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Jennifer F. McKinnon
Toni L. Carrell
*Editors*

# Underwater Archaeology of a Pacific Battlefield

## The WWII Battle of Saipan

Springer

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# Foreword

The Pacific region covers about one-third of the total surface area of the Earth and comprises over 1,000 islands and atolls. The Pacific Ocean's long history of human settlements and interactions with other regions endows it with a wealth of Underwater Cultural Heritage (UCH), ranging from submerged human settlements, venerated sites, shipwrecks, and indigenous aquaculture infrastructure such as fish weirs to World War II-related shipwrecks and aircrafts. This extremely rich submerged heritage represents great potential for scientific research, education, and sustainable development for the Pacific region.

In the twentieth century, the Pacific was among the major theaters of World War II. The Battle of Saipan, fought from June 15 to July 9, 1944, is especially known for its intensity, claiming numerous lives, including those of civilians and indigenous peoples. Since then, Saipan has undergone a great deal of change. What was once a battleground is now a popular travel destination with hotels and other tourist infrastructure.

This publication is a result of a project on an archaeological survey off the coast of Saipan on submerged and coastal cultural heritage relating to World War II. The publication compiles papers written by leading UCH experts who took part in the project from diverse perspectives, including maritime archaeology, marine biology, education, and public outreach. This book provides invaluable information for the monitoring and preservation of UCH sites, which will assist in developing a long-term management plan that also addresses the ethical issues of preserving UCH sites that are still part of the living memory of families and communities affected by World War II.

In 2001, UNESCO adopted the Convention for the Protection of the Underwater Cultural Heritage that establishes a protection regime for UCH. Its Preamble acknowledges "the importance of UCH as an integral part of the cultural heritage of humanity and a particularly important element in the history of peoples, nations and their relations with each other concerning their common heritage." In its

Annex, it also provides the important principle of preferencing in situ preservation, as well as practical rules for the UCH treatment and research, based on internationally recognized best practices.

This publication supports many of the principles promoted by the Convention. Congratulating the excellent work done by the project team, I would like to recommend this publication as an invaluable resource for not only scholars but also the general public.

UNESCO Office for the Pacific States Etienne Clement
10 September 2014
Apia, Solomon Islands

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# Abbreviations

| | |
|---|---|
| ABPP | American Battlefield Protection Program |
| AIVL | Advanced Imaging and Visualization Laboratory |
| AMTRAC | Amphibious tractor |
| ANOSIM | Analysis of similarity |
| ANOVA | Analyses of variance |
| AR | Artificial reef |
| CNMI | Commonwealth of the Northern Mariana Islands |
| CRM | Coastal Resources Management |
| DD | Duplex Drive |
| DEQ | Division of Environmental Quality |
| DFW | Department of Fisheries and Wildlife |
| DGPS | Differential Geographic Positioning System |
| ECU | East Carolina University |
| GIS | Geographic information system |
| HADS | Heritage Awareness Diving Seminar |
| HPO | Historic Preservation Office |
| IJN | Imperial Japanese Navy |
| KBS | Korean Broadcasting System |
| KOCOA | Key terrain, observation and fields of fire, cover and concealment, obstacles, avenues of approach |
| LCT | Landing craft tank |
| LST | Landing ship tanks |
| LVT | Landing vehicle tracked |
| MDS | Multidimensional scaling |
| MPAs | Marine protected areas |
| MUA | Museum of Underwater Archaeology |
| MVA | Marianas Visitors Authority |
| NHL | National Historic Landmark |
| NMHC | Northern Marianas Humanities Council |
| NOAA | National Oceanographic and Atmospheric Administration |

| | |
|---|---|
| NPS | National Park Service |
| PBEC | Pacific Basin Environmental Consultants |
| PMRI | Pacific Marine Resources Institute |
| SEARCH | Southeastern Archaeological Research, Inc. |
| Ships | Ships of Exploration and Discovery Research, Inc. |
| SIMPER | Similarity percentage analysis |
| SRC | Submerged Resources Center |
| UNESCO | United Nations Education, Scientific and Cultural Organization |
| UXO | Unexploded ordinance |
| WHOI | Woods Hole Oceanographic and Atmospheric Administration |
| WWI | First World War |
| WWII | Second World War |

**Considered common**

UK
US
SCUBA
PDF
NAUI, PADI, and SSI

# About the Editors

**Jennifer F. McKinnon** the senior editor, has nearly 20 years of experience conducting archaeology and 8 years of teaching maritime archaeology. McKinnon was employed as a Senior Lecturer at Flinders University, Australia, from 2006 to 2013 and now is an Assistant Professor at East Carolina University, North Carolina. During her time at Flinders, she was the principal investigator of the WWII Maritime Heritage Trail: Battle of Saipan Project, a multiyear teaching and research project that focused on the investigation and interpretation of the WWII Battle of Saipan. This project partnered with Ships of Discovery of which Jennifer is a Research Associate. The project had a strong community engagement component and included students, managers, volunteers, and colleagues from Australia, the USA, and Saipan. McKinnon received the Governor's Humanities Award for Preservation of CNMI Heritage in 2011 for her work in Saipan. McKinnon has coedited two books (In Situ *Conservation of Cultural Heritage*: *Public*, *Professionals and Preservation*, PAST Foundation; *A Year in Review*: *2006 Program in Maritime Archaeology*, Flinders University Maritime Archaeology Monograph Series), published a number of peer-reviewed journal articles (including *Journal of Maritime Archaeology*, *International Journal of Nautical Archaeology*, and *Bulletin of the Australasian Institute of Maritime Archaeology*), and written book chapters (two in Springer Press), as well as archaeological reports and public outreach products. McKinnon has also reviewed publications for *Journal of Maritime Archaeology*, *Post-Medieval Archaeology*, *Maney Publishing*, *Left Coast Press*, *International Journal of Nautical Archaeology*, *Historical Archaeology*, *Journal of Archaeological Method and Theory*, *Queensland Archaeological Research*, and *Northeastern Historical Archaeology.*

**Toni L. Carrell** coeditor, has 40 years of experience in maritime archaeology with experience in the Caribbean, Western Pacific, Mexico, Great Lakes, and in a variety of lakes and reservoirs in the USA. She was employed by the National Park Service Submerged Cultural Resources Unit (NPS-SCR) from 1976 to 1990. Carrell joined Ships of Discovery in 1990, where she serves as Vice President. During her time with the NPS-SCR, Carrell worked extensively in the Pacific and was the senior author of *Submerged Cultural Resources Assessment of Micronesia* (1990), the first comprehensive archaeological report focusing on underwater cultural heritage in the region. Carrell received an award in 1988 from the Republic of Palau, Bureau of Cultural Resources, for her supervision of Operation Sea Mark, a joint NPS and US Navy EOD project directed at documentation of shipwrecks in Palau. Prior to that, Carrell received an Advisory Council on Historic Preservation commendation for her work in Kosrae in 1981. She revisited her early work in the Pacific as the senior author of *Maritime History and Archaeology of the Commonwealth of the Northern Mariana Islands* (2009). Carrell has edited or contributed to numerous publications and archaeological reports, published in a variety of peer-reviewed journals (including *Journal of Field Archaeology*, *International Journal of Nautical Archaeology*, and *Historical Archaeology*), and served as a peer reviewer for the *International Journal of Nautical Archaeology*, among others. She has been collaborating with McKinnon since 2009 on the WWII Maritime Heritage Trail: Battle of Saipan Project.

# Introduction

By June of 1944, the wave of totalitarianism that had swept the globe for the previous 7 years had crested and was rapidly ebbing. In Europe, the allied nations had prepared and launched the most important assault in the western war over the beaches of Normandy. In the Central Pacific, a far lonlier conflict for the USA, the Navy, and Marine Corps, capitalizing on the bloody lessons of Tarawa (November 20–23, 1943) transformed a national predilection for industry and technology into the rote business of killing on a massive scale. While the battlefields of Europe saw their share of industrialized murder, nothing approached the scale and intensity of the island warfare of late 1943 through the ultimate epics of Iwo Jima and Okinawa in 1945. The Pacific War, visited on the incongruous paradises of the Caroline, Marshall, and Marianas islands, truly was, as author John W. Dower states, a "war without mercy."

The Second World War was, without a doubt, the most consequential historical event of the twentieth century. A global paroxysm of destruction that reached from the frozen wastes of Siberia to the steamy jungles of Burma, this event—or more properly, huge constellation of interrelated events—piled scars and detritus on landscapes and cultures that echo the scars left on bodies long after the conflict abated. While the bodies that bear those scars are now passing away at an increasing rate, the lands and cultures that survive retain them for examination. Some argue that WWII marked an end of innocence for the USA, but this shallow perspective ignores the fact that the USA never was innocent, never could be innocent and in the limelight of a global conflict, the tissue of this national mythology dissolved in the face of emerging world leadership. Herein lies the power of archaeology, for the structured scientific study of material remains—physical detritus left behind by interrelated processes of use, deposition, discard, and transformation—also pierces the tissues of mythology and propaganda that both fueled and interpreted the savagery of industrialized warfare as it occurred on distant landscapes. While few archaeologists cling to the naiveté of an "objective past," most acknowledge the interpretive constraints that material residues exert. This constraint, coupled with the perspective that passing decades provides, offers powerful opportunities for reflection, learning, and growth. Applied to the island of Saipan by a team of researchers as sensitive and deft as those that follow in this volume, we see a model of what can be accomplished for all involved—winners, losers, and bystanders alike.

In her introductory chapter to this work, Dr. McKinnon makes a point as simple as it is profound—the June 1944 invasion of Japanese occupied Saipan by two divisions of the US Marine Corps and a division of the US Army was but another episode, albeit a savage one, of colonial intervention in an indigenous way of life for the islanders. The Second World War was something that *happened to* the people of Saipan, and their agency in the events that preceded and occurred during the battle were minimal at best. While we may see a narrative of victory over totalitarianism and the legitimization of industrial might over a less capable foe and while the Japanese may see a narrative of sacrifice and service expressed through the shell-pocked concrete bunkers on the beaches, the current inhabitants of Saipan navigate daily through the remaining trees and may not see the forest of history and story that seems to attract and fascinate visiting tourists. In this volume we see, however, a due and appropriate deference to a third narrative—one for people that remained after a paroxysm of hatred and destruction that was not of their making subsided like a wave and left the flotsam and jetsam of war behind for study, reflection, and growth. While the chapters that follow discuss in detail corrosion, the creation of an interpretive film, and the field modification of amphibious tanks to better protect the crew, the underlying message and philosophy of presenting multiple sides to histories that are still fraught and emotionally charged, and to involving people in the creation and interpretation of stories about what *happened to them* should not be lost.

National Park Service Submerged Resources Center David L. Conlin
November 2014
Denver, Colorado, USA

# Chapter 1
# Underwater Archaeology of a WWII Battlefield

**Jennifer F. McKinnon**

## Introduction

The underwater archaeology of ancient battles and warships is not a new study but one that spans back to the beginning of the watery discipline; however, the underwater archaeology of modern military or conflict sites such as Second World War (WWII) battlefields is more recent (for Pacific examples, see Lenihan 1989; Rodgers et al. 1998; Jeffery 2007; Van Tilburg 2007). Because of its nascent status, many of the ethical and professional decisions about how we approach such sites, how we interpret the sites, and how we protect the sites remain to be considered. Conflict archaeology on land has been actively addressing these professional and ethical issues for a few decades and as Schofield (2009:27) points out, "there is a duty on those charged with presenting recent military sites to balance numerous responsibilities: to remember the fallen; to avoid trivialising contributions to the war effort; but also (I would argue) to ensure some emotional engagement with the subject." To say that conflict archaeology underwater is different from conflict archaeology on land is a gross misstatement; therefore, we must look to our dry colleagues to understand the issues related to archaeology of modern conflict sites.

In recent decades, there exists a growing body of research and literature on conflict archaeology and modern conflict archaeology, some of which was born out of the North American traditional battlefield archaeology, but much of which was the result

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of a new group of scholars, particularly in the United Kingdom, focused on sites more recent than pre-twentieth-century wars. Modern conflict archaeology is the study of twentieth- and twenty-first-century heritage, which is anthropological in nature and multidisciplinary (Saunders 2012:x). Modern conflict archaeology, because of its more recent subject matter, is complex as it is still a part of living memory, and often those involved or affected by conflict are still alive or their families are present. Furthermore, it involves recent or existing political and social strife and can involve ethnic and social issues of power struggles and inequality. This makes the investigation, interpretation, and protection of such sites more difficult and sensitive.

"The human need to confront the past, even its unpleasant aspects, is ingrained in our culture, as shown by tourism of battlegrounds and other 'sacred' sites sanctified by great loss of life in war or visiting scenes of disaster…The tourists at Pearl Harbor, Custer Battlefield, Johnstown, Dachau, and Hiroshima confront their human mortality and perhaps reaffirm their joy in personal survival" (Delgado 1991:np). Interestingly, sites associated with conflict and warfare "probably constitute the largest category of tourist attractions in the world" (Smith 1998:248). Battlefields and modern conflict sites are a massive draw for tourists around the world; in the United States, Civil War battlefields are recognized as a positive contributor to local economies both directly and indirectly. An example of how popular modern conflict sites are with the public is the USS *Arizona* Memorial at Pearl Harbor that averages 4,500 visitors per day.

Because these sites not only involved warring world powers but noncombatant civilians, their promotion and interpretation as tourist attractions demand professional and ethical considerations of the multiple layers of significance and meaning for those involved. "Professionals working at significant places need to understand how their work can potentially impact local communities, indigenous peoples and ethnic communities" (Little and Shackel 2014:42). Archaeology and heritage management is a political act and has to be considered as such, particularly when sites are interpreted and promoted. Interpreting heritage in such a way that it does not privilege one history over the other or trivialize the experience is critical.

The WWII Battle of Saipan in the Mariana Islands (June 15–July 9, 1944) is an example of such a modern conflict site that is multifaceted, having involved two world powers, Japan and the United States, as well as hundreds of civilians from multiple ethnic backgrounds including Chamorro, Carolinian, Korean, Japanese, and Okinawan (Fig. 1.1). The battle lasted twenty-five days but the lead up to it, the battle itself and the aftermath affected tremendously those who willingly participated and those who did not. Thousands of civilians and soldiers were killed or committed suicide, families were uprooted from their homes, lands were lost, crops devastated, and the very fabric of the landscape and seascape was altered permanently. Today, reminders of the battle on the island are inescapable, from the strafed and hollowed-out Japanese structures to the tanks sitting in the coastal waters, to the memorials that line Banzai Cliff, to the pillboxes dotting the picnic beaches. Yet all of these scars and features blend into the daily goings-on of island life and seem relegated to the fascination of curious tourists.

The cultural heritage of the Battle of Saipan has been the focus of a large-scale archaeological project from 2007 to present. The project primarily involved

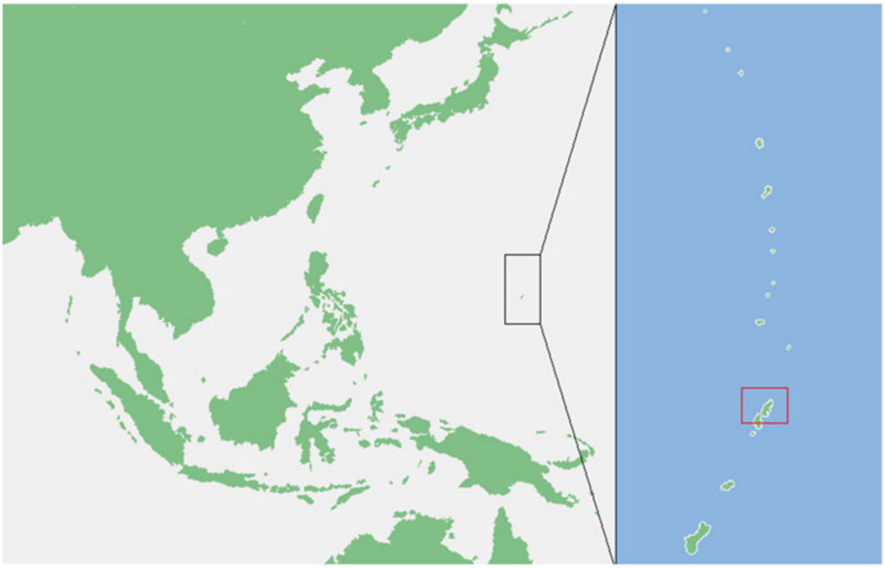

**Fig. 1.1** The Mariana Islands and Saipan's location

researchers from the nonprofit organization Ships of Exploration and Discovery Research, Inc. (Ships), Flinders University, and East Carolina University (ECU); however, many individuals and organizations were partners or assisted with the project (see Chap. 4). The work was partially funded through two National Park Service (NPS) American Battlefield Protection Program (ABPP) grants and a National Oceanic and Atmospheric Administration's (NOAA) Pacific Region Grants Cooperative grant, as well as a tremendous amount of in-kind support and funding. In short, the project was multinational, multidisciplinary, and interagency and involved a close partnership between academia and nonprofit, public, and government agencies. In a total of four years, historical and archaeological research and survey was conducted on 24 sites underwater and even more sites on land (see Chap. 4) a nine-site underwater heritage trail was created including posters in English and Japanese, underwater guides in English and Japanese, and a website; a 2D and RealD 3D 18-min interpretive film was produced in English with Japanese subtitles; an in situ conservation survey was conducted on 15 sites and a management plan was developed and written.

## WWII Heritage in the Pacific and Heritage Tourism

The development of a WWII heritage project originated in 2007 during conversations with the Commonwealth of the Northern Mariana Islands (CNMI) Historic Preservation Office (HPO). At that time, the HPO was interested in developing an underwater program or division that dealt specifically with underwater heritage.

They were keen to have staff trained in the methods of underwater archaeology and to attract researchers interested in conducting underwater archaeological research to CNMI's waters. The HPO had already organized a NPS-funded contract to conduct remote sensing of the entire western lagoons (Tanapag and Garapan), which was carried out by Southeastern Archaeological Research, Inc., (SEARCH) in 2008 (see Chap. 3). They organized a second NPS-funded contract to support the writing of a historical and archaeological maritime heritage context publication, which was carried out by Ships of Exploration and Discovery Research (Ships) in 2009 (Carrell 2009). What was missing from the plans was a public outreach component that could provide HPO with a presence on the water, facilitate more interaction with the diving community, and promote the preservation of Saipan's underwater heritage. In addition to this missing piece, Saipan's weakening economy was foremost on the minds of government officials and community, and conversations at the very top levels of government were centered on tourism, in particular eco- and heritage tourism. As a result, it was agreed that the development of an underwater heritage trail to promote Saipan's diverse WWII resources would be an apt solution to all of the issues outlined above.

Anecdotal evidence from other areas of the world where similar trails exist suggests that the development and promotion of underwater heritage trails helps to foster an appreciation for local heritage and contributes to its preservation into the future (Scott-Ireton 2005). By involving and educating the public, a sense of ownership and stewardship begins to develop and the communities begin to rally behind protecting the resources for future generations. However, Saipan's situation is different from other areas of the world where trails exist, in that the users that are attracted to and visit Saipan's underwater heritage sites are primarily tourists, not locals. Nevertheless, it is the locals who regulate and maintain the industry and therefore their livelihood depends on the heritage's sustainability.

"Cultural tourism has been regarded as the panacea to cure the economic troubles of the Pacific Island communities, particularly of the Pacific micro-states" (Spennemann et al. 2001:1). "Cultural," "heritage," and "ecotourism" are growing, and museums, heritage sites, and traditional festivals are drawing tourists to cultural attractions in the Pacific with more frequency. Heritage and ecotourists are generally attracted to the rarity and significance of particular natural and cultural sites and are generally more aware of the vulnerabilities of the resources. Perhaps due in part to the prefix, ecotourism is commonly held to be "softer" on the cultural and natural resources than mainstream tourism (Spennemann et al. 2001:31). Unfortunately, if eco- and heritage tourism, with its sustainable practices, is not encouraged in the planning practices of a community, impacts on prominent and renowned sites in the Pacific and in the CNMI will continue and worsen. The *CNMI Comprehensive Economic Development Strategic Plan* (2009–2014) states: "In the case of the CNMI, tourism has served as the primary industry followed by the garment industry. However, with the complete closure of the garment industry by 2009, tourism remains the only major industry to support the islands" (Commonwealth Economic Development Strategic Planning Commission 2009). Thus tourism is seen as not just *an* answer but the *only* answer for CNMI's economy, and further to the point, there is no mention of sustainable practices such as eco- or heritage tourism offer.

According to Spennemann et al. (2001:30), the development of heritage tourism opportunities worldwide has left Micronesia the last largely unassessed region. In 2000, the CNMI HPO and the NPS organized a Micronesia-wide symposium for the purpose of discussing methods of developing sustainable heritage tourism in Micronesia. Upon arriving, attendees were polled concerning their knowledge of heritage tourism and their expectations regarding the management of Micronesian environmental and cultural resources (Spennemann et al. 2001:30). Nearly 64 % of respondents agreed with the statement that heritage tourism does not exist as a bona fide industry but is a portion of the overall tourism industry. In spite of this, 91.6 % also thought that heritage tourism is more than a popular trend and has a remunerative future (Spennemann et al. 2001:31). Of ten options provided in the survey, archaeological sites were ranked as having the highest perceived tourism potential. However, non-Indigenous heritage locations (e.g., WWII sites) were ranked the poorest in terms of their potential for promoting ecotourism. As stated by Spennemann et al., "the fact that non-Indigenous heritage sites, and in particular WWII sites ranked so poor may be due to the negative perception of the war by the local population" (2001:32).

Western styles of cultural preservation tend to focus on tangible heritage while Micronesians display a preference for intangible heritage (e.g., traditional skills and knowledge). Therefore, they value more and have a stronger connection with their own intangible and tangible heritage. The obvious question not raised is: Why should islanders care about WWII heritage to begin with? Much like the archaeology of the Western Front in France and Belgium, Pacific War heritage can be considered "orphan heritage" because it is located on the lands and in the water of counties and communities who may not wish to recognize it (Price 2006). WWII in the Pacific, a momentous event in world history from a Western and Eastern perspective, is simply a brief interlude of colonial intervention from the Indigenous Pacific Islanders' point of view. With few exceptions, Pacific Islanders did not actively choose to be involved in the war. This view, though pragmatic, has the potential to hinder the effective preservation of non-Indigenous heritage resources. Nevertheless, it cannot be ignored. As Poyer et al. (2001) found when interviewing Micronesians about the war, WWII remains are of little interest to most, "but they want to preserve this history and to correct the imbalance that makes Islanders nearly invisible in American and Japanese accounts of the Pacific War."

CNMI's focus on tourism would undoubtedly stimulate the local economy, attracting visitors and drawing money to the islands. However, the connection between economic gain and heritage preservation is a precarious one in that heritage sites are vulnerable resources and almost certainly will be harmed by tourism activities. Over two decades ago, Carrell pointed out (1991:335): "developing tourism operations of the CNMI could cause heavy visitation to these sites by scuba divers. There is already a commercial tour submarine on Saipan that offers tours of some underwater sites. There have been reports of this tour submarine damaging some of the sites." This warning rings true today; therefore, an effective plan for promoting Saipan's underwater heritage sustainably through heritage trails while ensuring that the resources are not negatively impacted is timely and necessary.

Tourism and preservation of underwater heritage in the CNMI need to include careful consideration of all stakeholders and particularly a Pacific Islander's perspective, include education and training opportunities for agencies that regulate heritage, provide training opportunities for the dive industry that facilitates tourism, and conduct full-scale archaeological survey and site assessments. This project concerned itself with those special needs and designed a plan involving community outreach and involvement, training, education through interpretive materials, and cultural heritage management strategies for protection and sustainable use.

## Stakeholders

Collaboration with local and descendant communities is critical to the archaeology of conflict sites. Archaeologists have discussed collaboration in various practices or processes including public archaeology and community archaeology. Colwell-Chanthaphonh and Ferguson (2008) suggest that collaboration is a sliding scale from resistance to participation to collaboration, in that collaboration is comprised of full involvement from ideas to decision-making, where information flows freely both ways, and all parties' needs are recognized. This project endeavored to achieve this form of collaboration; in fact, the very idea of working on WWII sites was that of the local community (in contrast to the researcher's desires to study Spanish colonial sites from the outset). As a result, the project from the beginning included a wide range of active participants from agency staff to divers to community members who had the opportunity to provide their opinion, voice concerns, and make decisions.

Three agencies on the island played a crucial role in determining the success of the project efforts: the HPO, the Division of Environmental Quality (DEQ), and the Coastal Resources Management Office (CRM). In areas of the world where budgets, resources, and staff are limited, it is crucial to involve multiple agencies as they can collectively pool their resources for common interests (McKinnon 2014). This proved very true in the CNMI. Initial meetings and consultations were held with these agencies to assess their interest and involvement with the project (McKinnon and Carrell 2011). All three agencies contributed staff, equipment, and in-kind support throughout the project as well as oversight and input on interpretive materials and reports and publications.

Other partners and collaborators included: the Marianas Visitors Authority Office (MVA), a government-funded office focused on the development of tourism; the NPS American Memorial Park on Saipan and War in the Pacific National Historical Park on Guam; the Northern Marianas Humanities Council (NMHC), a nonprofit, government-funded program; the Pacific Marine Resources Institute (PMRI), a nonprofit organization with interests in traditional Micronesian fishing; the local dive club Marianas Dive; and Mariana Sports Club, Inc., the only dive industry organization on the island.

Interviews with Chamorro and Carolinian elders within the community were sought and encouraged throughout the project. Often these meetings were arranged by younger generations connected with the project who wanted their family's story recorded. The interviews were used to fill in the details of the history of the battle and expand the perspective of the story to include civilian and Indigenous interpretation.

Throughout the project, several public meetings and lectures were held on the island. These included PowerPoint presentations and question-and-answer sessions during which the public could comment on the work conducted. Crowds beyond 100 attendees were achieved which, for a small island, is remarkable participation. In addition to lectures, both TV and radio sessions were filmed in English, Chamorro, and Carolinian. These served the purpose of getting the word out and letting the community know how they could become involved in the project or provide input. Newspaper articles were also regularly published and all opportunities to be interviewed were accepted. The point of discussing the media activity of this project is to demonstrate that the project was never designed, nor was it executed as a "fly-in, fly-out" activity. As researchers, we were keenly aware that the Pacific has been plagued not only by multiple colonial interventions but also colonial researchers who fly in and collect the "earliest dates of occupation" to process in their laboratories elsewhere and report on in their academic journals. Instead, the project strove for transparency and communication with the public through media—budgets were published and the research objectives were broadcast widely. As Little and Shackel (2014:77) have rightly pointed out, "We have passed the tipping point; there is no way back to a heritage practice that operates as an expert-only domain independent of interested stakeholders."

## Training

Not only was training necessary to provide valuable information to the agencies and the public about underwater heritage, it was also seen as a chance to drum up local support for the project and possibly even train volunteer divers to assist with the survey. A training course was run in conjunction with Flinders University in July of 2009. The training provided participants with theoretical and practical knowledge about underwater archaeology. Participants were given two days of lectures and hands-on practice and then were involved in the mapping of an underwater archaeological site and an intertidal shipwreck site for non-divers. Twenty people participated in the training including three staff from HPO, twelve staff from CRM, one staff member from the Northern Mariana Island of History and Culture Museum, and four volunteers from Marianas Dive, a local dive club.

Two Heritage Awareness Diving Seminar Trainings (HADS) were run in April 2011 on Saipan in conjunction with the Florida-based Public Archaeology Network. The training was sponsored through grant funding from the NOAA Pacific Region Grants Cooperative. The grant was awarded to a collaborative partner on the island, PMRI, a local nonprofit organization concerned with environmental and historical research and sustainability. The training is a specialty course through the three largest diver certification programs in the world, NAUI, PADI, and SSI, for course directors, instructor trainers, instructors, dive masters, boat captains, and dive shop owners. It was developed to provide diving professionals with a greater knowledge of how to proactively protect shipwrecks, artificial reefs, and other submerged marine cultural heritage sites through acceptable diver behavior (Scott-Ireton 2008). The outcomes and benefits of HADS include increasing awareness of the fragility of submerged heritage; teaching proper anchoring, mooring, and diving behavior on such sites; and demonstrating the need for preservation of heritage for future generations and the economic benefits of heritage diving tourism.

A total of 16 participants took the free HADS training including dive shop owners, the president of a local dive organization, boat captains, dive instructors and dive masters, US Coast Guard staff, and a staff member from the NMHC. Participants attended a two-day course which included one day of PowerPoint presentations delivered by archaeologists and local agency staff including HPO and CRM and a second day of two boat dives in which they dived a site that is pristine and one that is heavily dived in order to compare the difference and understand diver impacts.

## The Trail

One of the challenges for heritage managers is to balance the protection of heritage with the provision and promotion of public access. Public outreach programs and education appear to be an effective management tool because they foster an appreciation for heritage and deliver important messages about valuing the past and preserving it for the future. The development of underwater or maritime heritage trails has proven to be a successful tool for balancing management needs with public access since their introduction in the mid-1980s (Spirek and Scott-Ireton 2003; Jameson and Scott-Ireton 2007; Scott-Ireton 2005). However, these products are not a one size fits all and need to be carefully researched to account for local needs; identify stakeholders; assess economic, political, and social concerns; and account for the multiple narratives present.

The WWII Maritime Heritage Trail: Battle of Saipan consists of nine stops with a total of twelve vehicles. Three US Sherman tanks, two Japanese landing craft, a Japanese Aichi E13A aircraft, a Japanese Kawanishi H8K aircraft, a US PBM Martin Mariner Aircraft, a US Avenger aircraft, a possible Japanese submarine chaser, a US Landing Vehicle Tracked (LVT), and a Japanese freighter comprise the trail (Fig. 1.2). Their locations vary from very nearshore in shallow water (2–3 ft) up to 30 ft of water on the barrier reef. Some of the sites can be accessed from shore via snorkel, making it accessible to those who are not scuba certified. Site selection was informed by consulting with the diving industry as well as diversity in vehicle type and ethnic association (i.e., Japanese and American).

After much public and agency consultation, it was decided that two types of interpretive products would be produced for the heritage trail. Nine underwater guides inclusive of site plans, site descriptions, access information, and a conservation

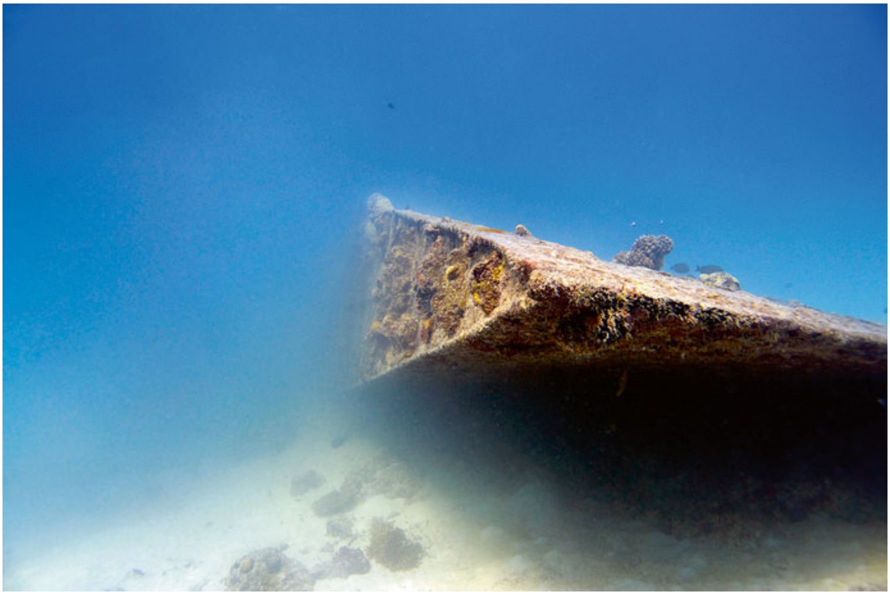

**Fig. 1.2** Bow of possible Japanese submarine chaser (Photo: Valeo Films)

message were produced on 100 % waterproof, 100 % recyclable, and 100 % tree-free paper (Fig. 1.3). Four themed posters also were produced including: *U.S. Aircraft*, *Japanese Aircraft*, *Shipwrecks*, and *Assault Vehicles*. The posters are 18 × 24 inches and double sided; the front includes a glossy photograph of a site and the back is populated with photographs as well as historical and archaeological information about the battle and the wrecks. The posters are inclusive of multiple viewpoints and include quotes of several individuals from varying ethnic backgrounds involved (i.e., Chamorro, Carolinian, Korean, Japanese, etc.). They also include a message about the importance of protecting sites, examples of diver impacts through intentional and non-intentional behavior, and specific information about the legislation that protects underwater sites. The posters and guides were designed in such a way that additional sites can be added to the trail if future funding and interest is available. All products were only printed in English and Japanese as funding was unavailable to print in Chamorro, Carolinian, Chinese, Korean, and Russian. The final PDF production prints of all the material were distributed to HPO, CRM, MVA, NPS, and NMHC so that reprints can be made based on local need. Copies of the posters were sent to the library and each school on the island to be used in education curriculum.


**Fig. 1.3** Interpretive underwater guide of Aichi A13A in Japanese

## The Film

One of the challenging and disappointing aspects of interpreting underwater sites is that non-divers cannot visit the site or participate in the discovery of swimming up to a shipwreck and sitting on the sandy bottom covered with fish and corals. It is just not the same standing on shore and reading a kiosk about the history of a shipwreck while looking over the expanse of the sea. Taking non-divers to sites, particularly NPS sites, is currently a focus of the NPS Submerged Resources Center (SRC)—and they are now doing the tours in 3D! After the trail was developed, a relationship came to fruition whereby the NPS SRC in collaboration with the Woods Hole Oceanographic institution (WHOI) would film all of the trail sites and create an interpretive film; this was supported by a second ABPP grant (see Chap. 11). The production of a film was launched and an 18-min colored, English (with Japanese subtitles) 2D and RealD 3D film was created. The film provides a mechanism for both divers and non-divers alike to visit the sites and learn about their history. It is shown at the NPS American Memorial Park on Saipan and War in the Pacific National Historical Park on Guam and is being considered for viewing at the USS *Arizona* Memorial in Honolulu. Copies of the film were sent to all schools on the island of Saipan so that it may be used as an educational tool in the classroom, and the film is on YouTube for free viewing and download. As a result, hundreds of thousands of people will now learn the history of the battle and can visit the aircraft, shipwrecks, and assault vehicles as they lay on the seabed.

## In Situ Survey and Management Plan

The need to develop a management plan for submerged WWII maritime heritage in Saipan's waters was identified during the planning stages and implementation of the trail. Throughout the archaeological survey and subsequent development of the trail, it was noted that certain sites were being negatively impacted by both natural and cultural factors (McKinnon and Carrell 2011). These impacts were identified as contributing to an overall loss of archaeological and historical context and affecting the structural integrity of the sites and their long-term survival. While some of these impacts were recorded during the archaeological survey for the development of the trail, they were not the primary focus of the project and were treated cursorily. Upon completion of the trail, it was deemed important to revisit selected sites and record baseline data to develop a plan to monitor, mitigate, and manage the sites into the future. A plan to conduct further archaeological survey and initiate in situ conservation surveys was developed and supported by the second ABPP grant (see Chap. 9). Understanding the condition of the resources through in situ and archaeological surveys is an important step in the management process. An agency cannot manage a site if they have no knowledge of its condition. The HPO needed information about the condition of the sites in order to make informed decisions about their management.

In situ surveys and studies are critical to regions such as the Pacific because there are limited resources (i.e., funding, staff, and facilities) to conduct recovery and conservation of submerged objects and sites. While the CNMI does benefit from grant funds distributed by the NPS, this funding is limited and often only covers a small portion of the compliance needs of the HPO (Ronnie Rodgers, personal communication, 2010). This means that the conservation and management of the resources must be done in situ.

Additional archaeological survey was conducted alongside the conservation survey in order to record new "control" sites not on the trail, so that they may be monitored long-term for comparison purposes. A steamship, a US aircraft, a US LVT, and a Japanese landing craft were added to the list of sites with archaeological and conservation data. Baseline conservation and archaeological data collected on new sites will be critical for HPO's understanding of the differential impacts of site visitation on those included in the trail. Plans to regularly collect conservation data for the purposes of monitoring the sites on and off the trail are underway, and this data can be collected by off-island specialists or by HPO staff.

Finally, all of the conservation and archaeological data was incorporated into a 111-page preservation and management plan that was reviewed and approved by the HPO. The plan identified the natural and cultural threats currently impacting underwater WWII sites in Saipan and provided recommendations for mitigating these threats and managing the sites in the short and long term. Each recommendation was made based on discussions with managing agencies and the dive community tempered with knowledge of the sites, their historical and archaeological context, the environmental and cultural impacts affecting the sites, and the social, economic, and political conditions of Saipan. Further, it was tempered with the knowledge and awareness that the plan was funded by an *American* battlefield grant, which presented yet another layer of postcolonial complexity when "recommending" what a community should do with *its* heritage.

The recommendations were separated into four broad categories: policies and procedures, programmatic recommendations, site-specific recommendations, and public outreach. Included within policies and procedures were legislative initiatives, capacity sharing and strategic planning, and interagency cooperative agreements. Programmatic recommendations focused on those areas that are mandated by various legislative requirements. Site-specific recommendations included direct and indirect site monitoring, while public outreach is self-explanatory. Each recommendation was followed by a discussion of underlying issues that constrain or impact implementation and then an action item with a proposed time frame. All of the recommendations were catered to suit the local conditions of the Saipan community and HPO so that the success of managing the sites will be that much more attainable.

O'Neill and Spennemann (2001:46) argue that efficacious preservation of cultural resources is dependent upon several factors: political will, community interest, and availability of resources. Saipan struggles in each of these areas; however, the largest roadblock is availability of resources. As Saipan's economy continues to weaken or remain stagnant, the impact on agencies that are charged with managing, protecting, and interpreting underwater heritage and the environment has had their budgets and personnel reduced. This presents particular challenges in the development of both community and agency action planning and implementation.

## Conclusion

The Battle of Saipan was an incredibly significant event for those residing on Saipan and for those who fought for control of the island. For better or worse, it has left a lasting, tangible legacy in the form of an incredible collection of heritage sites both underwater and on land. In fact, it can be said with certainty that this collection of shipwrecks, aircraft wrecks, and vehicle wrecks are like none other in the Pacific. However, these sites have multiple meaning to the multilayered community of Saipan. For some, they represent valor and success, but for others, they represent oppression, coercion, defeat, and colonial interference. "By opening up such sites to the popular gaze, archaeologists have the power to bring these debates into the public sphere, potentially undermining the hegemony of officially sanctioned memory and making the production of meaningful pasts a more inclusive process" (Moshenska 2006:58). The task of opening up these sites to the public becomes more than a celebration of war—it involves a close reflection of all narratives and a chance to confront the past for purposes of understanding the present.

Due to its remoteness, the CNMI's underwater cultural heritage sites have retained much of their historical and archaeological integrity and therefore are in need of more research and protection. The following chapters represent the efforts thus far of a research project aimed at recording, researching, and protecting Saipan's WWII underwater heritage sites. Lest we forget however that, "…the archaeology of modern warfare…is also an archaeology of us, reflecting our changing attitudes to conservation and to the need for preserving memories of past conflict in contemporary society" (Schofield 2009:137). This book then is a reflection of the editors' and authors' ideas and attitudes toward preserving and interpreting Saipan's WWII history, and it is also a community's and a network of colleagues' and collaborators', for which the work could not have been accomplished were it not for their ideas and their assistance.

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# Chapter 2
# A Historical Overview of the Battle for Saipan

**Genevieve Cabrera**

## Prewar Japanese Interest in the Northern Mariana Islands

Between the seventh and sixteenth centuries, Japan experienced an internal conflict of its own in that it was caught between a propensity to peacefully strengthen ties with its eastern neighbors and an inherent compulsion to strike out and manifest long-standing maritime pursuits all in the collective name of expanding national interests. During the sixteenth century, however, more aggressive ingress within Asia was thought necessary in order to stem the tide of Russia's eastward advancements. Simultaneously, the call to sea was lent greater credence. These maritime advancements were unfortunately short lived because in the century to follow, Japan undertook a self-imposed isolationist world view, which kept it cut off from the rest of the global community for two hundred and fifty years. It was not until the mid-nineteenth century, when Japan again saw fit to return to the more inclusive global order that it followed through with its push for expansion into the greater South Pacific. This included charting a course toward Micronesia and effectively encompassing the Northern Mariana Islands.

Although new for Japan, appearing on the Central and South Pacific scene was, by the late nineteenth century, a mainstay for other formidable European countries. Spain was still in the Marianas, having colonized the archipelago during the latter half of the seventeenth century and now had the Caroline Islands as well.[1] Her cessation of the Marshall Islands in 1885 paved the way for Germany to make good on its burgeoning expansionist ideologies. Meanwhile, farther south, France and Great

[1] With regard to the Marianas, bold initial (albeit unauthorized) inquiries in 1876 by Enomoto Takeaki, one of the foremost progenitors of Japan's *Nan'yō* (South Seas) doctrine, were put to Spain to see about her "willingness to sell the Mariana and Palau Islands" to Japan (Peattie 1988:5).

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Britain had laid claim to Tahiti and the Tuamotus and Fiji, respectively. To mitigate this and not be outpaced by the West, Japan undertook voyages of exploration in the hopes of finding yet unclaimed Pacific Islands. It did precisely this when in 1887 the Volcano Islands were discovered and subsequently claimed. For the next twenty years, Japan's prowess on the high seas went from exploration to lucrative commercial ventures in and around Micronesia further cementing its intent to remain a major political and economic contender if not leader. The opportunity to effectuate this latter objective came by way of Japan's auspicious victory in both the Sino-Japanese War (1894–1895) and the Russo-Japanese War (1904–1905).[2]

Germany, under whose control the Northern Mariana Islands, the Caroline Islands, and the Marshall Islands, along with the atolls of Kapingamarangi and Nukuoro existed from 1899 to 1914, was persistently monitoring Japan's commercial activities. Despite increasing German restrictions, Japan maintained its hold on a greater percentage of economic activity throughout German Micronesia. Germany could not claim the same for its commercial pursuits. With growing tensions in Europe, mounting arguments on the German home front over the unmerited financial burdens of its overseas territories, and the eventual outbreak of WWI, Japan's long-awaited opportunity to enter the Pacific theater finally rued the day. Weighing anchor off the reef just outside the village of Garapan, Saipan, and without having as much as a single shot fired, she came ashore, raised her flag, and declared her presence. The day was 14 October 1914.[3] It was not surprising that Japan's celerity in rooting its claims in Micronesia was not without its detractors, and the most prominent was the United States who also had a growing interest in the strategic importance of these Western Pacific Islands. This opposition was initially voiced in the discussions leading up to the Treaty of Versailles in 1919 wherein US President Woodrow Wilson proposed the establishment of the League of Nations to temper future discord among the developed countries. The United States, however, never became a member of the league.[4] In 1921, the league granted Japan a Class C mandate over the once German-held territories in the Pacific. In the meantime, Japan had already invested nearly seven years of administrative rule throughout its newly acquired insular possessions.

The decade and a half that followed witnessed tremendous economic activity for these mandated islands. In the Northern Mariana Islands, sugar indeed was king. Approximately thirty-eight percent of arable land on Saipan comprised the three sugarcane plantation sites, growing the main cash crop in the As Litú, Chacha, and Makpi (Marpi) areas. Tapioca came in second to none, while coffee and pineapples,

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[2] Pursuant to its defeat in the Spanish-American War (1898), Spain sold the Mariana Islands to Germany for 25 million pesetas; DM $16.7, US $4.2 million (Craddock 1982:2). Also see von Bennigsen, R., translated by Dirk H. R. Spennemann (2003:xv).

[3] Throughout the month of October 1914, Japanese naval contingents sailed to the German outposts (Palau, Yap, Ponape/Pohnpei, Truk/Chuuk, Kusaie/Kosrae, and Jaluit) officiating preliminary administrative procedures and giving notice to the local populace that Japan now had control over the islands (Peattie 1988:62).

[4] Upon its establishment in 1919, the league comprised forty-two nations. The staunch opposition to the United States' membership in the league came from the US Senate (https://history.state.gov).

predominantly grown on the hillsides of Mt. Tapotchau, augmented the island's crop offerings. The refinery in Chalan Kanoa was producing sugar, sugarcane byproducts such as molasses, and alcohol.[5] To the southwest and across the three-mile channel of pelagic fishing grounds lay Tinian, which had almost eighty percent of the island functioning as a sugarcane plantation with its own refinery and its population of nonindigenous farmers and farming families.[6] Farther southwest was Rota and although with approximately only nineteen percent of the island's arable land growing sugarcane, it also was the larger producer of phosphate among these three populated islands. In addition to the agricultural achievements, fishing and the production of *katsuobushi* (dried fish shavings) was equally prolific. Tourism also picked up pace. There were cruises between the three southern islands (Saipan, Tinian, and Rota; at times including Guam) as well as trips up to *Gani*.[7]

With heightened economic pursuits came the ever-increasing influx of immigrants. Not unlike Saipan and Tinian, Rota as well saw the arrival of Japanese and Okinawan farming families numbering in the thousands by the early to mid-1930s. So much so was this the case that the approximately 800 indigenous Chamorro and native Carolinians living on Rota were forcibly relocated from their long-standing familial lands in and around Songsong to the village of Tatachog. The unequivocal physical transformation of the islands did not go unnoticed by the local populace, and although they were also beneficiaries of revenue generated by sweeping economic windfall, the social disparities imposed upon them within the areas of education, employment, and most especially in the practice of civil liberties were leaving an indelible mark.

## Increasing Western Suspicions, Japan's Withdrawal from the League of Nations, and the Onset of Hostilities

Western powers, although not yet fully convinced of the arguments launched by the United States with respect to the implications of Japan's rapid transformation of its insular possessions, were, however, cautiously receptive to considerations over closer scrutiny of her adherence to the stipulations of her Class C mandate. Additionally, given the technological advancements in warfare and weaponry of the day, it was not implausible that Japan could quickly fortify the islands (and more precisely, the Northern Mariana Islands), but that it would be difficult to find evidence of any such violation seemed the greater concern because since the inception

[5] Hezel 1984. A brief economic history of Micronesia: Past achievements and future possibilities. Retrieved April 6, 2014, from http://micsem.org/pubs/articles/economic/frames/ecohistfr.htm

[6] During these economic boom years, there were no indigenous Chamorro and/or Carolinians residing on Tinian. It was not until 1948 that native islanders of Chamorro and/or Carolinian descent returned to Tinian to resettle the island.

[7] *Gani* is the ancient Chamorro term used to refer to the islands north of Saipan (Levesque 1993:175).

of her administrative control in 1914, she had effectively quelled and/or ousted Western economic interests with a consistent barrage of restrictions against access to her mandated Micronesian Islands. Of equal contention was the fact that between 1925 and 1938, Japan was already exporting millions of dollars in goods from the Northern Mariana Islands to the Japanese home islands and slowly but surely was undertaking improvements to port facilities and its airfields on Saipan, Tinian, Rota, and Pagan in the name of economic advancement.[8]

Japan's reaction to these hints of suspicion fueled the fire. During its 24 February 1933 assembly, after a speech by delegate Matsuoka Yosuke reiterating Japan's resolve over the issue involving Manchuria, the League of Nations voted to adopt the resolution demanding Japan's withdrawal of her military installations therein and to return Manchuria to China. Japan responded by walking out of the assembly vowing never to return.[9] What essentially followed were tighter restrictions on access to the islands as well as movement within and between them. In 1935, Japan formally withdrew from the league and proceeded with what some have argued to have been efforts to fortify the islands.[10] In 1938, Saipan and her sister islands were closed to all extraneous access. The principal officers of major companies and holdings as well as other professionals were advised to return to Japan. Interestingly enough, there is what appears to be a consequential absence of photographic documentation of the Northern Mariana Islands during this time as well.[11]

It is not inconceivable that among the native populace, there were those that had some notion that something was afoot, although they had learned during the previous Spanish and German administrations, respectively, not to make any direct inquiries.[12] The sociopolitical environment within which the native Chamorro and Carolinians of Saipan found themselves during the Japanese prewar administration was not in any way equitable in nature.[13] The administrators considered the natives *third-class citizens* with the Chamorro occupying a penultimate standing. Their first exposure to WWII hostilities came when preparations were underway for the Japanese invasion of the island of Guam. Before the arrival of European explorers, the ancient Chamorro of the Northern Mariana Islands and those of the island of Guam were one and the same people, one and the same culture. The geopolitical ramifications of the Spanish-American War of 1898 changed that affiliation. While not altogether dissimilar from the system of governance under Spain, the native Chamorro of

[8] Peattie provides an in-depth discussion of US efforts to amass intelligence about Japan's activities within the mandated islands (Peattie 1988:237–247).

[9] Brown (1933); Upon exiting the assembly, Matsuoka was reported to have said: "We are not coming back" (http://www.johndclare.net/league_of_nations6_news.htm, accessed 31 March 2014).

[10] Russell points out that the construction of As Lito Airfield was begun in 1934 and that a seaplane base at Puntan Flores was completed in 1935 (Russell 1983:21).

[11] A compendium of photographic material depicting the conditions of the Northern Mariana Islands did not appear until after WWII.

[12] Those that preferred not to wait to be told what to do proceeded to move to the family farmsteads along the higher elevations of the island.

[13] Nor was there equity during the Spanish or German administrations, respectively.

Guam found a growing affinity for its US administrators. Conversely, the native Chamorro and Carolinians of the Northern Mariana Islands, for the most part, had no such inclinations toward the German or subsequent Japanese rulers. When "battle" lines were drawn however, allegiance given relatively freely to the "state" compared with an absence of allegiance to anyone or anything other than to culture and family became the group's dismissive and divisive element. These contentions placed those Chamorro conscripted by the Japanese military to aid in Guam's invasion in opposition with their native Guamanian brethren.[14] War came to Guam 08 December 1941, precisely within an hour of the Japanese air fleet having taken off across the international dateline en route to Pearl Harbor, Hawaii.[15]

## The Battle for Saipan

Hostilities on Saipan itself actually began with three days of strafing prior to the Marines landing on the island's southwestern shoreline 15 June 1944. Stretching from the area immediately north of Agingan Point to just a little beyond present-day Quartermaster Road in the Chalan Laulau area, the landing beaches cover a linear distance of approximately 4.15 miles (6.68 km). Designated with code names Yellow, Blue, Green, and Red, the beaches were further delineated by sector numbers. Susupe Point, which was incorrectly referenced as "Puntan Afetña" on US military maps, functioned as the dividing line between the 4th and 2nd Marine Divisions.[16]

The 4th Marine Division covered the beaches south of Puntan Susupe. On a south-to-north orientation, these sectors were Yellow 3, 2, and 1 and Blue 2 and 1. The 4th was followed inland by the 27th Army Infantry Division, which comprised the reserve units. The 2nd Marine Division came up on the beaches to the north of Puntan Susupe, which included Green 2 and 1 and Red 3, 2, and 1. The fighting was its fiercest along Yellow Beach and some confusion in navigating the reef and currents pushed the 2nd Marine Division lines north of their intended objectives. The units had to make their way back to the designated sectors in order to push inland as planned. The gap that developed between the 4th and 2nd Marine Divisions over the Green 3 sector took three days to resolve. On the first day of the

[14] Whether or not this absence of allegiance to Japan was understood or appreciated by the native Guamanians, what was evident was that anything coming out of the NMI was touted to be Japanese and therefore was the enemy (Poyer 2001:39). The ramifications of what transpired during WWII influenced Guam to vote "NO" twice to the NMI's request for reunification in the 1960s. The considerations and perspectives of what happened on Guam during the Japanese invasion remain an extremely contentious issue to this day.

[15] The air strike targeted for Guam was comprised of planes that took off from Saipan's As Lito Airfield (Russell 1983:21).

[16] What consequently followed, and evidenced by oral accounts of the battle recounted by returning WWII veterans from 2003 and continuing and witnessed by this author, is the fact that what is today known as "Sugar Dock" ended up being the literal dividing line between the 4th and 2nd Marine Divisions.

assault, the US forces gained an area stretching 10,000 yards long, 1,000 yards deep at a cost of over 2,000 casualties.[17] An assault force comprising 66,000 men was committed for Saipan and Tinian while 39,000 were required for Guam. All told, 105,000 men were needed to bring down Japan's defenses in the Marianas.[18]

The campaign to capture Saipan, Tinian, and Guam was collectively known as *Operation Forager*. On Saipan, the main objectives were to secure the beachheads, capture As Lito Airfield, hold Mt. Tapochau, and push the remaining Japanese military contingents north toward Marpi Point. After the 27th Army took control of As Lito Airfield on 18 June and having secured Saipan's southern point (Naftan) together with the 4th Marine Division units, the drive northward was to have been effectuated with the 2nd Marine Division sweeping along the western shoreline and coastal inland areas while the 27th Army painstakingly picked its way through Saipan's central ridgeline and the 4th Marine Division maintaining the sweep along the eastern inland coastal and shoreline perimeters. Simultaneously, on the 18th, out at sea, the Japanese fleet (commanded by Vice Admiral Jisaburo Ozawa) sent to turn the tide against the US forces was intercepted by Vice Admiral Marc Mitscher and his Task Force 58. What ensued was the Battle of the Philippine Sea otherwise more popularly known as the *Great Marianas Turkey Shoot*.[19]

The initial strategies employed by US forces in the 1920s in preparing for a confrontation with Japan in an all-out Pacific War did not involve the Marianas in a predominant way. However, the advent of the B-29 Superfortress (long-range bomber) and a redirected focus on bombing raids as a means of wearing down Japanese military might brought the Marianas into prominence as the staging area for expansive airfields from which the bombing raids would run. Japan itself had similarly strategized and had intended for this purpose three airfields and one seaplane base on Saipan (and by which As Lito Airfield functioned as a forward maintenance and fighter base), four airfields on Tinian, two on Pagan, and one on Rota. She had also planned to install four airfields and one seaplane base on Guam after wresting it from US control.[20]

The next objective, beyond As Lito Airfield, was Mt. Tapochau, the highest point on Saipan along the central ridgeline and from which a 360-degree view line of the island was readily accessible. However, fighting for the 27th Army Infantry within the hills and pockets of "Death Valley" along the southeastern base of Mt. Tapotchau proved ill-fated for their commanding officer, General Ralph Smith, who was

[17] Russell (1994:15).

[18] Russell (1983:22).

[19] According to Russell, Ozawa's antiquated planes and equally inexperienced pilots were no match for Mitscher's advanced aircraft and seasoned pilots, which stemmed the tide of Japan's onslaught upon the Pacific (Russell 1994:18).

[20] In addition to As Lito Airfield on Saipan were the airstrips at Marpi Point and the stretch of Beach Road today running parallel to the beachhead from Susupe Point (southern end) to Kilili Beach (northern end). Both airstrips were still in arguably early stages of construction when the US Marines landed.

replaced by the Marine General Holland Smith.[21] Known to the island natives as *Papagú*, this area contained caves and fissures within which the Japanese were deeply entrenched and from which they fought the 27th Army and 4th Marine Division units to the greatest advantage possible. Despite this upper hand, the area was secured after several days of fierce fighting. When the 27th Army and 8th Marine units ascended Mt. Tapotchau, Japanese military personnel were nowhere to be found. It was by that time 27 June 1944, thirteen days into the Battle for Saipan.

The battle itself presented new issues rife with categorical challenges. In addition to being a high island, it also was one straddled with a large civilian population. While the US forces certainly understood and appreciated the existence of a civilian populace, they were ill-prepared for the actual count. A good number of the WWII veterans who participated in the battle have recounted over the past several decades how they were bringing in civilians within the first few hours of landing on the beaches (especially within the Yellow Beach landing sectors). Given these circumstances, the Marines had no choice but to put together makeshift stockades within which these civilians could be housed and protected. These roughshod trappings later gave way to a more organized facility known as Camp Susupe, which officially operated as a civilian camp 4 July 1944. Several months later in October, a second camp (Camp Chalan Kanoa) was established to cater to the native Chamorro and Carolinians. The Japanese, Okinawan, and Korean civilians remained in Camp Susupe.

While the Civil Affairs units were attending to the civilian issues in Camps Susupe and Chalan Kanoa, the 2nd Marine Division engaged their Japanese counterparts in Garapan, which was the first encounter of the enemy within a more urbanized setting. Within two days of fighting, Garapan fell under US control. At this point in the battle, the 27th Army Infantry was already advancing steadily along the central ridgeline and continued the momentum northward. By the evening of 6 July, they had pushed the front lines to the north and east of Tanapag Village. The final drive toward Marpi Point was now in the offing.

Lt. General Yoshitsugu Saito, overall commander of Japan's Imperial Army on Saipan, had no misgivings about the tenacity and progress of the advancing US forces. The Battle for Saipan had now become a battle of attrition for Japan. In keeping with the shogun code of Bushido and the philosophies of State Shinto, a counterattack was the only way to save face and for which Saito sent a request to mainland Japan for concurrence.[22] Upon the request's approval, Saito readied his remnant contingents for the *Gyokusai* despite his ill and weakened state.[23] He gave the orders

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[21] In the estimation of the Marines, the 27th Army Infantry Division was not achieving decisive results pursuant to the strategized assault plans and therefore relieved Major General Ralph Smith of his command (Crowl 1995:191–201).

[22] The Bushido code was one practiced especially by preceding generations of shogun wherein tenacity in battle and an honorable death by one's own hand instead of being captured by the enemy was tantamount to the glorification of country and emperor. When sidled with the ideologies of State Shinto, this glorification transcended toward an enlightened sense of nationalism and militarism.

[23] *Gyokusai* translates to "the crushing of the jewel" and for which Saito encouraged the approximately 3,000 remnant troops to take seven American lives for each Japanese life lost.

for the counterattack and to officers and enlisted alike; he stressed adherence to the Japanese battle ethics known as *Senjinkun* wherein honor is achieved in taking one's own life as opposed to suffering the disgrace of surrender and/or capture at the hands of the enemy.[24] Literally living by example, Saito committed himself to the *Senjinkun* once the initial wave of the *Gyokusai* descended the slopes abutting Makunsha to the west and the unsuspecting 1st and 2nd Battalions of the 105th Infantry.[25]

Previously, on 6 July, Lieutenant General Holland Smith ordered the 27th Army Infantry Division to join the 4th Marine Division in pushing the front line in a north-easterly direction to the island's tip and along with it, all remaining Japanese forces. It became apparent shortly after the 27th Army was engaged that it would not be able to stay abreast of the line alongside the 4th Marine Division. Smith changed tactics midmorning and had the 27th redirect to a northerly push up the western coastal stretch. They were to secure the area from just north of Tanapag Village to the coastal perimeter north of Makunsha; furthermore, the 27th Division battalions (165th and 105th Infantry) were to advance inland and secure Harakiri Gulch and Paradise Valley and from which they were to push the remnant Japanese forces north along the coast and northwest from the central ridgeline. The 4th Marine Division was responsible for the area due north and northeast of the 27th Army Infantry Division's designated front lines.[26] As the day progressed and the orders carried out, the 27th Army Infantry Division units and especially the 1st and 2nd Battalions of the 105th Infantry were positioned within reach of their northern perimeter. All the while, the 25th, 24th, and 23rd Marines were mopping up the eastern coastline and rounding about from their northeast line to meet the 27th Division units in the strategized effort to "pinch" off the remaining Japanese forces. The eastern coastal mop-up effort was beleaguered with caves and rock shelters from which civilians and Japanese military stragglers were continually being extracted. On the evening of 6 July, as the 25th Marines were about to dig in for the night at the base of Mt. Petosukara, a group of approximately seven hundred to eight hundred civilians intercepted the perimeters of the 25th Marines and surrendered.[27] Little did the mop-up units know what lay in store at dawn's light on the opposite side of the central ridgeline.

Comprised of approximately 3,000 souls, the three-pronged all-out charge began at about four o'clock the morning of 7 July. Coming out just south of Makunsha and over the lower slopes fronting the central ridgeline to the east, the main thrust of the *Gyokusai* pushed south along the area between the beach and the railroad tracks.[28]

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[24] Crowl (1995:257).

[25] Saito fell upon his own sword and then his adjutant shot him in the head (Crowl 1995:257). The participants of the *Gyokusai* were themselves armed with whatever they had remaining, which went from rusted guns to wooden poles to which knives or bayonets were fastened (Crowl 1995:258).

[26] Crowl (1995:247).

[27] Crowl (1995:248); Mt. Petosukara is the area of *Laderan i Tanki* on the current USGS topographical map of Saipan.

[28] Crowl discusses the existence of several reports wherein the actual count of the *Gyokusai* is generally accepted to be around 3,000. The lowest number of participants, offered by accounts of the charge, is 1,500 while others estimate it to have been 2,500–3,000 (Crowl 1995:258).

Across the nearly flat expanse of coastal terrain abutting the central ridgeline to the southeast went the other wave of the attack while the central line went right through the gap that lay between the 1st and 2nd Battalions of the 105th Infantry (who held the front lines nearer to the beach) and the 105th's 3rd Battalion (who held the line farther inland along the base of the central ridgeline).[29] Within about an hour, the Japanese forces went hand to hand with the 1st and 2nd Battalions overtaking them in less than thirty minutes.[30] So strong was this raging torrent that the US front lines were not just effectively pushed back out to sea, but all the way back to Tanapag Village where all seemed lost until the first signs of aid came around after over eight hours of close-range fighting with the Japanese. US forces began to regain lost ground thereafter, and by the evening of 7 July, all that was left to do was to extract surviving Japanese military stragglers and civilians from the myriad of caves and rock shelters that pockmarked the area. To the army's chagrin, Lt. General Holland Smith relieved the 27th Army Division of mop-up duty and assigned it to the 2nd Marine Division instead.[31] Over the course of the next two days, the 2nd Marine Division pushed north toward Marpi Point mopping up through the western shoreline and coastal inland areas while the 4th Marine Division (with its 165th Infantry reserve units) swept through the eastern coastal peripheries and terraces. At 4:15 p.m., 9 July 1944, Vice Admiral Richmond Kelly Turner declared Saipan "secured."[32]

Shortly after the announcement, the suicide jumps began. Japanese civilians that had taken heed of their military's propaganda about the American devils raping and devouring Japanese women and children, respectively, chose death over surrender. The jumps over the cliffs of Marpi Point were not specifically relegated to what today are known as Suicide Cliff and Banzai Cliff.[33] Japanese civilians jumped off the Marpi Point cliffs wherever they could do so. Those that jumped off the Suicide Cliff and surrounding areas fell upon the jagged coral limestone outcrop below. Those that leapt from the Banzai Cliff line met their demise in one of two ways: upon the rocks below that were exposed when the ocean swells receded or succumbing to the force of the churning currents particular to this area of the island's northern waters. Those that were nowhere near the cliff edge carried out the will of propaganda by huddling around a person or family member holding a grenade with the pin pulled. Those Japanese civilians and/or military that apparently had conflicts of conscience and were inclined to surrender were gunned down by Japanese military. The US troops were at a loss to stem this tide of submission to death.

[29] Ibid.

[30] O'Brien, F. A. (2003) *Battling for Saipan*: *The True Story of an American Hero—Lt. Col. William J. O'Brien*, The Ballantine Publishing Group.

[31] Lt. General Holland "Howling Mad" Smith's disdain for the army surfaced at every opportunity during the Battle for Saipan. However, scholarly research by Harry A. Gailey published in 1986 proved that such displays of contempt were "unwarranted and unconscionable" (O'brien 2003:xiii).

[32] The US flag was raised at Marpi Point earlier during the day of 9 July 1944. It was at 4:15 p.m., however, that the flag was officially raised at HQ in Chalan Kanoa and the announcement made by Admiral Turner (Russell 1994:25).

[33] The names of these two sites came about after WWII and specifically with historical reference to the occurrence of the suicide jumps 9 through 10 July 1944.

Desperate pleas from US military interpreters and from captured civilians (inclusive of children) largely went unheeded. Captains of US military sea vessels operating on the waters off Marpi Point pulling aboard survivors of the jumps had to turn off their engines because the propellers were cutting into the bodies of the dead adrift not in a tropical azure sea but one that ran blood-red. It is still not known exactly how many Japanese civilians perished (of their own accord) on these two fateful days.[34] It is known that the last group of native, non-Japanese civilians were extracted from Marpi Point 8 July 1944 and transported to Camp Susupe.[35] The mop-up efforts continued through the month of July and well into 6 August 1944. These efforts were conducted solely by the 27th Army Infantry Division. The 2nd and 4th Marine Divisions were relieved of mop-up duty and pulled back to prepare for the landing on nearby Tinian Island, the battle for which began 24 July and lasted through to 2 August 1944.

Although the Battle for Saipan and WWII's Pacific theater came to a close for the two warring factions, the conflict was far from concluded for the surviving native Chamorro and Carolinian islanders back in Camp Susupe. The chapter on colonialism, which was first written in 1668 under Spanish rule, was about to be given a fourth turn, this time with the United States at the helm as trustee for what was to become the Trust Territory of the Pacific Islands. The war and the battle come to life with each vivid recounting of those that fought it and those that survived it. The extant remnant features that comprise the battle sites out in Saipan's lagoon and surrounding waters, as well as those that riddle the island itself, are reminders of this devastating segment of native island history. Regrettably, the ravages of the battle rage on in the memories of the families of the 933 native men, women, and children that died in a conflict not of their making.[36] For these departed, there would never be resolution. They neither died fighting for principles of freedom nor defense of country. They simply died and ostensibly are categorized as *collateral damage*, but yet even this descriptor was never theirs for the choosing.

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[34] At the onset of the battle, the civilian count was approximately 40,000, inclusively, and of this number, a little over 4,000 comprised the native population of Chamorros and Carolinians (Russell 1994:32).

[35] This group included the surviving sisters of the order of the Mercedarian Missionaries of Berriz, Fr. Tardio Vasquez, S.J., Brother Gregorio Oroquieta, then novice Remedios Castro (native Chamorro), and several other native, non-Japanese civilians (Salaberria 1994:22–25, 37). Because of their deeply rooted Roman Catholic beliefs, it is doubtful that any native Chamorro and/or Carolinian civilians participated in the suicide jumps.

[36] Cabrera (2005:17) It behooves us all to consider the native island survivors of the battle that died or were incapacitated in subsequent years in what appear to be war-related trauma not unlike what we are seeing now with the returning veterans of conflicts in Iraq and Afghanistan and elsewhere in which the US military has been/is a participant.

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# Chapter 3
# Archaeological Survey of WWII Landing Beaches on the West Coast of Saipan

**Jason M. Burns and Michael C. Krivor**

## Introduction

From April 10 to May 6, 2008, maritime archaeologists with SEARCH of Pensacola, Florida, conducted a submerged cultural resource remote sensing survey and diver identification of high-probability targets along the west coast of Saipan, CNMI. All work was conducted under contract to the CNMI Department of Community and Cultural Affairs, HPO. HPO is mandated under Public Law No. 3–39 to ensure the identification and protection of significant archaeological, historic, and cultural resources in the CNMI. The survey was supported with Historic Preservation Funds provided by the NPS, Department of the Interior.

The purpose of the investigation was to locate and identify high-probability submerged archaeological resources inshore and offshore of Tanapag and Garapan Lagoons, along the west coast of Saipan. It was anticipated that the majority of resources documented during the investigation would be associated with the WWII Battle of Saipan in 1944.

The project was conducted in accordance with the National Historic Preservation Act of 1996, as amended (PL 89–665); the Archaeological and Historic Preservation Act, as amended (PL 93–291); the Abandoned Shipwreck Act of 1987; and the Advisory Council on Historic Preservation revised 36 CFR Part 800 Regulations. The work was also conducted in compliance with Public Law No. 3–39, Commonwealth Historic Preservation Act of 1982, and Public Law No. 3–33, Removal of Human Remains, and is consistent with the goals and strategies outlined in *Pacific Preservation*: *The Commonwealth of the Northern Mariana Islands State Historic Preservation Plan, 2004–2008*.

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While the remote sensing survey was broad in nature, the focus was on the WWII resources. Although designated a National Historic Landmark (NHL) in 1985, the landing beaches had never been systematically surveyed for submerged cultural resources. This survey intended to be a baseline inventory for future investigations to build upon and to supplement findings from previous submerged cultural resource investigations conducted from the late 1970s through 2001 (see Section "Previous Submerged Cultural Resource Studies" below).

### *Project Location and Environmental Setting*

The remote sensing survey covered the west coast of Saipan from Puntan Makpe (near Wing Beach) south to Agingan Point including all navigable portions of Tanapag and Garapan Lagoons, as well as 200 m outside the existing reef line (Fig. 3.1). The lagoons on Saipan are typical high-island barrier reef lagoons that form the largest lagoon complex in the island chain (Amesbury et al. 1979). Both lagoons range from 375 m (1,230 ft) to over 3.5 km (2.17 miles) in width. Water depths reach a maximum of 14 m (46 ft) in Tanapag Lagoon, but average less than 3 m (9.8 ft) throughout Garapan Lagoon (Amesbury et al. 1979). Much of the survey area inside Tanapag Lagoon was too shallow to navigate or was interspersed with coral heads and reef flats, making navigation difficult.

## Previous Submerged Cultural Resource Studies

There have been several previous submerged cultural resource surveys/assessments conducted in Saipan. Michael Thomas and Sam Price, of the Pacific Studies Institute on Guam, conducted the first survey in 1979/1980 for a proposed small boat harbor under contract to the US Army Corps of Engineers Pacific Ocean Division (Thomas and Price 1980). The literature search and visual/diver inspection of the "reef flat north of Micro Beach and the Fishing Base Dock and channel area west of Garapan" resulted in the documentation of objects "from the Japanese, WWII, and American periods" (Thomas and Price 1980:vi). Objects ranging from Japanese tugboats and harbor dredges to the remains of WWII steel pontoons and Japanese antiaircraft guns were documented in the Micro Beach area. Off Garapan, steel pontoons, metal debris, and a Japanese channel marker/lighthouse were documented in or on the water (Thomas and Price 1980:13).

From October 28–30, 1983, the NPS conducted a preliminary assessment of its submerged lands associated with American Memorial Park (100 m [328 ft] from the high tide line) (Miculka and Manibusan 1983). Forty submerged cultural resources were located in the waters that encompass modern day Micro Beach, Smiling Cove Marina/Small Boat Harbor, Outer Cove Marina, and inner Tanapag Lagoon. The majority of resources identified include the remains of US pontoons and barges. The "most significant" find was the remains of 14 railroad cars and associated rails from the prewar Japanese sugarcane railroad (Miculka and Manibusan 1983:2).

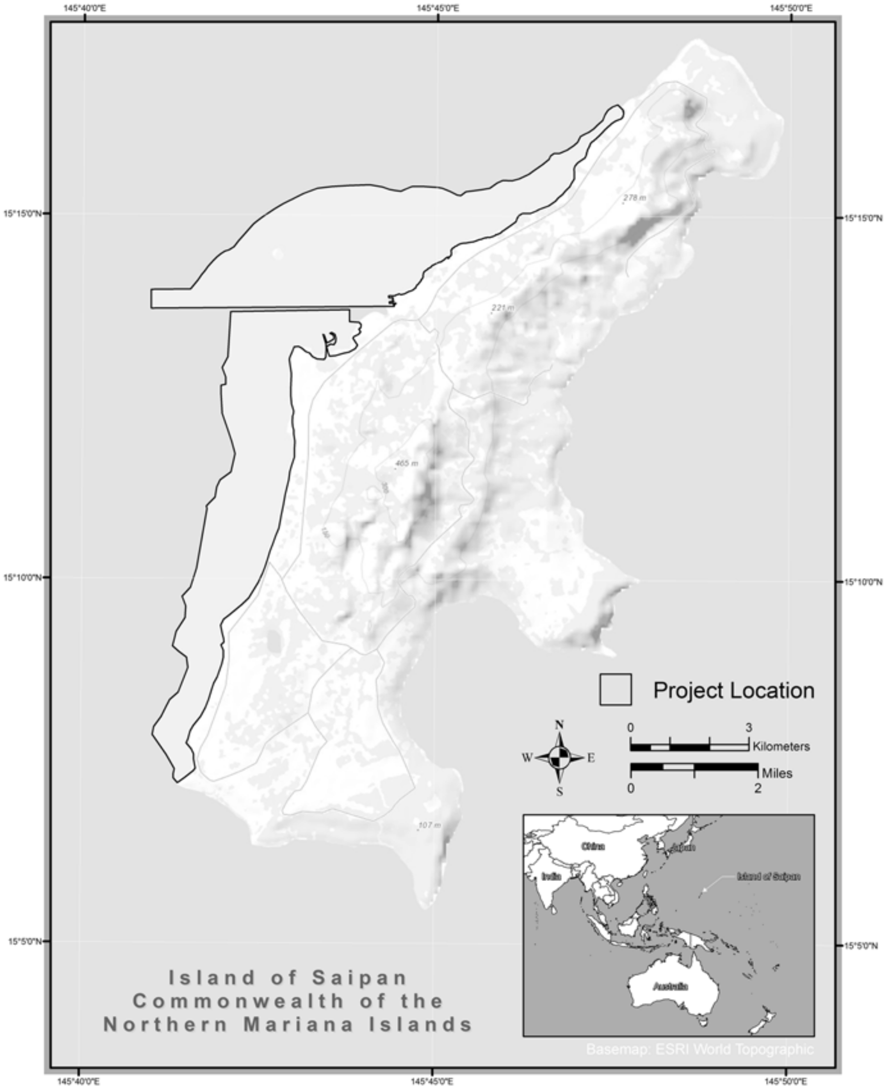


**Fig. 3.1** Project location on the west coast of Saipan

Follow-on investigations by the NPS were carried out from December 15–17, 1983, in the same areas of American Memorial Park as above (Miculka and Manibusan 1983). The investigation resulted in the identification of additional pontoons and barges (Miculka and Manibusan 1983:1).

In 1984, the NPS in conjunction with the University of Guam's Micronesian Area Research Center was contracted by the Defense Environmental Restoration Program to assess the submerged WWII remains in Saipan for their possible removal (Miculka et al. 1984). The survey documented the remains of a WWII Japanese freighter, Japanese submarine chaser or patrol boat, three US landing crafts, one

Japanese "Emily" flying boat, one Japanese "Jake" floatplane, and two US Sherman tanks. Recommendations included further identification on the majority of the sites and complete removal of 45 steel pontoons/barges recorded by the NPS in 1983 (Miculka et al. 1984:2).

In 1985, Pacific Basin Environmental Consultants (PBEC) conducted an underwater survey of Tanapag Lagoon for historic properties (PBEC 1985). The survey was conducted in conjunction with the Mañagaha Island Marine Park Management Plan and was supported by the HPO. The survey recorded 18 WWII sites in Tanapag Lagoon including airplanes, barges, boats, and debris as well as WWII resources on Mañagaha Island (PBEC 1985).

Beginning in 1986/1987, marine salvage firm Pacific Sea Resources salvaged the 1638 wreck of the *Nuestra Señora de la Concepcion* in the shallow waters off the south coast of Saipan near Agingan Point/Beach (Mathers et al. 1990).

The NPS team returned to Saipan in 1990 to measure, photograph, videotape, and document the WWII sites in the lagoons on Saipan (Miculka et al. 1990). In 1991, the NPS published the most comprehensive submerged cultural resource summary for Saipan and all of Micronesia. Toni Carrell's report entitled *Micronesia: Submerged Cultural Resources Assessment* includes chapters and research on Saipan and summarizes the NPS's previous research (Carrell 1991). The report details more than 50 shipwrecks/abandoned vessels on Saipan.

Beginning in 2001, the National Oceanic and Atmospheric Administration's Office of Response and Restoration initiated the Abandoned Vessel Inventory for CNMI (Lord and Plank 2003). While the study was not historic in nature, the majority of abandoned vessels recorded (28 out of 33) are considered historic resources. Most are WWII steel pontoons/barges and freighters (Lord and Plank 2003:12–15).

### *Landing Beaches, Aslito/Isley Field, and Marpi Point National Historic Landmark*

The WWII landing beaches on the west coast of Saipan were listed on the National Register of Historic Places and designated a NHL on February 4, 1985. The NHL encompasses 1,366 acres of land and water and is described as "The waters between the coral reefs and the land, including Lagunan Chalan Kanoa and Lagunan Garapan" (Thompson 1984). The NHL was designated based on the history of the area and the integrity of the landing beaches; no archaeological fieldwork was conducted.

## Survey Expectations

Shipwrecks, sunken aircraft, WWII debris, ammunition, and other associated material cultures were expected to be located within the project area given the extensive history of the Battle of Saipan. Due to the navigational hazard of the reef which forms the western edge of both Tanapag and Garapan Lagoons, submerged cultural resources were also anticipated along the offshore portion of the outlying reef face. Modern infrastructure (such as pipelines and sewer outfalls), debris, and other contemporary finds were also expected within the survey area.

## Remote Sensing Survey Equipment

Previous submerged cultural resource investigations relied mostly on historic research and visual surveys and did not incorporate the use of marine remote sensing equipment to thoroughly document all potential sites associated with the Battle of Saipan. In an attempt to broaden the understanding of potential resources within the project area, SEARCH proposed the use of a marine magnetometer, side-scan sonar, and Differential Global Positioning System (DGPS) to accurately document all potential resources along the west coast of Saipan.

SEARCH utilized a Marine Magnetics Explorer magnetometer and Trimble DSM 232 DGPS, integrated with HYPACK navigation software for the remote sensing survey of Tanapag and Garapan Lagoons. The Trimble DSM 232 DGPS provided submeter accuracy for all targets located during the survey. SEARCH also operated an Imagenex side-scan sonar to assist in identifying and delineating high-probability magnetic targets documented during the survey. The magnetometer records the absence or presence of objects that contain ferrous metal, and the side-scan sonar supplements the magnetometer data by assisting in identifying objects (i.e., shipwrecks, aircraft, debris) exposed on the seafloor.

The HYPACK navigation software allowed the survey team to design and delineate survey areas, collect single-beam data (i.e., magnetometer, DGPS), process and edit magnetometer data, and generate final products such as magnetic contour maps useful in relocating potentially significant submerged cultural resources.

SEARCH conducted the remote sensing survey and diver investigations from a variety of vessels depending upon the location of the survey. A deep draft survey vessel was used for work offshore the existing reef system, whereas shallower draft vessels were used within Tanapag and Garapan Lagoons, including a motorized catamaran.

## Remote Sensing Survey

The remote sensing survey covered those areas within Tanapag and Garapan Lagoons (as well as offshore of the outlying reef) where navigation was possible with a motor vessel. Prior to conducting the survey, a series of parallel track lines were created for all of the survey areas in HYPACK. Survey track lines varied in length and were spaced at 100-foot intervals.

## *Analysis*

Upon completion of the remote sensing survey, the magnetometer data were edited and subsequently analyzed for potentially significant anomalies. Processing the magnetometer data involved reviewing each track line and ensuring there were no magnetic spikes that may affect the contouring of the edited data. This allowed the analyst the opportunity to identify individual magnetic anomalies including location, gamma deviation, duration (in feet), type (monopole, dipole, multicomponent), and source.

Once the magnetic data had been edited, all individual targets were tabulated and the data subsequently contoured. The contouring of the data allowed archaeologists the opportunity to identify associations between magnetic anomalies as well as determine the spatial extent of each anomaly. A series of criteria were then applied to each magnetic anomaly to determine their potential to represent submerged cultural resources. The magnetic signature of historic shipwrecks tends to have more sizable gamma deviations (versus small, isolated targets) and longer durations. Those targets that are associated with other magnetic targets on adjacent track lines also tend to be more indicative of shipwreck sites than those that are strictly isolated to one track line. However, archaeologists also paid careful attention to smaller, isolated magnetic anomalies indicative of submerged aircraft and/or munitions.

Many factors determine the detection and strength of a magnetic anomaly including mass of the source of ferrous metal, sensor to source distance, and orientation of the sensor to the source to name a few. While interpretation of magnetic anomalies is not an exact science, the amplitude or strength, signature, and duration aid in determining whether an anomaly is a result of a single-source or a cluster of magnetic objects. These considerations among others are taken into account to determine whether a magnetic anomaly signifies an archaeologically or historically significant cultural object that warrants further investigation.

Lastly, the side-scan sonar assisted in identifying and delineating high-probability magnetometer targets. The sonar data was helpful in delineating exposed shipwrecks, aircraft, as well as debris fields exposed on the seafloor. In addition, the sonar provided additional DGPS locational information for each target.

## Diver Identification of High-Probability Targets

SEARCH conducted diver identification on a variety of high-probability targets documented during the remote sensing survey. To relocate these targets, SEARCH utilized the contoured magnetometer data as well as the DGPS integrated with HYPACK navigation software. Once a target was marked with a surface float, divers utilized SCUBA to visually search the seafloor for the source of the anomaly. If the anomaly was not identified immediately, a steel hand probe was used to penetrate the seafloor to a depth of four feet. Divers worked in cardinal directions from the surface float in an attempt to locate any buried targets. Once a target was located, a visual identification was made by the divers and photographs taken. Detailed dive logs were also kept for each target investigated.

## Results

SEARCH successfully completed the submerged cultural resource remote sensing survey and diver identification of high-probability targets.

### *Remote Sensing Survey*

A total of 512 line miles (823 km) were surveyed during the investigation. This included all navigable waters within Tanapag and Garapan Lagoons as well as 200 m offshore (west) of the outlying reef. Results of the remote sensing survey located a total of 1,543 magnetic anomalies throughout the project area. The magnetic anomalies included small, single point targets indicative of small, isolated ferrous metal objects (i.e., munitions, anchors, modern debris) to large objects (i.e., shipwrecks, amphibious tractors, tanks, as well as modern debris) recorded on multiple track lines.

Once each anomaly was analyzed (including location, gamma deviation, duration, and type), the magnetometer data was contoured to further define each target. All magnetic anomalies were then prioritized based on total gamma deviation, duration, and type (monopole, dipole, or multicomponent) as well as comparison to findings from previous submerged cultural resource surveys. Due to a limited time frame for diver investigations, most anomalies selected for identification consisted of larger magnetic targets considered easier to identify quickly. However, some smaller isolated targets were also investigated to determine their source.

### *Diver Investigations*

After prioritizing the magnetic anomalies, SEARCH conducted diver investigations on those targets thought to represent potentially significant submerged cultural resources associated with the Battle of Saipan. A total of 142 magnetic anomalies either were physically identified using SCUBA, were delineated with the side-scan sonar, or were previously identified during prior submerged cultural resource investigations.

## Tanapag Lagoon

Within Tanapag Lagoon, SEARCH archaeologists identified a diversity of cultural resources clearly associated with the Battle of Saipan. This included three Japanese Daihatsu landing crafts, a potential subchaser, a Japanese H8K3 "Emily" flying boat, a US TBM Avenger, an amphibious tractor (AMTRAC), airplane debris, possible seaplane tie-down anchors, anchor chain, and miscellaneous steam engine debris (Table 3.1).

## Garapan Lagoon

Diver investigations within Garapan Lagoon identified a wide variety of historic resources also likely associated with the Battle of Saipan. This included numerous shipwrecks (steamships, landing craft, pontoon boats, barges, and motor launches), M4A2 Sherman tanks, an AMTRAC, various anchors, shoreline structures (bulkhead/wharf), and miscellaneous iron debris (Table 3.2).

**Table 3.1** Magnetic anomalies identified within Tanapag Lagoon

| Target identification | Number |
|---|---|
| Japanese Daihatsu landing craft | 3 |
| Japanese subchaser | 1 |
| Japanese freighter (*Shoan Maru*) | 1 |
| Japanese H8K3 "Emily" flying boat | 1 |
| US TBM Avenger | 1 |
| AMTRAC | 1 |
| Miscellaneous airplane debris | 2 |
| Metal-reinforced concrete pads (seaplane tie-downs) | 2 |
| Anchor chain | 2 |
| Miscellaneous steam engine debris | 1 |
| Miscellaneous metal debris | 4 |

**Table 3.2** Magnetic anomalies identified within Garapan Lagoon

| Target identification | Number |
|---|---|
| Iron-hulled steamship | 2 |
| Barge | 1 |
| Landing craft | 13 |
| Pontoon boats | 2 |
| Motor launch | 2 |
| M4A2 Sherman tanks | 3 |
| AMTRAC | 1 |
| Anchors | 4 |
| Iron bulkhead | 1 |
| Concrete/metal wharf | 1 |
| Miscellaneous iron debris | 13 |

### *Informant-Reported Site*

A local informant reported the site of a suspected Japanese "Zero" aircraft south of Mañagaha Island on the reef face north of the Saipan Harbor Entrance Channel to SEARCH during the remote sensing survey. Investigation of the site revealed that the aircraft was actually a US TBM Avenger. The aircraft lies upside down with its landing gear extended into the water column. Remote sensing was not conducted over the site due to the extreme shallow water. This site was previously recorded in 1985 and 1991 (PBEC 1985:16 and Carrell 1991:508).

## Public Outreach

SEARCH, in conjunction with the online Museum of Underwater Archaeology (MUA), provided an online project journal of daily activities during the investigation. The mission of the MUA is to assist and promote the use of the Internet by ethical professional, student, and avocational underwater archaeologists by presenting research to the general public. The project journal highlighted aspects of the remote sensing survey, challenges encountered in the field, as well as results of diver investigations. To access the project journal, please visit http://www.uri.edu/artsci/his/mua/project_journals/saipan/saipan_intro.shtml.

To date, the project journal has had 11,782 page views by 9,039 unique visitors spanning over 50 countries. Of the last 500 visits to the journal, nearly 40 % (39.2 %) of visitors are from outside the United States indicating a diverse and global audience.

The authors also presented a lecture on the results of the project to the general public at the Visitors Center Theater at American Memorial Park in Saipan at the conclusion of the project. The well-attended lecture consisted of a PowerPoint presentation of the various cultural resources that were located during the investigation. The presentation was followed by a question and answer session and was cosponsored by the NMHC and the HPO.

## Conclusions and Recommendations

While the submerged cultural resource remote sensing survey was broad in nature, the focus was on the WWII resources associated with the Battle of Saipan. The investigation intended to be a baseline inventory for future endeavors to build upon. Results of the remote sensing survey documented a total of 1,543 magnetic anomalies. Of these, a total of 142 anomalies were identified through diver investigation, refined with the side-scan sonar, or had been previously identified.

SEARCH made a series of recommendations to the CNMI HPO based on the results of the investigation. This included additional remote sensing surveys and diver investigations to continue the identification and recordation of potentially significant anomalies documented during the current survey. A total of 1,396 magnetic anomalies remain unidentified along the west coast of Saipan, many likely associated with the Battle of Saipan. SEARCH also recommended that follow-on investigations include educational institutions and local dive clubs to assist in the development of a maritime heritage trail. It is a stated goal of the CNMI to provide visitors and residents alike the opportunity to learn about the history and culture of the islands and to provide for public participation in the preservation of those resources (Division of Historic Preservation 2003). Maritime heritage trails provide the opportunity to interpret resources to the diving and non-diving public. Topside displays and museum exhibits combined with the underwater resources enjoyed by divers will provide a tourism boost to the economy of Saipan.

SEARCH also proposed an expansion of the landing beaches, Aslito/Isley Field, and Marpi Point NHL boundary (officially listed on February 4, 1985). During the survey, SEARCH recorded 478 magnetic anomalies outside the existing NHL boundary. Several were identified during the investigation including nine US landing crafts, one AMTRAC, two US pontoons/barges, one 13-foot motor launch, and other WWII debris, all associated within the invasion of Saipan. The new nomination should update the status of previously identified resources, note non-contributing intrusions into the proposed boundaries, provide additional historical information not available in the 1980s, and include an expanded discussion of the submerged anomalies identified during the course of this survey, particularly those that are confirmed to be WWII artifacts.

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The project's web log/journal was created and maintained by T. Kurt Knoerl and the Museum of Underwater Archaeology. The Commonwealth Ports Authority, Port of Saipan Assistant Port Manager, Miguel Sablan, and MaryAnn Q. Lizama are acknowledged for their assistance throughout the project.

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# Chapter 4
# The Archaeological Survey of WWII Underwater Cultural Heritage: A Multiagency, Collaborative Approach

**Jason T. Raupp, Jennifer F. McKinnon, Peter Harvey, and John San Nicolas**

## Introduction

By far not a novel approach, the Saipan WWII maritime heritage project is yet another example of how "many hands make light work." This project was conceptualized as an inclusive and collaborative effort to include academia, nonprofit, government agency, and the local community in the study of Saipan's WWII submerged heritage. By taking this approach, it was hoped that more could be accomplished with fewer resources and a sense of stewardship for long-term preservation would take hold of the island. This chapter discusses the approach, methodology, and recording of Saipan's WWII maritime heritage.

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## Previous Archaeological Research on WWII-Era Sites

Prior to the Battle of Saipan WWII project, a number of submerged cultural resource and maritime heritage surveys were conducted in the waters surrounding Saipan (Thomas and Price 1980; Miculka and Manibusan 1983; Miculka et al. 1984; Pacific Basin Environmental 1985; Carrell 1991, 2009; Lord and Plank 2003; Burns 2008a, b) (see Chap. 3 for discussion of previous surveys). Though these efforts ranged in complexity from basic site identification projects to intensive remote sensing surveys, each provided data that proved valuable for conducting further research on underwater sites in Saipan. Particularly useful were the publications produced as a result of work conducted by the NPS (Carrell 1991), SEARCH (Burns 2008a, b), and Ships (Carrell 2009). The data recorded from these various projects offers the beginnings of a comprehensive survey of the WWII-era sites located in Saipan's lagoons and increased the efficiency of the archaeological surveys conducted for the project.

## Multiagency, Collaborative Approach

Three government agencies were critical to the success of this project. The HPO, situated under the Department of Community and Cultural Affairs, is the regulatory agency that governs archaeological, historical, and cultural resources in the CNMI; thus, it was imperative to maintain an open line of communication and collaborate with the office. HPO staff were involved in the project from its inception. First, they participated in trainings run by Flinders University faculty and then assisted with the archaeological recording of the sites. They also participated in the in situ conservation survey and facilitated communication with other agencies and the general public. Throughout the project, they reviewed all interpretative materials as well as archaeological reports and the final preservation plan.

CRM was established on 11 February 1983, with the implementation of Public Law 3-47 within the Office of the Governor. The CRM program was established in order to promote the conservation and wise development of coastal resources. CRM is responsible for general permitting activities that impact coastal resources in Saipan and, in particular, permits for water-related and dive tour operations. They have on-the-water capability to monitor waterborne activities and enforce violations. Similarly, the DEQ and agency mainly concerned with water quality and pollution have on-the-water capabilities and enforcement obligations. Unfortunately, neither of these agencies have staff with cultural heritage training or background; thus, it was important to have their staff involved in the underwater training offered by Flinders early in the project. CRM and DEQ staff were beneficial to the project in many ways. They collaborated in the fieldwork, provided useful information on the types of sites divers visited, provided background on dive industry regulations, assisted with unexploded ordinance (UXO) issues, and developed a mooring buoy project which installed moorings at selected sites on the underwater heritage trail. Combined these two agencies contributed a great amount of in-kind support through staff participation, boats, and fuel for the field projects.

The MVA, a government-funded office focused on the development of tourism, was also consulted. By providing demographic information on tourist divers and snorkelers, the project was able to understand the market better and create products that were suitable to multiple groups. As an example, the trail products were printed in both English and Japanese and were planned to be translated into Korean, Chinese, Russian, Chamorro, and Carolinian. MVA also provided assistance with dissemination of the posters to locals and tourists, as well as sharing important public feedback.

The NPS American Memorial Park on Saipan and War in the Pacific National Historical Park on Guam were key consultants. The superintendent and staff provided important insights into the needs of visitors. They reviewed the posters and trail guides for accuracy and provided guidance on the interpretive film. Because the film was designed from the outset to be shown in the park visitor centers, their input was particularly important.

The project team also held meetings with smaller community groups including nonprofit organizations. Two that were particularly helpful were the NMHC, a nonprofit supported by government funding, and the PMRI, a nonprofit with interests in traditional Micronesian fishing. Vital support from these organizations was provided in the form of local information about water resources and diving and contacts with smaller user groups including diving and fishing organizations. PMRI collaborated as the funding organization for the NOAA grant which facilitated the HADS training (as discussed in Chap. 1).

Consultation with diving and fishing groups included visits to local dive shops to receive feedback on needs at the local level. Two important groups, Marianas Dive and Mariana Sports Club, Inc., were consulted. Several members of the Marianas Dive group participated in trainings, and members of the Mariana Sports Club, Inc., provided valuable historical information and insight into the history of the wrecks.

Several off-island partners contributed to the long-term success of the project including organizations from Australia and the USA. Information, participation, and collaboration from all of these organizations materially informed the development of the project considerably and value-added both in knowledge and in-kind support. Researchers from Australian government agencies such as Heritage Victoria and Northern Territory Heritage Branch and the private consulting company Cosmos Archaeology were involved for their background knowledge in heritage trails and conservation. Other researchers and groups such as the Florida Public Archaeology Network in the USA contributed expertise in training and trail development.

The collaboration of the NPS SRC was crucial in bringing the interpretive film to completion. As one of few teams of maritime archaeologists and filmmakers focusing on underwater heritage, they participated directly in the filming, editing, and creation of the 2D and 3D films. WHOI, the videographers, and Windward Media, the film producers, although contracted for their services with grant funding, provided an incredible amount of service and skills in-kind to make the final film happen. Were it not for the collective in-kind services of SCR, WHOI, and Windward Media, the film would not have been possible.

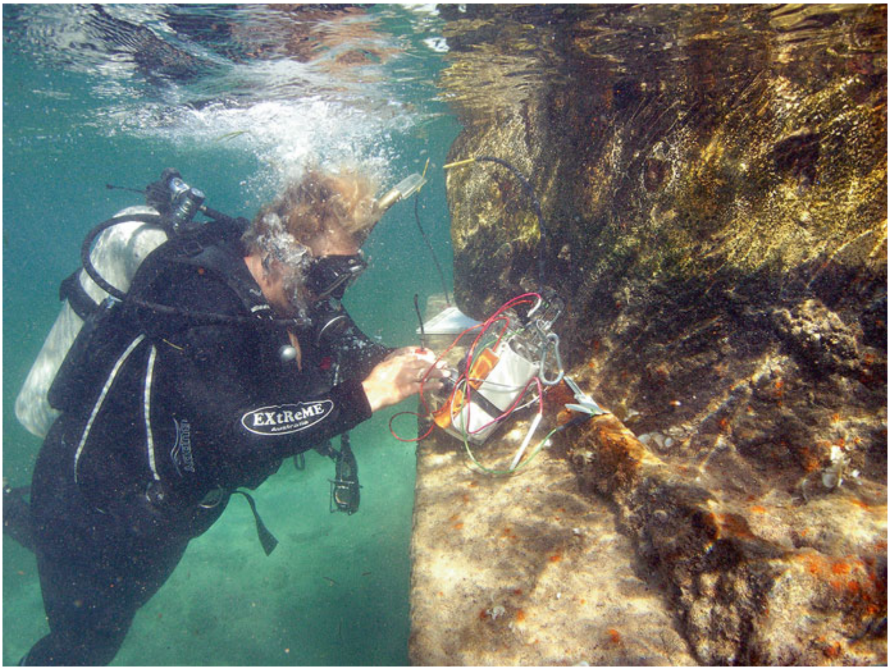

**Fig. 4.1** Conservation survey conducted on a M4 Sherman Tank (Photo: Jon Carpenter)

The project not only involved archaeologists and heritage managers but also included researchers from related fields such as marine biology and conservation science. Researchers from University of Sydney provided marine species identification to supplement the historical narrative of the underwater sites, as divers are equally interested in the marine life (see Chap. 10). Conservation scientists from the Western Australia Museum conducted an in situ conservation survey of sites both on and off the trail in order to collect baseline data about their preservation status for future monitoring (see Chap. 9). This data is critical to understanding how increasing diver visitation affects sites over the short and long term (Fig. 4.1).

Flinders University supported a field school that included 20 students and staff from Australia and the USA. This 2-week field school contributed greatly to the data collection of sites underwater as well as in the intertidal zone. Several master's theses were the result of student participation, four of which are included in this book (see Chap. 8).

## Legislation and Permitting

As with all scientific research conducted in the Northern Mariana Islands, prior to commencing fieldwork, it was necessary to consult with appropriate regulatory agencies. At the Federal level, these provisions included the National Historic

Preservation Act of 1966, as amended (PL 89-665); the Archaeological and Historic Preservation Act, as amended (PL 93-291); the Abandoned Shipwreck Act of 1987; and the Advisory Council on Historic Preservation revised 36 CFR Part 800 Regulations. The CNMI government also required that research be consistent with the goals and strategies outlined in *Pacific Preservation*: *The Commonwealth of the Northern Mariana Islands-2008 Historic Preservation Plan* and that the work is conducted under CMNI statutes including Public Law No. 3-39, Commonwealth Historic Preservation Act of 1982, and Public Law No. 3-33, Removal of Human Remains. After reviewing the proposed research design, HPO determined that the project posed no significant threats to any cultural resources and that no additional permit was necessary as all work would fall under a non-disturbance category.

As a result of increasing pressure on marine and coastal ecosystems from activities such as fishing and tourism as well as indirect impacts associated with pollution and sedimentation, in recent years, the CNMI government has established several marine protected areas (MPAs) (van Beukering 2006, p. 88). Located at different areas around the island, these include a number of sanctuaries and conservation areas intended to protect the different marine environments and allow for their management. Particularly relevant to this project was the Mañagaha MPA which is located within Tanapag Lagoon on the island's western side. Encompassing approximately 12 % of Saipan's total lagoon system, this MPA surrounds the small reef island of Mañagaha and provides protection for a rich diversity of coral and fish species (Schroer 2005). Since some of the site locations for the trail fall within the boundaries of an MPA, consultation with the Department of Fisheries and Wildlife (DFW) was also required. In order to conduct survey operations within the Mañagaha MPA, a Scientific Research License (Subsection 85-30.1-205) was required and issued by the DFW.

## Project Location and Logistics

The underwater sites investigated for this project are all located within two of Saipan's three lagoons. Created by a shallow fringing reef that runs along much of the island's western side, these are typical high-island barrier reef lagoons (Amesbury et al. 1979; Burns 2008a, b) and provide an exceptional environment for conducting underwater archaeological surveys. The northernmost and largest of the two is Tanapag Lagoon, which is characterized by a sandy seabed interspersed with a multitude of patch reefs. Depths in Tanapag range from less than one meter at its northern end to approximately 14 meters (m) in the shipping channel near its southern end. Located just to the south of Tanapag Lagoon and much smaller in area, Garapan Lagoon has an average depth of less than 3 m (Amesbury et al. 1979; Burns 2008a, b) and is largely covered with sea grasses and patches of sand. Though it is likely that many other wrecks associated with the Battle exist in deeper water on the seaward side of the fringing reef near both lagoons, those areas were not included in the project boundaries.

## *Project Vessels*

Because the fringing reef provides protection by acting as a break to the large swells experienced offshore, the operational conditions in the lagoons are generally favorable year-round. Though occasionally affected by inclement weather, the sea state within the lagoon is usually calm with wave heights of less than half a meter. As a result, the size of the vessels used for this project varied based on the number of divers onboard and the planned activities. During the July 2009 and February 2010 fieldwork, CRM and DEQ provided support to the project through the use of vessels and staff. The center console-style boats ranged in length from 5 to 7 m and proved to be optimal for the skin diving, scuba diving, and towboarding activities undertaken during this phase of the project.

The Flinders field school held in June 2010 required larger working platforms, and local dive boat charter Saipan Aqua Jet was contracted to provide two 9 m rigid hull inflatable vessels. Equipped with jet propulsion systems, these were a safe and effective diving platform for the almost constant diving operations each day. Though these vessels were later sold to another charter company—Axe Murderer Tours—one of them was again chartered in February 2012 for the in situ survey and filming project.

## *Diving Safety Considerations*

Saipan's tropical location is also ideal for diving operations. Since the air and water temperatures fluctuate only slightly throughout the year, the lagoons are home to an abundance of coral species and tropical fish, and the reefs are well known to divers around the world. Though the island has a thriving diving tourism industry, the local hospital does not house an operational recompression chamber. In cases of diving-related injuries requiring a chamber, victims are transported to Guam for treatment. For daily diving operations, oxygen safety kits were kept onboard at all times.

Diving conditions were considered comfortable and most participants could work underwater for extended periods in a bathing suit or 1 millimeter (mm) dive skin. Currents experienced in the lagoons are seasonal and result from tidal activity; they are, however, generally less than 1 knot so posed little threat to project divers. With the exception of a few sites located in the shipping channel, visibility on sites surveys averaged 20 m, which maximized working time underwater. The visibility also helped divers avoid contact with the fragile coral growth attached to most of the sites as well as with any hazardous marine life such as lion fish, striped catfish, or cone shells that can be found in Saipan's lagoons.

All skin and SCUBA divers were overseen by experienced and qualified project staff, and relevant information for each dive was recorded in an official log. A number of the air cylinders required were supplied by CRM as support to the grant, while others were rented on a daily basis through one of the island's many dive shops.

Though the shallow depths at most of these sites would have allowed for extended dives, a 60 min maximum dive time was observed. To ensure that divers had sufficient time to rest between repetitive dives, a surface interval of 60 min was also required. Basic archaeological equipment including tapes and slates were utilized during the survey and mapping of the sites. Though the majority of the necessary equipment was supplied by Flinders University as an in-kind contribution to the grant, HPO and CRM also provided the use of some underwater survey gear.

## *UXO*

Perhaps the most serious safety concern for this project was the potential for encountering UXO. US ships anchored offshore provided an almost constant barrage of cannon fire in support of the forces attempting to land on the island's beaches, while Japanese forces were fending off the invasion with their own fire power. Aircraft also flew almost incessant strikes throughout the battle, dropping bombs and strafing heavily armed Japanese ships and planes within the harbor. And though many of the projectiles successfully hit their intended targets, others fell short and failed to detonate. As a result of wartime and postwar demolition activities, the seabed around the island is littered with unexploded ammunition. Despite numerous efforts to clear the UXO from the lagoons, its presence on at least some of the sites surveyed was expected, and all project staff was made aware of its dangers. Due to the potentially volatile condition of UXO, when it was identified, operations in those areas ceased. The location of the ordnance was then recorded using the global positioning system (GPS), and a description of it was reported to DEQ, the agency tasked with professionally removing it from the lagoon.

## Recording Known and Unknown Sites

Among the first considerations for undertaking the archaeological component of this project was identifying and evaluating underwater WWII sites to determine their possible inclusion on the heritage trail. Initial consultation with staff from the various agencies, data contained in previous survey reports, and information obtained from local divers all indicated that a number of wrecked aircraft, ships, and landing vehicles were known and dived on regularly. Several of these sites were first identified by local scuba divers and have become well known as recreational diving spots. These include the remains of the possible Japanese freighter *Shoan Maru*, known locally as "the shipwreck" or "chinsen"; an H8K Kawanishi "Emily" flying boat, known locally as a "B-29"; the remains of a possible Japanese submarine chaser; and a Japanese Aichi E13A "Jake" float plane, known locally as a "Zero" (Fig. 4.2).

GPS coordinates for these known sites were obtained and cross checked with the locations for sonar and magnetic anomalies identified by SEARCH (Burns 2008a, b).

**Fig. 4.2** Bow of Japanese Daihatsu landing craft (Photo: Brett Seymour)

Each of these corresponded with significant remote sensing targets, and from this review, a list of potential targets was ascertained and used to initiate a program of site assessment and diver visual surveys beginning in April 2009 and continuing throughout the project. A site inspection sheet was completed for each site, and photographs and video of the site were collected. A professional photographer and videographer, Valeo Films, was hired to collect high-quality photographs and video for use in interpretive materials. This proved advantageous as often maritime archaeologists are not trained in photography or the photographs collected are typically more scientific and therefore are often not suitable for interpretation.

An assessment was prepared to determine whether or not the site would be included in the trail. This assessment was made based on several criteria including accessibility for scuba and snorkel, site interest (i.e., visually stimulating, marine life, intact, and recognizable), safety (i.e. existence of UXO), existing dive traffic (i.e., already a regular dive site or a new site), vulnerability or uniqueness (which might exclude a site), and representativeness (i.e., US versus Japanese and aircraft versus shipwreck versus vehicle).

For the sites that were ultimately destined for the trail, up-to-date and accurate site plans were necessary for the interpretive materials as was collecting baseline data on their condition for future monitoring. The project employed several techniques including baseline offsets and trilateration. For the sites that had existing scaled construction plans, those plans were copied onto Mylar and used to annotate changes and check measurements underwater. This process worked well as it sped up the measuring and drafting processes tremendously.

All data was stored centrally and later supplied to HPO as a package along with the reports. The locations of sites were also added to a geographic information system (GIS) database. A KOKOA analysis (Key Terrain, Observation and Fields of Fire, Cover and Concealment, Obstacles, Avenues of Approach) was conducted as a condition of the ABPP grant and presented in the final grant reports.

## *The Sites*

A total of 24 sites were recorded during the 2010 and 2012 underwater archaeological surveys in Saipan; these include 10 shipwrecks, 5 aircraft, 7 assault vehicles, and 1 aid to navigation (Table 4.1). Several of these sites were known through previous survey but had not been fully recorded archaeologically. The majority of the sites now have archaeological site plans; however, all of them are photographically documented and site assessment reports have been completed. It is hoped that with future funding, these sites can be assessed for and included on the National Register as a group or district listing and may be added to and expand the existing national landmark in the Landing Beaches area.

**Table 4.1** List of underwater WWII sites recorded in Saipan, CNMI

| Name of site | Affiliation | Date recorded | Trail |
|---|---|---|---|
| Merchant Ship, presumably *Shoan Maru*/Chinsen | Japanese | 2010 | Y |
| Possible auxiliary submarine chaser—main site | Japanese | 2010 | Y |
| Possible auxiliary submarine chaser—secondary site | Japanese | 2010 | N |
| Sherman tank 1 | US | 2010 | Y |
| Sherman tank 2 | US | 2010 | Y |
| Sherman tank 3 | US | 2010 | Y |
| LVT(A)-4 | US | 2010 | Y |
| Fishing base landing vehicle | US | 2010 | N |
| Fishing base landing vehicle 2 | US | 2010 | N |
| Landing craft | US | 2010 | N |
| Possible landing craft in shoreline | US | 2010 | N |
| Barges | US | 2010 | N |
| Barge near Japanese lighthouse | US | 2010 | N |
| Daihatsu landing craft 1 | Japanese | 2010 | Y |
| Daihatsu landing craft 2 | Japanese | 2010 | Y |
| Kawanishi H8K “Emily” aircraft | Japanese | 2010 | Y |
| Aichi E 13A “Jake” aircraft | Japanese | 2010 | Y |
| Martin PBM Mariner aircraft | US | 2010 | Y |
| TMB Avenger aircraft | US | 2010 | Y |
| Navigational marker | Japanese | 2010 | N |
| Unidentified steamship | Japanese? | 2012 | N |
| LVT 2 | US | 2012 | N |
| Daihatsu landing craft 3 | Japanese | 2012 | N |
| PB2Y Coronado aircraft | US | 2012 | N |

## Conclusion

Over the course of 6 weeks of fieldwork in 2010 and 2012, a large number of WWII-era underwater sites were archaeologically recorded, and several other potential targets were tested. This achievement would not have been possible were it not for the multiagency approach implemented early in the development of this project. The island of Saipan has a diverse array of stakeholders, managers, agencies, and public who are vested in the submerged heritage that lies in its waters. Through a collective, inclusive approach that recognizes the strengths and benefits of all stakeholders, a small proportion of Saipan's WWII heritage is now known and the outlook is bright for its protection. The more involved means the more invested.

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# Chapter 5
# In the Drink: Sunken Aircraft of the Battle of Saipan

**Samantha Bell**

## Introduction

The study of submerged aircraft as an archaeological resource is not common in the field of maritime archaeology. Most archaeologists in the field are not trained to understand these sites as extensively as shipwreck sites. Cooper accentuates this point by stating, “I am a nautical archaeologist whose work in developing a program for naval submerged cultural resources management ran headlong into the problems of evaluating submerged aircraft wrecks as a potential cultural resource” (Cooper 1994:135). However, as recently as January 2014, the Society for Historical Archaeology conference hosted a session specifically aimed at the study of submerged aircraft, which emphasizes the growing concern and interest with these types of sites. As this curiosity for submerged aircraft as an archaeological resource expands, the necessity of theoretical research is needed to broaden the spectrum of aircraft studies moving their research into the academic field of underwater archaeology.

One of the best ways to broaden our theoretical knowledge of these sites is by researching and understanding their site formation. Muckelroy defines shipwreck site formation as the process through which an organized assemblage of artifacts comprising a ship and its contents must pass through to produce the collection of items observed on the seabed (Muckelroy 1978:157). As the wrecking events of aircraft and ships are vastly different, it is speculated that the processes affecting their site formation may also be distinct. It is necessary to understand the various factors that may affect the site formation of submerged aircraft wreck sites to determine if there is a correlation with shipwreck site formation. This chapter will explore the site formation of four submerged WWII aircraft sites in Saipan, CNMI and anticipates

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its use in future examinations of these types of archaeological resources along with some of the previously established investigations (Coble 2004; Jung 1996, 2001, 2007a, b, 2008a, b, 2009).

## Aims and Objectives

The aim of the research conducted was to answer three questions relating to the theoretical and methodological practice in submerged aircraft archaeology:

- Can submerged WWII aircraft sites in Saipan, CNMI be investigated and understood using previous shipwreck models of site formation "process-oriented framework?"
- What adaptations to shipwreck site formation "process-oriented frameworks" are necessary for the interpretation of submerged aircraft sites?
- Does a site formation "process-oriented framework" developed for submerged aircraft wrecks allow for a comparative analysis and broader understanding of those aircraft and the cultural and environmental factors involved in their observed distribution on the seabed?

The four submerged aircraft sites researched in this study include an Aichi E13A (Aichi) Japanese reconnaissance floatplane, a Kawanishi H8K (Kawanishi) Japanese flying boat, a Martin PBM Mariner (Mariner) American flying boat, and a TBM Avenger (Avenger) American torpedo bomber. All four sites were involved in WWII operations and vary drastically in their observed site distribution. This chapter proposes adaptations to previously established shipwreck site formation models in order to comprehend submerged aircraft sites and processes in their site formation.

As established in previous chapters, the research conducted on the submerged aircraft sites were part of a larger project by Flinders University and Ships funded largely by the NPS ABPP grant and focused on the submerged remains from the Battle of Saipan during WWII.

## Background

### *Site Formation Literature*

Muckelroy (1978) published the seminal work on shipwreck site formation discussing the importance of identifying various processes that affect shipwreck sites in order to decipher the evidence present on the seabed. He introduces a visual diagram of a ships' wrecking event and the factors that affect it. These factors can be placed in two distinct categories: cultural factors affected by human inference including, but not limited to, jettisoning, salvage operations and recreational diver impacts (Gibbs 2006:4), and environmental factors which affected the physical, biological, and chemical environment in which the shipwrecks lie (Ward et al. 1998:561). Two notable expansions include Gibbs (2006) who takes a further in-depth look at the cultural processes affecting site formation and Ward et al. (1998) who provide a framework for natural processes involved in shipwreck site formation.

In Gibbs (2006) research, he proposes, "by adopting a process-oriented framework, we can integrate and synthesize the documentary, oral and archaeological evidence of human response to shipwreck into a structure which parallels the physical progress of danger." Gibbs suggests that in order to understand cultural processes, an understanding into the nature of the event is necessary. A "catastrophic" shipwreck event is going to have a different human reaction than a wreck that has been "intentionally deposited" or an abandoned vessel (Gibbs 2006:7). Gibbs provides definitions for two separate types of salvage including systematic salvage, involving professional salvers who are commissioned to remove all or some of the wreck material and/or cargo, and opportunistic salvage, a nonsystematic removal of material which is dependent on the accessibility of the shipwreck.

The research completed by Ward et al. (1998) examines environmental processes affecting shipwreck sites including the physical, biological, and chemical factors. Physical processes include various items which can cause physical changes to the wreck site, such as sediment scouring or loss in wreck structure due to wave action (Ward et al. 1998:562). Biological processes may include burrowing organisms or biological growth; this can be measured using growth rate equations (Ward et al. 1998:563). Chemical processes involve the reaction of the chemical make-up of shipwreck products with the sea; these processes can be measured using corrosion rate and growths rates of concretions (Ward et al. 1998:563).

The terminology and factors investigated above provided the backbone for the research conducted on the submerged aircraft sites in Saipan. The combination of all three was used as a basis of comparison between site formation processes affecting shipwreck sites and those processes that affect the submerged aircraft sites studied.

## *Site Descriptions and Histories*

Naval air forces played an essential role for both Japan and the US throughout WWII in the Pacific and in the US victory at Saipan. In a summary report describing their victory in the Pacific War, the US military asserts that control of the air was essential to the success of every major military operation in the Pacific. Air bombardments weakened Japanese forces prior to ground forces' penetration of Saipan by focusing their attacks on airfields and Japanese aircraft (Mason 1986:205). Below is a brief summary of the wreck sites and a short history of the four aircraft examined in this research.

## Aichi E13A

The Aichi, Allied code named "Jake," was a Japanese long-distance reconnaissance floatplane. This aircraft has the least visible damage of the aircraft sites examined and is located in 6 m of water on a relatively flat sandy seabed listing to port. The end of the tail and port wing are partially buried in sediment and sand shifts seasonally on site, but it never covers completely. One of the floats lies nearby the wreckage along with an unrelated landing gear component from another aircraft. This aircraft lies inverted on the seabed with some notable features including bomb dropping mechanism, hatch used for reconnaissance work, and a pontoon (Fig. 5.1).

The Japanese operated more aircraft of this type than any similar aircraft type during WWII (Francillon 1970:277). The Imperial Japanese Navy (IJN) required a long-range floatplane to provide escort to maritime convoys (Caoimh 2004:154). The first prototype of the Aichi E13A1 was completed in 1938 with a 1,060 hp Mitsubishi Kinsei 43 14-cylinder, air-cooled radial engine (1970:277). The Aichi E13A1 flew in reconnaissance patrols before the attack on Pearl Harbor (Caoimh 2004:154). It was used in bombing missions during the war where air opposition was limited. The aircraft did have its limitations including a small fuel tank, minimal crew protection, and limited defensive armament.

**Fig. 5.1** Flinders University student photographing the Aichi floatplane (Photo: Valeo Films)

## Kawanishi H8K

The Kawanishi, Allied code named "Emily," was a large four-engine Japanese reconnaissance flying boat. This aircraft lies inverted in 9 m of water with a substantial wreck site distribution. The main wreckage consists principally of the wing and other scattered components such as the four engines and propellers, bow gun turret, cockpit, and painted sections of the fuselage. This site is visited heavily by recreational divers and includes both Korean and Japanese monuments.

Its performance during WWII was considered exceptional with fast flying capabilities and superior hydrodynamic qualities than any American, British, or German contemporary (Green 1962:13). Design of the Kawanishi began in August 1938, after the IJN contracted Kawanishi Kokuki K.K. to develop a large four-engine maritime reconnaissance flying boat (Francillon 1970:307). Armament was also an important issue in the design, and Kawanishi developed the defense armament with three turrets (nose, dorsal, and tail) with 20 mm Type 99 Model 1 cannons as well as 7.7 mm machine guns in each of two hatches. When used in its original role as a maritime reconnaissance aircraft, it proved successful as the aircraft was able to complete its mission and defend itself appropriately (1970:309). Kawanishi received the reputation from allied forces as being one of the hardest Japanese aircraft to shoot down (Francillon 1970:310). In the Pacific, Kawanishi's were used extensively as reconnaissance planes, bombers, and transports (Jablonski 1972:232). The Kawanishi is considered to be the finest and fastest flying boat of WWII (Jablonski 1972:231; Allward 1981:119).

## Martin PBM Mariner

Mariner was a US flying boat used in offensive campaigns during WWII. It lies inverted on the sandy seabed in 7 m of water with a substantial site distribution. Overall damage to the aircraft structure is quite extensive, and the site is highly disarticulated and scattered over a relatively large area that likely indicates a catastrophic wrecking event. The engines and propellers are missing from site. The gun turrets, the tail section, and a portion of the cockpit are distributed over a 150 m area; other features of this site include gun turret, gun mount, ammo boxes, control levers, tail section, and the aircraft's discernible dihedral wing.

Mariners participated in all major campaigns in the Pacific including the Battle of Saipan where it participated in attacks on Japanese submarines, freighters, and aircraft (Hoffman 2004:xiii). The Mariner has been dubbed the "fighting flying boat" due to its service as a heavily armed reconnaissance flying boat (Hoffman 2004:1). The Mariner is often overshadowed by the infamous Catalina flying boats; however, the Mariner offered considerable military capability in comparison to the Catalinas. The Martin PBM Mariners were the second most widely used US flying boat during WWII (Allward 1981:116). With the mission to rescue downed airmen, the Mariner was a significant aircraft. Mariners were used for search, patrol, reconnaissance, and rescue missions during the Battle of Saipan (Hoffman 2004:39). After US troops declared victory in Saipan, PBM Mariners used the Japanese-built seaplane bases in Tanapag Lagoon as it provided protection from rough waters.

### TBM Avenger

The Avenger was a US torpedo bomber which was the most widely produced naval strike aircraft of all time (Tillman 1999:6). The aircraft lies inverted on the barrier reef in 3 m of water with a condensed site distribution mainly consisting of the central portion of the wing and extended landing gear. The aircraft is mostly submerged; however, the hydraulic landing gear is exposed at extreme low tides. The Avenger is missing its tail section, engine, and propeller although a few small sections of the wreck are scattered within 20–40 m. Other site features include part of a radial engine, a section of fuselage with an observation port, a turret ring, and radio box.

The Avenger played a significant role in the Battle of Saipan providing offensive support that contributed to the US victory. Avenger received its name from the Japanese attack on Pearl Harbor on 7 December 1941. General Motors produced thousands of Avengers during WWII; the Avenger was known as a rugged torpedo plane which was effectively used against surface vessels in the Pacific theater. Avengers participated in the initial air bombardments and strafing of Saipan preceding the ground troop landings (Hoffman 1950:36), and squadrons were focused on attacking Japanese aircraft carriers and combating Japanese aircraft units. Avengers also served with the Royal Navy, Royal New Zealand Air Force, and the French Navy.

## Methods

Chapters 1 and 3 have covered some of the preliminary investigations conducted by the NPS SCR and SEARCH on the sites in 1991 and 2008, respectively (Burns, 2008a, b). During the February 2010 field season, site plans were developed for the four aircraft sites using trilateration to accurately plot the wreck scatter on the seabed. The trilateration method enabled smaller movable objects of the site to be added to the site plan, but the focus during this field season remained on the identifiable aspects of the wreckage. Both the Aichi and the Avenger were fully recorded during this time due to their small size and limited wreck scatter. However, time restraints during this field season limited the amount of wreckage measured on the Mariner and Kawanishi. Any wreckage not documented during the February 2010 field season was recorded in June 2010 using radial and circle searches completed at various datum points on the wreck site. The February 2010 site plans were used for the positioning of new items found in relation to already recorded items. The items were recorded using distances from the datum point and compass bearings.

During the June 2010 field season, a photographic survey was used as the primary method of documenting the cultural and environmental impacts on the aircraft sites for their comparison to formation processes affecting shipwreck sites. This documentation provided insight to changes in the site distribution over time even between the February 2010 and June 2010 field seasons. Four different cameras were used during this survey including Ixus 990 IS, Canon PowerShot A640, a Canon PowerShot A630, and a Canon Digital Ixus 990 IS. Examples of photographic evidence collected during the environmental survey included biological data, evidence of disintegration, and presence of rust. To collect the cultural impacts on the sites, dive teams focused on visibly identifying examples including evidence of salvage, material subsequently deposited on site, movement of artifacts on the seabed, and the presence of graffiti. Evidence of the wrecking event was also noted as there were clear differences in the type of wrecking event endured by each aircraft.

## Analysis

A comparative analysis of the site formation processes was performed in accordance with established shipwreck models developed by Muckelroy (1978), Ward et al. (1998), and Gibbs (2006). The analysis of the aircraft has been broken into two sections including environmental impacts affecting the aircraft sites and cultural impacts. An in-depth look of the individual aircraft sites can be found in the master's thesis by this author (Bell 2010).

### *Environmental Impacts*

All four aircraft have relatively similar environmental profiles. The sites are located in Tanapag Lagoon and are mostly protected from wave action, strong currents, and sand scouring due to the lagoon's fringing reef. The Kawanishi, Aichi, and Mariner are all considered to be located in a low energy hydrodynamic environment. The Avenger is the only site affected by wave action causing disintegration of larger portions of the wings primarily along the connecting seams of the aluminum. There were no signs of sand scouring found on any of the four aircraft sites. The fine grain sand sediment budget is consistent on all four sites and does not appear to have any adverse effects on the aircraft. The movement of sand on the seabed was noted as being seasonal based on observations during the February and June 2010 field seasons.

A mucilaginous layer as described by MacLeod (2006) is prevalent on all sites, although its presence on the Avenger wreck is minimal, likely due to its location on the fringing reef. Coral growth is also observed on the aircraft and is most prominent on sites with exposed components rich in iron. The Avenger is the most affected by environmental processes where coral growth has dominated the aircraft structure, and disintegration is prominent. As a result of its location on an entirely sandy seabed, the Aichi is affected the least by environmental processes including coral and marine growth. A variety of fish species and invertebrates are found on the four aircraft sites, but their presence does not appear to adversely affect the aircraft themselves. Although the Avenger is located on the reef, fewer species of fish were noted near the aircraft than accounted for on the previous sites (see Chap. 10 for details about species counts).

## *Cultural Impacts*

The preliminary data comparing the cultural processes established for shipwreck sites with the processes found on the four known submerged aircraft wreck sites in Tanapag Lagoon is shown in Table 5.1. While it is apparent that many processes which affect shipwrecks similarly affect aircraft sites, there are several processes which do not affect the aircraft sites investigated in this study including a lack of evidence to suggest a deliberate running shore, refloating, jettisoning, salvage of jetsam/lagan/flotsam, or survivor salvage on any of the sites. All four sites have experienced a variety of foreign material deposition from subsequent human interactions. This material takes several forms including refuse, monuments, mooring ropes, and high voltage cables.

Both types of salvage are apparent on the aircraft sites. Evidence of systematic salvage was evident on three of the four sites. Some examples include the missing engines on the Mariner and missing tail fin and ailerons on the Aichi. Opportunistic salvage is only observed on the Kawanishi site, which is evidenced by the aircraft identification plate retrieved by a local dive shop owner. It is possible that the other sites have also experienced opportunistic salvage, but no discernible evidence was recorded.

Archaeological evidence suggests the intentional deposition and abandonment of the Aichi wreck site. This is indicated by the appearance of bullet exit holes and crimping near the tail of the aircraft as well as unassociated landing gear adjacent to the wreck. It is suspected that the crimping could be due to lifting the aircraft on or

**Table 5.1** Cultural processes affecting the sites

| Cultural processes for shipwrecks | Aichi | Kawanishi | Mariner | Avenger |
|---|---|---|---|---|
| Deliberate running ashore | – | – | – | – |
| Refloating | – | – | – | – |
| Jettisoning | – | – | – | – |
| Salvage of jetsam/lagan/flotsam | – | – | – | – |
| Survivor salvage | – | – | – | – |
| Systematic salvage | ✓ | – | ✓ | ✓ |
| Opportunistic salvage | – | ✓ | – | – |
| Intentional deposition | ✓ | – | – | – |
| abandonment | ✓ | – | – | – |
| Material subsequently deposited on sites | ✓ | ✓ | ✓ | ✓ |

off a vessel or towing with the use of a chain or rope. The bullet holes could be an indication that the aircraft was damaged and not worth retaining or the aircraft could have been shot to hasten the disposal of the aircraft. A similar process was apparent at the "scuttling" of the PBY Catalina flying boats of Rottnest Island, where one source indicated the use of tomahawks to create holes in the side of the aircraft in order for the craft to sink (McCarthy 1997:7).

Material subsequently deposited on site was observed on all sites and was most distinguishable on sites regularly visited. Refuse was noted on all sites, and a high voltage cable marker was visible on the Avenger site. The Kawanishi wreck site is visited most frequently by divers and thus experiences greater cultural impacts than the other sites. Interaction between the diving public and wreck sites can be described as a "scrambling device" with the movement of small mobile objects as observed on the Kawanishi and Mariner sites through the piling of ordinances and other small artifacts. It is suspected that as the knowledge of the Mariner becomes more widely known, it too will experience some of the similar effects by the diving public as the Kawanishi.

There are many similarities between the processes affecting shipwreck sites and submerged aircraft sites. The extracting filters observed on the wrecks include the process of wrecking, both systematic and opportunistic salvage, and the disintegration of perishables. While it was not discernible whether or not jettisoning occurred during the wrecking event of these sites, the extension of the Avenger landing gear suggests a form of "pre-impact warning" as described by Gibbs (2006). Scrambling devices recognized as affecting submerged aircraft sites include the process of wrecking, seabed movement, and modern influences. Even though none of the sites appear to be visibly affected by seabed movement, the site distribution of the Catalina wrecks sites in Roebuck Bay, Western Australia has been subject to extreme tidal changes and cyclones which vastly affected the site formation (Jung 2008a:274). The development of the observed site distribution is highly impacted by modern influences including the movement of small artifacts by recreational divers, graffiti, memorials, refuse, and anchor damage. These items may not be exclusive to submerged aircraft sites but include items not previously discussed as processes in the site formation of shipwrecks.

## Conclusions

Based on this analysis, it can be concluded that aircraft are capable of being investigated and understood using previously developed shipwreck models. Submerged aircraft undergo certain environmental and cultural processes that also affect the formation of shipwreck sites. The Avenger experiences a high energy hydrodynamic environment which is susceptible to physically dominated deterioration and high level of coral growth. The remaining sites encounter low energy environments that are subject to chemically and biologically dominated deterioration through a mucilaginous biological layer with intermittent coral. These are the same environments experienced by shipwreck sites; however, their compositional and structural differences make their corrosion rates incomparable.

Cultural factors affecting shipwreck sites include extracting filters and material subsequently deposited on site through the process of wrecking, jettisoning, and systematic and opportunistic salvage as described by both Muckelroy (1978) and Gibbs (2006). Gibbs also includes a disaster response framework contributing to the observed seabed distribution of shipwreck sites. As the aircraft wrecking process typically occurs relatively quickly, there may be little reaction time in the pre-impact phase by the pilot and crew. Possible actions or strategies by the pilot and crew may include self-ejection, fuel dumping, evacuation, and an attempt to slow or stop the aircraft from wrecking. The fully extended landing gear on the Avenger wreck site is an example of what may be present on site to demonstrate a response to the pre-impact phase.

Cultural response to the impact stage of the wrecking process of aircraft is difficult to determine from the archaeological record. It is suspected that if one survived the wrecking event, one would gather necessary items for their survival until rescued. Unlike shipwreck sites, it does not seem feasible that the crew would need to jettison heavy items or attempt a refloat of the aircraft. However, further study may prove that in some cases, crew members do in fact jettison certain items in the aircraft. Other items such as safety equipment and distress signals may be used in order to attract attention for rescue and for survival purposes. While not examined in this study, the development of a survivor camp in the recoil stages has been recorded as an option for aircraft that have wrecked near shore.

Additional cultural factors can be investigated through certain extracting filters including the process of wrecking, systematic salvage, and opportunistic salvage. Systematic and opportunistic salvage are processes of the rescue and post-disaster response stages. Both systematic salvage and opportunistic salvage were observed on the sites examined and should be considered when examining submerged aircraft sites. Although the posttrauma stage of disaster response is not found in the archaeological record, it is a process that also affects survivors of the wrecking event. If the aircraft wreck was a casualty of war, the posttraumatic effect can have a profound consequence on the life of a survivor. While the factors outlined by Muckelroy, Gibbs, and Ward et al. are typically pertinent to submerged aircraft sites, this study determined that additional variations are needed.

A submerged aircraft-specific site formation diagram incorporating ideas from Muckelroy, Gibbs, and Ward et al. and including necessary adaptations can be found in Fig. 5.2. Gibbs' addition to Muckleroy's diagram includes systematic salvage occurring before the disintegration of perishables, followed by opportunistic salvage, all of which involve the extraction of material from the wreck sites. Due to their presence on the sites studied, storage, intentional deposition, and abandonment are also incorporated into the diagram. Environmental factors contributing to the observed wreck distribution are exhibited as scrambling devices and extracting filters. As the same environmental processes affecting shipwreck sites also affect submerged aircraft sites, no adaptations were necessary for this aspect of the diagram. However, it should be noted that aircraft, particularly WWII aircraft, are not constructed to

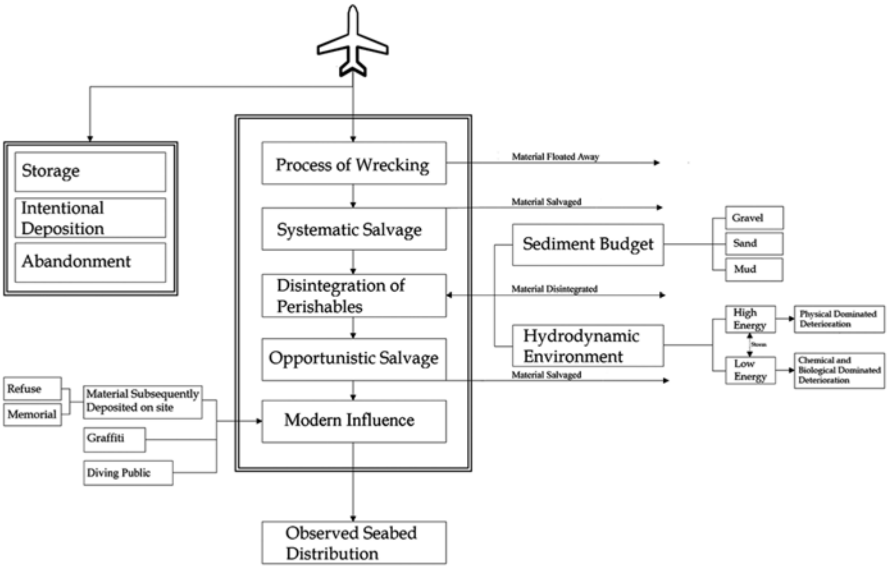


**Fig. 5.2** Flow diagram featuring environmental and cultural factors affecting submerged aircraft sites

last for substantial lengths of time (Whipple 1995:11). Additionally, aircraft are manufactured of lighter material for longer flight times and aerodynamic properties. Bearing this in mind, submerged aircraft wreck sites are going to have different interactions with their natural environment than shipwrecks, as they are comprised of strong heavy material built to survive the harsh conditions of the sea.

The major difference in the site formation models developed for shipwreck sites and the proposed submerged aircraft diagram are the addition of modern influences. This process on aircraft wreck sites is multifaceted, yet it is essential to recognize, as it contributes to the story of the aircraft wreck and the evolution of its distribution on the seabed. Material subsequently deposited on site is one example of a modern influence that affects the observed seabed distribution and can be classified as two distinct categories: refuse and memorial. Refuse, or material deposited on site without a particular purpose, is most apparent on sites examined where cans and bottles are scattered among the wreck assemblage but were unassociated. The second type is memorials found on site incorporating material into the site assemblage. An example of this process would be the Kawanishi wreck site that includes two monuments from separate nationalities deposited on the wreck site: Korean and Japanese. It is important to consider the significance of the Korean monument and the motives for placing a monument on a Japanese WWII aircraft. Carrell's report on the submerged resources in Micronesia exhibits the Aichi's propeller with an empty sake bottle and memorial prayer stick (Carrell 1991). These items cannot be situated in the same category of refuse as their placement on site serves a specific purpose and represents a distinctive chapter in the history of the wreck site.

Graffiti is an additional process of modern interaction which has an effect on the aircraft examined in this study. This process cannot be classified as an extracting filter, scrambling device, or material subsequently deposited on site as the graffiti observed was etched into the biological mucilaginous layer forming on the aluminum wing of the Kawanishi. Thus this process is in a category of its own as a contributor to the observed seabed distribution. The presence of graffiti has been noted on land-based public interpretive signs on shipwreck trails (Smith 2003:126); however, graffiti is often seen as vandalism on archaeological sites as an unacceptable form of social behavior (Moser 1992). Field argues that graffiti over a period of time may retain historic significance as a contributor to our understanding of an archaeological site (Field 2009:52). As the graffiti appears to be in the form of initials, it is difficult to determine if its presence is due to memorial, vandalism, or an alternative reason.

Modern influences can be considered a scrambling device through the process of public diving interactions with the wreck site. The Kawanishi and Mariner are excellent representations of how recreational diver activities can act as a scrambling device. Kawanishi is a well-known recreational dive site in Tanapag Lagoon, and the effect of divers as a scrambling device can be seen through the movement of objects on site including piling small artifacts around the small Japanese memorial and the movement of the ladder onto the aircraft wing. The movement of these objects has a substantial effect on the sites, as even between the February and June 2010 field seasons, the cockpit of the Kawanishi aircraft had been broken from its mount and subsequently balanced on its original location by the diving public.

A site formation "process-oriented framework" developed for submerged aircraft does allow for a comparative analysis and a broader understanding of factors involved in their observed wreck site distribution. While it is true that an archaeological investigation may be conducted using previously developed shipwreck site formation models on submerged aircraft sites, the additional processes proposed above help contribute to a further understanding of these sites. If modern influence as a site formation processes is necessary to understand the observed seabed distribution, then comprehension of the public attitude around aircraft sites is also essential.

It is important to understand the contemporary nature of aircraft and the passion the public has for wrecked aircraft. The search for aircraft wrecks seems to be an obsessive passion aimed at preserving the history or story of aircraft wrecks. Most authors who have written books on the subject recognize some kind of connection with the aircrafts, whether it is a veteran who previously flew the aircraft for the military or a childhood fascination (Hoffman 2001, 2004). This is important to consider when investigating aircraft sites archaeologically.

This study serves as preliminary research into site formation of submerged aircraft and has immense potential for future research. Further study into site formation processes of submerged aircraft sites will continue to broaden our understanding of these sites, as aircraft wrecks are from recent history and in general are not associated with the sea, and the public reacts differently to this type of site than a shipwreck site. This should be acknowledged by heritage managers in developing a management plan for these sites in order to fully understand the significance of submerged aircraft sites.

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# Chapter 6
# Whatever Works: Amphibious Tractors and Field Expedient Armor Modifications

**W. Shawn Arnold**

## Background

The LVT, also known as the AMTRAC or Amptrac, was essential to US forces during WWII in the Pacific Theater. The vessel possessed the unique ability to travel both in and out of the water allowing it to perform a diverse role in the war. Constructed of steel and kept afloat by air contained in pontoons located on both sides of the vehicle, the LVT's amphibious capability was achieved by a single engine propulsion system consisting of tracks mounted on the port and starboard sides. The vessel's tracks contain cleats known as grousers that act as paddles in order to propel the vehicle through the water and provide traction while crossing reef flats and shoreline terrain (United States Marine Corps Air-Ground Museum 1997).

Carrying capacity and the intended mission of the LVT changed through time and design alterations reflect these changes in the vehicle's seriation. The versatility of the LVT allowed for easy adaptation of a wide range of roles in amphibious warfare. The first military production model, the LVT-1, was introduced during the Solomon Islands campaign in 1942 (Croizat 1999). This model was originally intended to only carry cargo to the landing zone once troops secured the beachhead. However, because some Pacific islands possessed a fringing reef too shallow for traditional landing craft to cross, LVTs were used to ferry the invading forces to the shoreline (Croizat 1999). This change in the LVT's mission affected military doctrine for the remainder of WWII in the Pacific Theater.

Military leaders praised the versatility of the LVT from its first combat use, although some of the troops riding in these machines referred to them as "death

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traps" due to their slow speed and extremely thin armor (Bailey 1976; Crowl 1959). As the war continued, it became apparent that additional modifications were needed and the production of diverse special purpose designs commenced. As a result, a definite seriation of LVT design exists from cargo carrier (LVT-1, LVT-2, LVT-3, LVT-4), to armored troop delivery systems (LVT[A]-2 and LVT-4 [Armored Cab]), to armored artillery platforms (LVT[A]-1 and LVT[A]-4; these models were also known as Amphibious Tanks or Amtanks).

The ability to drive invasion forces from naval ships, through the ocean, over shallow reefs and deliver them on shore prevented considerable causalities; the alternative was making the invasion force wade hundreds and sometimes thousands of meters across lagoons under heavy enemy fire (Bailey 1976). Invasion forces quickly added machine guns to their LVTs and devised ways to improve the LVT with other field expedient armor modifications (Barker 2004). Boal (2006) defines "field expedient armor modifications" as changes made to a vehicle after it has left the production facilities. Field expedient armor modifications are not unique to LVTs; in fact most military vehicles experience some level of modification in the field. However, LVT field expedient armor modifications seem to have directly influenced future production designs on a level unmatched by other vehicles. These modifications can be traced through the vehicles' seriation and stand testament to the ingenuity of the crews operating these machines and the manufacturer's flexibility in incorporating design changes.

## Amphibious Vehicle Use

Six-hundred troop-carrying LVTs combined with 136 Amtanks invaded Saipan (Rottman 2004; Crowl 1959). The troops were ferried from their transport ships to Landing Ship Tanks (LSTs) carrying the LVTs 6 days before the invasion in order to expedite the landing force formation. On the morning of 14–15 June 2014, the LVTs disembarked and formed abreast at their respective landing zones. US air and naval bombardments ceased once the landing vehicles neared the beach, leaving the Amtanks as the only artillery support for the troops arriving behind them (Barker 2004). The AMTRACS operators' objective was to reach to their designated landing beaches, move 200 yards inland unload troops, and then move further inland to what was called the "first objective line" (O-1 line) (Chapin 1994). The plan was to keep the beaches uncluttered for the arrival of subsequent waves of landing forces; however, the rugged terrain proved to be a challenge for the LVTs. Debris from previous air strikes and naval bombardments coupled with the rugged terrain of Saipan prevented the LVTs from initially penetrating to the O-1 line, forcing troops to disembark on the beach (Rottman 2004; Chapin 1994; Crowl 1959).

After the initial assault, commanders employed LVT-2s and LVT-4s in missions including ship-to-shore supply delivery, evacuating wounded to hospital ships, running supplies inland, assisting Underwater Demolition Teams with blasting a boat channel through the reef, firefighting, and using salvage vessels for pushing stranded landing craft off the reef (Croizat 1953). Once the landing beaches were secured, LVT(A)-4s from the Marine's Second Armored Amphibian Battalion were used as artillery to destroy Japanese guns located near the water, while seizing the City of Garapan (Chapin 1994). Upon capturing Garapan, the Second Marine Division was placed into reserve status and the Army continued to push northward to Tanapag where they were to meet up with the fourth Marine Division (Rottman 2004).

Soon, LVTs were called upon to deliver supplies and ammunition to the troops fighting on the front lines of Tanapag Plains. The LVT's ability to travel through the water allowed it to more easily reach the front lines and provide desperately needed relief. On return trips, LVTs facilitated in evacuating casualties from the battlefield to medical stations (Bartholomees 1948). LVTs were also used near Tanapag for other missions including a small-scale amphibious assault on what is now Managaha Island in Tanapag Lagoon and to deal with Japanese soldiers who defiantly swam out to the reef in order to harass US forces and in some cases commit *seppuku* (Bailey 1976; Rottman 2004; Crowl 1959).

## Archaeological Investigations

The LVT(A)-4 site in Tanapag Lagoon was originally noted by SEARCH in a 2008 survey report (Burns 2008). The site is located in Tanapag Lagoon on the northwestern side of the island. It is submerged at a slight angle in a sandy area between patch reefs at a depth of approximately 10 ft (3.05 m) roughly 1,094 yd (1,000 m) from the shore. Students and staff from Flinders University and Ships US conducted initial site investigations on the LVT(A)-4 to assess the feasibility of including it in the WWII Maritime Heritage Trail in July 2009 and returned in February 2010 to record the site in detail. Archaeologists used scaled drawings of an LVT(A)-4 from *World War II AFV Plans: American Armored Fighting Vehicles* (Bradford 2007) to trace the existing portions of the site on to Mylar™. This information was used to record the site in its present condition and aid with monitoring changes to the site and its environment in the future (Fig. 6.1).

Field investigations reveal that the lower portion of the vessel is mostly intact; however, the majority of superstructure and exterior armor plating is missing. Also missing are the armor track covers, top and port side of the armored cab, splashguards, and practically all components from the engine room have been removed with the exception of the radial engine body and the port and starboard gas tanks. A 20 m circle search did not reveal any cultural material related to this or any other wreck. Notable damage includes collapsed superstructure and large holes in the bow armor and in the ballast area (pontoons) on both sides. The lateral supports, stanchions and transverse bulkhead, demonstrate signs of severe stress. The starboard stanchions are bent, causing the starboard lateral support to arch downward towards the turret, while the port lateral support is sheared off completely. The transverse bulkhead and associated support beams are collapsed under the turret.

The amphibious nature of LVTs presents an interesting question concerning site formation: Was the craft catastrophically lost in the water, either due to foundering or battle damage, or did the vessel become disabled on shore and was it then

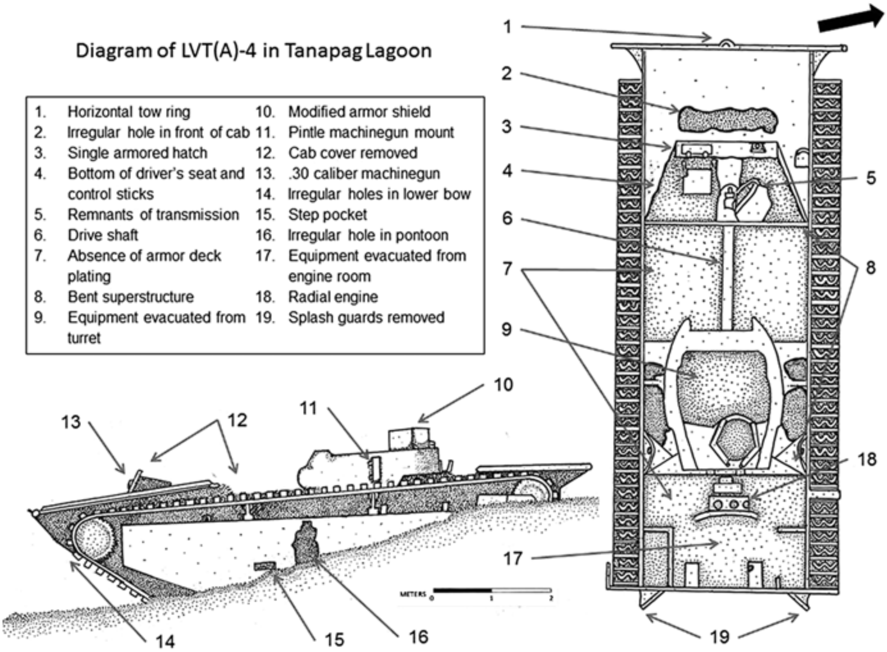


**Fig. 6.1** Diagram of site features

discarded in the water? Process analysis methodology can be used to help determine site formation where historic records are conflicting or non-existent (Gibbs 2006; Jung 2009). Site signatures presented in the works of Muckelroy (1978), Wardet al. (1999), Richards (2008), Gibbs (2006), and Jung (2009) can be used to help determine the nature of the site and the extent of any salvage efforts. What follows below is a discussion of the results of applying a process analysis to the LVT(A)-4 site in Saipan's lagoon (Fig. 6.2).

## Discussion

### *Pre-impact Threats, Assessments, and Strategies*

Historical research determined that the AMTRAC in question is an early production model LVT(A)-4 recognizable by the semi-closed 75 mm Howitzer turret with a single .50 caliber machine gun scarf ring on the rear and a single armored hatch on the windscreen. The windscreen of later production model LVT(A)-4s possessed two viewports and a .30 caliber machine gun, whereas the early models had a single armored hatch. The towing ring on the bow is mounted horizontally, while late production models have a vertical towing eye through which a large shackle is secured. The LVT(A)-4 was designed with a 75 mm Howitzer specifically engineered to

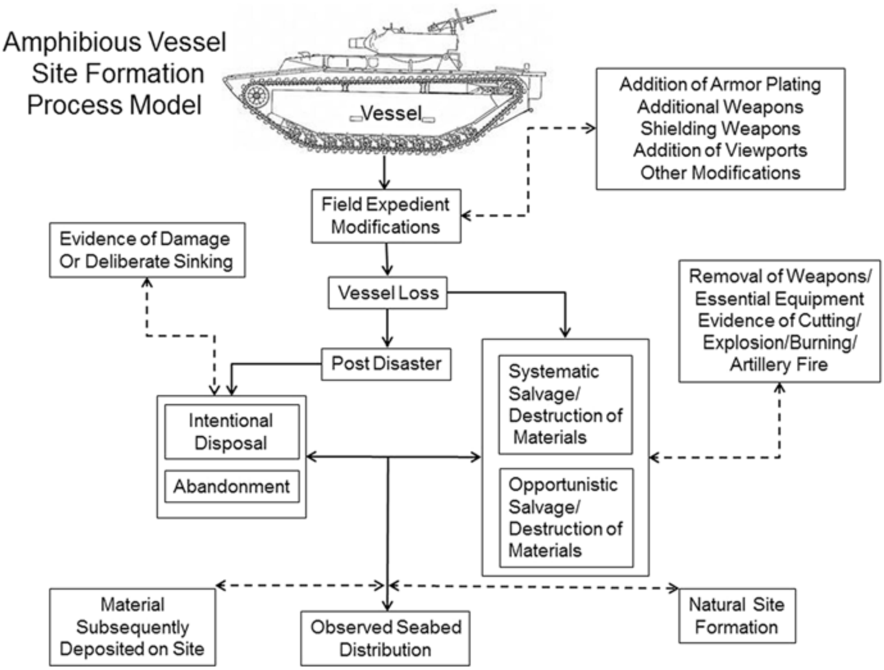


**Fig. 6.2** LVT site formation process model

destroy reinforced bunkers in response to pre-impact threats revealed through previous Pacific invasions and aerial reconnaissance (Gibbs 2006; Mesko 1993).

Archaeologists addressed questions of vessel modification based on Gibbs (2006) process model. By first identifying the pre-impact threats, assessments, and strategies of US forces, archaeologists are able to gain insight as to why some key decisions were made. The beaches chosen for the invasion possessed a shallow and, in places, exposed fringing reef roughly 1,500 m offshore, necessitating the need for amphibious craft. Shallow fringing reefs and large open lagoons were not the only challenging features of the terrain. Saipan’s western beaches were also lined with Japanese reinforced concrete bunkers containing artillery and machine guns. The defending soldiers placed range markers (bamboo stakes with flags attached) throughout the lagoon which allowed Japanese artillery and mortar crews the ability to effectively fire on the arriving US forces (Adams 1950; Goldberg 2007). These threats combined with known limitations of the LVT prompted crews to install field expedient armor modifications.

LVTs had the unfortunate mission of being the first in the line of enemy fire, and it is noted historically that LVT crews regularly added boilerplate to the bows of their craft because the hull armor was so thin coral would often puncture it while crossing shallow reefs (Barker 2004; Mesko 1993). Additionally, the armor was incapable of preventing small-caliber rounds from penetrating the interior of the vehicle. This fact is acknowledged by the adoption of a policy to carry wooden plugs for the purpose of plugging holes while the vessel was underway (Bailey 1976). As an added layer of protection, crews placed sandbags across the decks (Barker 2004). Field expedient modifications were not just limited to the exterior; inside crews regularly covered their radios with ponchos and rolled condoms over the microphones as makeshift waterproofing because the upper areas of the vessel leaked causing the communications gear to malfunction (Barker 2004).

The LVT(A)-4 in Tanapag Lagoon displays evidence of field expedient modifications. The actual gauged thickness of the lower bow and upper bow plating varies slightly but has an average thickness of approximately 5/8 in. (15.88 mm); the manufacturer's specification for this plating was 1/4 in. (6.35 mm) (Department of the Army 1951). If the original specification of 1/4 in. (6.35 mm) armor plating is added to the historically documented practice of adding 3/8 in. (9.53 mm) boilerplate, the sum of the combined thickness equals 5/8 in. (15.88 mm). The gauged thicknesses of the armored plates on the upper and lower portion of the bow indicate an added layer of protection that can be categorized as pre-impact modification due to a perceived threat.

A unique modification is the addition of an improvised armor shield around the .50 caliber machine gun mount built into the turret. This response to pre-impact threat analysis addressed the fact that the machine gunner was severely exposed to enemy gunfire. The shield is hexagonal in shape with the fore and aft sides of the shield left open (Arnold 2010). Additionally, a pintle machine gun mount is located on the port side of the howitzer turret. The addition of a .30 caliber machine gun mounted to the port side of the turret served to decrease the vulnerability of the vehicle. Likewise, the addition of a .30 caliber coaxial machine gun port to the bow, in front of the radio operator's seat, also decreased the vulnerability of the LVT by enabling the radio operator the ability to engage targets or provide suppressive fire in combat. The modifications present on this site are interpreted as having influenced a LVT(A)-4 revision nicknamed the "Mariana's Model" which adapted a .30 caliber machine gun on the bow and two .30 caliber machine guns mounted to the sides of the turret and removed the .50 caliber machine gun scarf ring. The change from .50 to .30 caliber machine guns is significant in that the .30 caliber rounds are much smaller and allowed the vehicle to carry more ammunition of a single type.

## *Post-disaster*

A direct hit by enemy ordnance would cause severe damage to a vehicle of this construction. If this were the site of a catastrophic loss, it would be expected that some heavier vehicle fragments would be located on or around the site (Muckelroy 1978). Additionally, the characteristics of metal damaged by ordnance include jagged, rough, and inconsistent edges. Due to the lack of debris field, the archaeological signature suggests post-disaster salvage and disposal efforts. Further, specific features of the vehicle that are missing and the evidence suggesting their removal indicate a post-battle salvage and disposal pattern.

The LVT displays smooth shearing in the cabin area. A hole located in the upper bow is smooth with an irregular shape that lacks jagged edges possibly due to a quick cutting job during salvage operations. The above and port side of the driver's cabin plating is completely missing and appears to have been cut away rather than suffering any explosive-related damage. The missing areas of the cab may have been cut away for easy access in order to salvage equipment and machinery. The fender assemblies appear to have been cut in order to remove the splashguards on both the port and starboard sides. The lack of superstructure and upper deck plates may indicate removal for salvage purposes prior to disposal as well.

The severity of damage to the superstructure is observable both fore and aft of the turret. It is possible that over time the weight of the turret and degradation of the structural supports caused it to collapse (Arnold 2010). Another possible reason for the collapse is outlined in the Army's Technical Manual for LVT(A)-4s. This manual describes that during the process of disposal, one should place a "3 lb charge against the right fuel tank between the engine and bulkhead" (Department of the Army 1951). This disposal method may have caused the bulkhead to collapse under the turret and resulted in the lateral supports giving way under the weight of the turret.

The Army's Technical Manual for LVT(A)-4s also outlines procedures for the evacuation of equipment and destruction of the vehicle to prevent enemy use (Department of the Army 1951). The processes of primary salvage are outlined in this manual by indicating what type of equipment should be evacuated or destroyed, and the processes of discard and abandonment are described by various means. The lack of equipment present in the cab may indicate intentional salvage. The manual also states that during disposal, a "2-lb charge be placed on the left side of the transmission as far forward as possible" (Department of the Army 1951). While the manual dates to 1951, this scenario may account for the holes in the starboard lower bow.

Interestingly, step pockets in the pontoons are intact on both sides of the vehicle with minimal signs of deterioration; however, there are large irregular holes with smooth edges in the pontoons. The manual indicates that the discard of an LVT by means of demolition requires that a 2-lb charge be placed at the center of the tracks and that the charges should be connected by detonating cord (Department of the Army 1951). Discard by gunfire is outlined by firing all available weapons at the engine compartment, suspension, and armament in the order specified (Department of the Army 1951). These holes do not appear to have been caused by explosion or gun fire as outlined in the manual. Perhaps the holes were cut in the pontoons to facilitate sinking at its present location after salvage occurred.

The turret has been stripped of the howitzer, sighting optics, traversing mechanics (gears and hand wheels), oil lines, and firing controls. The evacuation of these items during the disposal process is explicitly stated in the Army's manual. "All items of sighting and fire control equipment, including such items as periscopes, telescopes, and binoculars, are costly, difficult to replace, yet relatively light; hence, whenever practicable, they should be conserved and evacuated rather than destroyed. In the event of subsequent abandonment, the equipment will be completely destroyed, all optical elements and mountings smashed and firing tables, trajectory charts and inflammable items burned" (Department of the Army 1951).

There also is a lack of equipment present in the engine compartment, some of which could be due to deterioration processes over time. It is possible that the rubber engine components have decomposed; however, the missing valve covers and cylinder heads would have been removed manually. It is unknown if their removal occurred prior to or after this vehicle sunk. The lack of machinery suggests the engine compartment was stripped of all usable parts. The Army's Technical Manual for LVT(A)-4s does not specifically state how to disable an engine during disposal.

The lack of materials in or around the site as well as the missing equipment and evidence of its removal suggests salvage processes; however, it is unknown to what extent primary and secondary salvage occurred. The evacuation of all usable material prior to disposal is outlined in the Army's Technical Manual for LVTs (Department of the Army 1951:565–569). This manual appears to have been followed in most cases due to the evidence of evacuation of equipment. One discrepancy is that the manual calls for a craft to be dumped at a depth no less than 50 ft (15.24 m). The depth at which this site is located allows easy access for anyone with a shallow draft vessel to encounter the vehicle. This inconsistency might be explained by the distance from shore having been deemed far enough to prevent recovery, or the LVT may have suffered mechanical failure and was salvaged and disposed of in place. Another possibility is the vessel may have been under its own power during the disposal process, began flooding in route, and was simply abandoned. The method of disposing of an LVT by sinking while under its own power is outlined in the Army's Technical Manual for LVT(A)-4s with a note of caution: "If a drain plug must be removed from underneath the vehicle, this method of destruction can be undertaken only if the distance the vehicle has to travel to reach the necessary depth is not too great" (Department of the Army 1951). Historic sources do not mention the destruction or disposal of LVTs in or around Tanapag Lagoon, which limits the ability to match this particular LVT(A)-4 to a specific action. Unfortunately no serial numbers or other identification markers were located on this vessel, which further prevents tracing the vehicle to a specific US military unit for further research.

## Conclusion

This LVT(A)-4 shows signs of pre-impact threat response in the form of field expedient armor modifications. These modifications have been documented historically and now archaeologically, giving insight into how LVT crews viewed their machines as vehicles of war but also protective armor. The study of field expedient armor modifications, as they relate to the process of pre-impact threat assessments, presents a basis for understanding the degree of standardized modification between units and services. Both the troop carrying LVT-4 and the Amtank LVT(A)-4 with new modifications were introduced for the Battle of Saipan attesting to the attention given to pre-impact considerations by the production line. Further, archaeological evidence of the LVT(A)-4 in Tanapag Lagoon indicates that its crew considered additional pre-impact threats and modified their vessel accordingly, which directly influenced the LVT seriation and development of later models for the safety of their crews and effectiveness as vehicles of war.

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# Chapter 7
# Landing at Saipan: The Three M4 Sherman Tanks That Never Reached the Beach

**Matthew Hanks**

## Introduction

This chapter presents the archaeological investigation of three partially submerged M4 Sherman tanks deployed by the United States at the Battle of Saipan. The tanks, located just off Saipan's western coast, have been an alluring destination for beach visitors and local fishers for 70 years. Continuous human activity and natural processes have had a negative impact on the stability of the sites. As a result of the need to better understand these impacts, this research developed a site-specific methodology for recording, assessing, and monitoring natural and cultural impacts on submerged sites through data collected by means of archaeological and historical investigations.

On site at each tank, visible natural and cultural impacts were recorded using systematic archaeological survey methods. The data collection methodology was consistent between all three tanks to better facilitate comparison. A comprehensive photographic record of each site included missing or damaged components, components in eminent danger of being damaged or lost, active and passive corrosion, rubbish, prominent cracks or holes, and battle scars. GPS positions were recorded for each tank, and bearings of the tanks and gun turrets were taken. Depth measurements between the seabed and the water surface were recorded to assess tidal fluctuations and the proportion of each tank repeatedly exposed due to changing tides. The extent of vegetation surrounding each tank was also recorded, as active corrosion, tides, and vegetation all offer clues to the natural impacts on the tanks.

The archaeological data collected for each tank was then coupled with historical research from primary and secondary sources to investigate theories as to how these three tanks came to rest where they are today. The orientation and position of each

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M4 tank provides visitors with an insight into the first days of the Battle of Saipan and raises questions. How did these tanks become stranded? Did the tanks face heavy Japanese fire while crossing the reef? What role did tanks play in the battle? Answers to these questions provide an element of historical authenticity, which was previously missing in relation to the tanks' historical context.

This chapter has been adapted from a Master of Arts thesis by the author (Hanks 2010). In the interest of brevity, portions of the original research and data collected have been omitted to provide a more succinct overview of the work completed.

## The M4 "Sherman" Tank

Of the major powers involved in WWII, it was the United States that most neglected the expensive development of tank technologies during the inter-war recession (Grove 1978). As a result, the United States lacked a modern tank upon entering WWII in 1941. Following the Japanese attack on Pearl Harbor, a technically simple and reliable medium tank, labeled "M4," was quickly put into production. It was by no means the finest, most powerful, or well-armored tank serving in the worldwide conflict. The M4s' strength was in numbers since it was accepted as the standard combat tank of the US military, and the nation's industry was geared for the mass production of the tanks.

Approximately 50,000 M4 tanks were manufactured in the United States by the end of WWII (Grove 1978). Designated as a medium tank, M4s required a crew of five: the driver, the assistant driver/bow gunner, the ammunition loader, the gunner, and the tank commander. The armament aboard M4 tanks varied throughout WWII. The primary cannon bore was 75 millimeters (mm), followed by the more powerful 76 mm. A 105 mm howitzer was an additional and less common armament option. One .50 caliber anti-aircraft gun and two .30–06 caliber anti-personnel machine guns often accompanied the main cannons. Despite advances and modifications in later versions of the M4, the crew remained at five. Table 7.1 contains the specifications of a basic M4 tank model.

There were a vast number of M4 variants, each with distinctive features, shapes, and modifications. Although each version differed in appearance and equipment, the nomenclature of M4 tanks was based upon characteristics such as the type of

**Table 7.1** Specifications of a base model M4 tank (Grove 1978)

| | |
|---|---|
| Weight | 30.2 metric tons |
| Length | 5.84 m |
| Width | 2.66 m |
| Height | 2.74 m |
| Crew | 5 (commander, gunner, loader, driver, co-driver) |
| Operational range | 185 km, 662.4 L |
| Speed | 40 km per hour |

engine installed, production location, and/or fuel type (Grove 1978). US M4 tank variants included M4, M4A1, M4A2, M4A3, M4A4, and M4A6.

The US-built M4 tanks also served under other Allied forces during WWII. It is interesting to note that the British, who named their US-built tanks after American Civil War generals, were the first to christen the M4 tanks as "Shermans." The M3 Lee and Grant tanks also obtained their nicknames from the British (Grove 1978). The designations quickly caught on with US troops.

An in-depth discussion of each version of the Sherman tank would be lengthy. Thus, a general examination of the M4 models is outlined in Table 7.2. For a detailed history of the M4 Sherman models, refer to *World War II Tanks* by Grove (1978) or *Tanks* by Humble (1977).

A change in hull shape, armor thickness, and ammunition stowage took place at approximately the same time larger cannons were placed on M4 tanks. Armor was thickened from 62 to 75 mm, and the armor slope was decreased from 56° to 47° (Grove 1978; Humble 1977). Ammunition stowage was swapped from dry to wet as, once in the field, troops quickly recognized that one of the Shermans' weaknesses was their unprotected ammunition lockers. If the tanks' armor was penetrated, live ammunition in the dry bins was often punctured by shrapnel, set aflame, and exploded. Coupled with the tanks' gasoline fuel system, this flaw contributed to the nicknames "Tommy Cookers" and "Ronson lighters." To prevent this, engineers developed ammunition lockers surrounded by a glycol liquid, which diminished the threat of secondary fires and exploding ordnance within the tank (Grove 1978).

As a standard and mass-produced weapon, the M4 tank was a versatile vehicle. Sherman tanks could be fitted with flamethrowers or dozer attachments and were even used to lay bridges. The M4 chassis also served as the platform for several derivative armored vehicles such as minesweepers, tank destroyers, self-propelled

**Table 7.2** Comparison of nine M4 Sherman tank variants (Carrell 2009 from *Standard Ordnance Catalog*, 1944, Vol. 1)

| Designation | Main armament | Hull | Engine |
|---|---|---|---|
| M4(105) | 120 mm howitzer | Welded | Gasoline continental R975 radial |
| M4 composite | 75 mm | Cast front, welded sides | Gasoline continental R975 radial |
| M4A1(76)W | n/a | Cast | Gasoline continental R975 radial |
| M4A2[a] | 75 mm | Welded | Diesel GM 6,046 (2 × 6-71 inline) |
| M4A3W[a] | 75 mm | Welded | Gasoline Ford GAA V8 |
| M4A3E2 "Jumbo" | 75 mm (some 76 mm) | Welded | Gasoline Ford GAA V8 |
| M4A3E8(76)W "easy eight" | 76 mm | Welded | Gasoline Ford GAA V8 |
| M4A4 | 75 mm | Welded | Gasoline Chrysler A57 (5 × 6-cyl inline) |
| M4A6 | 75 mm | Cast front, welded sides | Diesel Caterpillar D200A radial |

[a]Primary variants used in the Pacific by the US Marine Corps. during WWII

artillery, and tank retrievers (Macksey 1971). Another variation featured Sherman tanks equipped with a Duplex Drive (DD) and propeller for amphibious operations such as D-Day at Normandy (Macksey 1971).

## M4 Sherman Tanks in Saipan

Relative to Europe, a small proportion of production M4 tanks were deployed to the Pacific Theater. Due to the nature of the war in the Pacific, few tank battles were fought between Japan and the United States. The Japanese forces never deployed many tanks because their operations were primarily either amphibious or close combat, in which tanks played a limited role (Macksey 1971). As the Japanese military seldom used any armor heavier than light tanks, Shermans fared better in the Pacific than against the more robust European Axis tanks. When facing off against the Japanese Type 95 *Ha-Go* light tanks and Type 97 *Chi-Ha* medium tanks, even the Shermans' early 75 mm main gun led to Allied dominance over Japanese tank designs. From the outset of the war, Japanese tanks floundered behind their naval and air technologies and never caught up. Similarly, Japanese anti-tank weapons were inferior to German weaponry. Instead, the Japanese resorted to innovative and extremely effective anti-tank techniques including mines fabricated from torpedoes.

Six tank battalions were deployed to the Marianas; however, only two battalions, those under the 2nd and 4th Marine Divisions, were used in the attack on Saipan (Caporale 1984). According to Rottman (2004), the Divisions had undergone reorganization in early 1944. At this time, the 2nd and 4th Marine Divisions' tank battalions replaced their M3A1 light tanks with 75 mm M4A2 Sherman medium tanks. The tank companies received 15 Shermans during this replacement, which were intended to serve as support vehicles during the US offensive push across Saipan's rugged interior (Rottman 2004).

Following the morning's initial amphibious invasion, the Marines were unloading their heavy equipment on Saipan by the afternoon of June 15, 1944. The M4 Sherman tanks and artillery had arrived. Most of the tanks made it ashore in decent shape, unlike the armored amphibious LVT(A)4s that suffered severe losses in the initial assault. The tanks motored over the shallow reef that hems in the landing beaches, but encountered several obstacles. Several tanks fell victim to high tides, Japanese artillery, saltwater short circuits, and other difficulties. Nonetheless, the arrival of the surviving tanks brought much needed firepower to the beach and boosted US morale (Goldberg 2007).

Upon arriving on Saipan, tank battalions were immediately sent into action. Sherman tanks spearheaded the Marines' inland attack on Saipan, knocking out Japanese gun emplacements and providing cover for advancing troops. Quickly realizing the threat the M4 tanks posed to their control of the island, the Japanese targeted US tanks with heavy artillery fire (Goldberg 2007).

During the first few days, Marines weathered numerous night and morning attacks by the Japanese defenders. For example, on the morning of June 16, 1944, Japanese forces launched a full-scale tank counterassault from Garapan on the 2nd Marine Division (Goldberg 2007). The US Marine battalions were overwhelmed and pushed back 50 meters (m) before reinforcements arrived. Soon they employed the M4 tanks and anti-tank bazookas, turning the tide of the skirmish. The Japanese tank attack set the tone for the following night as well. “The Japanese continued to attack, often fruitlessly, and suffered high losses, while the Marines took high but ever-decreasing casualties” (Goldberg 2007).

The night of June 16 and early morning of June 17 saw another attempt by Japanese troops to halt the advancing US forces. More than 500 Japanese troops and 30 tanks attacked US positions held by the 2nd Marine Division throughout the night (Goldberg 2007). Nonetheless, the Marines were prepared as more tanks, 75 mm guns, rocket launchers, and artillery shells were brought onshore. After 45 min, “the largest tank battle of the Pacific War up to that time” was over, and 29 Japanese tanks had been destroyed (Goldberg 2007). The M4 Sherman had made its presence known on Saipan.

## Site Locations and Descriptions

### *General Location*

All three M4 Sherman tanks are partially submerged on a shallow, flat, sandy substrate inside the barrier reef on the western side of Saipan. These sandy areas are interspersed with patches of various seagrass species. Oleai and Susupe beaches are east of the tanks and the shoreline runs roughly north-south. Due to their proximity to the beach, swimmers often use the tank sites as a course for a “tank swim,” fishing or dive platforms, or picnic tables. Unfortunately, unsightly rubbish and fishing lines are witness to the tanks’ popularity. Local tour boats also frequent the area.

### *Environmental Conditions*

The tanks are never completely inundated and the main gun turrets generally remain well above the waterline. It is worth noting, however, that the tidal nature of the sites is not conducive to the formation of protective concretions. Rather, the relatively high amount of water movement around the tanks increases corrosion potential and deterioration rates due to increased dissolved oxygen in the water.

There are a number of factors linked to metal corrosion in a marine environment. These include water pH, atmospheric and dissolved oxygen levels, temperature, water movement, salinity, growth of marine organisms, and metal composition, among others (North and MacLeod 1986). Located in a typical coastal environment, several of these attributes and chemical properties can be expected to affect the three M4 tank sites. First, they are located in a tidal zone and are subject to cyclical wetting and drying processes with exposure to direct sunlight. This places stress on the steel tank components, resulting in active corrosion, flaking, and fractures. Second, seawater contains high levels of chloride salts that accelerate the corrosion of ferrous metals. Furthermore, the action of the tide and breaking waves increases the dissolved oxygen levels in the seawater.

## *Corrosion*

Armored vehicles, such as tanks, are often on the frontlines in battle pushing forward and therefore take the brunt of enemy firepower. Tank armor, when it fulfills its function, will deflect and absorb the impact of heavy fire. This action leaves its mark on the vehicles. Battle scars on the three M4 tanks are evidence of the conflict they have endured. When combined, Saipan's environment and the tanks' hulk react, taking a toll on these cultural heritage resources in the form of holes, cracks, and corrosion.

All three Sherman tanks are moderately corroded below the waterline, while increased, uniform corrosion is apparent above the surface. This was identified on-site by the bright red/orange coloration of iron oxide (rust). The cyclical process of wetting and drying, coupled with direct exposure to the sun, wind, and elements, form an abrasive force that has unfavorable effects on cultural heritage.

Certain components of the tanks have disappeared altogether, while others are in danger of being lost. Natural processes such as corrosion as well as cultural impacts like salvage are the primary explanations for many missing components. This is particularly true of long, thin parts of the vehicles like the main gun barrel as well as movable parts such as brackets and hatches. Towing hooks, headlamp guards, chassis lift hooks, tools, sirens, and radio aerial antennas have been lost to salvage or natural processes.

## Tank 1

Tank 1 is the northernmost site, located approximately 120 m offshore. This tank has been identified as a M4A2 Dry model equipped with a 75 mm cannon. When deployed in 1944, a .50 caliber anti-aircraft gun and two .30–06 caliber anti-personnel machineguns accompanied the main cannon. However, these auxiliary guns are no longer present. A serial number, "D50878," was located on the turret of Tank 1. This alphanumeric sequence is indicative of a turret variation known as "low bustle" (Laughlin 2010) (Fig. 7.1). The front quadrant of this turret was designed with a uniform 76.2 mm thickness with the exception of the right front where two incisions were made to clear the turret traversing gear. The thickened turrets made their first appearance in April of 1943 and were in widespread use by August of the same year (Laughlin 2010).

**Fig. 7.1** The "low bustle" turret and 75 mm cannon of Tank 1. The heavy corrosion is evident in this photograph

M4A2 variants were equipped with twin General Motors 6-71 diesel engines and a welded hull (Grove 1978; Humble 1977). The 6-71 designation indicates that the engines were inline six cylinders, 71 series Detroit diesels. The hull of Tank 1 remains oriented with its bow toward the shore on a bearing of 133°. The 75 mm main cannon is fixed on a bearing of 197° (Fig. 7.1).

Tank 1 displays the undeniable signs of unabated corrosion above and below the waterline. Corrosion, cracks, and metal flaking can be linked to the loss of a notable amount of tank components.

## Tank 2

Tank 2 is also a M4A2 Dry tank with a 75 mm cannon (Fig. 7.2). Therefore, it was also equipped with twin General Motors 6-71 diesel engines. As is the case with Tank 1, none of the auxiliary weapons remain, though the mounts are still present. Tank 2 is located nearly 300 m south of Tank 1 and 450 m offshore. The welded hull of Tank 2 is oriented with its bow shoreward on a bearing of 145°. The main cannon is fixed on a bearing of 270°.

Much like Tank 1, Tank 2 looks as one might expect a vehicle made of rolled and cast steel to appear after 70 years of exposure to the elements. Tank 2 exhibits the signs of many years of corrosion and environmental pressure (Fig. 7.2). Many of the

**Fig. 7.2** View down the 75 mm muzzle of Tank 2. The landing beach the tank crew hoped to reach in June 1944 is just beyond the tank

removable components have been detached, and long, thin parts have become brittle and cracked. Components at risk of being lost include the 75 mm cannon barrel, hatches, and tow hooks while armor is dented and lifting hooks have been broken.

## Tank 3

Tank 3 is located approximately 1 km south of Tank 2 and 175 m offshore. This Sherman was identified as a M4A3 Wet model equipped with a 75 mm cannon. The auxiliary gun mounts are intact, but the weapons are absent. M4A3s were equipped with a Ford GAA V-8 gasoline engine and a welded hull (Grove 1978; Humble 1977). Tank 3 differs from Tank 1 and Tank 2, not only in that it is an M4A3 variant with wet ammunition stowage, but also its bow is pointing away from the beach on a bearing of 295°. If this were in fact its original position, this orientation would have put the Sherman in an extremely vulnerable position since the tank's engine is located in the stern. Incoming enemy fire could strike the thinner rear armor and potentially disable the engine.

A number of possible explanations could account for the orientation of Tank 3. The first theory holds that the forward gear was damaged, crippling Tank 3, and the crew attempted to reverse to the beach. Another theory suggests the tank crew became aware of a channel of deeper water between the tank and shore, turned the M4A3 around, and attempted to circumvent the deep water. The wreckage of a US landing craft lies in deep water between Tank 3 and the beach; its sinking may have alerted the tank crew to the danger. Lastly, Tank 3 may have been moved, turned, or repositioned after the battle during salvage operations.

**Fig. 7.3** View along the starboard side of Tank 3 showing the suspected broken muzzle end of the 75 mm cannon

The main cannon is fixed on a bearing of 60°. Corrosion and visitor activity has taken its toll on Tank 3. As was the case with Tank 2, both doors of the commander's hatch on the turret are still present. The 75 mm main cannon barrel is severely degraded and appears to have broken. Not only is the end of the remaining barrel rugged and corroded, but also a corroded ferrous cylinder rests near the starboard bow of the M4A3 (Fig. 7.3). It is suspected that this cylinder is the muzzle end of the barrel from Tank 3, which broke due to corrosion and/or physical stresses. The diameter and material are similar to that of the barrel on the turret.

The length of the barrel still fixed to the turret of Tank 3 is 1.82 m and the cylinder on the seabed is 1.33 m long giving the gun a proposed total length of 3.15 m. When compared to the 1.70 m long 75 mm cannon barrels on Tanks 1 and 2, a total length of 3.15 m seems rather long. However, Tank 3 is a different M4 variant than the previous two tanks and is equipped with a different turret, which may explain why it had a longer barrel. Since the initial barrel length is still in question, whether the barrel has indeed broken has not been confirmed.

Tank 3 is also different from Tanks 1 and 2 in that two metal rectangular panels were located near the southernmost Sherman. In June 2010, the larger panel was positioned 3.06 m from the southeast corner of the tank on a bearing of 175° and measured 68 cm by 168 cm. The smaller panel was found 6.80 m from the turret center on a bearing of 225°. It measured 45 cm by 97 cm. It is suspected that these are the missing engine deck cover and engine cowling. The dimensions are consistent with the measurements taken on the stern of the tank.

## Tank Condition Comparison

Located off the western coast of Saipan, the three M4 Sherman tanks share a common coastal environment. The tanks' current conditions are similarly unstable, yet they are at dissimilar stages of deterioration as a result of numerous individual factors. Natural processes affiliated with coastal marine environments play a major role in the corrosion potential of ferrous metals. As stated above, chlorides in the saltwater, exposure to ultraviolet sunlight, oxygenated water, colonizing marine growths, and even cyclical wetting and drying of tank components result in active corrosion. All three tanks display damage due to corrosion; components both above and below the waterline have swollen, cracked, and fallen apart. This is a natural process and will continue.

Each tank is also subjected to variable conditions dependent upon the Shermans' distance from shore, visitor traffic, and water depth. Therefore, one can expect to observe differences in the condition of each site. Distance from shore and visitor traffic share an inversely proportional relationship, in that the greater the distance, the fewer the visitors. Tank 2, being nearly 450 m offshore, showed noticeably less active corrosion and contained less rubbish than the tanks closer to the beach. Conversely, Tank 3 is within sight of a popular beach resort and displays the most corrosion of the three M4s.

## Separation Theories

The author offers several theories as to how Saipan's M4 Sherman tanks came to be separated from their unit and become stranded. The first hypothesis holds that the tides were misjudged, and the tanks, without amphibious DD modifications, were swamped when deployed into deep water. The second proposal is that the landing craft tank (LCT) transporting the tanks became disabled before reaching waters shallow enough for successful deployment. Rather than remaining stuck on the LCT, the tank crews started their engines and attempted to make the beach under their own power, but flooded in deep water. The final theory posits that the tanks took accurate enemy fire and were disabled before making landfall and/or fell into mortar or artillery pits and flooded (Macksey 1971).

Without having historical records or military reports chronicling the specific fate of the Sherman tanks, it is difficult to say with any certainty which, if any, of the theories represents what actually transpired. This is why archaeological investigations are integral to understanding the past. Realistically, one must also consider a multitude of variables. Complex machines, such as tanks, are made up of thousands of components, a number of which could have failed and potentially immobilized the vehicles. Other factors, such as human error, may also have contributed to the tanks' demise. Due to the distances between each tank, it is likely more than one theory is correct.

The first theory, that the tides had been misjudged and the tanks were deployed into deep water, seems unlikely. A mistake of this magnitude, although possible, does not fit the meticulous planning befitting a large-scale military invasion. If in doubt, the water depth could have been gauged by eyesight, vehicles already in the water, or other means. Furthermore, had this been the case, it seems more invading Sherman tanks would have swamped. According to Goldberg (2007), the heavy tanks were deployed well after the initial invasion on June 15, 1944, and most made it ashore in good shape.

The second theory, that the LCT became disabled by enemy fire before reaching suitably shallow waters, is also unlikely. The western shore of Saipan hosts a shallow fringing reef, inside which the three tanks rest. Having a deeper draft, the large LST would not have been able to ferry the tanks anywhere near where they are located today. Therefore, LSTs would have remained well outside the reef and out of range of Japanese artillery while LCTs transported the tanks to the reef and the beach. This theory loses credibility because the Sherman tanks did not participate in the initial invasion when Japanese artillery fire was the most intense. Although it is possible for the LCTs to have been knocked out, most enemy fire would have eased by the afternoon of June 15 as US troops pushed inland pulling the focus of Japanese defenders away from the coast.

The water depth and vegetation rings around the Sherman tanks may also offer clues as to their fate. One must consider that the Battle of Saipan took place 70 years ago and environmental indicators are somewhat unreliable in this case because they are subject to change due to natural processes over time. However, the environmental data collected in June 2010 offers some insight.

Tank 1 stands apart from Tanks 2 and 3 as the lower half of its roller assembly and suspension system is buried in sandy sediment. Tanks 2 and 3 clearly rest on top of the seabed. Tank 1 also has no vegetation directly adjacent to the vehicle, but is surrounded by a halo of sand. Seagrass appears between 3.5 and 5.5 m from the center of the tank's turret. Tanks 2 and 3 have vegetation growing all the way up to their tracks rather than resting in a barren sand flat like Tank 1. The buried track and sand halo around Tank 1 may indicate that the M4A2 fell into an artillery crater. On the other hand, Tank 1 is nearest to shore and rests in the shallowest water of the three tanks, which may also account for disparities in vegetation.

The third theory, that the M4 tanks took enemy fire and/or fell into artillery craters, appears to be most likely. Japanese defenders had strategically positioned flags off the coast so they could determine when enemy vessels entered the range of their guns. The barrage of well-aimed fire may have put the tanks out of commission as they crossed the reef. However, as stated above, enemy fire would have likely eased by the time the Shermans were deployed, as US troops had taken many of the Japanese coastal guns. Bomb craters left by US air strikes prior to the land invasion would have likely been located in this area, particularly due to the location of a nearby Japanese airstrip. These depressions would have been a significant and ever-present threat tank crews may have had difficulty identifying and avoiding. Thus, the possibility exists that an artillery or bomb crater could have taken the tanks out of action.

## Conclusion

The temperate climate, rich culture, and heritage attractions of Saipan unite to create bountiful opportunities for the continued development of heritage tourism on the island. The staff at the HPOUS, along with those at the helm of this book, is working to embrace these opportunities while balancing heritage site interpretation, public education, and site preservation. The location and deterioration of Saipan's three M4 Sherman tanks present unique challenges to this balance. Their proximity to the beach makes the tanks more easily accessible to beachgoers and the non-diving public than other submerged cultural heritage on the island, yet more frequent human activity and natural processes have a negative impact on the stability of the sites. The accessible nature of the tanks makes them a tangible example of why understanding and mitigating such impacts is a necessity to ensure the perpetuation of submerged cultural heritage.

Saipan possesses a rich collection of WWII cultural heritage both on land and underwater. However, it came at a cost. Saipan's Indigenous population struggled to survive a war that had come to their home and many lives were lost on both sides of the battle. Saipan's Sherman tanks are a visible reminder of solemn events that took place 70 years ago and a representation of a shared history. The goal of the research discussed in this chapter is to aid in the interpretation and preservation of Saipan's cultural resources for enjoyment of the public for years to come.

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# Chapter 8
# Between Land and Sea: Surveying the Shoreline

**C. Rachel Katz**

## Introduction

Saipan has undergone a great deal of change since the war. What was once a battleground is now a tourist destination for beachgoers, and small inlets and coves are now home to hulking metal pontoons. For 6 days in June of 2010, a small team undertook a survey of Saipan's west coast with the aim of creating a GIS database of the wartime artifacts strewn along the shore. By analyzing the artifacts' distribution patterns and then factoring in the cultural and industrial processes that have taken place since the war, we gain a better understanding of how postwar activities such as building and landscaping effect change to the battleground.

The distribution pattern of wartime features varies, some are in situ and others are not, and it is not always clear which ones have been moved. Pillboxes, for instance, are in situ, but many of the tanks found on the island, including one that now rests on top of a pillbox, are not. Moreover, there are smaller features, such as a rifle and a helmet that may well not have moved since 1944. While it can be difficult to tell in situ features from displaced ones, a cluster analysis sheds some light on the issue, particularly when the historical record is consulted.

In addition to individual feature and cluster analysis, KOCOA analysis was applied to the lagoon and landing beaches. Typically, KOCOA is used on traditional battlefields, particularly those dating to eighteenth- and nineteenth-century conflicts. A type of terrain analysis, KOCOA helps put the battlefield into perspective. Saipan was largely a terrestrial battle, but the first day was fought at the shoreline; a terrain analysis of Saipan's lagoon and landing beaches can help give insight into how the marine landing was planned and executed.

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## Shoreline Survey

### Methodology

Over the years Saipan's lagoons have been surveyed several times to document submerged WWII cultural resources (Burns 2008; Carrell 1991; Pacific Basin Environmental Consultants 1985; Thomas and Samuel 1980). All manner of wreckage has been found, including airplanes, landing vehicles, tanks, and a civilian cargo ship. These wrecks bear witness to the battle fought on Saipan and help illustrate the combined aerial, naval, and terrestrial nature of the engagement that took place.

As part of a larger project to build a maritime heritage trail on Saipan, the western shore was surveyed over 6 days in June 2010. Initially, only the northern half of the island's western coast, from the Sea Plane Ramp to Marpi Point, was scheduled for surveying, but as this portion was completed in good time, the southern half of the coast, from Sugar Dock to Agingan Point, was surveyed also. As much of the shoreline was surveyed on foot as was possible. Approximately 22 km of shoreline was walked, from Agingan Point in the south to Marpi in the north. In some cases it was impossible or unsafe to walk the coast, either because of environmental obstacles such as mangroves and deep water or because of private property restrictions. It is estimated that no more than 5 km of coastline between Agingan and Marpi points went unsurveyed.

The goal of the survey was to record any and all WWII-related features found on or just offshore in Garapan and Tanapag Lagoons. These include pillboxes and bunkers, craft wreckage, collapsed walls, debris, and miscellaneous items such as barrels and cylinders. As this was a survey-only project, no artifacts were removed. Instead, features were photographed and their locations logged with a Garmin GPS 76 unit or a Garmin Gecko 201. Verbal confirmation for each feature's coordinates ensured no mistakes were made during transcription. A database of all features was created and displayed using ESRI ArcMap 9.3. Satellite data for base maps were provided courtesy of NASA, and satellite derivatives were courtesy of the US Department of Agriculture.

### Feature Distribution

A total of 150 features were identified and recorded during the shoreline survey (Fig. 8.1). Features were classified by type based on their appearance and perceived function (Table 8.1). Eleven feature types were assigned. The greatest number of features belongs to either the "miscellaneous" or "building/structure" categories. Miscellaneous features are those that have no visible or immediately apparent purpose. This is different from "debris" which is interpreted as having been discarded. "Buildings" include standing structures, such as pillboxes and bunkers, and building remnants like collapsed walls. "Docks" and "jetties" are present either as extant

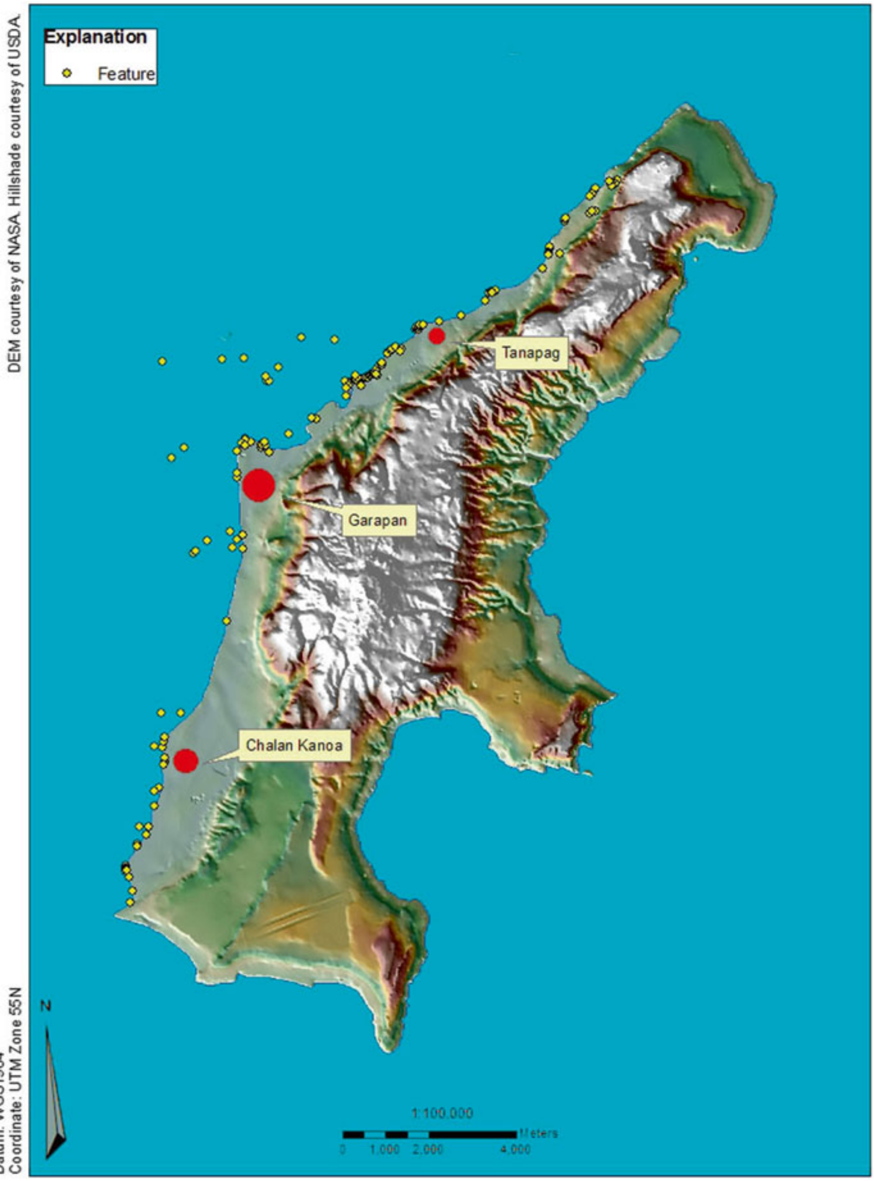


**Fig. 8.1** Distribution of features within the survey area

installations, or as wood or metal pilings. "Naval" features are different from "wrecks," and the category applies almost exclusively to US Navy pontoons, which are large, steel-cell constructions built as barges or piers (Moore 2006). Wrecks are wrecked watercraft or vessel parts.

**Table 8.1** Feature types and counts

| Type | Description | Example | Count |
|---|---|---|---|
| Building/structure | Standing structure or the remains of same | Pillbox, Quonset hut | 42 |
| Debris | Features which are recognizable as trash or detritus | Rubble | 13 |
| Gun | A gun or guns parts, large or small | Rifle | 4 |
| Memorial | Tributary permanent item | 2nd Marines memorial | 4 |
| Moorings | Usually a concrete block topped with a metal handle, used to tie up watercraft | Mooring block | 9 |
| Miscellaneous | Miscellaneous features that cannot be clearly identified or categorized | Concrete pad, air cylinder | 46 |
| Naval | Of, or pertaining to, the Navy or Navy vessels | Anchor, pontoon | 10 |
| NHL | National Historic Landmark | Yellow Beach | 5 |
| Plaque | Informational plaque, non-tributary | Carolinian village site formation placard | 1 |
| Wreck | Vessel wreckage | Japanese landing craft, PBM Mariner | 11 |
| Total | – | – | 150 |

The southern end of the survey area is within the boundaries of the Landing Beaches NHL. Designated in 1985, the NHL offers a level of conservation and protection to the area. As a result, the landing beaches are still littered with war-era material culture. Prior to designation, this area underwent significant landscape modification as resort hotels were constructed inland from the beach. Therefore, a certain amount of disturbance is expected to have taken place within the boundaries of the NHL. Heading north, the feature distribution thins out. Six features were identified between Agingan Point and the southern reaches of Garapan. This stretch of coast is parkland and was subject to extensive postwar cleanup and landscaping, which may account for the scarcity of features.

Feature counts increase around Garapan and north of the town with a relatively large concentration at Mutcho Point. These features are found inside American Memorial Park. The park is governed by the NPS and honors the US and Marianas peoples who died during the Battle of Saipan. Much of the park has been landscaped, but pillboxes and military miscellany and debris remain in situ within the park boundaries. The heavy concentration of features north of Garapan is mostly "miscellaneous," and for many of them, it is not possible to know if they are in situ or were moved to their present locations.

The Japanese planned to emplace a series of coastal defense and anti-aircraft guns around the island, but few were ready for use when the United States landed (Rottman 2004). Although many of these guns are still extant, none were found inside the survey area. Given that anti-aircraft guns are mobile and exist in other locations on Saipan, it is possible that they were moved out of the survey area in the years following the war.

Although a great deal of cleanup has taken place, guns, gun parts, and ammunition can be found throughout Saipan. The HPO has a process in place for public reporting of WWII-era ammunition and guns, and residents are discouraged from handling these items for safety reasons. During the survey, a rifle was found next to a helmet and the find was reported to the HPO. Only three other identified gun parts were found in addition to the rifle, suggesting that most of the guns and live ammunition have been removed from the shoreline.

## Feature 86

Of special interest to Saipan's wartime history is a find made north of Pau Pau Beach. Just up the coast from Pau Pau, the sandy shore gives way to large limestone outcroppings and boulders which obstruct the view from the ground but provide clear views from above. Here, the survey team identified two boulders which appeared to have been modified to create a camouflaged observation point or shooting position.

The concealed position, identified as Feature 86, is a low wall built between two boulders that offers a good line-of-sight south along the beach and west to the lagoon. Made of cement and locally available stones, the wall is 1.1 m wide and ranges from 1.9 to 2 m in height. Behind the wall, on the northern side, is an elevated area, although it is still low enough for the wall to conceal anyone seated on the floor.

Feature 86 is believed to be an infield modification, built just prior to or during the Battle of Saipan. This may be a variation on the "spider hole," a camouflaged observation point and/or shooting position. Spider holes may initially refer to foxholes dug during the American Civil War, but the term is more commonly used in relation to holes dug on Pacific battlefields by Japanese soldiers. A spider hole is hole about 5 ft deep, large enough for one person, and sometimes had a camouflaged cover (Cannon 1954). Feature 86 is not a hole dug in the ground and has no existing overhead cover, but the boulders and the trees that are found immediately upslope on this section of shore provide some cover and concealment, and the low wall blends in relatively well with the surroundings.

Most likely, this was used for observation; this stretch of shore saw little action, but the Japanese Army used scouts to radio the US positions to gunners stationed inland (Chapin 1994). Feature 86 does not appear on any battlefield maps of the island and is representative of an expedient, infield terrain modification. Its location illustrates the importance of archaeology survey of modern historic battlefields which can shed light on how opposing forces acted and reacted during conflict.

In addition to the shoreline survey, the team made an inventory of Quonset huts and bunkers. Ten Quonset huts line As Matuis Drive, near the northern end of the island, and were built after the United States secured Saipan. Three bunkers were found inland from the shore, near Garapan, and are Japanese installations. Some of the Quonset huts and bunkers were abandoned once their initial purpose was over and have since been overgrown. Others have been appropriated by locals and are now used as storage sheds. The survey of Quonset huts and bunkers illustrates how a local population deals with the remains of war leftover in their backyards. The reasons why some were left to rot while others were reappropriated are beyond the scope of this survey, but may include ease of access and state of repair.

## *Feature Clusters*

Three clusters containing a total of 66 features were visually identified based on general feature distribution (Fig. 8.2). The clusters are not uniform in either geographic size or feature count, but they do appear to be feature groupings.

Cluster 1 is between Agingan Point and Susupe Point and is part of the Landing Beaches NHL. Cluster 2 is at Mutcho Point, and some of its features are within the boundaries of American Memorial Park. To the north, between Garapan and Tanapag is Cluster 3. Unlike Clusters 1 and 2, Cluster 3 is not part of a designated historic site or park.

Cluster 1 is the largest cluster and contains the most features, the vast majority of which are "miscellaneous." The building features are either metal or concrete structures, none of which are intact. In addition to the buildings, a possible concealed defensive position, similar to Feature 86 found near Pau Pau Beach, was identified. Since Cluster 1 is within an historic landmark, the presence of landmark plaques is to be expected. The NHL was designated in 1985, meaning there is a 41-year period in which features and artifacts could have been disturbed. The two wrecks in the lagoon off the landing beaches are believed to be in their original locations, but it is difficult to ascertain whether all the features in Cluster 1 are in situ.

Cluster 2 is the smallest cluster in both size and feature count. The majority of features in Cluster 2 are building and naval types. The buildings are mostly pillboxes and one unknown structure. The naval features are all pontoons. While the pillboxes are in situ, the pontoons are likely not and were instead discarded in their present location. It cannot be conclusively stated if the five small wrecks, which are all vessel parts, are in their original locations, but the jetty pilings are in situ. Similar to Cluster 1, Cluster 2 is expected to contain historic markers, and it does, inside American Memorial Park.

Cluster 3 is the second largest cluster and has what appears to be a more even distribution of feature types. All of the miscellaneous features in this cluster are pipes or retaining walls. One pipe, complete with a support structure, extends into the lagoon and appears to be for drainage. The other pipes lie parallel to the shore and appear to have been dumped there. The debris in this cluster is a large scatter of rubble and may be a collapsed wall. Cluster 3 is the only cluster to contain moorings, and all are believed to have been brought from elsewhere; they are too large, closely spaced, too and close to shore to serve as effective moorings in their present location. The naval features are a sea plane dock and a barge. The dock was built during the Japanese occupation of Saipan, but the barge, like the pontoons in Cluster 2, appears to have been abandoned at the shore.

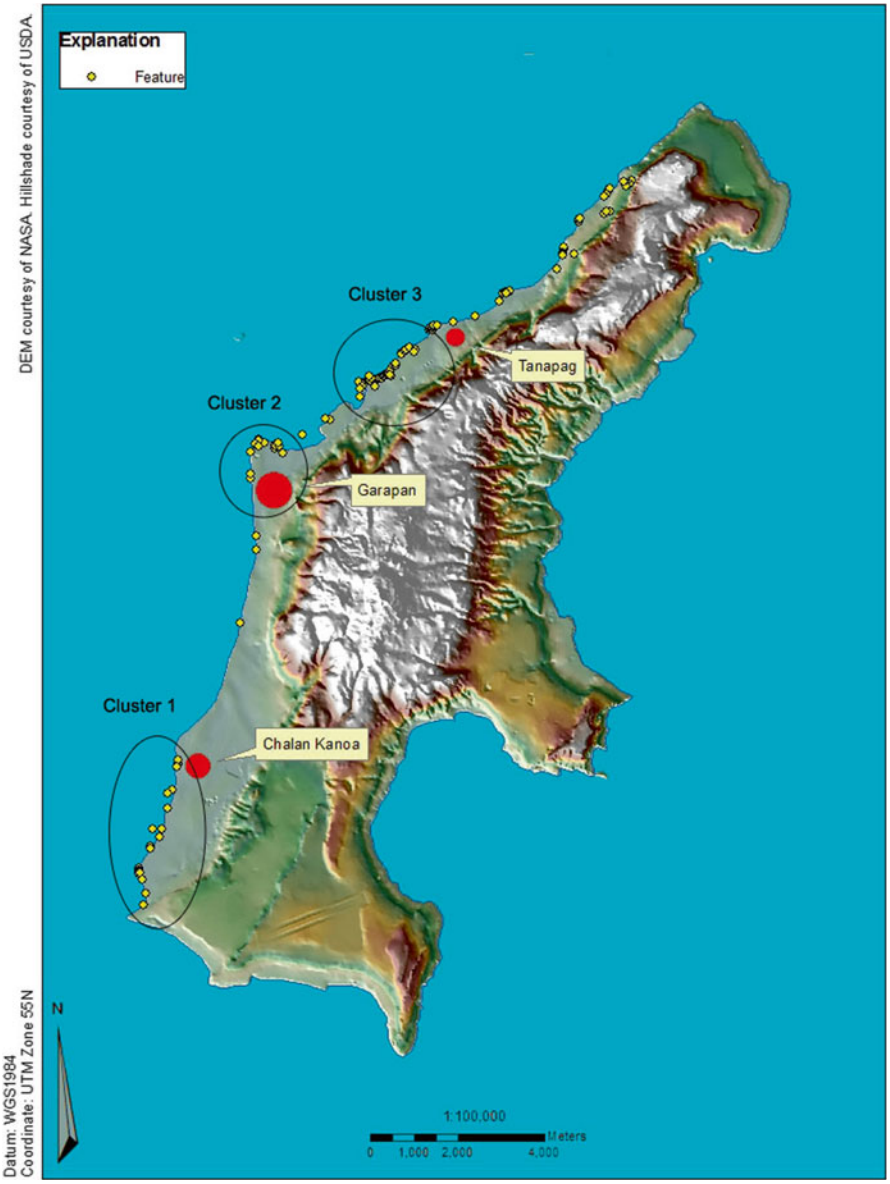


**Fig. 8.2** Feature clusters

The clustering effect appears to be due largely to postwar conservation and cultural activities. Both Clusters 1 and 2 are in areas which were less protected but now carry an NHL designation. Cluster 3 is not with the NHL, but its assemblage contains features that were removed from other locations at the end of the war.

In all clusters, as is the case with the survey area in general, it is difficult to identify which features are Japanese in origin and which were deposited by US forces. The exceptions are large permanent installations, pillboxes, and pontoons. The pillboxes were built by the Japanese, situated to provide views along the coast. Their distribution is tied to the island's geography, and this is why some are found within the clusters while others are not. The pontoons were brought to Saipan by the United States and discarded after use. Their distribution is derived from a purely functional use of the landscape, having been abandoned where they were least likely to pose a navigation hazard.

### Watercraft Abandonment

Similar to the pontoon abandonment site and the moorings in Cluster 3, two other identifiable discard sites were located during the survey. One is Puerto Rico dump, a locally known dump site with a large collection of debris, including a ship's ballast tank. The second is a small cove in which 13 pontoons were recorded.

The collection of pontoons can be interpreted as a watercraft abandonment site. Here, the deliberate discard of used pontoons is similar to other watercraft abandonment sites found elsewhere around the globe. Generally, a watercraft abandonment site forms over time, as ships and boats are discarded over a period of years. Typically, sites are discrete locations that are close to centers of industry but do not pose navigational hazards (Richards 2008). The first vessel to be abandoned in a safe and easy-to-access location invites others to be abandoned in the same place because people tend to discard unwanted materials where others have already done so. This same process is observed at Puerto Rico dump.

The pontoons recorded in this survey likely represent a single abandonment event, but the discard process is largely the same as that identified at other watercraft abandonment sites. The distribution of pontoons is derived from a purely functional use of the landscape and is not due to cultural or other organizational factors that can contribute to the formation of more traditional watercraft abandonment sites. Their discard was deliberate, and the location does not create a navigation hazard for other boaters in the lagoon.

## KOCOA

In accordance with the guidelines established by the ABPP, a KOCOA analysis was carried out within the survey area. KOCOA is a terrain analysis used to assess a landscape for tactical advantages and disadvantages. The acronym, first introduced in 1998, stands for Key terrain, Observation and fields of fire, Cover and concealment, Obstacles, and Avenues of approach and withdrawal (USMC 1998). KOCOA analysis has the ability to provide archaeologists with a better understanding of how people conceptualize and utilize the landscape during times of war (Hartgen Archaeological Associates 2009). On Saipan, KOCOA was applied to the survey area only.

## *Key Terrain*

Key terrain was identified as the landing beaches, the southern end of the island, and the mountains. Features within the key terrain are clustered toward the southern half of the landing beaches, along Yellow and Blue Beaches. Most are remnants of war, but some features, such as a collapsed wall, might postdate the invasion because there were few if any structures on the beaches when US forces arrived.

Few features were found along Red and Green Beaches. This part of the coast hosts a number of resort hotels and their beachfront is in the NHL. The hotels were built before the landing beaches were designated an historic landmark, and the lack of war-era features suggests extensive postwar disturbance during resort construction. Any and all debris would have been removed as part of the building process.

Scarlet Beach stands in sharp contrast to Red and Green Beaches. Here was found a heavy concentration of miscellany. Although no landing took place on Scarlet Beach, a large collection of WWII-era features were identified along the shoreline. This is also where the majority of pontoons were found, which clearly represents postwar deposition. Whether or not the rest of the Scarlet Beach assemblage was brought in from elsewhere is unknown.

## *Observation and Fields of Fire*

In order to repel any invading force, the Japanese military emplaced guns and built pillboxes to protect the shoreline. The pillboxes and other structures, such as Feature 86, mark the Japanese defensive positions along the shore. From these, Japanese soldiers had clear views up and down the coast from which to observe and fire upon the US landing force. Coconut groves inland from the landing beaches provided Japanese scouts with good vantage points from which to observe and fire upon the US troops. A sugar mill smokestack near Blue Beach 1 was also used as an observation point (Cooper 2009:106).

In an effort to mitigate the danger of crossing open water, Navy fighters strafed the shore as the landing force made their approach. Anticipating attack, the Japanese placed flags in the lagoon as sighting aids to better gauge the distance for their gunners.

### Cover and Concealment

It has already been established that the US landing force had little cover on approach. Similarly, their position on the beach was easily visible to the Japanese as was most of their movement over the island. Within the survey area, Feature 86 and the pillboxes are the only clearly identified features that would have provided cover and concealment.

### Obstacles

With its varied topography and additional environmental modifications made by the island's inhabitants, Saipan was host to a series of terrain features that proved troublesome for the United States. Just inland from the landing beaches, the sand gave way upslope to mud and overgrowth. A number of tanks were caught in the mud and could not pass through the vegetation, causing problems for the front line.

### Avenues of Approach and Withdrawal

Within the survey area, there is only one main avenue of approach: the lagoon. The three Sherman tanks off Afetna Point help identify the US approach. As the landing forced moved inland, the Japanese withdrawal pulled them out of the limits of survey area.

KOCOA is usually applied to Revolutionary and Civil War battlefields where the engagements lasted a few hours (Bedell 2006; Legg et al. 2005). On Saipan, the 3-week battle spread across an island 115 $km^2$ in size, and military objectives changed from day to day and week to week, which makes a single KOCOA analysis difficult. At present, a multilayered terrain analysis that captures the full extent of the engagement is beyond the scope of this chapter.

## Conclusion and Future Work

Saipan is not the same island it was when the Spanish landed in 1521, nor is it the same as when the United States landed in 1944, but some traces of its storied past remain. Pillboxes are found next to prehistoric Chamorro sites, and abandoned buildings mark the place where industry flourished and failed. Historically, Saipan has always been in a state of change, and the WWII cultural artifacts scattered along the island's western shore mark not a moment in time, but a transition from one state to the next.

Not only is the memory of both the US and Japanese forces preserved in the numerous monuments found around the island, but also in some of the features identified in this survey. Indeed, the very presence of WWII cultural resources serves as a constant reminder of the battle that took place in Saipan's waters and on its shores, but some features in particular carry the weight of remembrance. An old pillbox, now painted bright yellow, has a small Japanese sign on one wall. The sign appears to be a memorial plaque of sorts, and though partly degraded, it reads, "…67 years ago…troops Watanabe" (translation by team member Kotaro Yamafune).

The Battle for Saipan has left a lasting impression both on and off the island in terms of the WWII cultural resources that are found on land and in the lagoon. The survey of Saipan's west coast documents the military features still present on- and offshore. It led to the location of previously unknown infield modifications of the local environment, as well as a record of the use and disuse of war-era resources, and has identified loose patterns of feature distribution and deposition. When these findings are compared to the historical record, we gain a fuller understanding of how the battle unfolded and the changes that took place in the landscape during and since the war. The discovery of Feature 86 further highlights the importance of conducting archaeological survey of recent historical battlefields, as it does not appear on contemporary battle maps. KOCOA was applied to the survey area to gain a tactical understanding of the landscape and to better interpret the feature distribution.

Future work on Saipan's WWII history should include a multilayered terrain analysis that captures and represents the full scope of the battle. For this to happen, a complete survey of the island's defenses and military features is necessary. Gun emplacements and installations are to be found all over Saipan, and although they have been inventoried, they do not yet exist in a GIS database. A complete database of all of Saipan's WWII cultural resources, combined with battle maps and historic documents, will contextualize the entire island as a battlefield and lead to a better understanding of the conflict that took place in water and on land.

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# Chapter 9
# On-Site Conservation Surveys

**Vicki Richards and Jonathan Carpenter**

## Introduction

Conditions often exist in underwater environments that favor the long-term preservation of archaeological remains, and valuable information regarding our past can be gained through comprehensive archaeological investigation of these submerged sites. In more recent times, the archaeological community has moved away from the more traditional excavation and recovery methods and further towards on-site examination and in situ preservation of underwater cultural heritage sites. This trend has been politically galvanized in the recently ratified United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage (UNESCO 2001) that states as a fundamental principle, 'the preservation of underwater cultural heritage in situ should be considered as a first option'. However, this does not preclude partial or even total excavation and recovery of sites and associated artifacts, if they are considered under threat, for example, from natural or anthropogenic forces, such as industrial activity, coastal development, etc.

As the future of maritime archaeology moves further towards in situ management of underwater heritage sites, diving conservators and scientists play an increasingly important role in developing suitable management programs for underwater archaeological sites. One of the most important ways in which these specialists contribute to these management programs is by performing on-site conservation surveys.

The main aim of these on-site conservation surveys is to gather as much environmental and chemical information as possible, so the major degradative forces

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affecting the site and the associated artifacts can be assessed. This is expedited by taking physico-chemical measurements and sampling and analysing wreck material and the surrounding environment. Generally, factors such as water temperature, salinity, dissolved oxygen content, the pH levels and redox potentials ($E_{redox}$) of the water and sediment, turbulence, depth of submergence, extent of marine growth, burial history and artifact composition will affect the rate at which shipwreck sites degrade. By measuring these parameters, information can be gained which can be used to characterize a particular site in terms of the aggressiveness towards submerged materials.

In addition, the information gained from an on-site conservation survey will provide an invaluable aid in understanding the corrosion mechanisms and the modes of degradation of materials on archaeological sites. For example, the on-site values of pH and corrosion potential of metals allow the chemical state of these artifacts to be assessed, which will assist in determining the extent of deterioration and the structural integrity of a site. When monitoring these corrosion parameters at regular intervals, it is possible to predict the corrosion rate, and this information can then be used to estimate the longevity of a site and assist in establishing a suitable and effective management plan.

In February 2012, conservation surveys were conducted on 15 WWII wreck sites (10 iron alloy shipwrecks and 5 aluminum alloy aircraft wrecks) located primarily in Garapan and Tanapag Lagoons, Saipan, CNMI. The sites surveyed were as follows:

**Iron Alloy Wrecks**

M4 Sherman tank 1—Tank 1
M4 Sherman tank 3—Tank 3
Landing vehicle tracked 1—LVT1
Landing vehicle tracked 2—LVT2
Daihatsu landing craft 1—DAI1
Daihatsu landing craft 2—DAI2
Daihatsu landing craft 3—DAI3
Japanese freighter—JFR
Auxiliary submarine chaser—ASC
Steamship—SS

**Aluminum Alloy Aircraft Wrecks**

Grumman TBM Avenger—AVR
Aichi E13A—Jake
Martin PBM Mariner—MNR
Kawanishi H8K—Emily
Consolidated PB2Y Coronado—CRDO

This chapter will briefly describe the basics of metal corrosion and the interpretation of corrosion data and the results obtained from the conservation surveys and discuss the data with respect to site stability and suggest some recommendations for future monitoring and long-term preservation, which may assist in the development of a holistic management program for these underwater cultural heritage sites.

## Corrosion of Metals

### *Iron*

The corrosion mechanism for iron is very complex (North and MacLeod 1987: 76–80). The most distinctive feature of iron corrosion in warm to tropical seawater is the formation of hard concretions on the surface of the iron. As iron, recently submerged in a marine environment, begins to corrode, the metal has both cathodic and anodic areas on the one surface. However, the concretion produces a semipermeable layer on the surface of the iron which causes physical separation of the anodic and cathodic sites and reduces the rate of iron corrosion by effectively retarding the interchange of dissolved species between the iron and the open marine environment and increasing the oxygen diffusion path. Due to the isolation of the iron surface from the open seawater environment by concretion, the dominant cathodic reaction becomes the reduction of dissolved oxygen at the concretion/seawater interface producing hydroxyl ions and hydrogen gas. As the metallic iron surface corrodes under the concretion, the anodic reaction forms $Fe^{2+}$ and $Fe^{3+}$ ions which are then hydrolysed to produce hydrogen ions and ferrous or ferric oxy and hydroxy species. The combined effect of the anodic and hydrolysis reactions produces an acidic, iron-rich environment at the surface of the metallic iron. Charge neutrality is maintained by the outward diffusion, away from the metallic iron, of cations, such as $Fe^{2+}$, $Fe^{3+}$ and $H^+$, and a corresponding inward diffusion of anions, such as $Cl^-$ from the bulk seawater. The main corrosion product is ferrous chloride, and the surface pH of the residual iron surface decreases with respect to the pH of the surrounding seawater.

Eventually, when all the metallic iron has corroded, the solution under the concretion slowly equilibrates to that of the surrounding marine environment, and in practical terms, this state is represented by a void in the concretion of wrought iron objects and complete graphitization of cast iron artifacts.

### *Aluminum*

Aluminum is usually immune to corrosion in seawater due to the formation of a protective oxide layer with high electrical resistance, which blocks the exchange of electrons produced at the corroding aluminum surface being consumed by oxygen reduction at the seawater interface. However, when a defect in the protective film occurs, then the electrons can flow through the metal to the seawater interface, and corrosion will occur in the vicinity of the defect. This is called pitting corrosion and is exacerbated by chloride ions present in the marine environment (North and MacLeod 1987:95–98).

The main anodic reaction produces $Al^{3+}$ ions at the base of the pit, which are then hydrolysed to produce aluminum hydroxy species and hydrogen ions. The production of hydrogen ions in the base of the pit causes more corrosion of the aluminum metal. Charge neutrality is maintained by the outward diffusion of positive aluminum ions and the inward diffusion of chloride ions from the bulk seawater. When the aluminum ions reach the higher pH of the seawater, they will form hydrated aluminum oxide precipitates over the pit site.

Copper-aluminum alloys, such as duralumin, which has been extensively used in the manufacture of earlier aircraft, suffer from extensive intergranular corrosion in marine environments due to their metallographic structure. Basically, the aluminum-rich regions at the copper-aluminum grain boundaries corrode preferentially, effectively increasing the surface area where general corrosion can occur. When the copper-aluminum grains also corrode, blue-green copper corrosion products and grey-white aluminum hydroxides precipitate on the outer surface exposed to the surrounding seawater.

## *Corrosion Parameters*

The pH, corrosion potential, presence of entrapped gases and depth to solid metal are directly related to the condition of the residual metal. The water depth, the amount of dissolved oxygen in the seawater, the amount of water movement, the effective surface area, the salinity, the temperature and the metal composition will also affect the corrosion rates. A conservation survey will provide this information, and the general methodology is described in the section 'Methodology'.

### Pourbaix Diagrams

A convenient visual aid in viewing the effect that pH and corrosion potential have on metal corrosion is through a Pourbaix diagram (North and MacLeod 1987: 72–73). It is important to note that Pourbaix diagrams do not include kinetic information. They are only thermodynamic stability maps, which give an indication of the corrosion mechanisms and not the corrosion rate. However, they can be used as a general guide for interpretation of corrosion data.

The intercept of the surface pH and corrosion potential of the residual metal on a Pourbaix diagram will indicate whether a metal is actively corroding, has a passivating oxide layer that slows the corrosion rate or is not corroding at all (Fig. 9.1).

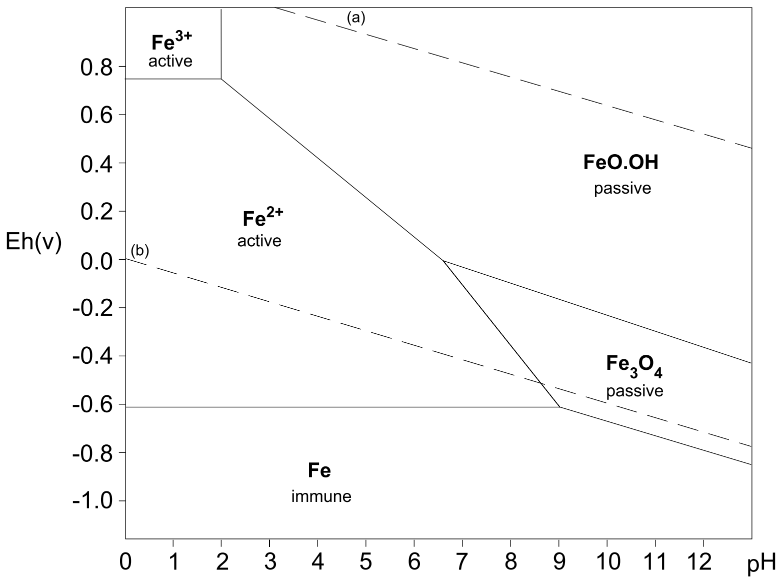


**Fig. 9.1** Pourbaix diagram for iron ($10^{-6}$ M) in aerobic seawater at 25 °C

Iron objects have been found in the immune region only when they are galvanically connected or in close proximity to a more reactive metal.

Temperature and salinity increases will decrease the solubility of dissolved oxygen in seawater, and since the reduction of dissolved oxygen is the rate-determining reaction in marine metal corrosion, this phenomenon is of importance. However, the depth of the site, the extent of water movement and the depth of burial in the sediment will have a greater effect on the concentration of dissolved oxygen available to the corroding metal surface. Since the water temperature and salinity are usually constant over a survey period on the same wreck site, differences in corrosion potentials of metal artifacts cannot be directly due to the dissolved oxygen concentration. However, one parameter that does decrease markedly with increasing depth is the total amount of water movement.

Factors affecting water movement on a wreck site are going to include the height and period of waves, the water depth, the prevailing currents and the turbulent motion associated with the wave break, seabed topography and object arrangement on the site. In shallow depths, there is much greater total water movement, and the higher the object profile above the seabed, the greater the turbulence causing increased corrosion. Therefore, lower corrosion potentials usually measured in deeper waters are a reflection of a lower oxygen flux to the corroding concreted iron objects.

## Corrosion Rates

The depth of corrosion or graphitization can be used to calculate the mean corrosion rate. The data for this relationship is obtained by measuring the depth of the corroded or graphitized layer, which is then divided by the number of years of submersion of the artifact to give an average annualized corrosion rate. This depth of corrosion is normally determined on objects where there is no or very little concretion, the concretion has been removed or there exists a very clear demarcation between the concretion and the corrosion phases. Owing to the non-uniform nature of corrosion across large objects, there is a need for caution in the interpretation of corrosion depths. Despite these anomalies, it is well known that the average long-term corrosion rate for isolated iron in aerobic seawater is approximately 0.1 mm per year (La Que 1975).

Corrosion potential ($E_{corr}$) data describes the electrochemical environment of the iron alloy that is electrically connected to the measurement point, and as such it is not as sensitive to changes in localized corrosion processes as the value of the pH recorded at the same point, provided no damage has occurred to the protective concretion layer. It has been shown that pH data is a useful guide to the corrosion rate, since the pH is controlled by the dynamic equilibrium (9.1) between the concentration of the $Fe^{2+}$ ions (represented as $FeCl_2$ in 9.1) and their acidic hydrolysis products and is, therefore, more sensitive to changes in apparent corrosion rate (MacLeod and Richards 2011).

$$2FeCl_2 + 2H_2O \rightarrow \left[Fe(OH)_2 \cdot FeCl_2\right] + 2H^+ + 2Cl^- \tag{9.1}$$

So, generally, as corrosion rate increases, the concentration of $Fe^{2+}$ ions underneath the protective layer of concretion increases; correspondingly, the extent of hydrolysis increases producing more hydrogen ions causing the pH to decrease (become more acidic).

In addition, MacLeod et al. (2007) have reported that the pH of corroding residual metal surfaces decreases linearly with increasing total thickness of the corrosion product layer and the encapsulating concretion ($d_{total}$). That is, generally, the thicker the $d_{total}$, the lower the surface pH but only if the concretion layer remains essentially undisturbed. That is, no damage occurs through human interference or natural phenomena, such as storms and cyclones or cyclic wetting/drying cycles. On wreck sites where there have been episodic deconcretion events, it takes some time for the marine organisms to regrow, and the rate of regrowth is dependent on a variety of interrelated factors. Thus, when measurement points are accessed, there is a chance that the pH recorded is more alkaline than the underlying long-term corrosion rates would indicate. In simple terms, more recently deconcreted and recolonized areas tend to present more alkaline pH values, whereas the fully matured sections possess more acidic values. In this instance, it is important not to confuse alkaline pH values with low corrosion rates for without knowledge of the corrosion thickness and the environmental history of the vessel, it is not wise to apply simplistic interpretation of the data as this can imply that the rate of corrosion is low whereas it is usually high in these particular areas.

## Methodology

A series of corrosion parameter measurements [pH, corrosion potential, total depth of penetration (concretion + corrosion), water depth] were conducted on each of the 15 wrecks to determine the underlying nature of the corrosion processes. The surface pH measurements were affected by a VWR epoxy body, flat surface pH electrode connected to a CyberScan 100 pH meter and the corrosion potentials measured via a platinum electrode connected to a high-impedance Finest digital multimeter set to read at 2 V direct current. Both meters were housed in a custom-built plexiglass waterproof housing. In order to obtain reproducible results, it was essential that the measurements were taken by a two-person dive team (one assistant diver, one operating diver): the assistant diver drilled and filled the holes, whilst the operating diver conducted the measurements and took the positional photographs. However, during this fieldwork season, in order to expedite the measuring process, a third diver filled the drill holes with epoxy, whilst a fourth diver took the photographs.

Contact was made with the underlying residual metal by drilling through the marine growth with an air-powered pneumatic drill equipped with a masonry tungsten-tipped bit. This type of drill bit drilled through the concretion and corrosion product layer but did not penetrate into the sound residual metal. When the drill could not penetrate further (the metal surface had been reached), the drill bit was removed by the assistant diver, and the operating diver immediately inserted the flat surface glass pH electrode into the drill hole. The minimum pH of the microenvironment created by the corroding metal was recorded.

Following the pH measurement, the platinum electrode was inserted into the same drill hole, and the corrosion potential (in volts) was recorded. Good electrical contact was made with the underlying metal when the voltage only changed by ±0.001 V measured against a flow-through silver/silver chloride/seawater reference electrode attached to the underwater housing lying immediately adjacent to the area of measurement. If the voltage reading was not stable, the assistant diver drilled another hole immediately adjacent to the previous position, and the entire measurement process was repeated (i.e. pH, corrosion potential, etc.).

The total depth of penetration (concretion + corrosion) was then measured with a plastic vernier. If possible, the depth of corrosion was also measured. This is where the protective encapsulating layer of marine concretion ceased and the original outer surface of the metal began measured to the bottom of the drill hole. However, this interface is extremely difficult to discern under most circumstances.

The water depth to the drill hole was then measured with a digital dive computer and a series of photographs taken to identify the measurement position on-site. The drill hole was then filled with an underwater curing two-part epoxy sealant (e.g. Selleys Knead It).

The measurement of pH on the aluminum alloy aircraft surfaces was difficult owing to the very thin layer, often less than 1 mm, of marine growth and corrosion products. The thin nature of this surface deposit and the inherent softness of aluminum alloys meant that the use of any form of drill was inappropriate. The assistant diver used the flat end of a diving knife to scrape the surface, and immediately the operating diver placed the pH electrode against the exposed shiny metal surface to record the underlying acidity. These experimental difficulties meant that the pH values on the aircraft were generally very conservative, i.e. generally the pH will be lower than was reported. The corrosion potential, water depth and photographs were then taken, but obviously the depth of penetration was not measured, and there was no requirement to fill any drill holes with epoxy.

The temperature, salinity and dissolved oxygen content of the seawater column were measured on each site at 0.5 m intervals to the seabed surface with the appropriate underwater sensors connected to a TPS 90DC microprocessor, which was located on the dive boat.

Finally an on-site conservation survey data sheet was completed for every site (Appendix A).

## Conservation Assessment of the Wreck Sites

### *General*

In general, the physico-chemical measurements (pH, $E_{redox}$, dissolved oxygen, salinity, temperature, etc.) of the local environment surrounding the wreck sites in Saipan are typical for a shallow, near-coastal, open circulation, oxidizing marine environment, where corrosion rates are likely to be relatively high for both ferrous alloy wrecks and aluminum alloy aircraft. All of the wrecks and the aircraft were mostly exposed with only very thin layers of sediment covering some lower-profile areas lying on the seabed, which would be particularly mobile during periods of excessive water movement (i.e. storm and cyclonic activity). Hence, natural protection via seasonal sediment burial would be very unlikely for any of the wrecks surveyed in 2012.

### *Iron Alloy Wrecks*

The corrosion parameters of a number of different areas on each of the ten iron alloy wrecks in Saipan were measured during the survey period. In order to compare the corrosion data collected from the different positions measured on the iron wrecks, the corrosion potentials ($E_{corr}$) and the pH of the residual iron alloy surfaces were plotted on the iron Pourbaix diagram in aerobic seawater at 25 °C (Fig. 9.1). Generally, the intercepts of all points measured on the iron alloy wrecks either lay in the active corrosion region, where ferrous ions are the thermodynamically stable chemical species and corrosion will continue until all iron is consumed, lay on the equilibrium line between active corrosion and the passive region, which implies that

**Table 9.1** Average corrosion parameter measurements for all iron alloy wrecks

| Wreck | Average corrosion potential vs. NHE (V) (all points) | Average pH (acidic) | Average pH (alkaline) | Average pH (all points) | Average $d_{total}$ (mm) |
|---|---|---|---|---|---|
| Sherman tank 1 | −0.305 ± 0.003 | – | – | 6.86 ± 0.09 | 19 ± 11 |
| Sherman tank 3 | −0.320 ± 0.003 | – | – | 6.34 ± 0.33 | 6 ± 4 |
| LVT1 | −0.322 ± 0.002 | – | – | 6.40 ± 1.18 | 18 ± 7 |
| LVT2 | −0.295 ± 0.028 | – | – | 7.13 ± 0.79 | 7 ± 4 |
| DAI1 | −0.334 ± 0.009 | 6.17 ± 0.32 | 7.68 ± 0.36 | 7.22 ± 0.80 | 9 ± 7 |
| DAI2 | −0.325 ± 0.002 | 6.09 ± 0.00 | 6.68 ± 0.05 | 6.39 ± 0.34 | 11 ± 12 |
| DAI3 | −0.338 ± 0.001 | 6.34 ± 0.18 | 7.50 ± 0.42 | 7.15 ± 0.66 | 6 ± 4 |
| JFR | −0.339 ± 0.007 | – | – | 7.29 ± 0.68 | 5 ± 4 |
| ASC | −0.327 ± 0.004 | – | – | 7.34 ± 0.72 | 6 ± 7 |
| SS | −0.355 ± 0.003 | – | – | 7.83 ± 0.49 | 4 ± 3 |

the typical aerobic corrosion mechanism where the major stable chemical species is the ferrous ion ($Fe^{2+}$) is in equilibrium with the formation of an insoluble corrosion product layer of magnetite ($Fe_3O_4$) or lay in the passive magnetite region ($Fe_3O_4$) indicating there was very little if any residual metal remaining in those areas. Generally, with film-free corrosion mechanisms, such as those occurring on concreted iron artifacts, an increase in the corrosion potential (tending more positive) indicates an increase in the corrosion of the metal.

The average corrosion parameters ($E_{corr}$, pH values and $d_{total}$) of all measurement points on each iron wreck are shown in Table 9.1. However, for many of the wrecks, there are no statistically valid differences between the average corrosion parameter measurements as they fall within the maximum/minimum range calculated from the standard deviations for each set of data points, making it difficult to determine any differences in corrosion rates between the wrecks based on the corrosion parameter data. However, some conclusions can be drawn if only based on some of the corrosion parameter data in conjunction with the environmental and historical information.

The average corrosion potential for Tank 1 was −0.305 ± 0.003 V, which is only 15 mV more positive than Tank 3; hence, it is not possible to determine any differences in corrosion behavior between the measurement points on Tank 3 and between Tank 1 and Tank 3 based on the $E_{corr}$ data. The decrease of 0.52 pH units for Tank 3 indicates that there has been a statistically significant increase in the corrosion rate of Tank 3 as compared to Tank 1 and, in conjunction with the thinner $d_{totals}$ measured on Tank 3, suggests that the natural and cultural impacts of the local environment on Tank 3 are more aggressive than those experienced by Tank 1. More importantly, as there appears to be more tourist activity associated with Tank 3, it may be this increase in human interference that is causing the accelerated deterioration of Tank 3.

It is difficult to say whether the LVT2 is corroding at a faster rate than the LVT1 as all average measurements are within their respective statistical errors. However, considering the extent of deterioration of the LVT2 as compared to the LVT1, it would appear that the natural and cultural impacts on the LVT2 would be greater than those experienced by the LVT1.

Based on the average pH values of the more alkaline positions on the Daihatsu wrecks, which were 6.68 ± 0.05 on DAI2 and 7.68 ± 0.36 and 7.50 ± 0.42 on DAI1 and DAI3, respectively, some differences in corrosion rate can be ascertained. The decrease in average pH of DAI2 suggests that it may be corroding at a slightly faster rate than both DAI1 and DAI3. This is not unexpected as it is known that isolated iron artifacts and steel hull structures that have been damaged either through natural phenomena (e.g. cyclonic activity) or human intervention (e.g. salvage, explosive damage during WWII) possess higher corrosion rates than those hull structures that are relatively intact (i.e. DAI1 and DAI3), where the current density of the corrosion process can be spread over a much larger surface area effectively lowering the corrosion rate. In addition, it appears that DAI1 and DAI3 are corroding at relatively similar rates, despite the fact that DAI3 is a much shallower site, where it would be expected that the corrosion rate would be slightly higher. This would seem to suggest that human interference (i.e. recreational diving activities) is having some impact on the deterioration rate of the deeper DAI1 site.

Based on the corrosion parameter measurements, it is difficult to determine any changes in corrosion behavior of the larger shipwrecks, the JFR, the ASC and the SS, as most average measurements are within their respective statistical errors. However, based on the average corrosion potentials of the JFR (–0.339 ± 0.007 V), the ASC (–0.327 ± 0.004 V) and the SS (–0.355 ± 0.003 V), it appears that the small but statistically valid decrease in the corrosion potential ($E_{corr}$) of the SS suggests that this vessel is corroding at a slower rate than both the ASC and the JFR and the small increase in the average $E_{corr}$ of the ASC suggests that it may be corroding at a slightly faster rate than JFR. This is not unexpected as steel hull structures that have been extensively damaged (i.e. ASC) possess higher corrosion rates than those hull structures that are relatively intact (i.e. JFR and the SS). This would seem to suggest that human interference (i.e. recreational diving activities) is having some impact on the deterioration rate of the JFR and ASC sites as the SS site is not on the diving heritage trail. However, the local environment (i.e. increase in turbidity) may also be contributing to this decrease in the corrosion rate on the SS site.

## *Aluminum Alloy Aircraft Wrecks*

The corrosion parameters of a number of different areas on each of the five aluminum alloy aircraft wrecks in Saipan were measured during the survey period. In order to compare the corrosion data collected from the different positions measured on the aircraft, the corrosion potentials ($E_{corr}$) and the pH of the residual aluminum alloy surfaces were plotted on the aluminum Pourbaix diagram in aerobic

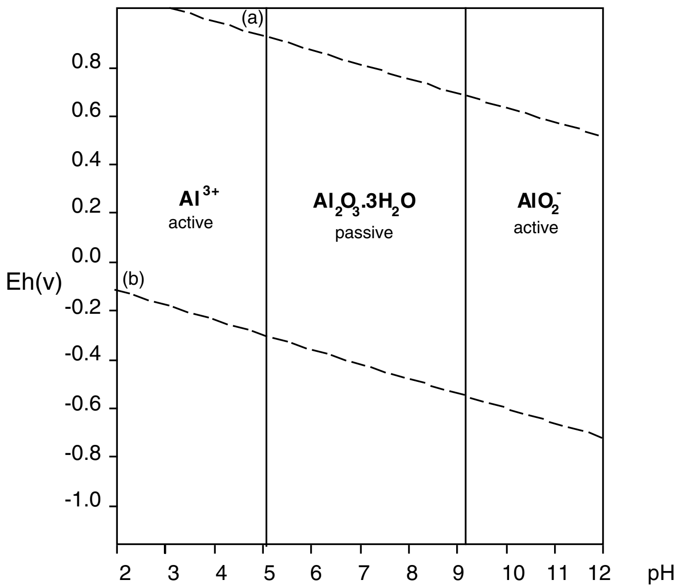


**Fig. 9.2** Pourbaix diagram for aluminum ($3.7 \times 10^{-6}$ M) in aerobic seawater at 25 °C

seawater at 25 °C (Fig. 9.2). From these Pourbaix diagrams, the intercepts of all points measured on all aircraft lie in the passive region, where $Al_2O_3{\cdot}3H_2O$ is the dominant corrosion product and forms a continuous passivating layer, effectively slowing corrosion rates. This is a very common corrosion state for aluminum alloy aircraft in marine environments. However, this particular Pourbaix diagram is only applicable to pure aluminum in seawater, and most of the aircraft manufactured during WWII used a variety of aluminum alloys consisting mainly of aluminum but including varying concentrations of minor alloying constituents (e.g. iron, copper, magnesium, manganese, zinc and silicon) in order to change the functionality of the aluminum. One of the most common alloying metals used was copper (e.g. duralumin) which was added to aluminum to increase its strength; however, the presence of the copper dramatically decreased the corrosion resistance of the metal to seawater. The other issue that will increase the deterioration rates of the aircraft is galvanic corrosion, where the more reactive aluminum alloys will corrode faster effectively protecting the more noble metals, such as iron and copper. All these issues combined make it extremely difficult to determine any differences in corrosion rates based on the corrosion parameter data. For example, the average corrosion potential and pH values for all measurement points for each wreck are shown in Table 9.2 (columns 2 and 3), and from this data it is obvious that there are no statistically valid differences between any of the average corrosion parameter measurements as all fall within the maximum/minimum range calculated from the standard deviations for each set of data points.

However, since all aluminum alloys are corroding in a common oxidizing marine environment in Tanapag Lagoon, the different values of the corrosion potentials

**Table 9.2** Average corrosion parameter measurements for all aluminum alloy aircraft wrecks

| Wreck | Average corrosion potential vs. NHE (V) (all points) | Average pH (all points) | Average corrosion potential vs. NHE (V) (major group) | Average pH (major group) | Average water depth (m) |
|---|---|---|---|---|---|
| Avenger (AVR) | –0.440 ± 0.021 | 8.06 ± 0.11 | –0.438 ± 0.001 | 8.08 ± 0.08 | 2.2 ± 0.9 |
| Aichi E13A (Jake) | –0.443 ± 0.011 | 7.99 ± 0.09 | –0.446 ± 0.003 | 8.01 ± 0.07 | 6.1 ± 0.3 |
| Mariner (MNR) | –0.446 ± 0.037 | 8.10 ± 0.26 | –0.458 ± 0.008 | 7.97 ± 0.10 | 6.4 ± 0.6 |
| Kawanishi H8K (Emily) | –0.467 ± 0.009 | 8.02 ± 0.17 | –0.474 ± 0.001 | 7.95 ± 0.17 | 8.0 ± 0.6 |
| Coronado (CRDO) | –0.465 ± 0.014 | 7.96 ± 0.07 | –0.459 ± 0.008 | 7.95 ± 0.07 | 7.4 ± 0.4 |

may provide a guide to the underlying differences in alloy composition of the aircraft. Since the corrosion potentials of aluminum alloys containing higher concentrations of less reactive metals, such as copper, become more positive (more anodic), it is possible to determine differences in the metal compositions of the major structural components of the aircraft. Hence, if the average corrosion potentials of the largest group of measurement points with similar $E_{corr}$ values on each of the wrecks are compared (Table 9.2—column 4), some differences between the aircraft metal compositions become more apparent. Unfortunately, again the average pH values for the same group of points are within statistical error and, thus, cannot be used in the interpretation. So based on this average $E_{corr}$ data, the metal composition of the aluminum alloys for each aircraft, in the order of decreasing concentrations of incorporated copper (or other less reactive metals), is Avenger > Jake > Mariner ~ Coronado > Emily. That is, the Avenger may have the highest concentration of copper in this group of aluminum alloys measured, whilst the Emily will have the lowest based on this data set. This may have consequences for the corrosion rates of these aircraft as higher concentrations of copper will increase the rate of pitting and intergranular corrosion if the aircraft are subjected to similar environmental conditions and other complicating factors, such as increases in corrosion through stress and metal fatigue, are absent. Since this is not the case with these aircraft (i.e. the Avenger lies in a very aggressive, shallower marine environment, and the Coronado is extensively damaged with separate sections strewn over a very large area), this highlights the problem with interpreting corrosion data based on only one set of corrosion parameter measurements.

In conclusion, a holistic approach must be taken using all the data obtained including the environmental and historical information in order to understand the corrosion processes occurring on a wreck site. Hence, continued observation of the sites and further corrosion measurements in the future may assist in corroborating or refuting the aforementioned inferences.

## Conservation Management Recommendations

The submerged shipwrecks and aircraft wrecks located in Saipan are a significant part of WWII history and are one of the main tourist attractions in Saipan. It is therefore important that appropriate management plans are implemented to ensure the future preservation of these sites. The scope of the work includes ongoing monitoring of the status of the natural and cultural attributes of the wrecks and the integrity of these underwater archaeological sites. Specific guidelines detailing the range of corrosion aspects to be documented on a regular basis will empower Saipan HPO field staff to implement regular and effective monitoring surveys integral for their future preservation. The guidelines will provide consistent and comparative data, which will assist in the implementation of any future conservation management strategies.

Regular site inspections are an integral part of the overall management strategy for a submerged site. The primary focus of an on-site corrosion survey is to collect as much pertinent information as possible to assist in ascertaining the extent of deterioration and structural integrity of a site. Further inspections are then required at regular intervals and especially after any severe storm or cyclonic activity, so any changes in the integrity of the site are noted by direct comparison with earlier surveys. The more surveys carried out, the better as it will provide more information regarding the rate of deterioration and the inherent stability of a site, which will assist in recognizing which sites are a priority for future implementation of appropriate in situ conservation management strategies.

The first step in implementing any corrosion survey is to gather the information outlined in the 'On-Site Corrosion Survey Data Sheet' (Appendix B). Much of this information is self-explanatory, but some basic explanations and examples of some of the criteria included in this form are described below.

*Weather and sea conditions*, *swell and tidal information*, *and current*—The amount of oxygen impingement to the surface of a metal will directly affect the corrosion rate. Without direct access to probes to measure the dissolved oxygen concentration in the water column, it is imperative that the amount of water movement on a site is documented. For example, any increase in water movement (increased swell, tidal movement, current, etc.) will increase the amount of oxygen available to a metal surface and, in turn, increase the corrosion rate.

*Water temperature*—The effects of water temperature on corrosion rates are complicated by its effect on biological growth; however, in the absence of biological considerations, the rate of corrosion would be expected to double with every 10 °C rise in water temperature. On the other hand, increases in water temperature will increase the growth rate of encrusting organisms and the depth of the concretion layer on the metal surface, which may reduce the corrosion rate. In addition, the concentration of dissolved oxygen decreases with increasing temperature; therefore, it is important to measure the water temperature on-site, and when possible, the annual ranges in an area should also be noted.

*Water depth to wreck* (minimum, maximum)—The depth range of the submerged site from the shallowest to the deepest section includes the depths of any large structural features (e.g. the shallowest section of the freighter is the top of the bow at 2 m, the major structure at 5–7 m and the seabed at 11 m). The depth of a site may have an influence on the corrosion rate because in general, as water depth increases, the amount of water movement decreases, decreasing the amount of oxygen availability to a metal surface and, hence, the corrosion rate. In addition, changes in the maximum and minimum water depth are a simple way to monitor the overall collapse of the vessel on the seabed.

*Visibility*—This should be an approximation. Visibility on submerged sites is quite variable and influenced by many factors, some of which can affect the deterioration rate of sites. For example, increased water movement can lift sediment into the water column, which can then essentially sandblast the metal surface and rapidly erode any protective corrosion/concretion layers, thereby increasing the corrosion rate. Alternatively, sites where the visibility is more often than not poor may discourage diving activity and therefore decrease damage by limiting human disturbance.

*Distance from land/reef*—The distance and direction of a submerged site from land, reef or man-made construction can have an influence on the amount of water movement a site experiences and, hence, the corrosion rate. For example, a site located in the lee of an island may be protected from seasonal increases in water movement (e.g. during monsoons, typhoons, etc.) effectively lowering the average corrosion rate. Alternatively, a site located adjacent to a reef may experience increased water movement and, hence, an increased corrosion rate.

*Freshwater influence*—In general, metal corrosion rates decrease with decreasing salinity; hence, metals in freshwater are generally better preserved than those located in marine environments. Therefore, if there is a large increase in the volume of freshwater from rainwater runoff, rivers, etc., on a site, the salinity will decrease, thus reducing the corrosion rate.

*Site dimensions* (area)—This is essentially a measure of the scatter of debris on a submerged site which may have an influence on localized turbulence and increase the surface area exposed to dissolved oxygen and, hence, change the average corrosion rates of the different sections scattered over a site.

*Site orientation*—The orientation of a submerged site can affect the corrosion rate by changing the amount of water movement around a site. For example, a wreck that has a list to port may show signs of increased corrosion on the more exposed starboard side compared to the more protected port side of the vessel (e.g. Jake aircraft). Another point that has to be considered, especially on wrecks that are not upright (e.g. auxiliary submarine chaser), is the increase in stress on the vessel's hull structure causing increased corrosion rates in the long term.

*Composition of dominant wreck material*—It is important to identify the dominant material/s a submerged site primarily consists of as it will have a significant effect on the type and amount of biological growth on the metal surface, the primary corrosion mechanisms and, hence, the corrosion rates. For example, iron promotes biological growth and is characterized by relatively thick concretion layers and significant amounts of secondary marine growth, such as corals. This semipermeable protective layer essentially changes the nature of the local microenvironment from that of normal seawater and effectively slows down the rate of corrosion. On the other hand, aluminum is biologically inert and generally characterized by little marine growth, often only being covered by a thin gelatinous layer of corrosion products and marine algae.

Another factor to consider is galvanic corrosion. When two dissimilar metals are in direct electrical contact with each other, the more active metal (e.g. aluminum) will corrode faster than normal, and the other more noble metal (e.g. iron) will be protected. For example, aluminum in direct physical contact with iron will corrode at a faster rate than just aluminum on its own, and therefore the structural integrity of the aluminum of the galvanic couple will deteriorate at a faster rate.

*Dominant encrusting organisms on surface* (type, abundance, photograph)—This need only be a very general survey, photographically documenting the main encrusting organisms present on the dominant material types (e.g. iron, aluminum, etc.) comprising the submerged site. If the site is large or scattered over a large area, then fully document a few areas (e.g. bow, midships and stern) that can be monitored at regular intervals in the future. The type and abundance of colonizing organisms can have a significant effect on the rate of corrosion of metals and the degradation rate of organic materials. For example, a relatively thick concretion layer may decrease the corrosion rate of iron by effectively separating the metal surface from the seawater and protecting the underlying metal from physical damage, but conversely, areas that are covered in large, very prominent encrusting organisms may increase localized water turbulence, and this, in turn, may cause an increase in the corrosion rate. In addition, documenting any areas where changes have occurred (i.e. through storm damage or human interference) can assist in monitoring the rate of recolonization. If the damage is extensive, then fully document a few areas that can be monitored at regular intervals in the future.

*Evidence of active corrosion*—Evidence of active corrosion on iron is characterized by the typical red-/brown-colored corrosion products (rust). It is more difficult to identify active corrosion on aluminum due to the protective oxide layer that forms on the metal surface, and often the first sign of active corrosion is total perforation of thinner structural plates; however, sometimes it can be characterized by localized areas of white/grey pustules. In addition, copper-aluminum alloys, such as duralumin, suffer from extensive corrosion in seawater. In this case, active corrosion is characterized by a combination of the white/grey aluminum oxide pustules and the typical blue/green copper corrosion products. If the active corrosion is relatively uniform over a site, then fully document a few areas (e.g. bow, midships and stern) that can be monitored at regular intervals in the future. It is imperative that these areas of active corrosion are accurately documented in the initial survey (water depth, general description of position and photographic documentation), so the information gathered on any subsequent surveys can be directly compared to this baseline survey, so any changes in the number and/or extent of the active areas can be noted. Obviously, a submerged site exhibiting increased active corrosion indicates that there is an increase in the corrosion rate.

*Evidence of damage*—Damage caused to submerged sites by human interference and/or periods of excessive water movement (storms, typhoons, etc.) is easily identified by large areas of exposed metal generally devoid of secondary marine growth. Often, the metal will show signs of active corrosion. It is imperative that these damaged areas are accurately documented in the initial survey (water depth, general description of position and photographic documentation), so the information gathered on any subsequent surveys can be directly compared to this baseline survey, so any changes in the corrosion activity, extent of colonization, etc., can be noted in the future. A submerged site with large expanses of damage will exhibit increased localized corrosion rates.

*Evidence of structural collapse*—It is imperative that a submerged site is accurately documented over its entire length during the initial survey, concentrating on areas that would be more prone to structural collapse. In this way, any changes in the structural integrity of a site can be accurately monitored.

*Evidence of human disturbance*—It is imperative that a submerged site is accurately photographically documented over its entire length and breadth during the initial survey, so any evidence of human disturbance (e.g. broken corals caused by diver damage, damage due to inappropriate anchoring procedures, removal of artifacts, etc.) can be monitored in the future. If feasible, photographically document any conglomeration of artifacts during the initial survey, so any changes in the condition of the artifacts or, more importantly, removal of the artifacts from the site can be monitored during subsequent surveys.

In addition, some general points to consider when performing on-site corrosion surveys are outlined below.

1. It may be advisable to conduct the first dive on any submerged site as a reconnaissance survey in order to plan what information and documentation are actually required for the initial survey and how the survey will be carried out.
2. It is imperative that an initial survey is carried out on every submerged site, so the information gathered during subsequent surveys can be directly compared to this baseline survey. This is necessary in order to ascertain if any changes have occurred to the site with respect to its corrosion state (increases in the extent and number of areas exhibiting active corrosion; changes in structural integrity; changes in the extent of damage due to human disturbance, such as anchor damage, salvage, pollution, etc.) in the future. The baseline survey must be as compre-

hensive as possible; then it can be used as the basis for subsequent surveys where any changes that occur are documented rather than duplicating the initial survey.

3. One of the most important aspects of the corrosion survey is the photographic documentation of any changes that occur on a site. This will then allow meaningful comparisons to be made in the future to ascertain if any significant changes have occurred to the corrosion rate and structural integrity of a particular site.

Without access to the underwater corrosion equipment, the most important aspect of the regular site inspections is the photographic documentation of any changes that occur on a site. This will then allow meaningful comparisons to be made in the future to ascertain if any significant changes to a particular site have occurred. In addition, it is recommended that another full corrosion and environmental survey using the underwater corrosion survey equipment is performed in another few years. In this way, from comparisons of the regular site inspection results and the additional corrosion parameter data for each wreck site, it will be possible to ascertain if there is indeed any effect from diving tourism on the sites and if it is at all comparable to the detrimental effects afforded by natural occurrences, such as seasonal storm and cyclonic activity. Finally, using a combination of information gathered from these surveys, it will be possible to prioritize these submerged sites with respect to their overall in situ management requirements and the most appropriate management plans determined and applied to each site.

## Appendix A: On-Site Conservation Survey Data Sheet

Date of survey
Time of survey
Aim of survey
Personnel
Site (name, date and type)
Location
Distance from land/reef
Site classification
Site dimensions (length, width, area)
Site orientation
Seabed topography
Marine macrofauna and flora (type and abundance) (photograph)
Wreck-specific types of marine life (photograph)
Composition of dominant wreck material (in situ observation, cargo influence)
Exposed artifacts (type, material, apparent condition, degree of completeness, distribution)
Degree of site exposure (area, height above seabed)
Evidence of seasonal exposure

Evidence or potential for storm, cyclone influence
Evidence of human disturbance (salvage, pollution, modern contamination, water activities)

Weather conditions
Sea conditions
Swell
Current (rate, direction, speed)
Tidal information
Freshwater/saltwater influence (rivers, springs, seawater)

Water temperature (surface, at depth)
Salinity/conductivity water (surface, at depth)
Dissolved oxygen content water (surface, at depth)
pH water (surface, at depth)
Redox potential water (surface, at depth)
Water depth (minimum, maximum)
Visibility (material type in suspension)
General sediment composition (in situ observation)
Mobility of sediment surface (rippling, direction and frequency)
Sediment slope
Probe depth to wreck material (extent of burial)
Depth to stable seabed (evident by black/anaerobic layer)
Sediment gradation (changes in color)
Sediment photography (surface, gradation, at depth)
Sediment sampling (sample all significant layers)
Sediment analysis (particle size distribution, inorganic elements, organic content, nutrients, microorganisms)
pH sediment (measure all significant layers)
Redox potential sediment (measure all significant layers)

Timber infestation by marine borers (active, depth to non-activity)
Probe depths of timbers (exposed, buried)
pH profiles of timbers (exposed, buried)
Timber samples (wood identification, maximum water content, FT-IR, $^{13}$C-NMR, Py-GC-MS)

Corrosion potential metals (concretion/metal interface)
Surface pH metals (concretion/metal interface)
Depth of concretion and graphitization
Depth of concretion
Depth of graphitization
Sample concretion (optional)
Sample metals (optional)

## Appendix B: On-Site Corrosion Survey Data Sheet

Date of survey:________________________________________
Time of survey:________________________________________
Personnel:___________________________________________
Site (name, date and type):________________________________
Location and GPS co-ordinates:_____________________________
Weather and sea conditions:______________________________
Swell and tidal information:______________________________
Current (rate, direction, speed):___________________________
Water temperature:_____________________________________
Water depth to wreck (minimum, maximum):____________________
Visibility (meters):_____________________________________
Distance and direction from land/reef:________________________
Freshwater influence (e.g. rivers, springs, rainwater runoff):____________
Site dimensions (length, width, area):________________________
Site orientation (e.g. upright, list to port or starboard, upside down):________
Composition of dominant wreck material (e.g. iron, aluminum):__________
Dominant encrusting organisms on surface (type, abundance and photograph):
_____________________________

Evidence of active corrosion (depth, position and photograph): Y/N ____________
________________________________________________________

Evidence of dynamite and/or storm damage (depth, position and photograph): Y/N
________________________________________________________

Evidence of structural collapse (depth, position and photograph): Y/N __________
________________________________________________________

Evidence of human disturbance (e.g. salvage, pollution) (depth, position and photograph): Y/N ________________________________________________

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# Chapter 10
# Fish Habitat Provided by Saipan's WWII Submerged Heritage

**Ashley M. Fowler and David J. Booth**

## Artificial Reefs, Vessel Reefs and Their Associated Biological Communities

The amount of artificial habitat (termed 'artificial reef', AR) in marine systems is rapidly increasing worldwide. ARs can either be planned, in the case of specifically designed units for ecological purposes (e.g. fishery enhancement reefs), or unplanned, where the creation of a reef is not an intended outcome of deployment (e.g. breakwaters, shipwrecks). While planned ARs are now widely used for fisheries and conservation purposes, the amount of this reef type is dwarfed by the amount of unplanned AR. Infrastructure in particular is becoming the dominant reef type in numerous nearshore and estuarine locations. For example, the breakwaters constructed around the man-made Palm Islands off the coast of Dubai, United Arab Emirates, are 65 km long and represent more than a 50 % increase in hard-bottom habitat in the region (Burt et al. 2009). In Sydney Harbour, Australia, over 50 % of the foreshore habitat has been replaced with seawalls (Chapman 2003).

### *The Ecological Role of ARs*

Despite their proliferation, the potential benefits and impacts of ARs (planned or otherwise) remain unclear. It has been suggested that ARs could help to conserve reef communities and protect against diversity loss by acting as surrogates for degraded

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natural reefs. This role of ARs is likely to be particularly beneficial in developing nations where reefs provide an important source of food and income for local communities. To fulfil this role, ARs must develop biological communities that are similar to the reefs they are replacing. Otherwise, they are simply generating new reef ecosystems rather than acting as surrogates for existing ones. In support of their ability to act as reef surrogates, some ARs have been shown to develop similar abundances and species diversity to nearby natural reefs (Bohnsack et al. 1994; Clark and Edwards 1999; Rilov and Benayahu 2000; Perkol-Finkel and Benayahu 2004; Burt et al. 2009). However, results have varied widely among studies, and species composition has often been shown to differ between ARs and natural reefs (Clark and Edwards 1994, 1999; Perkol-Finkel et al. 2006; Burt et al. 2009). If ARs do not mimic communities on natural reefs, a substantial increase in AR habitat could alter community structure away from a natural state and do little to maintain natural diversity levels. Determining how closely ARs can approximate communities on natural reefs is critical for an accurate assessment of their potential ecological benefit (or impact).

The ability of ARs to mimic the functional aspects of natural reefs is perhaps even more important than their ability to mimic taxonomic composition. If ARs are incapable of fulfilling essential ecosystem functions, including provision of adequate food resources, nursery habitat and shelter from predation, then they are unlikely to develop and sustain viable reef communities. A key aspect of ecosystem function is that of functional diversity. Different groups of organisms fulfil different ecological roles, for example, grazers on coral reefs prevent overgrowth of algae, which in turn allows corals to settle and grow. If a functional group is lost, this may result in a disruption to normal ecosystem function and a change in ecosystem state (e.g. coral-algal phase shifts in the Caribbean following overfishing of grazers, Hughes 1994). High functional diversity, i.e. a large number of different functional groups, provides redundancy in case one functional group is lost. Ecosystems with high functional diversity are therefore expected to be more resilient to environmental perturbations than ecosystems with low functional diversity. Few studies have examined functional aspects of ARs or how functional diversity compares to that of natural reefs. Given that communities on most ARs have had considerably less time to develop than those on natural reefs (decades vs. millennia), we might predict that functional diversity will be lower on ARs than natural reefs. Determining if ARs function similarly to natural reefs, and whether ARs can approximate functional diversity, is essential for evaluating the relative quality of the habitat provided by ARs.

In addition to developing different communities, ARs may actually influence the structure and function of communities on nearby natural reefs. Perhaps the greatest debate surrounding the use of ARs is whether they create 'new' biomass of reef organisms (referred to as 'production') or simply redistribute existing biomass on surrounding reefs (referred to as 'attraction', see Bohnsack 1989). Production involves a gain to the local ecosystem and is an implicit goal for most AR deployments. In contrast, attraction may involve an impact on surrounding natural reefs as organisms (biomass) are drawn away from them toward the newly created habitat. Such a scenario may result in decreased biomass on natural reefs in the deployment area, as well as a change in their community structure and composition. Attraction may also cause indirect effects on natural reefs including food-web alterations resulting from changes in the relative abundance of particular trophic groups (e.g. loss of herbivores to ARs), as well as changes in population-regulating processes, such as reduced recruitment (through recruit interception) and increased predation (export of predators from ARs). Although attraction has been recorded many times, particularly for fishes, the resulting effects on surrounding reef assemblages have rarely been investigated. Only two studies have examined changes to natural fish assemblages following AR deployment (Stone et al. 1979; Masuda et al. 2010), and only one of these examined multiple ARs (Masuda et al. 2010). Further investigation of the potential of ARs to affect the assemblage structure and species composition of nearby natural reefs is essential for assessing any potential impacts of AR deployment.

### *Vessel Reefs*

Sunken vessels (herein, 'vessel reefs') are a specific type of AR which are becoming increasingly popular with both environmental managers and recreational users. Vessel reefs are renowned for their ability to support high densities of fish, and the popularity of shipwrecks as fishing and dive sites has prompted the creation of new vessel reefs through the deliberate deployment of obsolete vessels. The use of obsolete vessels for ARs also reduces costs, allowing much larger ARs to be constructed than would otherwise be possible. The largest AR in the world is a vessel reef located in 64 m water depth off the coast of Florida. It was created in 2006 by sinking an obsolete aircraft carrier (USS *Oriskany* [CV-34]) and has a footprint of 1.07 Ha.

Despite their popularity, little is known about the fish assemblages that develop on vessel reefs or how they compare to those on natural reefs. It may be predicted that vessel reefs will develop substantially different assemblages to those on natural reefs, due to the considerable structural differences between the two reef types (Hixon and Beets 1993). However, the few studies comparing fish assemblages between vessel and natural reefs have produced mixed results (Jones and Thompson 1978; Arena et al. 2007; Honório et al. 2010). Arena et al. (2007) found that deliberately deployed vessel reefs off the south-eastern coast of Florida supported much higher abundances and biomass than nearby coral reefs, while Jones and Thompson (1978) found that fish assemblages on shipwrecks off Key Largo, Florida, were more similar to assemblages on nearby coral reefs than to each other. Honório et al. (2010) compared fish assemblages between shipwrecks and rocky reefs off the north-eastern coast of Brazil and found little difference in species composition. Such studies have generally been hindered by investigation of only a few vessel reefs, with little consideration of the effect of reef age on assemblage structure or composition (but see Arena et al. 2007). In addition, studies have rarely accounted for the effect of reef size on associated assemblages and have usually compared isolated vessel reefs with large continuous natural reefs. As deployment of vessel reefs increases, there is a need for rigorous investigation of their ability to approximate the structure and function of fish assemblages on natural reefs. Such information will allow an assessment of their likely ecological benefit (or impact) and allow for informed decisions to be made regarding future deployments.

From an archaeological perspective, knowledge of the biological communities associated with submerged heritage is important for understanding their current context, as well as potential impacts on the site. Wrecks become integrated into the marine environment and continue their human interaction through provision of diving and fishing opportunities, particularly in shallow water locations. While such sites can provide important ecosystem services for local communities (e.g. food sources for subsistence communities), physical damage resulting from human interaction can also affect structural integrity and degradation rates. Knowledge of the biological communities associated with individual wrecks (e.g. large fish populations) can be used to predict the type(s) and extent of human interaction and therefore assist development of appropriate management strategies (e.g. exclusion of fishing). Some aspects of the biological community also directly impact submerged heritage, such as fouling organisms (e.g. barnacles) which provide a physical barrier to sea water (Thomson 1997). Knowledge of their coverage and growth can provide insights into corrosion rates of metal objects associated with submerged heritage. Maritime archaeologists can obtain biological information on submerged heritage through collaborations with ecologists investigating the reef-like properties of wrecks. In return, ecologists receive detailed information on the dimensions, construction materials and age of wrecks, which is necessary for identifying the driving factors of species composition on wrecks.

## Fish Surveys on WWII Wrecks in Tanapag Lagoon, Saipan

In 2010, an archaeological expedition to investigate WWII ship and plane wrecks from the Battle of Saipan (June, 1944) provided a rare opportunity to examine reef fish assemblages that develop on vessel reefs. Numerous wrecked and discarded vessels are located in Tanapag Lagoon (hereafter ‘Lagoon’) on the north-western side of Saipan, Northern Mariana Islands. Due to their old age (65 years), associated fish assemblages were likely well established and therefore represented a mature ‘end point’ along the continuum of assemblage development. Using underwater visual surveys, we aimed to determine whether fish assemblages associated with the wrecks approximated those on nearby coral reefs. In addition to species composition, we also examined the range of feeding groups (e.g. carnivores, herbivores) present on wrecks to determine if assemblages likely functioned similarly to those on surrounding reefs. Because the wrecks ranged greatly in size, we were also able to examine the effect of vessel reef size on associated fish assemblages. Finally, we compared adjacent pairs of wrecks and reefs to identify potential effects of vessel reefs on natural fish assemblages.

## *Surveyed Wrecks and Reefs*

We surveyed seven wrecks located within a 4.2 $km^2$ area of the Lagoon, bounded by Garapan, Tanapag Harbour and Mañagaha Island. Wrecks included both ships and planes and were selected to provide a large size range of artificial habitat (20–2,000 $m^2$, Table 10.1). Wrecks were located on bare sand at depths ranging from 3 to 10 m (Table 10.1). Vertical relief of wrecks ranged from 1 to 6 m; however, only the *Subchaser* and *Shoan* wrecks exceeded 2 m relief (Table 10.1). Wreck structure generally consisted of flat surfaces punctuated by medium to large interstices (0.5–2 m diameter) and included numerous internal spaces and overhangs (Fig. 10.1). Surfaces were covered with sparse turfing algae and supported few corals or other encrusting invertebrates compared to natural patch reefs (<10 % cover, Fig. 10.1).

One natural patch reef was surveyed adjacent (≤50 m away) to each wreck (Table 10.1). Reefs were located in various directions relative to adjacent wrecks, resulting in the interspersion of wrecks and reefs within the study area. Reef size was estimated using a combination of underwater observations during surveys, surface observations from the research vessel and measurements from satellite images (Google Earth, Google Incorporated). Reefs ranged in size from 40 to 5,000 $m^2$, and there was no clear relationship between reef size and size of adjacent wrecks, i.e. small patch reefs were simply not paired with small wrecks (Table 10.1). Reef habitat consisted of emergent rock, supporting 50–90 % live cover of small- to medium-sized encrusting and massive corals. Reef surfaces were rugose, with numerous small (0.1–0.3 m diameter) holes, but few large holes and overhangs.

## *Survey Design*

Fishes were counted along 3 replicate transects (5 m × 2 m × 1.5 m) at each wreck and reef by a single experienced observer (AMF) using SCUBA. Transect size was selected to ensure that transects did not overlap at any site and was therefore dictated by the size of smallest wrecks and reefs. Prior to the start of a transect,

**Table 10.1** Characteristics of 7 wrecks and adjacent coral patch reefs surveyed in Tanapag Lagoon on the north-western side of Saipan, Northern Mariana Islands

| Wreck name | Wreck type | Wreck depth (m) | Vertical relief (m) | Wreck area ($m^2$) | Approx. area of adjacent reef ($m^2$) | Distance to natural reef (m) |
|---|---|---|---|---|---|---|
| Avenger | Plane | 3 | 1.5 | 20 | 40 | 20 |
| Jake | Plane | 6 | 1.0 | 24 | 40 | 10 |
| Mariner | Plane | 7 | 2.0 | 50 | 50 | 10 |
| Daihatsu | Ship | 10 | 1.5 | 64 | 600 | 50 |
| Emily | Plane | 6 | 2.0 | 93 | 60 | 10 |
| Subchaser | Ship | 9 | 4.0 | 400 | 5,000 | 30 |
| Freighter | Ship | 7 | 6.0 | 2,000 | 40 | 15 |

**Fig. 10.1** The habitat provided by WWII heritage in Tanapag Lagoon and associated fishes. Clockwise from top left: (**a**) flat surfaces and reduced coral cover typical of wreck habitat, (**b**) damselfish species that were major contributors to assemblage differences between wrecks and reefs and (**c**) overhangs created by wrecks providing shelter for nocturnal *Myripristis* sp.

the abundance of large mobile species was recorded from a distance in order to ensure that diver presence did not result in underestimates of these species. Small site-attached species were then recorded while swimming along the transect at a constant speed of ~2 m $min^{-1}$. Fishes were identified down to species using Myers (1989) and Randall et al. (1997) and were also allocated to primary feeding group, i.e. grazer, scraper-excavator, planktivore, invertivore, corallivore, piscivore-invertivore and piscivore using Froese and Pauly (2011).

Fish assemblages can vary considerably throughout the year, so wrecks and reefs were surveyed twice (mid-February and mid-June) to ensure that any differences observed between the two reef types were not just short-term anomalies. Five wrecks and adjacent reefs were surveyed in February, and 7 wrecks (including the original 5) and adjacent reefs were surveyed in June. The smallest and largest wrecks were included in both survey periods, so an identical size range of wrecks was covered despite a difference in the number of reefs. Environmental conditions were similar between sampling periods (current speeds ≤0.2 m $s^{-1}$, visibility ≥20 m); however, water temperatures were 25–26 °C in February and 28–29 °C in June.

## *Data Analysis*

Fish assemblages were compared between wrecks and reefs using both multivariate and univariate statistical techniques. Species composition and feeding group composition were visually compared between wrecks and reefs using multidimensional scaling (MDS) plots based on ranked Bray-Curtis similarity values calculated from multispecies abundance data. Separate plots were created for the two sampling periods. In all cases, abundance data were square-root transformed to balance the contribution of rare and common species. The statistical significance of visual differences between groups was tested using a one-way analysis of similarity (ANOSIM), and the species and feeding groups contributing the most to differences between groups were identified using similarity percentage analysis (SIMPER) (Clarke and Warwick 2001). Parrotfish (Scaridae) were excluded from analyses of species composition, because this group could not be consistently identified to species.

Total fish abundance (number of individuals per 10 $m^2$), species richness ($S$) and diversity (Shannon-Wiener, $H'$) were compared between reef types (wrecks and reefs), sites (5 wrecks/reefs) and sampling periods (February and June) using 3-factor analyses of variance (ANOVAs). Reef type was treated as a fixed factor, while site and sampling period were treated as random factors, with site nested in reef type. In order to balance comparisons between sampling periods, the two extra wrecks (and adjacent reefs) surveyed in June were removed from these analyses. Total abundance and species richness data were $\log_{10}(x+1)$ transformed to meet the assumptions of normality and homogeneity of variance. Diversity data did not require transformation.

To determine if larger wrecks supported more abundant and diverse fish assemblages than smaller wrecks, the relationship between wreck size and each of total fish abundance, species richness and diversity was tested using linear regression. Linear regression was also used to determine if wrecks affected the fish assemblages on adjacent natural reefs, by testing the relationship between assemblage parameters on reefs and the size of the adjacent wreck. Wrecks were paired with the nearest adjacent patch reef (Table 10.1). A $p$-value $<0.05$ was considered statistically significant for all tests.

## Did Fish Assemblages on the WWII Wrecks Differ from Surrounding Coral Reefs?

### *Abundance, Species Richness and Diversity*

Total abundance, species richness and diversity did not differ significantly between wrecks and reefs (ANOVAs: all $p>0.14$), and this result was consistent across the two sampling periods (ANOVAs, interaction term: reef type × season, all $p>0.27$). These results indicate that the WWII wrecks in Tanapag Lagoon support fish assemblages with similar overall properties to those on surrounding coral reefs. The results also support the conclusion that well-established vessel reefs are capable of at least grossly approximating fish abundances and assemblage parameters (i.e. species richness, diversity) on coral reefs. However, mixed results among previous studies and limitations of experimental design have made it difficult to assess the generality of this conclusion. Fish abundances, species richness and diversity levels on vessel reefs have been found to be similar or different to those on surrounding natural reefs, depending on the study considered (Jones and Thompson 1978; Diamant et al. 1986; Arena et al. 2007; Honório et al. 2010). Results from most studies are also difficult to interpret, because typically only 1–2 vessel reefs were investigated, or the potential confounding effects of vessel reef age and size were not considered, or both.

The current study provided a good test of whether vessel reefs can develop similar fish assemblages to coral reefs, because the potential confounding factors of reef age and size were minimized. Fish assemblages on ARs are known take decades to develop and stabilize following deployment (Relini et al. 2002). Therefore, assemblages on young vessel reefs may differ to those on surrounding natural reefs simply because they have not fully developed yet, rather than any real difference in the habitat they provide. The old age of wrecks in Tanapag Lagoon meant that fish assemblages had likely reached a 'mature end point' in their development, thereby minimizing the potential confounding effect of reef age on comparisons with natural reefs. Reef size is also known to influence fish assemblages (Carr and Hixon 1997). Therefore, vessel reefs that differ in size to coral reefs are likely to support different fish assemblages, even if they provide similar habitat. The comparable size between most of the wrecks and coral patch reefs in Tanapag Lagoon meant that comparisons of assemblages were unlikely to be confounded by differences in size between the two reef types.

The minimization of confounding factors may explain why our results differed to those of Arena et al. (2007), who conducted the most comprehensive investigation of fish assemblages on vessel reefs prior to the current study. They compared fish assemblages on 6 vessel reefs to those on surrounding coral reefs in Florida and found that both fish abundance and species richness differed between the two reef types. However, the vessel reefs were many orders of magnitude smaller than surrounding coral reefs, and the two reef types were also not completely interspersed in space. Arena et al. (2007) also identified a trend of increasing species richness with increasing vessel reef age, suggesting assemblages may not yet have stabilized on some of their vessel reefs (3 out of 6 vessel reefs <10 years old).

## *Species Composition*

We recorded 78 species from 22 families on wrecks and reefs in Tanapag Lagoon (Table 10.2). Sixty-seven species were found on wrecks, of which 22 were exclusive to this reef type (28 % of total species), while 56 species were found on natural reefs, of which 11 species were exclusive to this reef type (14 % of total species). Despite finding no differences in species richness and diversity between wrecks and

**Table 10.2** Mean abundance of the fish species observed on wrecks and reefs in Tanapag Lagoon, Saipan

| Species | Family | Mean wreck abundance (per 10 $m^2$) | Mean reef abundance (per 10 $m^2$) | Contribution to difference (%) |
|---|---|---|---|---|
| *Abudefduf sexfasciatus*[a] | Pomacentridae | 0.97 | 0.51 | 0.77 |
| *Abudefduf vaigiensis* | Pomacentridae | 0.03 | 0.03 | 0.01 |
| *Acanthurus nigricans*[a] | Acanthuridae | 0.98 | 0.50 | 0.63 |
| *Acanthurus nigricauda* | Acanthuridae | 0.03 | 0.19 | 0.05 |
| *Acanthurus nigrofuscus* | Acanthuridae | 0.05 | 0.18 | 0.03 |
| *Acanthurus pyroferus* | Acanthuridae | 0.07 | 0.03 | 0.04 |
| *Amblygobius phalaena* | Gobiidae | 0.00 | 0.06 | 0.04 |
| *Anampses twistii* | Labridae | 0.05 | 0.00 | 0.03 |
| *Apogon cyanosoma* | Apogonidae | 0.18 | 0.00 | 0.09 |
| *Aulostomus chinensis* | Fistulariidae | 0.04 | 0.00 | 0.02 |
| *Bodianus axillaris* | Labridae | 0.05 | 0.06 | 0.06 |
| *Canthigaster solandri* | Tetraodontidae | 0.17 | 0.07 | 0.12 |
| *Centropyge flavissimus* | Pomacanthidae | 0.12 | 0.17 | 0.16 |
| *Cephalopholis urodeta* | Serranidae | 0.03 | 0.04 | 0.05 |
| *Chaetodon auriga* | Chaetodontidae | 0.06 | 0.15 | 0.10 |
| *Chaetodon citrinellus*[a] | Chaetodontidae | 0.72 | 0.13 | 0.41 |

(continued)

**Table 10.2** (continued)

| Species | Family | Mean wreck abundance (per 10 m$^2$) | Mean reef abundance (per 10 m$^2$) | Contribution to difference (%) |
|---|---|---|---|---|
| *Chaetodon ornatissimus* | Chaetodontidae | 0.03 | 0.08 | 0.09 |
| *Chaetodon punctatofasciatus* | Chaetodontidae | 0.17 | 0.00 | 0.08 |
| *Chaetodon reticulatus* | Chaetodontidae | 0.00 | 0.04 | 0.04 |
| *Chaetodon trifasciatus* | Chaetodontidae | 0.05 | 0.03 | 0.03 |
| *Chaetodon ulietensis* | Chaetodontidae | 0.11 | 0.00 | 0.05 |
| *Cheilinus chlorourus* | Labridae | 0.00 | 0.03 | 0.00 |
| *Cheilinus oxycephalus* | Labridae | 0.13 | 0.00 | 0.07 |
| *Cheilinus trilobatus* | Labridae | 0.04 | 0.09 | 0.05 |
| *Cheilinus unifasciatus* | Labridae | 0.00 | 0.13 | 0.04 |
| *Chromis viridis*[a] | Pomacentridae | 0.56 | 1.30 | 1.06 |
| *Chrysiptera biocellata* | Pomacentridae | 0.00 | 0.04 | 0.04 |
| *Chrysiptera traceyi* | Pomacentridae | 0.04 | 0.03 | 0.02 |
| *Coris aygula* | Labridae | 0.07 | 0.00 | 0.04 |
| *Coris gaimard* | Labridae | 0.00 | 0.04 | 0.04 |
| *Ctenochaetus striatus*[a] | Acanthuridae | 1.52 | 1.28 | 1.34 |
| *Dascyllus aruanus*[a] | Pomacentridae | 1.03 | 1.09 | 0.93 |
| *Dascyllus reticulatus*[a] | Pomacentridae | 0.97 | 1.10 | 1.04 |
| *Dascyllus trimaculatus*[a] | Pomacentridae | 0.66 | 0.08 | 0.33 |
| *Diproctacanthus xanthurus* | Labridae | 0.00 | 0.07 | 0.07 |
| *Epibulus insidiator* | Labridae | 0.05 | 0.03 | 0.02 |
| *Epinephelus merra* | Serranidae | 0.08 | 0.03 | 0.04 |
| *Forcipiger flavissimus* | Chaetodontidae | 0.00 | 0.06 | 0.00 |
| *Gomphosus varius* | Labridae | 0.07 | 0.38 | 0.18 |
| *Gymnothorax javanicus* | Muraenidae | 0.04 | 0.00 | 0.02 |
| *Halichoeres biocellatus* | Labridae | 0.08 | 0.23 | 0.11 |
| *Halichoeres hortulanus* | Labridae | 0.14 | 0.11 | 0.07 |
| *Halichoeres marginatus* | Labridae | 0.05 | 0.00 | 0.03 |
| *Halichoeres trimaculatus*[a] | Labridae | 0.41 | 0.61 | 0.46 |
| *Hemigymnus melapterus* | Labridae | 0.00 | 0.03 | 0.00 |
| *Heniochus chrysostomus* | Chaetodontidae | 0.03 | 0.00 | 0.01 |
| *Labroides bicolor* | Labridae | 0.17 | 0.06 | 0.08 |
| *Labroides dimidiatus* | Labridae | 0.20 | 0.40 | 0.26 |
| *Lutjanus fulvus* | Lutjanidae | 0.06 | 0.00 | 0.03 |
| *Lutjanus kasmira* | Lutjanidae | 0.20 | 0.00 | 0.10 |
| *Macolor niger* | Lutjanidae | 0.09 | 0.00 | 0.04 |
| *Meiacanthus atrodorsalis* | Blenniidae | 0.16 | 0.16 | 0.15 |
| *Monotaxis grandoculis* | Lethrinidae | 0.06 | 0.00 | 0.03 |
| *Mulloidichthys flavolineatus* | Mullidae | 0.29 | 0.00 | 0.14 |
| *Myripristis* sp. | Holocentridae | 0.46 | 0.11 | 0.23 |
| *Naso lituratus* | Acanthuridae | 0.16 | 0.20 | 0.12 |

(continued)

**Table 10.2** (continued)

| Species | Family | Mean wreck abundance (per 10 $m^2$) | Mean reef abundance (per 10 $m^2$) | Contribution to difference (%) |
|---|---|---|---|---|
| *Neoniphon sammara* | Holocentridae | 0.08 | 0.00 | 0.04 |
| *Novaculichthys taeniourus* | Labridae | 0.00 | 0.06 | 0.04 |
| *Ostracion meleagris* | Ostraciidae | 0.03 | 0.00 | 0.01 |
| *Paracirrhites arcatus* | Cirrhitidae | 0.09 | 0.06 | 0.04 |
| *Parupeneus multifasciatus* | Mullidae | 0.11 | 0.12 | 0.06 |
| *Plectroglyphidodon dickii* | Pomacentridae | 0.09 | 0.00 | 0.04 |
| *Plectroglyphidodon lacrymatus* | Pomacentridae | 0.03 | 0.32 | 0.14 |
| *Pomacentrus pavo* | Pomacentridae | 0.13 | 0.13 | 0.14 |
| *Pomacentrus vaiuli*[a] | Pomacentridae | 1.34 | 3.26 | 2.24 |
| *Pseudocheilinus evanidus* | Labridae | 0.06 | 0.18 | 0.08 |
| *Pseudocheilinus hexataenia* | Labridae | 0.04 | 0.00 | 0.02 |
| *Pygoplites diacanthus* | Pomacanthidae | 0.03 | 0.00 | 0.01 |
| *Scolopsis lineatus* | Nemipteridae | 0.17 | 0.04 | 0.12 |
| *Stegastes albifasciatus* | Pomacentridae | 0.03 | 0.00 | 0.01 |
| *Stegastes nigricans*[a] | Pomacentridae | 1.23 | 0.64 | 0.88 |
| *Stethojulis bandanensis* | Labridae | 0.10 | 0.13 | 0.15 |
| *Thalassoma hardwicke* | Labridae | 0.05 | 0.05 | 0.03 |
| *Thalassoma lutescens* | Labridae | 0.60 | 0.56 | 0.46 |
| *Thalassoma quinquevittatum* | Labridae | 0.00 | 0.03 | 0.00 |
| *Valenciennea strigata* | Gobiidae | 0.04 | 0.00 | 0.02 |
| *Zanclus cornutus* | Zanclidae | 0.29 | 0.14 | 0.21 |
| *Zebrasoma flavescens* | Acanthuridae | 0.22 | 0.29 | 0.21 |

Abundances represent an average across both survey periods (February and June, 2010). The percentage contribution to assemblage differences between the two reef types is also indicated for each species, as determined by SIMPER analysis
[a]Indicates a major contributor to assemblage differences

reefs (section 'Abundance, Species Richness and Diversity'), partial separation of data clusters on the ordination plots indicated differences in species composition between the two reef types in both sampling periods (Fig. 10.2a, b). These differences were confirmed using statistical tests (ANOSIM: February, $R=0.341$, $p<0.001$; June, $R=0.189$, $p<0.001$); however, the low $R$-value in June suggested there were only minor differences in species composition between reef types in this sampling period ($R<2$, Clarke and Warwick 2001). Damselfishes (family Pomacentridae) contributed most to the assemblage differences between wrecks and reefs (SIMPER analysis, Table 10.2, Fig. 10.1), and major contributing species were similar between the two sampling periods. Preferences for reef type were also consistent between the two sampling periods for most major contributing species; however, three (*Dascyllus aruanus*, *Dascyllus reticulatus*, *Halichoeres trimaculatus*) were more abundant on one reef type in one sampling period and then more abundant on the other reef type in the other sampling period.

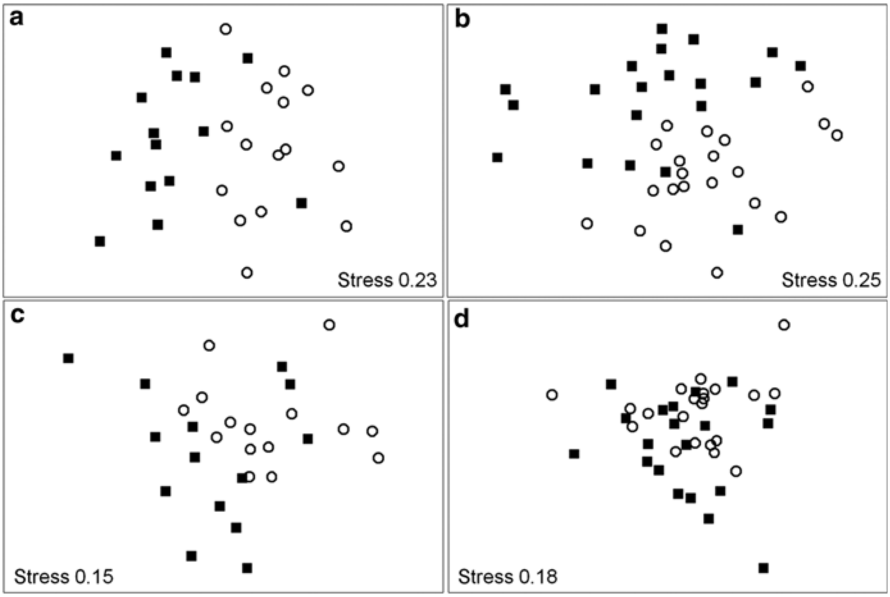


**Fig. 10.2** Ordination plots comparing species composition between wrecks (*squares*) and reefs (*circles*) in (**a**) February and (**b**) June and feeding group composition between wrecks and reefs in (**c**) February and (**d**) June during 2010 in Tanapag Lagoon

The consistent differences in species composition between wrecks and reefs in Tanapag Lagoon suggest that our results are unlikely to represent an anomalous event. However, the current study only investigated fish assemblages twice during a single year, and fish assemblages on reefs are known to vary greatly among seasons and years. Therefore, further surveys are required to determine the degree of both intra- and interannual variability in assemblages associated with the wrecks. Species composition on wrecks could potentially approximate composition on surrounding reefs during other seasons or other years, depending on the factors driving recruitment, migration and mortality of inhabiting species.

Similar to the assemblage parameters, it is unclear whether the differences we found in species composition between wrecks and reefs in Tanapag Lagoon are representative of vessel reefs in general. Previous studies comparing species composition of fish assemblages between vessel reefs and coral reefs have produced mixed results. Arena et al. (2007) found strong differences in composition between the two reef types (74 % dissimilarity) on the Florida coast, whereas Honório et al. (2010) found little difference in composition between the two reef types on the Brazilian coast. Differences in species composition between other types of ARs and coral reefs have often been reported (Bohnsack et al. 1994; Rooker et al. 1997; Clark and Edwards 1999; Rilov and Benayahu 2000; Burt et al. 2009) and, similar to the current study, have been found to occur despite similar levels of diversity between the two reef types (Rooker et al. 1997; Burt et al. 2009). If this pattern is generally confirmed for vessel reefs, large additions of vessel reef habitat may not overly affect fish diversity within an area, but may affect relative abundances of particular species.

The differences in species composition between wrecks and reefs in the current study were most likely caused by differences in habitat structure and composition, because other major differences (i.e. reef age, size, position) between the two reef types were either minimized or eliminated. The wrecks and reefs differed markedly in both physical and biological habitat characteristics; wrecks had larger interstices and more vertical surfaces, but lower rugosity and coral cover, than natural reefs (Fig. 10.1). Such habitat characteristics are known to influence species composition of fish assemblages, due to species-specific microhabitat preferences (Syms and Jones 2000) and the effect of refuge size and availability on levels of predation and competition (Shulman 1984; Hixon and Beets 1993). If differences in species composition between wrecks and reefs in the current study were driven by differences in physical habitat characteristics, it is unlikely that species composition on wrecks will ever completely match that on nearby reefs, at least until the wrecks lose structural integrity and begin to break down. This has implications for the use of vessel reefs to conserve declining reef fish assemblages or to protect against diversity loss, because assemblages that develop on vessel reefs may not be representative of those that are lost. This also has broader implications for the use of 'materials of opportunity' (e.g. car bodies) for planned ARs, as well as the installation of marine infrastructure, both of which rarely approximate the habitat characteristics of natural reefs.

Despite supporting different species, the habitat provided by wrecks in Tanapag Lagoon did not appear to be deficient relative to natural reef habitat. There was no clear preference for either reef type among the main species responsible for assemblage differences between wrecks and reefs (abundances, Table 10.2), as might be expected if one reef type provided generally superior resources (e.g. food, shelter) compared to the other. Therefore, vessel reefs are still likely to have conservation value in circumstances where natural reefs are in severe decline, and closely approximating assemblages is not a priority (Clark and Edwards 1999).

## *Feeding Group Composition*

In contrast to species composition, feeding group composition was similar between wrecks and reefs. No significant difference in feeding groups was found between reef types in February (Fig. 10.2c, ANOSIM: $R=0.07$, $p=0.07$), and although a significant difference was found in June (Fig. 10.2d, ANOSIM: $R=0.08$, $p=0.02$), the $R$-value was negligible. All six feeding groups present on reefs were also present on wrecks, as well as an additional group (piscivores). These results suggest that the wrecks may function similarly to surrounding coral reefs in regard to trophic interactions, but comparisons of fish diets and feeding rates between the two reef types would be required to confirm this.

Our results contrast with those of most previous studies which have found differences in feeding groups between ARs and natural reefs, most commonly, a higher abundance of planktivores on ARs (Bohnsack et al. 1994; Rilov and Benayahu 2000;

Arena et al. 2007). Unlike the current study, vertical relief of ARs in these studies was generally greater than natural reefs; therefore, higher abundances of planktivores on ARs may have resulted from increased feeding opportunities higher up in the water column (Rilov and Benayahu 2000; Arena et al. 2007). However, ARs were also not completely interspersed with natural reefs in these studies, and differences in feeding groups may have simply resulted from spatial variation in available food resources (e.g. more plankton in areas with strong current, see Arena et al. 2007), rather than differences in foraging opportunities resulting from habitat differences. Our results indicate that vessel reefs are capable of approximating feeding group composition on coral reefs, but this may depend on the similarity of particular habitat characteristics between the two reef types, such as vertical relief. Further investigation of the effect of habitat characteristics on the relative abundance of functional groups would assist in determining which characteristics of vessel reefs, and ARs in general, are most important for approximating community functions on natural reefs.

## The Effect of Wreck Size on Associated Fish Assemblages

Larger wrecks supported more species and a greater diversity of fish than smaller wrecks in June (species richness, $r^2=0.60$, df=6, $p=0.04$; diversity, $r^2=0.93$, df=6, $p<0.001$; Fig. 10.3a, b), but not in February (species richness, $r^2=0.29$, df=4,

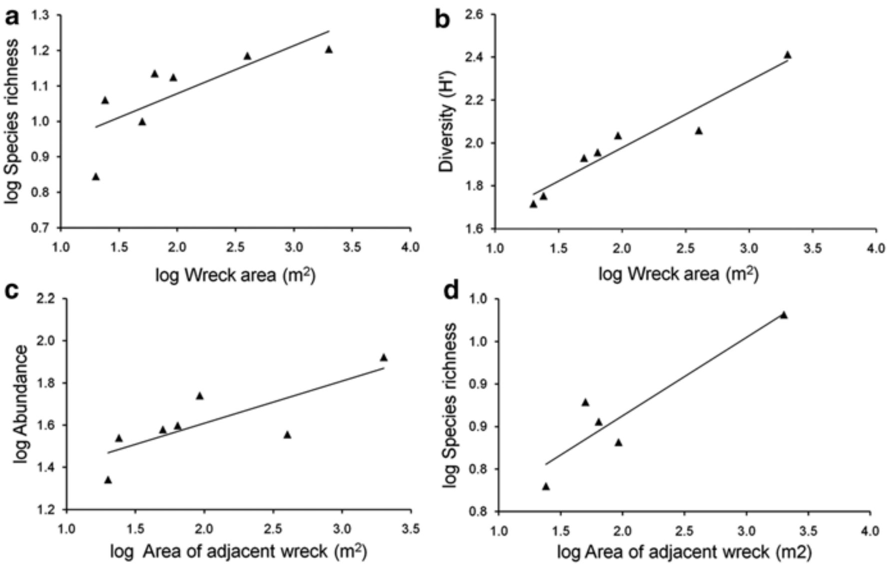


**Fig. 10.3** Relationships between wreck area and (**a**) species richness and (**b**) diversity of associated fish assemblages in June, 2010. Also shown are relationships between area of the adjacent wreck and (**c**) abundance on reefs in June and (**d**) species richness on reefs in February

$p=0.35$; diversity, $r^2=0.32$, df=4, $p=0.32$). Larger wrecks also appeared to support greater abundances of fish than smaller wrecks; however, this result was not statistically significant in either sampling period (February, $r^2=0.69$, df=4, $p=0.08$; June, $r^2=0.13$, df=6, $p=0.43$). These results suggest that the larger wrecks in Tanapag Lagoon (e.g. the Japanese freighter) may provide more valuable fish habitat than smaller wrecks, at least in terms of gross assemblage parameters. However, the inconsistent results indicate further investigation is required to confirm the patterns observed here. The absence of relationships between wreck size and assemblage parameters in February may have resulted from low statistical power due to the fewer wrecks (five compared to seven) surveyed in this sampling period. Alternatively, relationships between wreck size and assemblage parameters may be temporally variable, and surveys conducted over extended time periods may be required to fully describe the variability in this system.

Understanding the effects of vessel reef size on fish assemblages is important for evaluating whether particular installations are likely to approximate assemblages on nearby natural reefs. For example, knowledge of the minimum size of vessel reef required to achieve a specific level of diversity may prevent the installation of reefs which are too small to achieve that target. Our study is the first to investigate the effect of vessel reef size on the structure and composition of associated fish assemblages. The wrecks examined were useful for this purpose, because they ranged greatly in size (20–2,000 $m^2$) and were all the same age, thereby eliminating the potential confounding effect of age on assemblage comparisons. The positive relationships we found between wreck size and both species richness and diversity are similar to positive relationships found between reef size and assemblage parameters on natural reefs (Gladfelter et al. 1980; Chittaro 2002). Together, these findings suggest that larger vessel reefs may generally maximise desirable assemblage parameters; however, further investigations are required to confirm this conclusion in other locations and habitats (e.g. temperate rocky reef habitats).

## The Effect of Wrecks on Adjacent Reefs

A positive relationship was found between fish abundance on reefs and size of the adjacent wreck in June ($r^2=0.63$, df=6, $p=0.03$; Fig. 10.3c), but not in February ($r^2=0.50$, df=4, $p=0.18$). A positive relationship was also found between species richness and size of the adjacent wreck in February ($r^2=0.84$, df=4, $p=0.03$; Fig. 10.3d), but not in June ($r^2=0.08$, df=6, $p=0.55$). These relationships suggest that the wrecks influenced assemblages on neighboring reefs in Tanapag Lagoon to some degree, because there was no relationship between the size of reefs and their adjacent wrecks (i.e. larger reefs were not simply paired with larger wrecks). However, we cannot confirm here that wrecks affected assemblages on adjacent reefs, because reef assemblages were not surveyed both before and after the addition of wrecks. Additionally, the relationship between species richness on reefs and size of the adjacent wreck in February is primarily driven by the smallest and largest data points, and a similar relationship was not detected in June. Our results suggest that deployment of vessel reefs in close proximity to natural reefs may affect natural fish assemblages; however, effects may be difficult to detect due to variability through time. Ultimately, manipulative experiments in which natural reef assemblages are surveyed both before and after the addition of vessel reefs will be required to confirm whether vessel reefs are generally capable of influencing existing reef fish assemblages. Such experiments would also be valuable for testing whether other types of ARs are capable of affecting fish assemblages on nearby natural reefs.

## Conclusion

Although the purpose was unintended, WWII heritage in Tanapag Lagoon now functions as artificial reef (AR). The wrecks provide habitat for a wide range of reef fish species and approximate many aspects of the fish assemblages on surrounding coral reefs. These assemblages likely benefit local communities through provision of spear- and line-fishing opportunities, as well as the provision of attractive diving experiences. The latter function is also likely to benefit local communities indirectly through increased tourism and associated expenditure. These community benefits are similar to the goals of deliberate vessel reef deployments, as well as the goals of AR programs in general. WWII heritage in Tanapag Lagoon therefore provides tangible ecosystem services in addition to their cultural significance.

The environmental benefits of WWII heritage in Tanapag Lagoon are less clear than the community benefits. Although the wrecks appeared to support flourishing fish assemblages, the way in which these assemblages have developed, and are now maintained, is critical to their impact on the lagoonal ecosystem. One of the major criticisms of ARs is that they simply attract fish away from surrounding natural reefs, rather than producing their own fish biomass (see Bohnsack 1989 for a discussion of the 'attraction vs. production' debate). If the fishes we observed on the wrecks in Tanapag Lagoon are primarily attracted there from adjacent reefs, then the wrecks may actually be detracting from natural fish assemblages in the lagoon rather than enhancing them. Although we could not confirm (or disprove) attraction in the current study, our discovery that the abundance of fish on reefs was related to the size of the adjacent wreck indicates wrecks have at least some influence on reefs in the lagoon. Investigation of fish assemblages on reefs that are distant from wrecks would be required to elucidate the potential impact(s) of WWII heritage on coral reefs in Tanapag Lagoon.

The current study provides an example of the benefits of collaboration between maritime archaeologists and marine ecologists when researching sunken vessels. Our investigation of the reef-like properties of wrecks was greatly assisted by the site information obtained by maritime archaeologists on the project, which was particularly useful for understanding structural aspects of the habitat provided by wrecks. The information on wreck dimensions provided by archaeologists also assisted investigation of the relationships between assemblage parameters (e.g. diversity) and wreck surface area. Given the number of wrecks and the scale of the study site, such information could not have been obtained by us without considerable detraction from ecological surveys. In return, the information obtained on fish assemblages should provide archaeologists with a more holistic view of the current context of WWII heritage in Tanapag Lagoon. In particular, the discovery that wrecks support abundant and diverse fish assemblages suggests the sites may be subject to considerable fishing activity, which must be factored into ongoing management strategies.

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# Chapter 11
# Captured in Color: The Making of an Interpretive Film

**Toni L. Carrell**

## Why a Film? Introduction

Public outreach and education are necessary components for the long-term protection of cultural heritage. Most often, this outreach takes the form of brochures, posters, visitor days, websites, trails, and museum exhibits. However, once all the posters or brochures have been given away and once all the dive guides are "used up," their impact and effect on behavior rapidly diminish. The same can be said of underwater trails and visitor days. A website, while useful, still requires the public to actively seek out the information and tends more toward a single user rather than large groups of people. The impact is narrow and of limited duration. Museum displays, while becoming more interactive and engaging, are inherently limited in their reach and scope and with declining visitation among younger users, losing ground to other venues. In order to proactively reach a diverse and widespread audience, other avenues of public outreach and education are needed. The ubiquity of smartphones, tablets, and similar devices is an opportunity to reach out to a broader audience. The user-friendliness of sites such as YouTube for online streaming is the opportunity to move from relatively static to active content.

It is an accepted truism that film can consistently reach more people over time than an inherently finite supply of books, pamphlets, posters, and static museum exhibits. Depending upon where a film is shown, for example, in the United Kingdom, films about archaeology shown on TV regularly receive 3–5 million viewers *per airing* (Clack 2006:87). In comparison, the British Museum had slightly fewer than 5.5 million visitors in *all* of 2005 (Clack 2006:87).

The implication is clear: in a single hour, a film can reach nearly as many people as the largest heritage museums in the world can reach in an entire year.

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The power of film to reach a diverse audience and to reinforce its message is evident. It also has the advantage of being unlimited in its use, reuse, and venue. With the rise of streaming technology, it can now be viewed worldwide. Film can do all of this at a fraction of the cost of print media per target audience member. So the question is not “why a film?” but “why *not* a film?”.

## So You Think You Are a Ken Burns? Partnering with a Professional Filmmaker

Given the ubiquity of smartphone and tablet apps to capture and even edit video, you would expect Steven Spielberg or Ken Burns to have a lot of competition in the film arena. Fortunately, for the viewing public, that is not the case and making a compelling and memorable film still requires the skills of a professional. If a film is in your public outreach future, getting the help of an experienced documentary filmmaker is the most critical first step (Fig. 11.1).

They will not expect you to be an expert in the technicalities or language of filmmaking or scriptwriting, but they will expect you to (1) clearly articulate the purpose and goal of the film, (2) identify the target audiences, and (3) establish

**Fig. 11.1** The involvement of an experienced documentarian will insure the best possible film product. Richard Coberly, Windward Media, is using a high-definition camera to capture the story of WWII survivors and their descendants on Saipan. (Photo: Toni Carrell)

where the film will be shown and how distributed. Each of these elements has a direct bearing on the final product. Because a documentary *a la* Ken Burns is not the same as an interpretive film, careful consideration of these fundamentals in advance will bring clarity and focus to the project. Equally important is spending time at the outset to educate the filmmakers about your research and getting educated by them. A good filmmaker will listen to you and ask a lot of questions. Getting them involved at the earliest possible opportunity will pay off in the quality of the film.

The interpretive film *WWII Maritime Heritage Trail*: *Battle of Saipan* produced for the multi-year Battle of Saipan underwater cultural heritage project had two goals: to educate the local population and tourists about underwater cultural heritage and to encourage its appreciation and preservation. The inveiglement for this prosaic message was telling the story of the battle through the sites that are scattered across Saipan's seabed including aircraft, tanks, landing vehicles, and ships. The viewer goes on an underwater virtual tour of the sites that comprise the *WWII Underwater Heritage Trail* developed under our 2009 NPS ABPP Grant (McKinnon and Carrell 2011) while the film was produced under a 2012 ABPP Grant (McKinnon and Carrell 2014).

Battlefield sites are becoming sites of reconciliation and collective remembrance. A film that provides accurate information and does so in a respectful manner can take the single perspective of "us" versus "them" and turn it into a viewpoint that reflects a shared experience. It can encourage "ownership" across time, distance, and cultures. As the standard of living has increased in developing countries, visitors from Russia, Japan, Korea, and China to Saipan have increased exponentially. Special tours arranged by organizations with ties in those countries bring in (quite literally) busloads of tourists. From the outset of the project, the international visitor was a primary member of our target audience. Because Japanese are the majority of the visitors to Saipan, in an effort to broaden and deepen its impact, the film was subtitled in Japanese.

Visitors by far have the greatest impact on cultural heritage sites, and visitors, whether they remain on land or venture into the sea, will take home the story that the sites represent. But the story will only be remembered if the film is effective and engaging. Determining effectiveness is difficult—as archaeologists, we view films and other media through an academic lens. What we take for granted as common knowledge is often new or even confusing information in the eyes of the public. A good filmmaker will guide you toward an effective film based on the target audience, the venues where it will be shown, and how it will be used. Working closely with the scriptwriter to insure accuracy of the facts is not the same as writing an engaging script. Insuring that the script effectively tells a compelling story requires close collaboration with the filmmaker and trust in their expertise. A good film is a true partnership.

In order to get feedback on the film's message and effectiveness prior to finalizing it, and lacking the ability to rent a local theater for a preview showing, the film was shown to a number of different "test" target audiences: university students, family members, friends, resource managers, park staff, tour operators, and members of other ethnic backgrounds. From the professional audience, the most often received comment was that the conservation/preservation message was clear and not overbearing and the overall tone and feeling of the film were positive and respectful. From park staff, the response was very positive and only recommended adding Chinese subtitles. Subtitling in Korean and Russian was also suggested. Under ABPP Grant that included this film (McKinnon and Carrell 2014), the funds to accomplish those translations and film editing were unavailable.

From non-professional friends, family, and others, comments (and an audible sigh) occurred when damage through vandalism was mentioned and shown. They generally expressed a deep concern that this would lead to the destruction of the site and a loss to future generations. This feeling was the same whether the individual was a diver or non-diver. It did not matter whether the individual ever anticipated visiting the site. The feedback from all of the test groups, while overwhelmingly positive, also alerted us that we needed to emphasize the unique nature of this particular group of sites. Their accessibility, diversity, and good preservation were understood and recognized by us, but when the test viewers saw the sites, they were surprised. As a result of this direct feedback, we modified our script to better reflect the visitor opportunities and dangers of damage.

Where and how the film will be shown and distributed is another consideration in planning the production. Many of Saipan's tour groups include the NPS American Memorial Park visitor center on their list of stops. There are also tour organizations that cater to the diving public and they too bring their customers to the visitor center. By using the American Memorial Park visitor center as a primary point of distribution, the film is in a setting geared toward an audience prepared for thoughtful contemplation. To meet the requirements of the NPS accessibility guidelines, there is also a version that is subtitled in English for the hearing impaired. Showing it at the visitor center also meant that the film needed to be long enough to adequately tell the story but not so long as to impede the visitor experience. The 17-minute film is only slightly longer than the typical 13–15-minute offering.

A secondary point of distribution is the school system. This may prove to be the best and longest-lived impact and where the concept of preserving sites that exemplify a shared history will be the most influential. Teachers can use the film as one element in a suite of tools to teach the next generations about their history and their stories.

Finally, we live in a digital age where content is available 24 × 7. Nearly everyone expects that anything can be accessed with the touch of a few keys. The third point of distribution is YouTube, which has become the de facto source for video uploads and searches. To access a global audience, Ships set up a dedicated YouTube channel (http://www.youtube.com/user/ShipsOfDiscovery) to showcase this film, among others.

With these three venues for distribution in mind, the film was produced in high-definition Blu-ray for general use, standard definition for use on a laptop or desktop computer, and for the greatest immersive experience in high-definition 3D. This latter presented a series of challenges.

## Do We Need Industrial Light and Magic? Technical Considerations

There is no question that the advances in film technology have made the viewing experience more intense, more lifelike, and more immersive. High definition, special effects, blue screen, and digital sound with up to 12 channels can transport and awe. Even my tablet and smartphone can record and view in high definition. But do you need all those bells and whistles to create a compelling film and what are the implications of their attempted use?

Because we were committed to producing the film for use in the American Memorial Park visitor center and distributing it to schools and libraries, the decisions to produce in high-definition Blu-ray and standard definition were a given. Subtitling for the hearing impaired and for Japanese viewers was a straightforward task that was well within the capabilities of the film's editors and their edit suite software. Where we pushed the envelope was in deciding to layer on high-definition 3D.

We were extremely fortunate to partner with WHOI's Advanced Imaging and Visualization Laboratory (AIVL) and the NPS's SRC for the film capture. The specialized equipment (stereoscopic, HD 3D diver-held cameras), knowledge, and skills of the team from these two organizations were crucial to this aspect of the filming (Fig. 11.2). The film capture was both thrilling and amazing. The rough cut results beyond our wildest imagination. The quality of the images means that we

**Fig. 11.2** Brett Seymour, NPS SRC, is using a high-definition stereoscopic 3D camera with hard-wire surface connection to record the details of a US Army landing craft in Saipan. (Photo: Lou Larmar, WHOI AVIL)

have records of the sites that can be examined down to the minutest detail for long-term monitoring and documentation. Because the film capture used two "eyes," we can view just one of the "eyes" without any special equipment. Would we want this quality again? Absolutely!

Our difficulties came in two forms: providing equipment to the park to show the 3D and editing the film with subtitles.

If you have ever gone to a 3D film at the movies you know, that part of the package is a pair of special glasses, often marked with the logo RealD 3D. This technology uses glasses with polarized lenses that filter the projection, allowing one eye to see only one image. They require no electronics or batteries and are inexpensive. At the movies, a special silver screen is required; at home, a special polarized filter is built into the TV screen. This is where an understating of the venue where a film will be shown can have a direct bearing on your film.

Many visitor centers already have the means to show a DVD; however, very few are able to show 3D. Absent the purchase of a special screen to project the film, it still requires the purchase of a 3D-capable player, special television, and glasses. While the glasses are cheap, as low as 50 cents per pair, the player and television are not. The up-front expense of the player and TV and the ongoing expense of the glasses are considerations that have to be carefully weighed when choosing to use any form of 3D. If the organization or park has a limited budget, 3D may not be the most appropriate option. Still for our project, the trade-off to show the film in 3D was considered worth the effort. Because the SRC is actively involved in RealD 3D image capture, they generously provided American Memorial Park with the player, television, and some glasses to start with.

Among the technical editing issues we faced was that of laying in the subtitles in a 3D environment. Keep in mind that they are "floating" in front of the images that are themselves "floating." The problem is one of insuring that the combination does not result in making the viewer dizzy or nauseous. This required a time-consuming and painstaking effort.

Surprisingly, even the edit suite software came into play. Until 2012, Apple's professional video editing software Final Cut Pro was an industry standard; but as a result of significant changes in the program, many professionals, including our team, were forced to abandon it during the production in favor of Adobe's Premiere Pro. Naturally, it was not just a matter of opening our project in the new program; it had to be rebuilt from the ground up in the new proprietary format. Can you spell delay? And in case you are wondering, Adobe's Premiere Pro has also recently changed significantly forcing yet another format migration for filmmakers.

I mention this not because you as the archaeologist are likely to be involved in this aspect, but as a cautionary tale that you can expect unanticipated delays that are beyond the control of everyone on the team. Here again is where collaborating with professionals will keep you on track and the film moving forward. Windward Media, our scriptwriters and directors, and Brett Seymour at SCR, both with extensive hands-on editing experience, worked together to overcome these obstacles. While the project was delayed, it was not stopped.

A good film is difficult enough at the best of times; 3D carries that difficulty to a whole new level. If you are committed to and have the funding for a 3D film, be sure to work with a team of filmmakers with specific experience in 3D. The technology is changing rapidly, but what won't change for the foreseeable future is that it is expensive and complex and the decision to use it should be based on a thorough knowledge of all its potential pitfalls. Finally, ask yourself and the filmmaker, what will the 3D accomplish for your project that high-definition 2D will not?

To be sure, the finished interpretive film of the WWII underwater sites in Saipan is beautiful. The 3D images jump off the screen in only the way that 3D can. Do we love the film? You bet! But all the extra expense, complexity, and effort of 3D versus straight up high definition *for this application* were not our best up-front decision. Would we tackle 3D again knowing what we now know? Probably not. Would we do another film? Absolutely!

## Are We Ignoring the Political Nature of the Past? Social, Ethical, and Professional Responsibilities

Modern conflict archaeology presents a wide range of challenges in its scientific investigation, interpretation, and public outreach. Certainly, the political nature of the past is something archaeologists would like to avoid. We tend to view ourselves as impartial investigators able to rise above such messy issues. Although 2014 is the 100th anniversary of the outbreak of World War I and is beyond living memory, World War II, Korea, Vietnam, Desert Storm, Bosnia, Iraq, Afghanistan, and Syria, to name a few, are still politically charged. These modern conflicts are within living memory of grandparents, parents, and more recently friends, husbands, wives, brothers, sisters, and children.

As a result, we find ourselves "embroiled with communities that, rather than being passive consumers of the pasts that archaeologists produce, challenge the right of archaeologists to produce those pasts without the involvement of the community" (Walker 2003). These living communities view modern conflicts through the lens of race, ethnicity, religion, gender, and class. As Walker points out, there are segments of this audience that may find our research questions, and by extension our interpretations, not only irrelevant but even offensive (2003).

How do we as interpreters of the past insure that our work is relevant to the communities who may have lived the conflict, relevant to the present generation, and relevant to the public who may not know anything or very little about it? Because film is so immediate and has the potential to influence viewpoints, our social, ethical, and professional responsibilities as scientists, interpreters, and filmmakers are of even greater concern.

It may be useful in considering these responsibilities to reflect on how we view sites of modern conflict and military heritage sites. Schofield suggests that the importance of these sites is in their communal value as sites of a commemorative and symbolic nature, such as war memorials; their social value, such as sites that reflect national identity; and sites of spiritual value, such as those that embody a sense of place (2009). Moshenska further suggests that the archaeology of modern conflict—and I would argue its interpretation—is most effective when conducted as community archaeology (2009).

Archaeology by its nature is in the public; sites are open and easily visible, and visitors can watch and ask questions. Underwater archaeology by contrast is hidden; sites are not visible from shore and can only be accessed via boat. But these limitations can be overcome by engaging in active public dialog. During the multi-year Saipan Battlefield project, every opportunity for radio, TV, or newspaper interview was accepted. Multiple public presentations were given, and as importantly informal, meetings with community members and elders held. During these presentations and meetings, people were encouraged to tell us their stories and share their memories. The value of this approach is reflected in what the community learns and shares about itself, what we as archaeologists learned about the community, and what both parties discovered they did not know about the past. This knowledge informed our approach to the interpretive film insuring that it would be relevant to all the stakeholders.

Rüütel states that the ideal anthropological film is an historical document and should avoid unrealistic situations and staged scenes (2009). The anthropological/scientific film is one that is driven above all by the necessity to accurately document that which may be lost or is rapidly diminishing. An interpretive film, on the other hand, has a little more liberty to reconstruct scenes or situations to better provide context.

How far to go in creating context can be ethically ambiguous. Was it unethical for photographer Alexander Gardner to stage the bodies of fallen soldiers after the battles of Antietam and Gettysburg (Frassanito 1996)? The manipulation of settings in the early years of photography was not frowned upon. Today, it is completely unethical. During and immediately after WWII, Japanese or German soldiers were regularly depicted in film as caricatures emphasizing the extreme. Today, such racist depictions are unacceptable. But can one go too far the other way and be "too even-handed"? The Flanders Fields Museum at Ypres (Ieper) has extensive exhibits and tours available to commemorate World War I (1914–1918). According to a recent visitor, the exhibits are technologically cutting edge with touch screens, video projections, and soundscapes. What is missing is a full explanation of the "why" of the war and why soldiers suffered to the extreme degree that they did (Douglas Scott 2104, personal communication). The larger, controversial context was missing.

At first glance, the relationship between the filmmaker and the archaeologist in this regard could present problems. Certainly, a film that is meant for a wider audience requires a sensitive sense of discretion and reflection. Insuring that the context provided is accurate is the responsibility of the archaeologist. Insuring that the context is also visually and narratively engaging is the responsibility of the filmmaker. Selecting an experienced documentarian that has worked with archaeologists can eliminate this potential incongruity. They will not come at you with an agenda or put you in a situation where the film gets in the way of the facts. They will not try to manipulate you or the project with an eye toward "an angle" or pure entertainment.

They will not force you into an ethical dilemma. We were extremely fortunate to have the services of Windward Media, an award-winning film company that has co-produced several documentaries with HoustonPBS. Their deep understanding of the process of archaeological research, the scientific method, combined with their experience in the viewer perspective made for a seamless integration of facts and art.

In *Living Archaeology*: *Conflict and Media*, Clack (2006) states, "In recording places of conflict good practice involves being innovative in narrating a personal story. In addition, an appreciation of the politics of representation is advised. … Challenging what is popularly held to be 'known' about past conflict is one way in which notions of authenticity can be questioned." Historic conflict sites tend to promote the dominant narrative and as professionals, we should seek to uncover the pasts that have been buried or suppressed no matter how painful or uncomfortable. Excavations on sites of genocide can be "acts of defiant remembering against dominant narratives of collective amnesia" (Moshenska 2009).

The study of conflict sites often unearths the belongings of ordinary people; this is no less true of sites underwater. The ships, and to a lesser degree planes, found on the seabed often contain items of clothing, cutlery, eyeglasses, cups and bowls, and even the human remains of those who served and lost their lives. Moshenska (2009) calls this the history-from-below perspective that emphasizes the experience of conflict from the bottom up rather than the top down represented in mainstream military history. When uncovered by the archaeologist or observed directly or indirectly through the media or film, these ordinary items tend to have a profound impact. It removes the impersonal and firmly embeds the personal in a site. The same can be said for historic photographs. Their careful selection and integration can reinforce the personal stories that a conflict often obscures (Fig. 11.3).

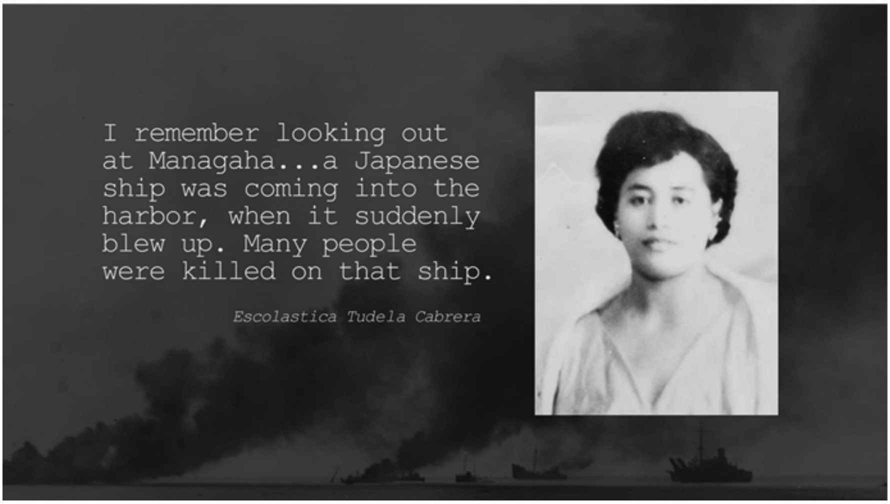


**Fig. 11.3** Escolastica Tudela Cabrera was just a young woman during the Battle of Saipan. Her words echo both the reality and sorrow of the battle and its huge loss of life. This is one of the images used in the film *WWII Maritime Heritage Trail*: *Battle of Saipan*. (Photo: Windward Media)

We have a professional responsibility not only to insure accurate and respectful interpretation, but to consider *all* stakeholders and groups that had a role in the conflict, including its unwilling participants. An interpretive film that does a good job of portraying the human element represented in conflict sites can be a powerful mechanism to bring together diverse and previously estranged peoples. Because the subtle impact of images, historic or modern, emphasizes our shared humanity, they should be selected with an eye toward representing all of the participants.

The interpretive film for the Saipan Battlefield project also had to consider the uniquely non-European and non-Asian perspective of the Pacific Islands people. Western styles of cultural preservation tend to focus on tangible heritage while Micronesians display a preference for non-tangible heritage (e.g., traditional skills and knowledge) (O'Neill and Spennemann 2001). According to Spennemann, some have argued that WWII remains are left to deteriorate by the Indigenous Micronesian populations because they do not care about them or at least were not concerned about them in the past. But why should they care? With few exceptions, the Pacific Islanders did not actively choose to be involved in the War. According to Spennemann (1992:15):

> It happened around them; it happened against them. Their islands were bombed and burned; their gardens burned by napalm or destroyed by tanks plowing through them; their villages shelled by naval vessels and canoes sunk by aircraft; the islanders themselves were commandeered for forced labor, experienced food shortages and starvation.

For the Chamorro and Carolinian descendants of those who lost their lives on Saipan during WWII, there is a built-in affinity for the locations where these events occurred, but not necessarily the "debris" resulting from the events.

The challenge of the film was to bring these perspectives together into a shared story and a shared history that could lead to a shared desire to preserve the sites. To give voice, quite literally, to these different stakeholders, we used images and words of US and Japanese soldiers and a young Chamorro woman who witnessed the battle. These narratives tie the film together.

## Conclusion

If you are considering an interpretive film for your project, seek out the most experienced documentary filmmakers you can find. Plan on having a long and detailed conversation about all of the aspects of your research, not just the purpose of the film but how and where it will be viewed and the target audiences. Your responsibility as the archaeologist is to insure the accuracy and honesty of the story. Their responsibility is to ensure that the story is told well.

The true test of the success or failure of our film will be the response of the visitors who see it at the American Memorial Park visitor center. National Parks have a long history of providing intelligent, informative, unbiased information to educate and enlighten the public. It is hoped that this film will support that mission and lead to a greater sense of shared ownership for these and other WWII heritage sites. Only time (and visitor feedback) will tell.

The rise of global tourism and more particularly eco- and cultural tourism is forcing communities to look beyond industry as engines for sustainable economic growth. For a small country such as the CNMI, tourism has arguably become its most important economic driver. A good interpretive film can be an important element in an integrated tourism plan. It will allow the visitor to take the stories of the past with them.

WWII in the Pacific, a momentous event in world history from a Western and Eastern perspective, is simply a brief interlude from the Indigenous Pacific Islanders' point of view (Spennemann 1992:15). This perspective, though pragmatic, has the potential to hinder the effective preservation of non-Indigenous heritage resources. Heritage managers in the CNMI face numerous challenges in balancing site protection with public interpretation. The fragility, vulnerability, and significance of the resources make the sites more susceptible to visitor impacts. A film can educate managers and even give them the information they need to better argue for preservation, but it cannot take the place of committed stakeholders and government agencies to take on the hard tasks of management and protection.

In modern conflict archaeology, an interpretive film that is produced with respect, sensitivity, and a commitment to all of the stakeholders can bring together diverse and estranged communities. It can be one element in reconciliation and healing, memorialization, and commemoration. As importantly, it can be distributed worldwide, used and reused, and viewed by more people in a single viewing than a book, journal article, or museum exhibit can be read or seen in a year. In just the first 3 months after posting the interpretive film to Ships' YouTube channel, and with virtually no effort at advertising, it received over 800 visits. In our global environment, it can truly reflect our shared history, our shared story, and our shared humanity.

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# Chapter 12
# "They Drank Their Own Tears": Archaeology of Conflict Sites

**Jennifer F. McKinnon**

## Introduction

The subject of this chapter is not about how many troops were on the ground, how many and what types of vehicles were used, the positions and movements at sea or over the terrain, or the type of ammunition used. It is about the human element and legacy left after the battle, it is about the way in which we as archaeologists and managers understand how world wars shape culture and communities and how it affects us as individuals, it is about the value the community places on heritage related to the battle, and it is about how that heritage is represented and discussed in a public forum. This chapter takes a step back from the individual sites, artifacts, and landscapes and focuses on the people and places and what we as archaeologists experience when we engage in archaeology at conflict sites.

There are several concerns archaeologists have when it comes to sites of conflict. One concern is that by preserving and interpreting conflict sites, we are prolonging the time it takes for healing and promoting often unresolved political and historical tensions. An alternative view is that addressing conflict sites openly helps to heal the wounds and can provide significant cultural and educational resources and lessons, "as well as economic potential if marketed effectively" (Schofield 2009:51). What the work in Saipan has demonstrated is that the process of addressing conflict sites swings on a pendulum between these two extremes and in no particular pattern or timing. During the Battle of Saipan project, both ends of the spectrum and the gray zone in between became

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apparent. What follows is a discussion about the unresolved tensions as well as the healing capabilities of reflecting upon war and a little bit of the in-between.

## Monuments and Memorialization

The process of memorialization both from the perspective of sites being actual monuments and the process of memorialization through ceremony, remembrance, visitation commemorations, interpretive monuments, storytelling, and individual acts that transpire at significant places is a subject both historians and archaeologists have expended great amounts of time trying to understand (Schofield and Johnson 2006). The motivations behind and behaviors of individuals and groups who partake in memorialization whether on a private personal level or as an outward group activity have yet to be fully explored at WWII sites in Saipan. This is one area of investigation that has the potential to address the spectrum and range of responses and feelings a community might have to conflict sites and their study and interpretation. As an example, in Saipan, memorialization can be characterized as both definitions: sites as monuments as well as acts of memorialization, and not just by one ethnic group but by many both on land *and* in the water. Sites such as Banzai Cliff and Suicide Cliff where hundreds of civilians (mostly Japanese) committed suicide near the end of the battle are both monuments and areas where memorialization takes place. The cliffs are crowded with individual, group, and government-sponsored monuments dedicated to the lives of those who committed suicide as well as the US and Japanese soldiers and Korean, Japanese, Chinese, and Indigenous civilians who endured the battle. The monuments themselves range from small offerings of food, paper cranes, candy, and incense, to monumental slabs of inscribed granite, to initials carved into cacti pads.

Other sites on land are off the beaten track and knowledge of their location comes through first-hand account or through family members who know the location, such as caves used as shelter during the war. These sites have small individual or family offerings in the form of food, small memorials (i.e., paper cranes, stupas, tablets, statues), or personal objects. The sites are on both public lands and private lands, and if on private, the permission of landowners may or may not be sought.

The process of memorialization does not stop at the water's edge but continues into the waters surrounding the island. Two monuments are located on the Kawanishi H8K "Emily" site—one is Japanese and the other Korean. The Korean monument is a large block of granite set upon a granite platform. It was placed on the site by *Challenge! Earth Exploration*, a television adventure series that previously aired on the Korean Broadcasting System (KBS). On one side in both Korean and English is written "Spirits sacrificed in the Pacific War, rest in peace, KBS Challenge! Earth Exploration, Inmolt Engineering Co. Ltd." A second side lists the director, producer, and others involved in the program's placement of the monument. The other two sides have a series of memorial poems and statements including "to spirits who hired to the compulsory military service and died during the Pacific War" and another that reads "anger, tears and grunge." These inscriptions clearly indicate a Korean involvement in the battle and emphasize the hostility and sadness of Korean conscripts who were forced into service. It is uncertain why a Japanese aircraft was selected for the placement of this Korean monument and the answer can only be found by contacting the *Challenge*! *Earth Exploration* crew. It may be related to the "Emily" being a popular dive site which is accessed by a number of dive tour operators and thus, the impact of the monument would be greater on divers. The question remains unanswered but the message is clear—the Korean community is keenly aware of their role in the battle as conscripted labor. The ability for memorials to express anger and blame represents a political element in the process of memorialization that is directive and non-dismissive of the events and actions. Reactions to the monument by two Japanese divers on separate occasions were unsympathetic and borderline anger that a Korean monument was on a Japanese plane in which only Japanese would have perished. One cannot help but wonder if these reactions are residual of the historical relationship between Japan and Korea. As Little and Shackel (2014:40) have pointed out, "Heritage conflicts are not abstract, but are intensely meaningful to the communities and individuals involved in them, heightening the importance of ethical engagement."

A second Japanese monument is located on the site and is an epitaph for an individual (Fig. 12.1). As the first few letters are in a special writing style, they are undecipherable; however, the last four characters translate to "Underwater (seabed) War Memorial." The monument is made of granite and is similar in shape to that of a wooden stupa used for modern Japanese Buddhist-style graves. This monument appears to have been erected by an individual or family. At the base of the monuments, many small movable objects have been placed on the seabed including several gas cylinders.

On this same site, there appears another arguable form of memorialization which may represent an individual's visitation—etched graffiti in the wing of the plane (Fig. 12.2). While in a traditional definition graffiti is a form of vandalism and can protest or represent a person's identity, graffiti also can be viewed as an act of memorialization. Archaeologists view it as destructive to the very fabric of historical and cultural sites and while this is true, we still need to consider the meaning behind this destructive behavior and what it represents of the person(s) who created it and their relationship with the sites (Frederick and Clark 2014; Fernandes 2010).

A second equally destructive behavior that also can be considered a form of memorialization is the collection and arrangement of moveable artifacts on a site or the addition of materials to a site (i.e., sake bottles or tea kettles). This behavior occurred in conjunction with or after the placement of the Japanese monument on the "Emily" site, but it is seen in other places as well including the Japanese freighter (aka *Shoan Maru*) where 50 caliber rounds have been placed in patterns on a Korean monument. The Martin PBM Mariner site has been the subject of recent collection and piling of artifacts which has been documented in photography from early 2010 to the present (Fig. 12.3). Photographs from the 1980s show that objects are also brought down on sites, as evidenced by the wooden stupa and sake bottle placed on the propeller of the Aichi E31A "Jake" site. A tea kettle was also found on the "Emily" site in proximity to the Japanese monument. When discussing this behavior of collecting and aggregating artifacts or adding offerings on site with the dive community, they all suggest it is the Asian and more particularly the Japanese diving community who are responsible. This raises an interesting juxtaposition between


**Fig. 12.1** Japanese monument with collected air cylinders stacked around base (Photo: Brett Seymour)

Japanese and Korean divers who like to “make” things (i.e., creating small memorials out of items) and US divers who have a tendency to “take” things (i.e., souveniring mementos).

The large granite monuments will stand the test of time, but the spontaneous, portable, and/or organic memorials of small groups, families, or individuals are less likely to survive as they may disintegrate, be altered, or even removed. While their accretion speaks to the time in which they were placed on the ground or in the sea, our understanding of them as memorials represent the plurality and diversity of the

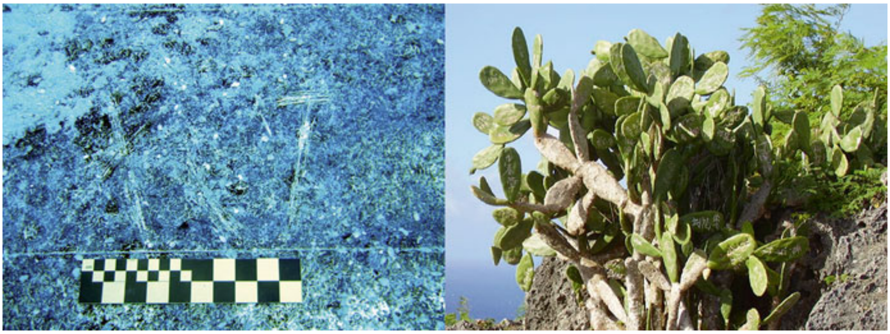

**Fig. 12.2** Graffiti etched into the aircraft wing and graffiti etched into cacti atop Suicide Cliff

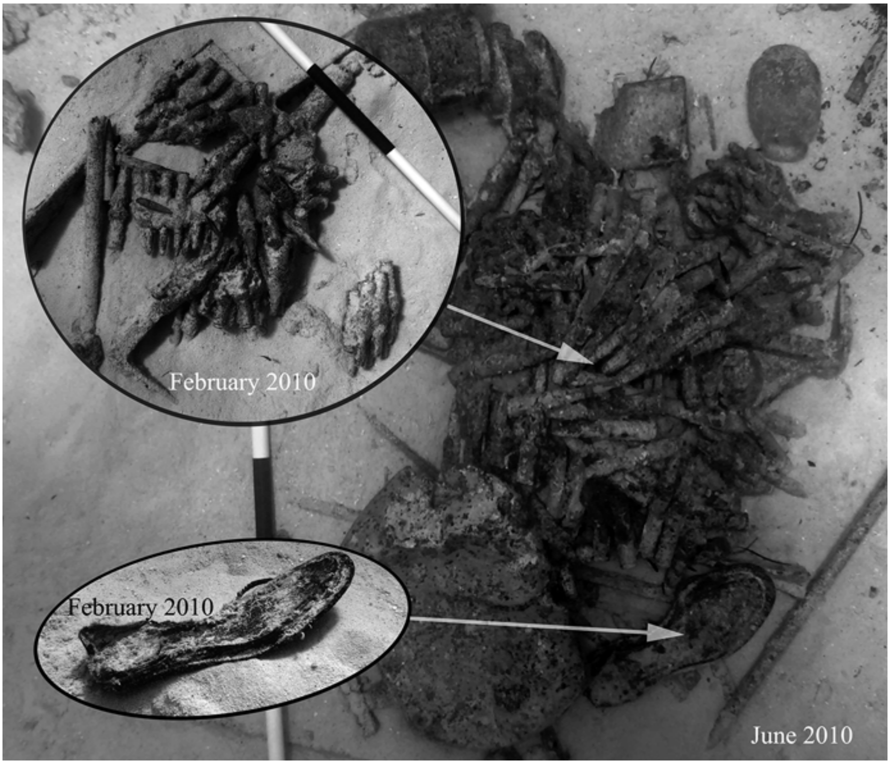


**Fig. 12.3** Comparison of moveable objects on Mariner site (Photo: Sam Bell)

community and individuals who were touched by the battle over time. From paper cranes, to incense, to American flags, to Virgin Mary statues, the memorials represent and express both the collective loss and constitution of the battlefield community. An in-depth, cross-cultural study of monuments on Saipan is much needed.

## Monuments of War: Heritage or Off-Limits

An interesting phenomena but one that should not be surprising is the fact that some WWII sites/battles within the Pacific are considered more acceptable or are more attractive to visit than others, particularly for Japanese tourists. This comes as a lesson in generalizing about heritage tourism for specific cultural markets, as what may work for one battle or site may not work for the next. As an example, within Saipan, there are sites that Japanese tourists will not dive. According to a local well-respected Japanese dive tour operator, many Japanese divers are reluctant and refuse to dive in the vicinity of Banzai Cliff because of the "souls" that are left behind. He went as far to say that some that had dived the site reported seeing spirits in the water. What is interesting is that Japanese tourists appear to have no or fewer reservations about visiting the terrestrial counterpart of these sites which see tourists by the busload on a daily basis. The difference between the terrestrial and underwater context of these sites warrants more investigation.

Broadly speaking, Saipan is probably the most heavily visited battlefield of WWII by Japanese peoples within the Pacific. This is not just because it is closer to the Japanese homeland, but likely because it was once part of the Japanese holdings and many families still consider it home. Japan held the Mariana Islands from 1914 until the battle in 1944, but even before they received the islands as a mandate territory under the League of Nations, the Japanese controlled all commerce and shipping within the Marianas. As a result, there exists a connection with Saipan that is not just militaristic. Pearl Harbor is another site that is visited with great frequency by Japanese tourists, and it could be posited that this is related to the Japanese Empire's success at the site during WWII. Places like Chuuk Lagoon, where US forces launched Operation Hailstone sinking 52 ships within the lagoon and destroying over 400 aircraft (Jeffery 2004:109),was a complete disaster and loss for the Japanese Empire and, as such, may be innately less appealing. More study is needed as to the motivations of Japanese tourists and WWII sites and battles within the Pacific.

Japanese tourists are not the only cultural group with limits on sites that are considered undesirable to visit. On the island of Saipan, there are individuals of Chamorro and Carolinian descent who find certain sites taboo or undesirable to visit. Cave sites are, for some, off-limits because of the spirits that reside inside or within their vicinity. During a recent project that involved recording WWII-related caves, this was a theme that came up regularly when speaking with locals—from their youth, many were scared to enter the caves for fear of spirits or leftover traps or dangers from the war.

## Memories and Rebuilding

"Archaeology as a process of commemoration can be used to draw out individual memories and make memorialization a collective endeavor. The distortions of memory and the problems of memory work make this difficult, but the potential for inclusive and interdisciplinary work cannot be ignored" (Moshenska 2006:65). Much of the focus on memory collection of WWII involves that of veterans, and more particularly male veterans, while less attention has been paid to the memory collection of women and civilians who were involved and impacted by the war. The collection of civilian memories, particularly Indigenous memories, was important to the project, as the goal was to be inclusive and multivocal in our attempt to interpret the battle and heritage. Thus, speaking to both men and women who endured the battle was critical to understanding the story and challenging the history that involves only a Japanese and American narrative.

Throughout the research project, I had a chance to meet with many civilian survivors of the battle, particularly those of Chamorro and Carolinian descent, to record their memories. More times than not, those conversations veered toward the post-battle memories rather than the actual battle, despite my efforts to return to the actual event. And in some instances, elders were not interested in discussing the battle at all. Memories of war are incredibly complex involving injury, loss, and destruction. Their study is also subject to many problems such as memory loss, distortion, and even social or political strategies. With the risk of generalizing, trivializing, and aggrandizing, the reactions to discussing memories of the battle focusing on the post-battle period seemed to be related to a cultural and historical essence of survival and rebuilding—an essence that was built upon and strengthened by a historical narrative of colonial intervention with the Spanish in the 1600s, the Germans in the late nineteenth century, the Japanese in the early twentieth century, and the USA in the mid-twentieth century to the present.

The epitome of this resilience is characterized in the phrase "they drank their own tears" which was the title of a children's book on elder memories of WWII and was repeated time and again by elder Escolastica Cabrera in her account of the battle. This phrase comes from Esco's family story of sheltering in the caves during which the thirsty children were told by their father to continue crying but to catch their tears so that they could quench their thirst (Escolastica B. Tudela-Cabrera, personal communication, 2013). Esco in particular focused much of her recollection on the post-battle period during which she, and later her husband, became successful entrepreneurs providing beauty shop services, catering for schoolchildren, and operating a store. Her stories centered on the opportunities that the battle brought for her family as opposed to the destructive nature of war. This general sense of resilience is not restricted to Esco but was carried throughout conversations with many elders.

However, this is not to suggest that civilians were not and still do not harbor feelings of anger, distrust, and accountability for the "twenty-five days of battle… borne upon their non-combative shoulders" (Cabrera 2015). Subsequent generations, in particular, recognize the devastation the battle brought to their islands, which impacted not just their parents and grandparents but the "ancients" whose histories and heritage were wiped from the landscape and seascape through the destructive process of war (i.e., tunneling, burning, bombing, etc.). The loss of Indigenous cultural heritage in war compounds the loss of generations that extend well beyond those that can be accounted for.

The Chamorro and Carolinian struggle to have their history and culture adequately recognized and protected continues to this day with US government plans to use islands in the Marianas for military training, which would destroy pristine ancient sites (Franklin 2013). For many on the island, remembering and communicating the battle is as much a social and political platform on which to make present and future decisions about their involvement and protest in ongoing colonial and military activities, as it is a historical narrative. Thus, the archaeological investigation of the battle can serve as a mechanism for local communities and individuals to remind themselves of the destructive interference of war and advance their current narratives of resistance.

## Conclusion

As early as 1995, a generation ago, archaeologists identified the importance of engaging with local communities and understanding and mitigating the negative impacts of our work (Pyburn and Wilk 1995), and those ideas of engagement and reflection have continued to be developed and refined today. Some have even suggested that what we do should evolve as a human rights-based practice or a form of civic engagement and social justice (Little and Shackel 2014). This call for not just a reflective, inclusive approach, but an active or even activist approach is apropos for a place like the Pacific where vestiges of colonial military practices are still part of the landscape and seascape and are actively carried out today. While the remains of the Battle of Saipan may seem like a backdrop against which the community of Saipan goes about its day, they are much more. The sites are signs of devastation and decay, reminders of rebuilding and hope, platforms for unresolved anger and distrust, mechanisms for healing, and stages for resistance. In the words of Desmond Tutu (1999:31), "the past, far from disappearing or lying down and being quiet, is embarrassingly persistent, and will return and haunt us unless it has been dealt with adequately. Unless we look the beast in the eye we will find that it returns to hold us hostage."

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