuukese, although more than 1,000 Chuukese were killed during the war (Denfeld, 1980). The US considered dropping the atomic bomb on the Japanese fleet in Chuuk but decided against it when conventional warfare was found to have been successful (Delgado *et al*., 1991; Stewart, 1989).

Many of the ships sunk in Chuuk were merchant ships. The naval vessels, including the 62,000-ton battleship *Musashi,* were aware that an attack was imminent and departed on 10 February 1944. Chuuk was one of the three main bases used by the merchant marine to supply materials and personnel during the war. The loss of 266,083 tons of merchant marine ships in February 1944 was the second greatest monthly loss during the entire war, virtually cutting off the access of personnel and equipment to other parts of Micronesia, the Solomon Islands and Rabaul in New Guinea (Parillo, 1993). Morison (1975) who compiled the official history of the US Navy in WWII stated that 'the strike on Truk demonstrated a virtual revolution in naval warfare; the aircraft carrier emerged as the capital ship of the future, with unlimited potentialities'.

The WWII shipwrecks and aircraft located in Chuuk Lagoon are not unique. Over 3,000 Japanese Navy and merchant ships (10,583,755 tons) were sunk during WWII and the majority are scattered throughout the Pacific (United States Joint Army-Navy Assessment Committee (JANAC), 1947). The terrestrial WWII sites are also not unique. The Marshall Islands, Pohnpei, Palau and others have terrestrial sites related to WWII. What is distinctive about the underwater and terrestrial sites in Chuuk is their exceptional quantity and quality. Denfield (1980) found that Chuuk 'has *in situ* as many guns as all of Europe' and prominent cinematographer Al Giddings (in Lindemann, 1982) stated that the Chuuk Lagoon shipwrecks are 'one of the great undersea wonders of the world'.

What contributes to the value of the Chuuk Lagoon shipwreck sites is that they are located in an environment that has provided them with considerable natural protection and made them easily accessible to divers. When diving the shipwrecks, the nature of the remaining material and the damage inflicted from the US bombing is evident and one can gain a strong sense of what happened when the ships were sunk. It is possible to envision the massive explosions that caused them to sink, and to examine what material the Japanese needed and carried on-board. There is no more dramatic way to appreciate the power, devastation and tragic nature of war than viewing these shipwrecks and there are probably no other sites on land or underwater anywhere else that can do this. In addition, the rich and diverse (and potentially unique) marine flora and fauna adds to the great appeal as an underwater spectacle. These values caused the author to investigate whether they meet the criteria for World Heritage Site listing (Jeffery, 2004).

[10] Chuuk is located about 3,700 km south-east of Tokyo and about 4,000 km north of Sydney.

[11] *Naval Aviation News,* October 1, 1945: 10

Figure 5-2. The 7,000-ton aircraft transport vessel *Fujikawa Maru*. © Greg Adams 2002

The war was a terrible time for Chuukese. They were forced out of their homes, away from the land and islands and pressed into working for the Japanese war effort. They suffered the greatest loss of life in the Caroline Islands from the almost daily bombing (Poyer *et al*., 2001). Turner and Falgout (2002) concluded 'Those who experienced the intense suffering during the Japanese military build-up and the American campaign describe it as the greatest hardship they ever endured'. Similarly, Poyer *et al*. (2001) found that 'WWII in Micronesia meant, in short, both terrible suffering and momentous change. Nothing would ever be the same again'. Chuuk has been home to indigenous people for about 2,000 years. Traditions, customs, cultural practices, the extended family, land, food, magic and folklore are very important aspects of Chuukese life (Ashby, 1985; Gladwin and Sarason, 1953; Hezel, 1992; King and Parker, 1984). For Chuukese, traditional sites and intangible heritage are more important than most WWII sites, although the terrible suffering associated with terrestrial WWII sites can invoke a 'sense of belonging' to these sites. This has caused conflict in the management of the submerged WWII sites. To some Chuukese involved in the tourism industry, they are regarded as a valuable tourism resource, but in terms of significant sites in their history, they play a minor role, if any at all, to most Chuukese. The sites are also dynamite fished and are a source of souvenirs; in other words they are a valuable economic resource. Arimichy Rudolph, a Chuukese colleague from Chuuk Historic Preservation Office (HPO), explained that the submerged WWII sites 'tell us about the bad time in the history of Chuuk' and the terrestrial WWII sites are significant 'because they tell about the hardship our parents went through at that time' (Jeffery, 2007). This is an interesting distinction between the two types of WWII sites, the terrestrial sites have a more personal, family connection and therefore providing a 'sense of belonging' for many Chuukese.

Figure 5-3. Artefacts collected and stacked in *Shinkoku Maru* in 1978. ©Colin Hodson

Figure 5-4. Artefacts collected and stacked in the same area in *Shinkoku Maru* in 2000. ©Colin Hodson

The Japanese also have a different view of the sites; they regard them as 'war graves', and a 'continual source of national sorrow' since the shipwrecks are 'open war graves' (Bailey, 2000). Japanese groups have recovered some human remains but some still exist on the shipwreck sites. Although the Japanese Government acknowledge that the shipwreck tourism industry is a valuable source of revenue for Chuuk, many Japanese are not happy with it. Some believe that there is still the need for 'end of war processes' such as the recovery of personal effects and human remains, the 'holding of services, consoling of souls and the need to promote recovery'.[12] A number of Japanese war veterans and younger folk also believe the submerged WWII sites have value in interpreting the futile and tragic nature of war for the benefit of younger Japanese so similar things do not happen in the future (Jeffery, 2007).

To the US the submerged WWII sites are important sites associated with the victory of WWII, and a valuable diving destination. In the nomination for National Historic Landmark (NHL) designation, the significance assessment focused on the historic significance of the Japanese shipwrecks and aircraft, their destruction by the US Navy's carrier fleet and aircraft, and how the 'legendary invulnerable Truk' was destroyed (NPS, 1985). The NHL nomination included a statement about its value to dive tourism, 'the 'underwater fleet' at Truk, festooned with an infinite variety of marine life and containing the honoured remains of the Japanese warriors, is one of the world's underwater wonders' and a 'Mecca for divers worldwide' (NPS, 1985).

[12] From an interview conducted by Mohri, Yachiyo of a war veteran who stated, 'In our Buddhist thought, unless cremating those that die, their spirits lose their way to nirvana so they would be wondering around forever' (Mohri, Yachiyo 2004 personal communication).

Chuuk proclaimed legislation to protect the submerged WWII sites in August 1971. The legislation has been amended three times, the last time in February 2000 when it was incorporated into the Draft Chuuk State Code, Title 25, Maritime and Marine Resources and documented as Chapter 8, Chuuk Lagoon Monument. The law has changed only marginally; it has essentially remained a law prohibiting the removal of artefacts and with a provision that allows for funds to be collected through a mandatory dive guide and the payment of a US$30 (US$50 in 2017) annual fee per diver (Jeffery, 2007). The US Government placed the sites on the National Register of Historic Places in 1976, and declared the sites to be a NHL in 1985, one of 2,300 sites throughout the US and its territories, and one of only two NHL sites in the FSM. The submerged WWII sites have therefore been recognized as significant shipwreck sites at a FSM state and US federal level. In 2002, the submerged WWII sites were given a threatened status by US NPS because of 'significant deterioration, vandalism and looting'.[13]

As previously stated, the conflicts in the uses, values and management of the submerged WWII sites have been explored elsewhere by the author (Jeffery, 2007). In 1989, the US did explore different approaches to management through an investigation into establishing an FSM National Park but this does not appear to have been acted upon (NPS, 1989). Another consideration could be to incorporate the management of the Chuuk Lagoon submerged WWII sites or its Park into the War in the Pacific National Park based in Guam, given its role in managing and interpreting all sites associated with the War in the Pacific. These issues are further discussed in the conclusion, in the light of new developments and research regarding the condition and longevity of many of the known sites.

13 See http://tps.cr.nps.gov/nhl/detail.cfm?ResourceId=1708&ResourceType, Accessed 8 June 2012

Figure 5-5. Photo-mosaic of the bridge face of *Fujikawa Maru* showing the impact of dynamite fishing. This area should be totally covered with corals and sponges but many have been killed by dynamite fishing which also greatly weakens the iron structure and renews corrosion. In 2012, Dianne Strong, a frequent visitor to Chuuk reported that the bridge collapsed in the middle. ©Bill Jeffery 2006

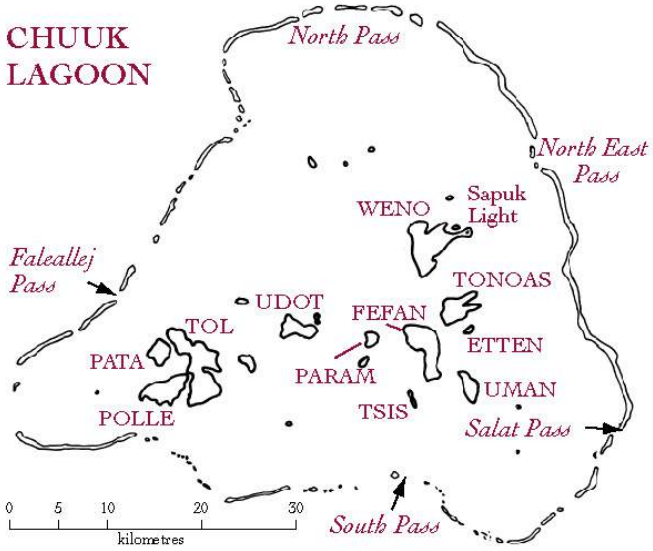

Figure 5-6. Chuuk Lagoon showing some of the major islands and the passages through the barrier reef. ©Judi Francis

Site documentation and surveys

Research carried out by the author (using four primary and four secondary historical sources) and field surveys, in conjunction with additional information obtained from oral histories, produced an up-to-date list of the submerged WWII sites in Chuuk Lagoon (Appendix one) in 2007. A number of new sites, or additional site information are included, namely: the ship *Sapporo Maru,* 'Unknown D' site, No. 47 (comprising four landing craft, vehicle and aircraft remains), Gunboat ('Unknown E' site, No. 48), 'Unknown F' site, No. 49 (unidentified wreckage at 70 m), converted bonito fishing vessel ('Unknown G', No. 50) and *Muraki Maru.*

The discovery of the Sapporo Maru

The discovery of the *Sapporo Maru* and the recovery of the vessel's bell is an example of what can happen with the discovery of a new site in Chuuk. In February 2002, a search for *Sapporo Maru* was conducted in an area of about one square km to the south-west of *Kiyosumi Maru*. Toward the end of the survey, a shipwreck site was found which a diver survey confirmed was the *Sapporo Maru* (Green, 2002).

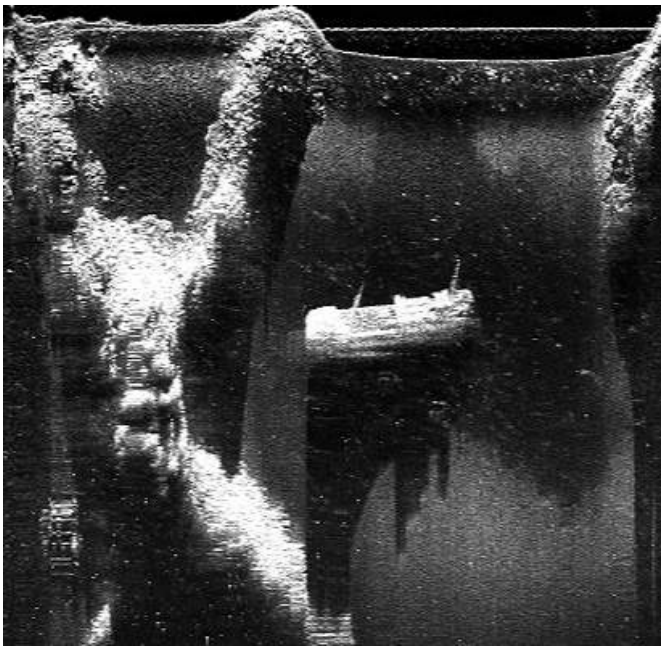

Figure 5-7. *Sapporo Maru* can be seen to the right of middle in this side scan sonar image. The vessel is sitting upright and intact with a slight list to starboard (right). The bow is to the left, forward and stern masts can be seen lying to starboard, and the start of the bridge is clearly evident about half way back along the vessel. The relief of the vessel has caused the seabed to the left of the vessel to be in shadow. Other seabed features (in white) are natural reef. ©Jeremy Green

The vessel was a small ship, 44 m in length, 7.3 m in breadth, 361 tons, built in 1930 as a refrigerated fish carrier, and used by the Japanese Navy as a deep-sea fishing trawler (*Lloyd's Register of Shipping 1940–41)*.

Figure 5-8. *Sapporo Maru* bell ©Dan Bailey, 2004

During a second dive on the site on 19 February with Ansito Walter (Governor of Chuuk), Dan Bailey and others located the ship's bell in its original position on the outside of the bridge. Within 24 hours of this inspection, the bell was taken from its position on the bridge, damaging part of the bridge in the process. Police investigations revealed that a Chuukese dive guide had taken it, but they concluded there was no breach of the law as it was still located (hidden) on the site which was verified by the author during a dive on the site. It was subsequently ascertained that the dive guide took the bell off the bridge to keep it from falling into the hands of a foreign diver and therefore leaving the country. The bell has since been recovered and found its way into a local collection that is planned to be exhibited. The bell reveals the name of the vessel, *Sapporo Maru* and its date of construction.[14]

Chuuk Lagoon's submerged WWII aircraft

From primary and secondary documents, it is believed that 453 Japanese aircraft from WWII were damaged and many could remain in Chuuk today (Jeffery, 2007). Many of the aircraft remains could be located in the lagoon waters, on the islands or outside of the lagoon. It has also been ascertained that 37 American and one to four British aircraft were lost during the fighting (Jeffery, 2007).[15] At the commencement of the author's 2001 survey, seven Japanese aircraft remains were known within the lagoon. While some anecdotal information alluded to a number of other aircraft that might be located in the lagoon, the only site investigated was of a US aircraft which was investigated in association with the Underwater Archaeology Branch of the US Navy Historical Center, in Washington. It was identified it as a Douglas SBD-5 Dauntless.[16]

[14] Mohri, Yachiyo translated the text on the bell, being: 'Sapporo Maru' and 'Shouwa 5 nenn 11 gatsu' (November in the 5th year of Shouwa period. i.e. November, 1930).

[15] A British carrier fleet attacked the base in June 1945, inflicting little damage but serving as training exercise for the new units of the fleet.

[16] Details of this site came from Chuuk State Historic Preservation Officer, David Welle, who as a child used to sit in the cockpit and he described US markings on the fuselage.

Figure 5-9. The bow showing the bowsprit, sponsons on the port side and the bandstand on 'Unknown G' site. ©Bill Jeffery, 2006

Figure 5-10. *Tubastrea micantha* coral © Bill Jeffery, 2006

Corrosion survey

An aim of this survey was to ascertain the current state of corrosion and estimate the longevity of the submerged WWII sites. The primary metal of the sites is iron, steel and/or aluminium. Ferrous metals are highly prone to corrosion in a marine environment and although concretion can build-up to slow down corrosion rates, natural and human related interference can change and accelerate it, leading to structural collapse. This collapse may be a justified part of site management, if based on the values of a site in association with a conservation assessment. This is an ongoing issue under investigation with the USS *Arizona* in Hawaii (Lenihan, 2001). Given the diverse values and issues inherent in some of the submerged WWII sites in Chuuk and throughout the Pacific (war graves, tourism, oil pollution), allowing vessels to collapse as part of their management, needs to be considered comprehensively and critically assessed.

Figure 5-11. Taking corrosion measurements on the hull of *Kensho Maru*. This part of the vessel was in poor condition as can be seen by the corrosion plume that was produced by drilling into the hull. © Bill Jeffery, 2007

Data collected from corrosion surveys can also play a role in technical and scientific research. Surveys have become a standard approach worldwide, in order to understand rates of corrosion and what is influencing site conditions. Through these studies, it is possible to ascertain site stability and longevity – an important issue for diving tourism and protection of the environment from oil leakage. It is unknown how much oil is still trapped in the lagoon sites, or if it has dissipated gradually over the last 60+ years as is suggested by Earle and Giddings (1976). While renewed metal corrosion is visible in areas of dynamite fishing, it is not known to what degree this is accelerating and diminishing the integrity of the ship's structure. Corrosion surveys allow this to be measured and monitored. Coupled with the impacts from infrequent typhoons, the potential collapse of some ships is real and if oil is released in large quantities, it could have a devastating impact on the marine environment.

An initial corrosion survey of ten shipwrecks and four aircraft was conducted by MacLeod in 2002 (MacLeod, 2003; 2005; 2006a; 2006b). The methods used in the survey, the analysis and findings can be found in Macleod's 2003 report. Some of his key findings were:

> Based on this provisional estimate of perforation times, many of the wrecks in Chuuk Lagoon will retain their existing integrity for only the next ten to fifteen years before they begin to undergo significant collapse. This has major implications for the management of the sites and for the safety of divers undertaking penetration dives. Analysis of the corrosion behaviour on the wrecks has shown up irrefutable evidence of the damaging effects of episodic changes to the microenvironment of the wrecks. Such changes are consistent with major microenvironment damage that is consistent with physical impact of either shockwaves from dynamite fishing or from massive tropical storms. The periodic shedding of the protective layers of marine concretion cannot be allowed to continue, since this will inevitably result in an increased rate of decay of the shipwrecks.

The corrosion analysis was achieved through determining the annual corrosion rate of the metals (depth of graphitization of a cast iron object divided by the number of years a vessel had been submerged). This algorithm has a direct relationship with corrosion potential or voltage (relative to a reference electrode) which can be measured from other metals such as wrought iron and steel. Through investigating the thicknesses of various metals found in ship's specifications in *Lloyds Register*, and measuring their corrosion potential, it is possible to determine their corrosion rate. MacLeod (2003) found *Fujikawa Maru* structurally intact and in the best condition in relation to overall corrosion damage compared to the 13 other shipwrecks and aircraft. He also found that the Chuuk submerged WWII sites are 'corroding at 26–30 per cent slower than the open ocean wrecks at the same depth' (MacLeod, 2003).

Earthwatch Institute project 2006–2008

The Earthwatch Institute project implemented a multi-disciplinary investigation of the submerged WWII sites through the involvement of various specialists supported by volunteers from around the world and a renewed and increasing involvement with Chuuk Government agencies, particularly the Department of Marine Resources which is the key agency administering the Chuuk legislation protecting the submerged WWII sites. The project allowed for further collaboration with Ian MacLeod, and initiated collaboration

with a marine ecologist, Maria Beger; marine biologists, Mandy Hengeveld and Mike Emslie; and conservation scientist, Vicki Richards.[17] The project had a number of research questions, but a major aim was to assist the Chuuk Government with information on the tangible values, health and longevity of the sites, all of which would be useful in their management. The Earthwatch (EW) project was also considered some recompense for the help many Chuuk Government and dive shop staff provided in the earlier research that commenced in 2001. The project allowed the investigation of such issues as evidence of leaking oil and the structural integrity of the shipwrecks, which could support the Chuuk Government in soliciting funds and support for remedial work. Maria Beger and Mandy Hengeveld proposed in the EW Project to investigate:

> The coral reef communities, diversity and health in Chuuk, although considered very rich, is poorly documented. For instance, while the expected number of scleractinian corals is 391, only 92 are presently recorded in the IUCN-WCMC database for the Federated States of Micronesia (Spalding *et al.*, 2001). Practically no speci c coral reef data exist. The most recent 'Status of Coral Reefs of the World' report describes Chuuk as the largest exporter of commercial reef sh species, and notes that destructive shing practices with explosives from the shipwrecks have caused reef damage in the lagoon (Wilkinson, 2002). No information about coral reef health or the status of the artificial reefs, the shipwrecks, was presented. By comparing reef communities and diversity on natural reefs with those on the shipwrecks, predictions about colonization processes, human impacts and future marine resource development can be made. Conservation of coral reef communities will be of great benefit to maintain economic values of sites and biophysical function of the ecosystem. There has been no recent survey of the current status and diversity of coral reefs in Chuuk, thus this survey will provide much needed data to local and regional authorities for management.

Marine biologist Sylvia Earle made similar comments on the value of the marine biology and the need for further studies during a 1975 survey of the submerged WWII sites (Earle and Giddings, 1976).

Site surveys commenced in July 2006 and five teams (each containing six EW volunteers and team leaders) implemented biological and corrosion surveys on 11 selected sites (Jeffery, 2007a). Tangible outcomes included the compilation of a marine invertebrate and vertebrate species databases (including a comparison with island reefs and the barrier reef). A total of 266 species from 33 families of reef fishes were recorded and surprisingly two of the shipwrecks, *Kensho Maru* and *Fujikawa Maru,* had the highest density of reef fishes from the ten sites (including three natural reefs) surveyed (Emslie *et al*., 2007). The reef around the South Pass (channel through the barrier reef) revealed the lowest density of any site surveyed, although it was found this reef had the greatest variety of species. While *Kensho Maru* and *Fujikawa Maru* contained the largest number of reef fish in the transects surveyed, it was found that many species of larger fish normally found in reef communities did not exist on the shipwrecks. This is considered to be a consequence of over-fishing, most likely associated with dynamite fishing practices. Other issues of concern recorded by Emslie (*et al*., 2007) were the numerous signs of damage from crown-of-thorns starfish (*Acanthaster planci*) to an extent that would be considered 'plague proportions on Australia's Great Barrier Reef', and a number of large *Lobophyllia* colonies that had been damaged, presumably by anchors. Comparative surveys were implemented on the barrier reef in regard to the impact of dynamite fishing in 2006 and 2008 and it was found many areas had been greatly affected and had large areas of dead coral (Mandy Hengeveld, personal communication, 2008).

[17] Jeffery, Berger and MacLeod were Principal Investigators of the Earthwatch project and a number of other maritime archaeologists, marine ecology and conservation specialists were involved in the project who supervised the EW volunteers.

On a more positive note, a rare scleractinian coral, *Acropora pichoni,* was found on *Fujikawa Maru*. Ten individuals were found at depths between 13–20 m which is significantly shallower than its purported depth range. Rare species are not common on artificial reefs and it 'highlights the potential of artificial reef habitat to act as a refuge for rare coral reef species, and also emphasizes the need of protecting the Chuuk wrecks for biodiversity conservation' (Beger and Richards, 2006). An investigation into the relationship of benthic material and metal corrosion on many of the submerged WWII sites, in which the rugosity (the roughness of growth on the concreted metal surfaces) influences corrosion was initiated in 2006 and continued during 2007 and 2008 (MacLeod *et al*., 2007). The increased surface roughness brings about increased water flow or turbulence over the wreck and this increases the flux of dissolved oxygen to the surface and thus the amount of corrosion increases (Emslie *et al*., 2007). During the 2007 fieldwork, MacLeod found the thickness of the concretion on the *Susuki* patrol boat and *Fujikawa Maru* to be significantly less and in combination with more acidic pH values (which reflected localized corrosion rates) concluded the sites had been affected by dynamite fishing, and were 17 per cent and 46 per cent respectively more corroded, since his initial survey in 2002. This work is the first quantification of the impact of dynamite fishing and diving tourism activities, such as tying off on wrecks and concretion damage/souveniring by divers (MacLeod *et al*., 2011). The summary paper also noted that increased corrosion rates observed shortly after dynamite fishing events recover relatively quickly and begin to revert to the long-term values as the damaged areas become once again covered by marine organisms. The work is leading to the development of corrosion and biodynamic interaction models that will further the understanding of the corrosion and longevity of the sites and assist in their future management (Emslie *et al*., 2007; MacLeod *et al*., 2007).

Figure 5-12. EW volunteers recording benthic material within a quadrant on *Kensho Maru*. ©Bill Jeffery 2007

The EW volunteers (the majority being Americans) were very keen to dive the submerged WWII sites, but they knew little about Chuuk, its people, and the many social and political issues they face today. Broadening the context of the sites, from symbols of US victory and unequalled dive destinations, to their social relevance to Chuukese and Japanese people during the war and today, were some of the other objectives of the EW project. From the personal comments received, and the discussions had with some of the EW volunteers, it was felt that this had been partly achieved as shown in the following formal EW feedback from two of the 2007 volunteers:

> I've gained a greater understanding of the people of Chuuk, and reasons for their indifference to the wealth of WWII shipwrecks in their lagoon. I've also gained an appreciation of how difficult it may be to preserve these wrecks, given the fact that the Chuukese in general do not regard

these as a resource or as treasure, but rather as reminders of a painful time during which they were innocent bystanders in a war between superpowers;

and

I have a much greater appreciation for the environmental, social and cultural issues facing Chuuk and the wrecks in Truk Lagoon. It is an extremely complicated issue that will take a multi-dimensional approach to finding a solution. This awareness will allow me to speak more intelligently to others interested in helping be a part of the solution.

The EW project followed a series of maritime archaeology capacity-building training programmes conducted by the author over a number of years in Chuuk with HPO staff from the four FSM states (Pohnpei, Kosrae, Yap and Chuuk). This culminated in an intensive programme in 2006 where the US Historic Preservation Fund provided additional funds to purchase diving, recording (GPS) and photographic equipment for each of the states. This work was enhanced in 2007 when the various specialists involved in the EW project developed an archaeological, ecological and conservation recording package to be used by FSM HPO staff (and volunteers) in recording and monitoring the values and health of underwater cultural heritage sites (Jeffery *et al*., 2007).[18] The package could be used on similar sites anywhere in the world with minor modifications and called 'UCHeck'.

During the 2007 EW field work, an investigation of a site (*Hoyo Maru)* reported to be leaking oil was conducted. Although no effects of oil pollution could be found on the site, a 1–2 km slick was witnessed being blown toward an area of mangroves on Tonoas. A water sample was collected and passed onto the Chuuk Department of Marine Resources, as was a full report on the project's findings (Emslie *et al*., 2007). In 2008, this slick was noticed again along with bubbles of oil rising from the shipwreck. This was filmed and documented in a report for the Chuuk and FSM Governments and US NPS. EW generated considerable international publicity about this issue and it continues to attract media interest given the worldwide concern for marine oil spills.[19] Despite initial concerns for the Chuuk tourism industry brought about by the media attention, Chuukese officials recognized that resources could be obtained to investigate the issue. The report showed that the oil leakage was a potential problem and that it should be more thoroughly investigated. Chuuk Lagoon contains three Japanese oil tanker wrecks (*Hoyo Maru*, *Fujisan Maru* and *Shinkoku Maru*) that have the potential to carry up to 32,000 tons of oil (Bailey, 2000). Preliminary research suggested that the oil from the other tankers was transferred to *Hoyo Maru*, the one now leaking (Takuya Nagaoka, personal communication, 2009). In 2008, Japanese interests asked a local diver in Chuuk to investigate the matter but it is unknown what he found or reported (Aisek Gradvin, personal communication, 2008). It is unknown if the US Government has investigated the matter. The Secretariat of the Pacific Regional Environment Program (SPREP) followed up with a Strategic Environmental Assessment, which was conducted 'to model the possible direction and impacts of any spills from the *Hoyo Maru*.' They concluded if oil was released from the shipwreck it could reach Fefan within one hour, 'thus allowing for limited response options' (Talouli *et al*., n.d). No one appears to have dived the site as part of this investigation and they recommended 'an in-depth assessment of the *Hoyo Maru* be carried out to determine extent of corrosion and amount of possible oil left on board' (Talouli *et al*. n.d). This had already partly been implemented during the EW project. Unfortunately communication between the authors of the SPREP report and the author of this report (and MacLeod and Richards) did not occur; otherwise the SPREP report would have been much more informative.

[18] This was also funded by the US Historic Preservation Fund

[19] New Scientist. http://www.newscientist.com/article/dn14645?DCMP=ILC-hmts&nsref=news1_head_dn14645. Australian Broadcasting Commission (ABC) Foreign Correspondent documentary. April 2011. http://www.abc.net.au/foreign/content/2011/s3189254.htm. Accessed 3 June 2012.

Oil leaking from the USS *Mississinewa* in Ulithi Atoll in Yap in August 2001 demonstrated the vulnerability of submerged WWII sites to corrosion and deterioration caused by storms (Monfils *et al*., 2006; Smith, 2004). Subsequently SPREP was commissioned to develop a regional strategy on the issues associated with oil release in an uncontrolled manner from submerged WWII sites throughout the Pacific and East Asia. Phase I of the study involved data collection and risk assessment of oil contamination. SPREP have developed a database of over 3,800 WWII shipwrecks lying throughout the Pacific and East Asia including 330 tankers and oilers (Monfils *et al*., 2006). Research suggests that the oil still contained in the WWII shipwrecks (worldwide) could vary from 2.5 to 20 million tonnes; as a comparison the Deepwater Horizon oil well in the Gulf of Mexico released about 1.2 million tonnes.[20] Phase II of the SPREP marine pollution strategy from WWII shipwrecks has not been developed; Talouli (*et al*., n.d) reported that SPREP 'would have no further action on the strategy, and that further developments be undertaken bilaterally between the flag state and the coastal state'.

On 23 September 2011, the President of the Federated States of Micronesia, H.E. Emanuel Mori appealed to the 66th United Nations General Assembly in New York for assistance in this matter:[21]

> Oil from some of the shipwrecks in my State of Chuuk has already started leaking. Any disaster could have a devastating effect on the environment, our food chain, and the surrounding reefs that serve as breeding grounds for many fish species. It will also adversely impact our tourism industry which depends largely on coral and shipwreck diving. In this respect, and to avoid a major environmental disaster, I am now appealing to the international community for immediate assistance.

[20] New Scientist article. http://www.newscientist.com/article/mg20727763.100-defuse-this-oil-time-bomb.html. Accessed online, 9 October 2015.

[21] http://www.fsmgov.org/fsmun/ga66_main.htm. Accessed 9 October 2015.

CONCLUSIONS

There is considerable conflict in the management of the Chuuk Lagoon shipwrecks. Dynamite fishing, tourism, potential oil pollution, and safeguarding of human remains are some of the main issues although it would appear many of the human remains have been recovered. However, some divers will pay the dive guides an additional fee if they can see a human skull, and a few have been hidden, to be revealed for such occasions.

Dynamite fishing is an illegal and totally destructive fishing practice, and while the scale of it in Chuuk has diminished, it nevertheless is still practiced. Dynamite fishing not only kills edible fish, but all living animals and in the case of the shipwrecks, it strips away the protective layer of marine concretion, renewing and accelerating corrosion (Macleod, 2003). Potentially other munitions, mines and bombs could also be seriously affected, possibly leading to their decay and detonation underwater. In 1976–77 explosions were heard on Uman Island and thought to have come from the *Gosei Maru*. This shipwreck contains a number of torpedoes and upon investigation it was found that the 'high pressure vessels inside the torpedo body were deteriorating to the point that they would rupture and the high pressure gas would be released' (Bailey, 2000). In 1977, intentional detonations were carried out on the remaining torpedoes but further explosions were reported to have occurred in 1998. Detonations were also carried out on the *Fujikawa Maru* in the 1970s for similar reasons to which Bailey (2000) laments: 'The resulting explosion was highly damaging to animal and plant life on the wreck; the amount of marine life today is only a fraction of the prolific growth that was present before'. There are many other types of munitions on many of the shipwrecks which could be equally as dangerous – not only for the fabric of the ship but also for all divers. There are different views on this though, some say the picric acid which the Japanese used to detonate the explosives is dissipating slowly into the sea rendering them harmless (Earle and Giddings, 1976). Others regard the munitions as potentially very dangerous. Another view is that the explosive material is still useable and they are not benign,

although the picric acid in sea water should crystallize and not detonate, unless knocked (Bill Utley, personal communication, 2007).

Dynamite fishing could eventually cause some ships to collapse, resulting in the destruction of habitats and the complete loss of edible fish, and it could lead to the demise of the tourism industry. Its value as an economic initiative is therefore short-lived with long-term consequences on other values of the sites and the broader marine environment. Dynamite fishers have greatly affected the integrity of *Fujikawa Maru*, *Nippo Maru* (which has lost all its sea mines) and *San Francisco Maru,* by recovering munitions to make small bombs for fishing (Hezel and Graham, 1997). An additional impact of dynamite fishing is that it is not limited to the shipwrecks – bombs are thrown onto the reefs killing everything in its sphere of influence. During the December 2006 EW expedition, marine biologist Mandy Hengeveld investigated a small section of the barrier reef near the North East Pass, and found the area to be greatly affected by dynamite (Amanda Hengeveld, personal communication, 2006). The Chuuk Government has legislation that prohibits dynamite fishing but enforcement does not appear to be reducing its operations. It is an activity that, although it provides considerable short term financial rewards, is in conflict with the safety, health and well-being of the Chuukese, and with the government and community who need to provide ongoing care to those injured.

In 2006, the Chuuk State Government began to consider World Heritage nomination of the cultural and natural heritage sites and values of Chuuk Lagoon and the adjacent Kuop Atoll. The major impediment in realizing this goal is the current ineffective management and the large impact of dynamite fishing on the marine flora and fauna throughout Chuuk Lagoon.

Any single country would find the effective management of 50+ shipwrecks and hundreds of aircraft related to WWII daunting. Given the wide range of values and uses of the site between the Chuukese, Japanese and Americans, a more collaborative and effective management approach is not only required but essential to address conflicts and concerns regarding the longevity of the sites and potential marine environment pollution. This can only work if all stakeholders join together with adequate resources. Chuuk and the Federated States of Micronesia do not have the resources. The US$50 diver fee appears not to have been used in site management. Instead, it seems to have been spent in employing Chuukese in government jobs, arguably a justifiable action when unemployment is about 22 per cent. Japan has formally declared an ongoing interest in their shipwrecks, and in collaboration with the US, the FSM and Chuuk, this would seem the most effective partnership in managing this important heritage (United States Department of State (US DS), 2004). It seems totally incongruous to have a small, developing country whose people were innocent bystanders in a war between two superpowers now wear the burden of their conflict.

In Australia, the Dutch shipwrecks located off Western Australia have been effectively managed through a cooperative arrangement between the Governments of Western Australia, Australia and the Netherlands. There are also a number of arrangements between countries in relation to particular shipwrecks, including the *Titanic*[22] and the American CSS *Alabama* which sank off France (Guerout, 1997). There will probably be many more given the current peak international agreement on managing underwater cultural heritage, the UNESCO Convention on the Protection of Underwater Cultural Heritage 2001, which encourages these types of bilateral and multilateral agreements (UNESCO, 2001).

The concept of the FSM National Park raised by the US NPS (1989) could be revisited as part of these considerations. It is, therefore, time for some serious multinational discussions on how the submerged WWII sites can be effectively managed for the benefit of all stakeholders and the broader international community. *In situ* site

[22] Negotiations about the management of the *Titanic* have been ongoing for several years and an agreement was signed by the UK (2003) and the USA (2004). http://www.gc.noaa.gov/documents/05varmer2006an.pdf

preservation of the submerged WWII sites in Chuuk Lagoon allows divers from all nations to view the tragedies and destruction caused by war, and stimulates them to think of the futility of war. They can also serve to help people understand how indigenous communities were impacted by the war and of their ongoing relations with various nations; issues that could be investigated not just in Chuuk but also throughout the Pacific. A determined effort into better management of these sites must be made, before it is too late.

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APPENDIX 1: A LIST OF SHIPWRECK SITES IN CHUUK LAGOON COMPILED BY JEFFERY, 2007

Site Name	Site No.	Recorded site length (m)	Measured site length (m)	Gross Tonnage	Latitude	Longitude
Aikoku Maru	1	152	Broken in two (106)	10,438	7°37′N	151°91′E
Amagisan Maru	2	137	133	7,620	7°29′N	151°86′E
CHA 29	3	49		420	7°51′N	151°84′E
CHA 46	4	26		130	7°43′N	151°92′E
CHA 66	5	26		130	7°40′N	151°85′E
Ei-sen No. 761	6	34	34	300	7°37′N	151°86′E
Fujikawa Maru	7	133	133	6,938	7°34′N	151°88′E
Fujisan Maru	8	150		9,524	7°42′N	151°89′E
Fumitzuki	9	97	95–100	1,590	7°41′N	151°73′E
Futagami	10	40	40	625	7°37′N	151°85′E
Gosei Maru	11	83	80	1,931	7°31′N	151°88′E
Hanakawa Maru	12	112		4,739	7°33′N	151°64′E
Heian Maru	13	156	160	11,614	7°38′N	151°85′E
Hino Maru No. 2	14	61	60	998	7°30′N	151°87′E
Hoki Maru	15	137	108	7,112	7°35′N	151°91′E
Hokuyo Maru	16	109	101	4,217	7°36′N	151°90′E
Hoyo Maru	17	144	146	8,691	7°37′N	151°84′E
I-169	18	103	99	1,785	7°38′N	151°84′E
Katsurigisan Maru	19	87		2,427	7°49′N	151°95′E
Kensho Maru	20	117	116	4,862	7°37′N	151°84′E
Kikukawa Maru	21	108	88	3,833	7°35′N	151°91′E
Kiyosumi Maru	22	138	143	8,614	7°37′N	151°84′E
Kotohira Maru	23			30?	7°41′N	151°83′E
Minsei	24	41		378	7°55′N	151°85′E
Momokawa Maru	25	108	55–74	3,829	7°37′N	151°90′E
Muraki Maru	26			15	7°12′N	151°95′E
Nagano Maru	27	105	151	3,824	7°36′N	151°91′E
Nippo Maru	28	108	93	3,764	7°38′N	151°91′E
Oite	29	100		1,523	7°61′N	151°83′E
Ojima	30	49	Debris field up to 200m	812	7°35′N	151°91′E
Reiyo Maru	31	122	106	5,446	7°36′N	151°91′E
Rio de Janeiro Maru	32	141	138	9,626	7°30′N	151°89′E
San Francisco Maru	33	117	132	5,831	7°36′N	151°90′E

Sapporo Maru	34	44	49	361	7°36′N	151°83′E
Seiko Maru	35	120	126	5,385	7°36′N	151°90′E
Shinkoku Maru	36	152	154	10,020	7°40′N	151°77′E
Shotan Maru	37	87	68	2,829	7°36′N	151°91′E
Susuki	38	84	72	935	7°37′N	151°85′E
Tachi Maru	39	82		1,891	7°37′N	151°80′E
Taiho Maru	40	98		2,827	7°30′N	151°85′E
Taijun Maru	41			1,278	7°44′N	151°83′E
Unkai Maru No. 6	42	101	104	3,220	7°31′N	151°88′E
Unknown A	43	39		350?	7°30′N	151°86′E
Unknown B	44			250?	7°30′N	151°87′E
Unknown C	45	30		90	7°30′N	151°86′E
Unknown D	46			?	7°36′N	151°85′E
Unknown E	47		19	20?	7°38′N	151°86′E
Unknown F	48		67	?	7°37′N	151°91′E
Unknown G	49		35	c.150	7°38′N	151°85′E
Yamagiri Maru	50	134	137	6,438	7°38′N	151°82′E
Yamakisan Maru	51	113	95	4,776	7°29′N	151°86′E
Yubae Maru	52	93	90	3,217	7°30′N	151°86′E