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Lust for rust : wreck divers and the management of underwater cultural heritage

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Lust for rust

Wreck divers and the management of underwater cultural heritage

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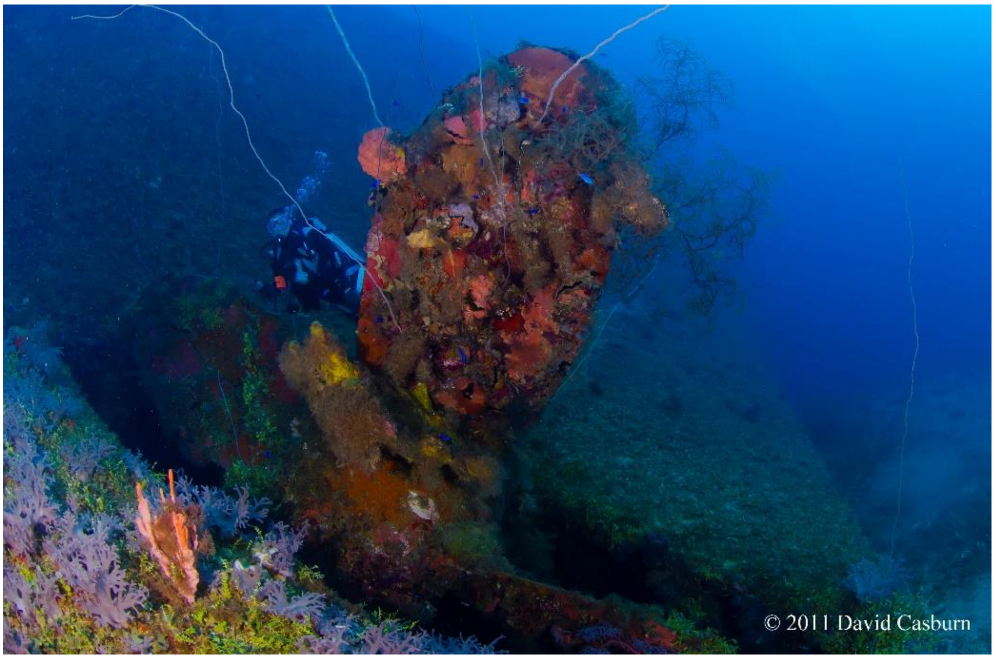

25 June 2018

I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

I acknowledge that I have read and understood the University's rules, requirements, procedures and policy relating to my higher degree research award and to my thesis. I certify that I have complied with the rules, requirements, procedures and policy of the University (as they may be from time to time).

Signed:

Joanne Edney

25 June 2018

Prologue

The catalyst for this research came from an unexpected and unrelated source. The approach taken to the research was inspired when I was a protected area manager, responsible for a number of terrestrial protected areas. One of these reserves was being adversely, and heavily, impacted by illegal downhill mountain biking. I realised that to be able to manage this group of recreationists I needed to know more about them, particularly their motivations for participating in the activity, so I could understand the types of experiences they were seeking, and which experiences were most important to them. Having this information would make it possible to identify more appropriate alternative sites, and explore ways to meet their aspirations without damaging the reserve. I also realised that gaining an understanding of the group's attitudes towards the management regulations that were in place would enable insight into likely support or opposition to these regulations, and in turn likely levels of voluntary compliance. With this in mind, I approached my manager with this suggested way of addressing the problem, but was instead told to undertake a law enforcement blitz. The management response was incredibly frustrating because a law enforcement blitz was unlikely to achieve a sustainable management solution to the problem in the short, medium or longer-term. As my frustration mounted, I decided to apply this approach to an activity I was passionate about – wreck diving, and develop an approach that may also be transferrable to other activities. Although the research presented in this thesis focuses on wreck diving, the approach taken was intended to be relevant to other outdoor recreational activities in different settings.

Abstract

Shipwrecks are mysterious, beautiful and evocative. They offer divers unique, diverse and more challenging diving experiences than general scuba diving. It is not surprising, therefore, that interest in and demand for wreck diving has grown as the recreational diving community has expanded and matured over the past six decades. However, shipwrecks are also fragile, non-renewable finite resources, and important elements of our underwater cultural heritage. Wreck diving can result in negative impacts on the cultural heritage values of shipwrecks. An understanding of wreck diver behaviour, motivations and attitudes can assist heritage managers to balance protection of underwater cultural heritage and diver access to high quality diving experiences. The purpose of this research was to address the gaps in the literature pertaining to wreck diver behaviour, motivations and attitudes, and to identify opportunities for enhanced integration of divers and the management of underwater cultural heritage, focusing on the Asia-Pacific region.

Pragmatism and mixed methods methodology was used to address the research objectives. The underwater behaviour of 20 wreck divers at Chuuk Lagoon, in the Federated States of Micronesia, was examined and analysed to gain an understanding of wreck diver behaviour. A sample of 724 wreck divers participated in a self-completed web-based survey, targeted at the key source populations of wreck divers who visit the Asia-Pacific region. Data from the survey was used to analyse wreck diver motivations and attitudes.

Outcomes of the study of in-water behaviour revealed that the majority of wreck divers behave responsibly underwater and do not participate in behaviours detrimental to the cultural heritage values of shipwrecks. A small minority of divers are responsible for the majority of contact behaviours, and the primary source of these behaviours were men and Australians. Less experienced divers were responsible for more contact behaviours than more experienced divers. The in-water behavioural study of divers represents a key contribution of this research by providing the first empirical description and analysis of wreck diver behaviour.

Survey findings revealed the majority of wreck divers are male, aged between 35 and 64 years of age, hold a Bachelor or higher degree, and are experienced divers with high levels of dive certification. The majority of wreck divers are primarily motivated to see historically significant shipwrecks, artefacts and marine life and to enjoy the peace and tranquillity of the underwater environment. However, motivations are complex and influenced by certain diver profile variables. This research generated a conceptual model of wreck diver motivations, the Wreck Diver Motivations Model. The model illustrates the diversity and complexities in diver motivations, providing a more comprehensive understanding of diver motivations.

Most wreck divers indicated in-principle support for the use of management controls to protect wrecks. However, only two specific controls were supported: the use of penalties and permits. There was strong opposition to the exclusion of divers from shipwrecks. Similar to motivations, attitudes were also found to be complex and influenced by certain diver profile variables. Two models of diver attitudes were generated from this research, the Wreck Diver Opposition to Management Controls Model and Wreck Diver Support for Management Controls Model. These models illustrate the complexities and diversity inherent in diver attitudes, enriching understanding of wreck diver attitudes. The three conceptual models generated from the research make a key contribution to heritage management, and scuba and outdoor recreation research.

A review of the literature regarding approaches to managing diver impacts on underwater cultural heritage identified three key opportunities to integrate divers in the management of underwater cultural heritage. These were engagement and partnership programs, maritime archaeology training for divers, and collaboration and consultation with divers regarding the management of sites. The Wreck Diver Motivations Model can also assist in enhancing integration of divers and the management of underwater cultural heritage by providing managers with insights into the effects of management decisions on diver experiences and preferences, on different segments of the wreck diving community. The two conceptual models of diver attitudes allow managers to identify the segments of the wreck diving community likely to oppose or support specific management controls, and gauge likely levels of voluntary compliance with management rules.

Publications arising from this research

Publication

Edney, J. (2016). A framework for managing diver impacts on historic shipwrecks. *Journal of Maritime Archaeology*, *11*(3), 271-297. doi:10.1007/s11457-016-9165-4.

Conference presentations

Revealing the secret life of wreck divers. Presented at the 9th International Congress on Coastal and Marine Tourism, Global challenges local solutions, Gothenburg, Sweden, 13-16 June 2017.

The secret life of wreck divers. Presented at the 6th International Congress on Underwater Archaeology (IKUWA6), Celebrating our shared heritage, 28 November - 2 December 2016, Fremantle, Western Australia.

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Abbreviations & acronyms

BCD	Buoyancy control device
FSM	Federated States of Micronesia
N (or n)	Number
PADI	Professional Association of Diving Instructors
SD	Standard deviation
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States of America

Chapter 1 – Introduction

1.1 Study background

The study was commenced at Charles Sturt University and completed at Southern Cross University. This thesis represents an evolution of thinking. The study started out with a focus on the idea of culture and differences in motivations and attitudes based on a range of cultural variables of wreck divers, including but not limited to their age, education, dive experience and training, country of residence, birth or nationality and whether participants resided in a major city or rural or regional areas. With the change in university and the evolution of the researcher's thinking, the focus of the study shifted and sharpened to gaining a more comprehensive understanding of wreck divers and their role in the management of underwater cultural heritage. The data collected in the survey reflects the initial focus, and is discussed in more detail in Chapter 5.

1.2 Research aim and objectives

The aim of this research is to gain a comprehensive understanding of wreck diver attitudes, behaviour and motivations, to assist heritage managers balance underwater cultural heritage protection and diver access to high quality diving experiences. The empirical focus of this study will be the behaviour of wreck divers in the Asia-Pacific region, as well as the characteristics, motivations, and attitudes of wreck divers from the major source populations of wreck divers to the Asia-Pacific region.

The study aim will be achieved by addressing the following objectives:

1. Examine and critique wreck diver behaviour, motivations and attitudes.
2. Explore the possibilities for an enhanced integration of divers and the management of underwater cultural heritage.

1.3 Justification of the research

Recreational scuba diving became a reality in the mid-1940s, when equipment became more reliable and accessible to the general public (Dimmock & Cummins, 2013). Since the 1940s, the dive industry has grown substantially. It is now a multi-billion dollar industry that continues to expand. The dive community is active and mobile and dive tourism has become significant to many local economies. It forms an important part of the global tourism industry, and is considered one of the fastest growing areas of special interest tourism (Andy, Lee, & Tzeng, 2014; Dimmock & Cummins, 2013; Edney, 2006, 2012a, 2017; Klint et al., 2012).

Commensurate with the growth and maturation of the dive industry has been an increased interest in, and demand for, wreck diving. Wreck diving offers more challenging and diverse diving experiences, which divers seek as their level of skill and experience rise (Cater, 2008; Edney, 2016). Shipwrecks have, therefore, become important recreational and tourism resources. However, they are also important components of underwater cultural heritage, and use of shipwreck sites by divers can diminish their cultural heritage values, along with their recreation and tourism values (Edney, 2016). The growth in the number of divers visiting shipwrecks has seen an increase in adverse impacts on these sites, particularly those with high levels of visitation. The impacts associated with recreational scuba diving include boat anchor and mooring damage, impairment of site integrity and stability, the effects of unintentional and intentional diver contacts with wrecks, and the effects of divers exhaled air bubbles coming into contact with wrecks. These impacts are described in detail in Chapter 4.

Shipwrecks are fragile, non-renewable and finite resources (Delgado, 1988b; Scott-Ireton, 2005; Vrana & Mahoney, 1995). Therefore, effective management of shipwreck sites is essential if their cultural heritage, recreation and tourism values are to be protected (Edney, 2016, 2017). Adverse impacts on the marine environment associated with recreational use are known to be greater when managers do not understand recreational user groups' preferences and attitudes towards various management strategies that may be used to avoid or mitigate these impacts. Therefore, understanding the divers visiting shipwrecks is crucial to the effective management of these sites. More effective management of sites can be achieved when managers understand the motivations of the groups using sites and their attitudes to management rules (Edney, 2017; Sorice, Oh, & Ditton, 2007). When the motivations, preferences and characteristics of a recreational user group are understood, it is possible to achieve a better balance between management objectives and access to sites, and therefore more effective management of sites (Young & Loomis, 2010).

There is now a substantial and growing body of literature about general scuba divers, highlighted in Chapter 3, which is in contrast to the dearth of literature specific to wreck divers. There are few examples in the literature of studies specific to wreck divers. The first example was a study of wreck divers in the Great Lakes region of the United States by Holecek and Lothrop (1980a, 1980b). However, it is dated, based on a small sample size, and is focused on cold, freshwater wreck diving.

More recently, there have been two studies specific to wreck divers. The first was a study of wreck divers at Chuuk Lagoon, in the Federated States of Micronesia, reported in Edney (2011b, 2012a). The second was a study of Australian wreck divers, reported in Edney (2011b, 2012b) and Edney and Spennemann (2014, 2015). These recent studies have provided some base-line data about the characteristics, motivations, preferences and attitudes of Australian wreck divers, and some limited information about wreck divers from other nations, predominantly North America. The outcomes of these studies have included recognition that certain diver profile variables, such as gender and dive specialisation, moderate diver motivations and attitudes. A more detailed discussion of the findings of the wreck diving literature is contained in Chapter 3.

The recent studies of wreck divers recognised the need for more research to determine the characteristics, motivations and attitudes of the range of divers visiting underwater cultural heritage sites in the Asia-Pacific region. Understanding diver motivations is important for heritage managers because it allows them to understand the types of experiences sought and preferred by divers, and the opportunity to provide for these in management strategies. It can also give managers insights into the effect management decisions may have on diver experiences. A clear understanding of diver attitudes to management controls is advantageous for heritage managers because it enables them to understand the likely support for, or opposition to, management rules at sites. Having an insight into the likely levels of acceptance of management rules allows managers to gauge likely levels of voluntary compliance with these rules by divers. Shipwrecks are challenging to monitor due to their location, and costs of enforcement and surveillance are high (Edney, 2016; McKinnon, 2015; Scott-Ireton & McKinnon, 2015; Smith & Anderson, 2004). Therefore, maximising voluntary compliance is beneficial, and likely to achieve more effective site management. It is also desirable from a recreation management perspective, because allowing divers more freedom at sites can mean higher quality recreation experiences for divers (Edney, 2016; Lucas, 1983; Manning, 1999; Sorice, Oh, & Ditton, 2009).

Notably, the literature review has revealed that there are no examples of empirical studies of actual wreck diver behaviour. Consequently, heritage managers are required to make management decisions based on assumed diver behaviour, and anecdotal information. If actual behaviour was understood, the effectiveness of management strategies for underwater cultural heritage sites visited by divers could be enhanced.

The review of the literature has therefore highlighted gaps. The most significant gap being the lack of empirical studies into actual diver behaviour. The other gaps relate to the motivations and attitudes of wreck divers. A more comprehensive understanding that encompasses the range of wreck divers who visit shipwrecks in the Asia-Pacific region, and the diversity within this wreck diving community is required. The review of the literature has also highlighted a need to identify ways that the integration of divers and the management of underwater cultural heritage may be enhanced. This study seeks to address these gaps in the wreck diving literature, and to identify opportunities for enhanced integration of divers and the management of underwater cultural heritage. Although the focus is on the application of this information to heritage managers, it may also be useful to dive and tourism operators and planners, as it enables them to offer experiences more closely aligned with wreck diver aspirations. It can be used by the dive industry to inform the marketing and promotion of dive opportunities.

1.4 Relationship of the researcher to the study

The researcher has spent most of her life doing things related to water, and scuba diving was a natural progression. She is passionate about scuba diving, and has been enjoying it for over 35 years. The researcher is an avid wreck diver whose primary motivation for learning to dive was to explore shipwrecks. She has dived in a number of different locations throughout the Asia-Pacific region including Australia, Commonwealth of the Northern Mariana Islands (Saipan), Federated States of Micronesia (Chuuk), Indonesia (Bali), Malaysia, Palau, Papua New Guinea, Solomon Islands, Vanuatu, United States (Guam & Hawai’i). The researcher is always seeking opportunities to dive shipwrecks and dreaming about her next dive trip.

Since learning to dive in 1982, scuba diving has been a big part of the researcher’s life. Each dive has increased her desire for more diving. While all types of wrecks are her favourite type of diving, she also loves just spending time underwater being part of the marine environment and hanging out with marine life. The researcher is also a current PADI (Professional Association of Diving Instructors) Master Scuba Diver Trainer, who began teaching scuba diving in 1984. Introducing other people to the wonders and joy of diving, and helping them learn new skills to further their ability to explore the marine environment, is still something she continues to find very rewarding.

Alongside her diving experience, the researcher also has almost 32 years-experience working in the public sector. This experience included environmental survey, research and management, threatened species conservation, and terrestrial and marine protected area management. Her role in protected area management included the management of biodiversity, cultural heritage (Indigenous and non-Indigenous), recreation and tourism. This experience has included operational, planning and policy aspects of these roles.

The researcher brings all of her diving and work experience to this project and acknowledges that these experiences will have influenced this research. This background has informed the research direction and approach. The researcher's professional and personal background motivated her MAppSc research into wreck divers and the management of underwater cultural heritage, and this study that has expanded on her earlier work. The researcher brings to this study an understanding from the perspective of both the recreationist and manager, the ability to engage with and understand wreck divers, and to observe them underwater.

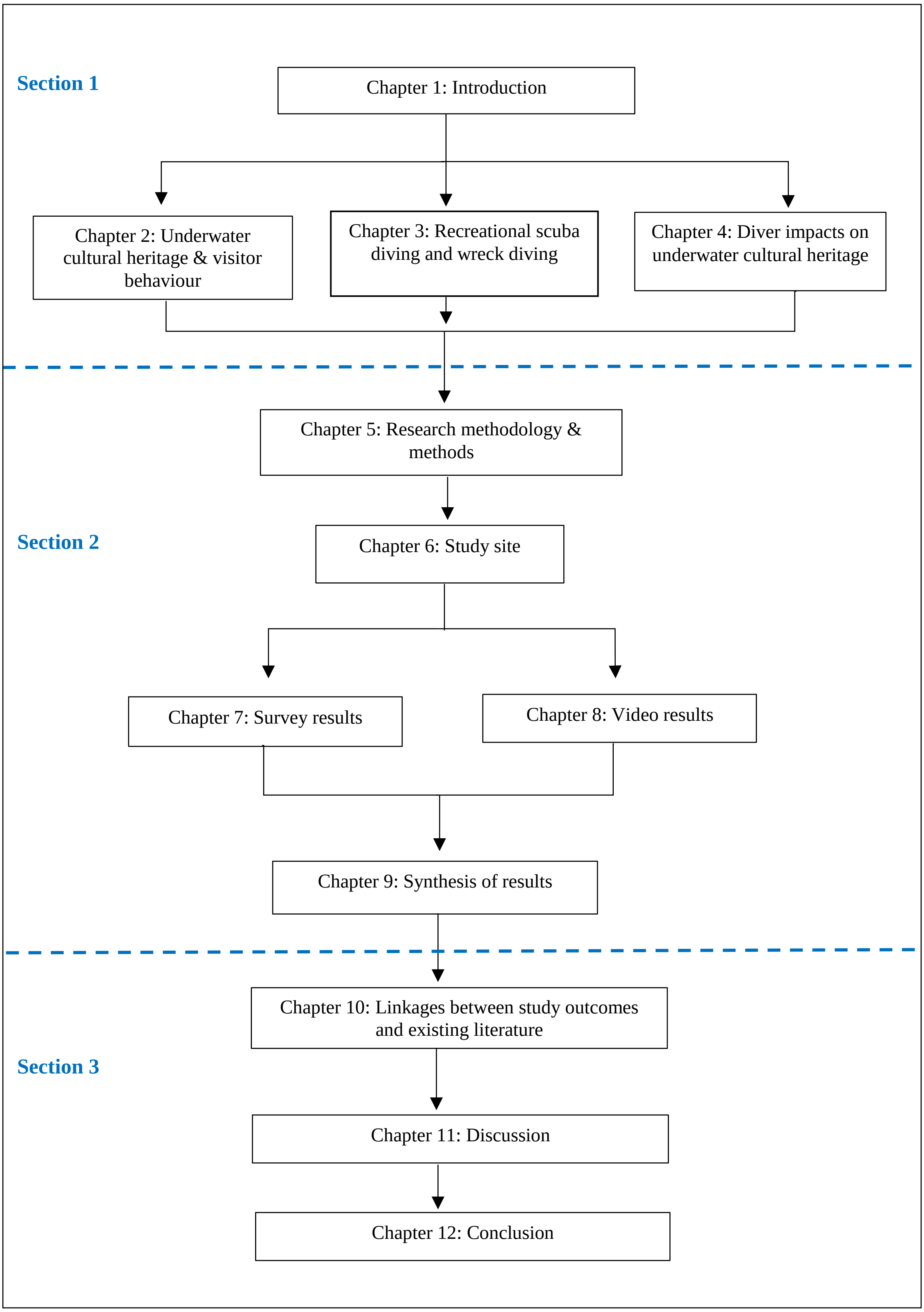
1.5 Thesis structure and outline

This thesis consists of twelve chapters, contained within three sections. The structure of the thesis is illustrated at Figure 1. The relationship between the research objectives and the thesis chapters are presented in Table 1.

Section 1 of the thesis contains four chapters: an introduction and three literature review chapters. Three literature review chapters were necessary because three core areas needed to be explored in setting the context and framework for this research. This current chapter provides an introduction and background to this thesis, including the research aim and objectives, a justification of the research, a description of the relationship of the researcher to this study and an outline of the thesis structure. Chapter 2 provides an outline of the concepts and meanings associated with heritage, with a focus on underwater cultural heritage, briefly describes heritage tourism, and links wreck diving to heritage tourism. Following this, the factors that may influence diver behaviour at underwater cultural heritage sites are introduced and briefly described. These include environmentally responsible behaviour, recreation specialisation theory and common pool resources. The benefits of encouraging voluntary compliance with management rules, and means of achieving high levels of voluntary compliance are outlined. Chapter 3 provides a brief outline of the history of recreational scuba diving, describes the range of opportunities available to recreational scuba divers, discusses the attraction of scuba diving, gives an overview of the scuba literature, describes wreck diving and provides a review of the wreck diving literature, and identifies gaps in the literature. Chapter 4 describes the potential negative impacts of recreational diving on underwater cultural heritage, focusing on shipwrecks, and the range of regulatory and non-regulatory approaches to managing such impacts. The impacts associated with diving, and their management, are illustrated with examples from the Asia-Pacific Region.

Section 2 is comprised of five chapters: one that describes and justifies the methodology and study methods, one that describes the study site, and three results chapters. The methodological framework and methods used in this research are described in Chapter 5. This chapter also provides a description of the research strategy, including methods and data analysis techniques used in the survey and behavioural observations, limitations associated with the methods, the ethical considerations relevant to this study and the ethical framework used. Chapter 6 introduces Chuuk Lagoon in the Federated States of Micronesia, the study site for the behavioural observations. An overview of the geography, economy, legal context and historical background of Chuuk is given to provide context for the diving environment and associated management issues. The results of the analysis of the survey data, including diver profiles, motivations for wreck diving and wreck diver attitudes to management controls to protect underwater cultural heritage are presented in Chapter 7. Chapter 8 presents the results of the behavioural observations of wreck divers and dive guides, with a focus on the video observations of participant divers. This chapter presents a considerable amount of data, and is therefore a necessarily large and data rich chapter. In view of the large amount of data presented in Chapters 7, 8 and 9 provides a synthesis of these results and a comparison of the key findings of the survey and behavioural observations.

Figure 1 **Thesis outline**



Section 3 consists of three chapters: linkages between study outcomes and existing literature, discussion and conclusion. In Chapter 10, the outcomes of this research are linked with relevant existing literature, and similarities and contrasts are identified and discussed. Key outcomes of this study are discussed, and conceptual models of wreck diver motivations and attitudes developed from this research are presented in Chapter 11. Chapter 12 provides a summary of key findings of this research and their alignment with the research aim and objectives. It concludes with an outline of suggestions for future research stemming from this research.

Table 1 Relationship between research objectives and thesis chapters

Objective Number	Objective description	Chapter
1	Examine and critique diver behaviour, motivations and attitudes	7, 8, 9, 10 & 11
2	Explore the possibilities for an enhanced integration of divers and the management of underwater cultural heritage	4, 10, 11

This thesis contains many images of the shipwrecks at Chuuk Lagoon. These shipwrecks are the graves of many Japanese servicemen, and the remains of some of these people are visible to divers. Readers are advised that this thesis contains images of some of the human remains present on the shipwrecks at Chuuk.

Chapter 2 – Underwater cultural heritage and visitor behaviour

2.1 Introduction

This chapter commences with brief description of the concept and meaning of heritage broadly, then focuses on cultural heritage. Underwater cultural heritage is defined and an outline of the different values of shipwrecks is provided, followed by a brief discussion of cultural heritage tourism and the relationship of wreck diving to heritage tourism. The chapter then discusses factors that may influence diver behaviour at underwater cultural heritage sites. Environmentally responsible behaviour is briefly described, with a focus on the factors managers may need to consider when aiming to influence the behaviour of recreationists. Recreation specialisation theory and its application to outdoor recreation management, including scuba diving, is discussed. A brief outline of the meaning of the concept of common pool resources and its relevance to the ocean and use of the ocean is provided. The chapter concludes with a brief discussion of the benefits of seeking to achieve voluntary compliance with laws and management strategies, and what managers can do to encourage and improve voluntary compliance with rules.

2.2 Heritage

Heritage '… is the things of value that are inherited', that we want to keep (Hall & McArthur, 1998, p. 4) and share with present and future generations (Aplin, 2002). Heritage is important to society. It can add perspective and meaning to our lives and give a sense of belonging. Heritage helps to define our identities as communities and individuals, and can also define a place or locality (Aplin, 2002; Hall & McArthur, 1996; McArthur & Hall, 1996). Heritage places provide visitors a tangible connection between the past, present and future (Millar, 1989).

Heritage is often arbitrarily divided into natural and cultural categories, particularly by Western cultures (Aplin, 2002; Pearson & Sullivan, 1995). Natural heritage includes biodiversity and natural phenomena, such as oceans, rivers, lakes, wetlands, canyons, mountains, glaciers, deserts and other landforms (Australian Heritage Commission & CRC for Sustainable Tourism, 2001; Timothy, 2011). Cultural heritage is the result of human processes and activities, and can be tangible and intangible. Cultural heritage has three components: immovable heritage, movable heritage and non-material heritage, all of which are often closely linked. Immovable heritage includes cultural landscapes, buildings, places and sites. Movable heritage are things such as artefacts, works of art, books and furniture. Non-material heritage includes traditions, folklore, music, dance, ceremonies, rituals and food (Aplin, 2002; Pearson & Sullivan, 1995; Timothy, 2011).

Heritage is a culturally constructed concept and set of values, and as such holds different meanings and importance for different individuals and groups. These differences are due to the nature of the heritage resource itself, along with the backgrounds, personalities, values and attitudes of individuals and groups. The perception of the level of importance of heritage is influenced by culture and values. Consequently, what is valued and considered worth protecting by one individual or group may not be valued by another, and perceptions about heritage value are not fixed. These perceptions can change as values and attitudes change (Aplin, 2002; Hall & McArthur, 1996).

Heritage significance is usually defined by spatial scales, from personal to local, regional, national and global (Aplin, 2002). It is identified by a range of factors, which generally fall into four categories: scientific and educational, economic, socio-cultural and political values (Hall & McArthur, 1996). Because heritage is a culturally constructed concept it is subjective, and the level of significance is a reflection of collective values (Aplin, 2002; Hall & McArthur, 1998). The way in which governments, or other hegemonic groups deal with heritage is important, because it plays a major role in developing and maintaining a sense of pride, self-worth and identity at the individual and community level (Aplin, 2002).

The way heritage is defined by different nations is often a reflection of the values or agenda of the dominant group(s) in society. However, it is important that heritage is inclusive and does not exclude minority groups. Heritage should not be used to weaken or strengthen the sense of identity of particular groups based on political motivations and agendas. If heritage is not inclusive of the range of values held by society, this may result in contested heritage, and in some cases dissonant heritage. Contested heritage can occur when there is disagreement about what heritage means, heritage values or who heritage belongs to (Aplin, 2002; Boyd, Cotter, Gardiner, & Taylor, 2005; Timothy, 2011). Heritage dissonance occurs when there are differing views about the way heritage is presented, including ‘true’ or objective accounts of history. History can be presented and interpreted in a variety of ways, and it is unlikely that any account of history will be objective. Most commonly, this occurs when more than one group makes claims to the same past and heritage places, but place different values, meanings and interpretations on it. The result can be that some groups have their part of heritage overlooked or dismissed. Heritage dissonance can also occur when there is disagreement within a social group, such as certain religious groups or nationalities (Timothy, 2011).

Recognition of heritage has a major effect on group morale. When a group's heritage becomes marginalised or excluded it can also marginalise and disempower the group (Aplin, 2002). The question of who has claim of association over heritage is, therefore, an important one. The Western concept of heritage is tied to legal and economic ownership, yet this can overlook the varied personal and emotional associations with heritage places. Another more inclusive way of dealing with heritage is to recognise and acknowledge the various 'cognitive owners' of these places. Cognitive owners are those with conceptual, intellectual, and/or spiritual links to a place. Each attaches meaning to the place, which in turn is expressed in their behaviour and interactions, and therefore impacts on these places (Boyd, Cotter, O'Connor, & Sattler, 1996; Boyd, 2012; Boyd et al., 2005).

The concept of cognitive ownership of heritage places recognises that heritage places may have many and varied 'owners'. It acknowledges and accepts that each place will have multiple meanings, and the legitimacy of these multiple associations and meanings. In doing so, this legitimises community access to heritage. Cognitive ownership is about identifying all parties who have associations with the place and understanding these associations. It does not entail making value judgements about whose association or meaning takes precedence over another, and is not used to assess the significance of a place. Cognitive ownership provides a practical framework for identifying and understanding the range of connections and associations different groups have with a site, their behaviour at a site and the interactions between different cognitive owners. It allows managers to gain a more holistic and deeper understanding of the way different groups' value and connect with a place. By accounting for this range of cognitive owners more inclusive management frameworks can be applied to these places, and more inclusive management can achieve more effective management outcomes (Boyd et al., 1996; Boyd, 2012; Boyd et al., 2005).

It is critical that heritage is accessible to ensure its relevance now and into the future (Garrod & Fyall, 2000). However, it is recognised that visitation can cause negative impacts on cultural heritage, the landscape it is located in and the host community. Therefore, it is important a balance is maintained so these places are protected and tourism is sustainable (Garrod & Fyall, 2000; Timothy, 2011).

2.2.1 Underwater cultural heritage

2.2.1.1 General

Underwater cultural heritage is essentially an environmentally defined component of cultural heritage (Forrest, 2002). It is cultural heritage that is located underwater or was previously underwater (UNESCO, 2017c). The most common formal means of protecting underwater cultural heritage is through the application of heritage legislation (Staniforth, Hunter, & Jateff, 2009), and the various laws that different nations have in place each have their own definition of underwater cultural heritage. However, a universally accepted definition is contained within Article 1 of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage (the Convention):

> '1. (a) "Underwater cultural heritage" means all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years such as:
>
> (i) sites, structures, buildings, artefacts and human remains, together with their archaeological and natural context;
>
> (ii) vessels, aircraft, other vehicles or any part thereof, their cargo or other contents, together with their archaeological and natural context; and
>
> (iii) objects of prehistoric character.
>
> (b) Pipelines and cables placed on the seabed shall not be considered as underwater cultural heritage.
>
> (c) Installations other than pipelines and cables, placed on the seabed and still in use, shall not be considered as underwater cultural heritage.' (UNESCO, 2001, Article 1).

The Convention came into force in 2009. It recognises the importance of underwater cultural heritage to humanity and sets minimum standards for its protection. The Convention focuses on heritage protection issues and does not regulate ownership.

The main principle of the Convention is an obligation to provide effective protection to preserve underwater cultural heritage. This is usually achieved through the enactment of laws (section 4.4.1.1). Other key principles include that in situ preservation should be the first option for management, and no commercial exploitation of underwater cultural heritage. Commercial exploitation does not include research or access for tourism. Additionally, the Convention encourages training and information sharing between States, including the promotion of training in underwater archaeology and promoting public awareness (Staniforth et al., 2009; UNESCO, 2017a).

The Convention has been ratified by 58 States to date, and there is a notable dearth of ratification by Asia-Pacific States, including Australia (UNESCO, 2017a, 2017b), with the exception of the Federated States of Micronesia. The Federated States of Micronesia announced on 6 March 2018 that it would ratify the Convention, following consultation with government agencies, key stakeholders and heritage experts (UNESCO, 2018).

Although the Convention has not been ratified by all nations, it provides a generally accepted framework for managing underwater cultural heritage globally. Many States who are not signatories to the Convention apply the guidelines contained in the Annex of the Convention to the management of underwater cultural heritage (Staniforth et al., 2009). These guidelines are also applied to the management of sites that do not strictly meet the Convention's definition of underwater cultural heritage of having been submerged for less than 100 years.

2.2.1.2 Shipwrecks

The focus of this study is the relationship of divers to tangible components of underwater cultural heritage, primarily shipwrecks. Shipwrecks hold a great deal of value, appeal and interest to society generally, as well as to many divers. They can evoke intense emotions because shipwreck events demonstrate the power of the sea and fragility of humans, and can bring out extremes in human behaviour. So much so that shipwrecks and the stories associated with them often feature in art, literature, music, folklore and mythology (Delgado, 1988b; Kenderdine, 1997; Nutley, 1996).

Key values of shipwrecks include their cultural heritage, education, economic, and tourism values (Delgado, 1988b). The cultural heritage values of shipwrecks are important. These include their anthropological, archaeological, historic, cultural and social values. Shipwrecks are a significant element of underwater cultural heritage, and are fragile, non-renewable finite resources. They cannot be replaced or restored to their original condition, and unlike reefs, cannot regenerate once disturbed or damaged (Delgado, 1988b; Scott-Ireton, 2005; Vrana & Mahoney, 1995).

Historically, ships have been important to society for communication, defence, exploration, fisheries, migration, passenger transport and recreation. As such, they can provide valuable information about commerce, culture, defence, engineering, naval architecture, and shipbuilding. Shipwrecks have been described by some as ‘time-capsules’ because they were designed to be relatively self-sufficient. They were effectively sealed off once they left a port and only opened up when they arrived at another port. Much of what was taken aboard a ship was retained. In this sense, they can also provide interesting insights into human behaviour. They contain information that reflects the behavioural characteristics and patterns of the individuals and groups that were on board the ship, the foods and medicines used, the culture that produced the ship, and the history associated with the ports visited and the location where the wrecking event occurred. The historical values of shipwrecks are varied, and can be due to the significance of the type of vessel or what it was carrying, the record of the life and times of ordinary people they contain, or because it was associated with historically significant events or people. The loss of life often associated with shipwrecks can also make them important graves or memorials, and in some cases war graves (Australian Institute for Maritime Archaeology & Australian Cultural Development Office, 1994; Delgado, 1988b; Edney, 2006, 2016; Henderson, 1986; Kaoru & Hoagland, 1994; Kenderdine, 1997; Panakera, 2007; Scott-Ireton, 2005; Vrana & Mahoney, 1995).

The scientific values of shipwrecks include the marine biodiversity attracted to them. As artificial reefs, shipwrecks can provide important insights into reef ecology, particularly information about the process of biological colonisation, and can be important for the abundance and variety of marine life they attract. Shipwrecks also give insights into site formation processes and the environmental processes that affect shipwrecks (Jeffery, 2004a, 2004b; Jewell, 2004; Kenderdine, 1997; Randell, 1998). These scientific values, along with their cultural heritage values, mean that the educational values of shipwrecks are both diverse and immense (Edney, 2006).

The economic values of shipwrecks are derived from the commercial value of the cargo they contain, the materials they were constructed from and their machinery and fittings, which are often made from valuable metals. Many of these items are salvaged soon after the wrecking event. However, these commercial values also result in shipwrecks being illegally salvaged and looted by treasure hunters, sometimes centuries after the wrecking event (Delgado, 1988a, 1988b; Kenderdine, 1997; Staniforth et al., 2009; Vrana & Mahoney, 1995). Shipwrecks can also be important economically for commercial fisheries, and recreational fishers, due to their ability to attract fish life to areas of low fish abundance and because they aggregate fish (Branden, Pollard, & Reimers, 1994; Edney & Spennemann, 2014).

The tourism values of shipwrecks are another important component of their economic values (Finney, 2002; Viduka & Raupp, 2008). For example, the historic shipwreck, the *SS Yongala* (1911) off Queensland in Australia, was estimated to have provided $1 million annually to charter boat owners alone in the 1990s. Associated businesses, such as airlines, accommodation providers, restaurants, dive gear sales and hire, and other shops also benefit (Cuthill, 1998; Jeffery, 2003a). During the 1990s, it was estimated that around 6,400 dives per year were made on the *Yongala*, and this number had increased to 13,500 during the first nine months of 2001 (Cuthill, 1998; Jewell, 2004). At Chuuk, in the Federated States of Micronesia, dive tourism associated with the shipwrecks is a major source of revenue, and while economic values have not been quantified, dive permits alone have, in the past, raised as much as US$90,000 annually (Jeffery, 2004a). They presently raise around US$66,000 annually (D. Strong, personal communication, 8 March 2016). However, this figure represents a minor portion of diver expenditure. Considerably more is spent on dive charters, transport, accommodation and food. The economic values of vessels sunk purposefully as dive attractions have had more economic assessments undertaken on them than historic shipwrecks. In Australia, for example, it has been estimated that the revenue derived from divers visiting the ex-*HMAS Brisbane* was around $4.5 million per year (Schaffer & Lawley, 2010).

Another element of tourism values of shipwrecks are their recreation values. Shipwrecks are beautiful, majestic, intriguing and evocative. Seeing a shipwreck resting on the seabed covered in a rich variety and abundance of marine life holds great aesthetic appeal (Delgado, 1988b; Edney, 2006; Kenderdine, 1997). Shipwrecks offer divers an experience like no other. Divers can enjoy the unique experience of seeing cultural and natural heritage on the same dive (Edney, 2006; Stolk, Markwell, & Jenkins, 2005). They gain access to the past and have the opportunity to connect with the history associated with the wreck and the wrecking event. Being able to see the contents of a shipwreck, the personal effects of those on board, and fittings and machinery on a shipwreck add another dimension to the dive experience, and is an experience few other people gain access to. Divers are able to observe what happened to the ship and the effects of immersion in the marine environment over time. Shipwrecks also offer diverse, and in many cases, more challenging diving experiences. Divers are able to dive a vast array of vessels, such as passenger liners, cargo ships, war ships, fishing vessels, as well as different types of aircraft. They can see vessels and aircraft of different ages and different types of construction in a range of different environments and depths, and in various states of decay (Delgado, 1988a, 1988b; Edney, 2006, 2012a, 2016; Kenderdine, 1997; Scott-Ireton, 2005). Many divers travel to visit shipwrecks because they do not have access to wrecks in their locality, or to enjoy diving different wrecks in different environments.

2.2.2 Cultural heritage tourism

Heritage tourism is a type of special interest tourism, and cultural heritage tourism is a form of heritage tourism. It is tourism that involves viewing or experiencing cultural heritage (i.e. immovable heritage, moveable heritage and non-material heritage), as opposed to tourism focusing on natural heritage, which is usually referred to as ecotourism, nature-based tourism or outdoor recreation (McKercher, Ho & du Cros, 2002; Timothy, 2011).

Cultural heritage tourism is a key element of tourism industries, and is presently considered one of the most important types of tourism (Aplin, 2002; Timothy, 2014). It has been estimated that between 50 and 80 percent of all domestic and international travel includes some form of cultural heritage tourism, making it of great significance to the economies of many tourist destinations (Timothy, 2014). Cultural heritage tourism is also important because it can help justify and gain support for the relevance of cultural heritage and its conservation, and the revenue associated with it can make an important contribution the conservation and management of heritage places (McKercher et al., 2005; Timothy, 2014).

Cultural heritage tourists range from serious to casual. The serious heritage tourists seek destinations where they can see and experience various aspects of cultural heritage, while casual heritage tourists are usually attracted to a destination for other reasons, with the cultural heritage aspect being incidental to the main purpose of the trip. This, combined with the diversity of forms of cultural heritage tourism (for example, historical, industrial, dark, religious, art and literary) means there are a wide range of factors which motivate heritage tourists to visit particular destinations (Timothy, 2011). Heritage relating to war, such as visiting battlefields, is one of the most popular forms of cultural heritage tourism. The most common reasons people visit battlefields are commemoration, education and nostalgia. This form of heritage tourism also fits within the dark tourism category, as battlefields are sites of suffering, death and often atrocities (Austin, 2002; Cooper, 2007; Lennon & Foley, 2000; Panakera, 2007; Prideaux, 2007; Timothy, 2011, 2014).

Although scuba diving is frequently referred to and promoted as nature-based tourism or ecotourism (Hammerton & Bucher, 2015), it can also be a form of cultural heritage tourism when the dive tourists visit underwater cultural heritage. This form of dive tourism has been be referred to as dive heritage tourism (McKinnon, 2015; Viduka & Raupp, 2008). Indeed, some dive heritage tourists may also be considered dark or battlefield tourists, depending on the wrecks they are visiting (Cooper, 2007; Lennon & Foley, 2000; Panakera, 2007). For example, World War II produced sites now popular with battlefield tourists, including scuba divers (Cooper, 2007). The divers visiting Chuuk, in the Federated States of Micronesia, where fieldwork was carried out for this study, may be viewed as dive heritage tourists participating in battlefield tourism. The shipwrecks and submerged aircraft at Chuuk were involved in World War II and are discussed in more detail in Chapter 6.

2.3 Environmentally responsible behaviour

Human behaviour and the processes that determine it are complex, and consequently difficult to accurately predict (Brown, Ham, & Hughes, 2010; Cottrell & Graefe, 1997; Hines, Hungerford, & Tomera, 1987). Environmentally responsible behaviour refers to behaviour that supports the protection of the natural and built environment, and includes actions that lead to the sustainable use of the environment (Halpenny, 2010; Lee, Jan, & Yang, 2013; Steg & Vlek, 2009). Understanding the factors influencing environmentally responsible behaviour can be important in reducing recreationists' impacts on the environment, and is relevant to dive heritage tourism (Bamberg, 2013; Hines et al., 1987).

A range of socio-demographic variables have been found to affect behaviour, including, age (Yagil, 1998), gender (Hudgens & Fatkin, 1985; Lonczak, Neighbors, & Donovan, 2007; Yagil, 1998), ethnicity and nationality (Baas, Ewert, & Chavez, 1993; Pizam & Sussman, 1995). Other factors that can shape recreation and leisure behaviour, include place attachment (see for example, Halpenny, 2010; Ramkissoon, Smith, & Weiler, 2013) and recreation specialisation (see for example, Anderson & Loomis, 2011; Ditton, Loomis & Choi, 1992; Ditton & Oh, 2008). However, these factors are not always considered reliable predictors of behaviour (Cottrell & Graefe, 1997).

Determining the factors that enable environmentally responsible behaviour to be forecast is complex and multifaceted (Cottrell & Graefe, 1997; Hines et al., 1987). It is understood to be largely driven by a combination of self-interest, and concern for protection of the environment for present and future generations (Bamberg & Möser, 2007).

Other factors which are said to shape environmentally responsible behaviour include exposure to environmental issues through recreational experience, and level of knowledge and concern about environmental issues (Ballantyne, Packer, & Falk, 2011; Blake, 2001; Brown et al., 2010; Cottrell, 2003; Cottrell & Graefe, 1997; Ham et al., 2008; Roggenbuck, 1992). It is important for heritage managers to understand the factors that shape environmentally responsible behaviour because it strongly affects the impact recreationists have on the environment where their activity is carried out (Roggenbuck, 1992).

Over the past two decades two models have been primarily applied to studies aimed at predicting or influencing environmentally responsible behaviour, the theory of planned behaviour and the norm activation model. Both have had varying levels of success in predicting behaviour (Bamberg, 2013; Hines et al., 1987).

2.3.1 Theory of planned behaviour

In general terms, the theory of planned behaviour posits that an individual's intention to perform a given behaviour can predict their behaviour. Three factors determine intention: attitude, subjective norm and the extent of perceived behavioural control.

An individual's attitude refers to the '…degree to which a person has a favorable or unfavorable evaluation of the behavior in question', subjective norm '…refers to the social pressure to perform or not to perform the behavior' and perceived behavioural control refers to the '…perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles' (Ajzen, 1991, p. 188). This model is favoured by researchers who consider self-interest as the more influential driver of environmentally responsible behaviour (Bamberg & Möser, 2007).

The theory of planned behaviour has been applied to the study of the behaviour of scuba divers. Apps, Lloyd and Dimmock's (2014) study of divers in Australia applied the theory to gain an understanding of diver beliefs regarding approaching grey nurse sharks (*Carcharias taurus*). This study found the divers' decision about approaching these sharks was influenced by their perceptions of the opinions of other divers. In a similar study, Apps, Dimmock and Lloyd (2015) applied the theory of reasoned action, which the theory of planned behaviour was developed from, to diver beliefs about approaching grey nurse sharks. A key finding of this study was the willingness of participants to comply with dive staff, indicating that dive staff can play an important role in communicating and encouraging divers to engage in appropriate behaviours. A key finding of Ong and Musa's (2011) study of divers in Malaysia was that the theory of planned behaviour was a useful starting point for understanding and measuring environmentally responsible diver behaviour. However, each of these studies were based on self-reported intentions, therefore it is not known how, or if, the findings may relate to actual diver behaviour.

2.3.2 Norm activation model

Researchers who consider pro-social norms (i.e. concern for protection of the environment for present and future generations) the primary driver of pro-environmental behaviour tend to use the norm-activation model as their theoretical framework (Bamberg & Möser, 2007). The key principle of the norm activation model is that moral or social norms determine pro-social behaviours (Bamberg & Möser, 2007). Norms can be described as '…standards that individuals use for evaluating activities, environments, or management proposals as good or bad, better or worse' and '…define what people think behavior and conditions should be' (Vaske & Donnelly, 2002, pp. 256-257). Norms influence behaviour through sanctions and obligations. Sanctions are rewards or punishments, and can be formal or informal.

Examples of rewards include medals (formal) or an approving look (informal), while examples of punishments include jail (formal) or a disapproving look (informal) (Heywood, 1996b).

Norms operate at a number of levels from individual to group, community and societal, and act to control behaviour by maintaining conformity and preventing non-conformity (Heywood, 1996a, 1996b). Normative research can provide a framework for understanding the behaviour of participants in outdoor recreation, and this model has made an important contribution to the understanding of behaviour in outdoor recreation (Heywood, 1996a, 1996b; Heywood, Manning, & Vaske, 2002).

Normative research has been applied to the study of the behaviour of scuba divers. Anderson and Loomis's (2011) study of divers in the United States and Salim, Bahauddin and Mohamed's (2013) study of divers in Malaysia applied normative research to diver specialisation (section 2.4). Ong and Musa's (2011) study of divers in Malaysia applied norm activation theory to gain an understanding of environmentally responsible diver behaviour. This study found personal norms (an individual's personal beliefs about whether acting in a certain way was right or wrong) to be the major influence on whether divers engaged in contact behaviours. In this study, contact behaviours included touching, standing and holding onto coral, as well as feeding marine life. The study also found subjective norms, which refer to the influence of others on the diver (e.g. dive guides, dive buddy, family and friends), were mediated by personal norms, and there was a positive relationship between personal and subjective norms. However, this study was based on self-reported behaviour and it is not known whether there is a relationship between these findings and actual diver behaviour.

2.4 Recreation specialisation and scuba diving

2.4.1 Recreation specialisation theory

The concept of recreation specialisation was first described by Bryan (1977), who recognised that participants within a recreational activity were not homogenous. Their level of development, or specialisation, in the activity affected their preferences and behaviour. Bryan (1977, p. 175) defined recreation specialisation as '…a continuum of behavior from the general to the particular, reflected by equipment and skills used in the sport and activity setting preferences'. The highly specialised and committed recreationists are at one end of the spectrum and those with more generalist interests at the other. A key implication of Bryan's (1977) recreation specialisation model was that managers should take recreation specialisation into account when managing recreationists.

Although Bryan's (1977) initial conceptualisation of recreation specialisation was based on a study of trout fishers in the United States, it was intended as a conceptual framework that could be applied to other recreational activities. Indeed, recreational specialisation theory has evolved since Bryan's (1977) initial work, and has been applied to a variety of outdoor recreational activities across a wide range of settings. These activities include bird watching, boating, camping, canoeing and white water rafting, fishing, hiking, hunting, rock climbing and scuba diving (Anderson & Loomis, 2011; Hawkins, Loomis, & Salz, 2009; Scott, 2012). It has also been applied to heritage tourism (Kerstetter, Confer, & Graefe, 2001).

For any given recreational activity there is variation among participants, including their characteristics, motivations, preferences and behaviour (Scott, 2012). This within-activity heterogeneity of recreationists presents challenges for managers seeking to balance the provision of high quality recreational experiences with protection of the environment where the activity is carried out (Oh & Ditton, 2006). Recreation specialisation theory places recreationists participating in the same activity into meaningful sub-groups based on their level of specialisation. The attitudes, characteristics, preferences, motivations and behaviour of these sub-groups are then examined (Hawkins et al., 2009; Salz, Loomis, & Finn, 2001). This approach is in contrast to the more traditional approach of collecting data about participants of a recreational activity, aggregating them, averaging the result, then managing participants as a homogenous group based on the average participant (Ditton et al., 1992; Hawkins et al., 2009; Salz & Loomis, 2005; Young & Loomis, 2010).

Understanding the diversity within recreational user groups is advantageous for managers because management decisions based on the average participant are likely to overlook the needs of many in the group (Salz & Loomis, 2005). When managers understand the range of motivations, attitudes, behaviour and preferences within recreational groups they are able to gain a better understanding of the range of needs and likely acceptance of management strategies. As a result, managers are better placed to develop more robust and successful management strategies (Bentz, Lopes, Calado, & Dearden, 2016; Salz & Loomis, 2005).

Different participants in a given recreational activity derive and seek different benefits from the activity. Recreation specialisation theory predicts these variations to occur based on their level of specialisation (Anderson & Loomis, 2011; Ditton et al., 1992; Hawkins et al., 2009; Scott, 2012; Scott, Ditton, Stoll, & Eubanks, 2005; Thapa, Graefe, & Meyer, 2005; Virden & Schreyer, 1988). As the level of specialisation rises, setting preferences, attitudes, values, beliefs and techniques used may change (Thapa et al., 2005).

Recreation specialisation theory predicts that as the level of specialisation increases, the level of dependency on specific resources, for example a favoured dive site, also increases. This is because the more highly specialised participants place more importance on non-activity specific elements of the experience, while less specialised participants place more importance on activity specific elements. Support for more restrictive regulations and conservation is predicted to increase with increasing levels of specialisation (Bryan, 1977; Ditton et al., 1992; Oh & Ditton, 2006; Salz & Loomis, 2005).

Recreation specialisation theory also predicts that highly specialised recreationists will have higher levels of awareness of the potential impacts of their activity and support for management actions aimed at mitigating these impacts. This support will occur even though the management actions may reduce their freedom, which is an important facet of enjoyment of recreational activities (Sorice et al., 2009).

Studies have found correlations between behaviours, attitudes and support for management rules associated with level of recreation specialisation. Acceptance and support for rules and norms associated with an activity have been found to increase with increasing levels of specialisation. This occurs even though these management actions may reduce the recreationists' freedom. More highly specialised recreationists have been found to demonstrate more concern for environmental issues and place more importance on the protection of natural settings. This is most likely because these participants want to be able to continue to have high quality experiences when undertaking their recreational pursuit, and have a better understanding of the potential impacts of the activity than less specialised participants (Ditton et al., 1992; Scott et al., 2005; Sorice et al., 2009; Thapa et al., 2005; Thapa, Graefe, & Meyer, 2006).

2.4.2 Recreation specialisation and scuba diving

Recreation specialisation has been used to study scuba divers. Studies of recreation specialisation and scuba diving have used different methods to determine participants' level of specialisation. Some studies relied on self-classification by participants (Bentz et al., 2016; Salim et al., 2013; Sorice et al., 2009; Todd, Cooper, & Graefe, 2001). Other studies have used a recreation specialisation index to determine participants' level of specialisation from their responses to a series of questions based on orientation, experience, relationships and commitment to the activity (Anderson & Loomis, 2011; Paterson & Loomis, 2010; Young & Loomis, 2010). Another approach, similar to the recreation specialisation index, is based on the scoring of responses to a range of questions, such as level of experience, certification level, frequency of participation, enduring involvement, dive gear owned, other locations visited for diving and ownership of marine species identification guides (Dearden, Bennett, & Rollins, 2006; Thapa et al., 2005, 2006).

The studies of recreation specialisation in scuba diving have had mixed results in relation to their consistency with recreation specialisation theory. Studies which demonstrated consistency with recreation specialisation theory include Thapa et al.'s (2005, 2006), Young and Loomis' (2010), Paterson and Loomis' (2010), and Anderson and Loomis' (2011) studies of divers in Florida, United States; Salim et al.'s (2013) study of divers in the Perhentian Islands, Malaysia; and, Dearden et al.'s (2006) study of divers in Phuket, Thailand. Although Anderson and Loomis' (2011) and Salim et al.'s (2013) studies were consistent with the theory, the magnitude of differences between levels of specialisation were small regarding environmentally responsible behaviours.

Bentz et al.'s (2016) study of divers in the Azores, Portugal, had mixed findings, with some being consistent with the theory and others not. The findings of other studies have been inconsistent with recreation specialisation theory. These include Todd, Cooper and Graefe's (2001) study of divers in the Great Lakes region of the United States, and Sorice et al.'s (2009) study of divers in Texas, United States.

2.4.2.1 Studies consistent with recreation specialisation theory

Thapa et al.'s (2005, 2006) studies of divers in Florida found highly specialised divers had more marine-based environmental knowledge and higher levels of self-reported environmentally responsible behaviour than the less specialised divers. Further, recreation specialisation was found to have a stronger influence on environmentally responsible behaviours than the divers' level of environmental knowledge. Thapa et al.'s studies found recreation specialisation was a strong predictor of environmentally responsible diving behaviours, and useful for understanding these behaviours.

Young and Loomis' (2010) study of divers' ability to perceive reef condition in the Florida Keys found highly specialised divers were better able to determine changes in reef condition associated with ecological health, and found lower quality reef conditions less acceptable than less specialised divers. These findings suggest that more specialised divers have more specific resource requirements, and therefore higher levels of resource dependency than less specialised divers. Paterson and Loomis' (2010) study of divers in the Florida Keys found more specialised divers had higher levels of resource dependency and were more likely to comply with rules and regulations.

Anderson and Loomis' (2011) study of divers in the Florida Keys found divers with higher levels of specialisation were more supportive of the types of environmentally responsible behaviours that would ensure that diving can continue on coral reefs than did less specialised divers. However, the differences between specialisation levels were not as distinct as expected. Salim et al.'s (2013) study of divers in Malaysia found that the more highly specialised divers were more aware of, and engaged less in, unacceptable self-reported behaviours such as touching corals than the less specialised divers. However, the differences between the levels of specialisation were small.

Dearden et al.'s (2006) study of divers in Phuket, found an understanding of diver specialisation useful for managing diver impacts on coral reefs. This study found divers are not a homogenous group, and differences in motivations, characteristics and satisfaction were correlated with their level of specialisation. Less specialised divers were more interested in increasing their knowledge and diving skills, easy dive conditions, good visibility, and the non-dive characteristics of a location, such as good weather. In contrast, the characteristics of the actual dive were more important to the highly specialised divers. As level of specialisation increased, seeing particular marine life and special underwater features, and opportunities for underwater photography increased in importance. The study also found that divers with lower levels of specialisation had less specific requirements that could be easily met at most locations, while the more highly specialised divers had more specific requirements, particularly in relation to seeing specific marine life and opportunities for underwater photography.

Significantly, Dearden et al. (2006) also found that generally, the more specialised divers have less impact on the marine environment than less specialised divers. The study recommended that sites be managed in a way that does not exclude the highly specialised divers when controlling or restricting access to sites. This is an important consideration because it gives the more highly specialised divers access to sites with high biodiversity, which they are dependent on, and ensures that the divers with the lowest resource requirements do not damage higher quality sites. This study highlights the need for managers to provide a range of dive opportunities to cater to all levels of diver specialisation.

2.4.2.2 Studies with mixed findings with respect to recreation specialisation theory

Bentz et al. (2016) study of divers in the Azores, Portugal, examined the influence of diver specialisation on motivations. The study found a link between motivations and specialisation. The more highly specialised divers were motivated to see sharks and manta rays, and underwater geological formations (e.g. arches, caves and seamounts), and preferred sites that were undamaged, unpolluted and not crowded. In contrast, the less specialised divers were more motivated to develop their knowledge and skills, and by adventure, spending time with family and friends, good visibility, seeing a diverse range of marine life and easy diving conditions. This study found that diver motivations were largely consistent with recreation specialisation theory, with the exception of leaning more about biodiversity and spending time with family and friends (social dimension of diving), and the authors considered that these variations may be influenced by the destination.

2.4.2.3 Studies inconsistent with recreation specialisation theory

Contrary to recreation specialisation theory, Todd et al.’s (2001) study of divers in the Great Lakes region of the United States found more highly specialized divers were less supportive of invasive management controls than the less specialised divers. The more specialised divers also considered touching and removing artefacts acceptable, while the less specialised divers did not. This was attributed to more specialised divers wanting to take responsibility for their own behaviour. It was also suggested that it may be due to the more specialised divers having experienced the implications of these rules, whereas it was a more hypothetical situation for the less specialised divers.

Similarly, Sorice et al.’s (2009) study of divers in Texas found highly specialised divers were less supportive of marine protected area management restrictions than less specialised divers. Support for management controls aimed at protecting the marine environment were expected to increase with increasing levels of diver specialisation, consistent with recreation specialisation theory. Sorice et al. suggested this may be because more highly specialised divers have higher levels of skill and awareness of impacts that enable them to minimise their impacts, and did not want their leisure experience controlled (i.e. wanted behavioural freedom in their activity). The management controls examined by this study directly affected freedom of participation and access to sites by divers.

Another explanation for the inconsistency between Sorice et al.’s (2009) study and recreation specialisation theory may be due to scuba diving being a self-regulated activity. As such, behavioural ethics are largely communicated to divers during diver training courses, rather than through government regulations, and may be a factor influencing highly specialised divers opposition to government regulations. It may also be because of the higher levels of resource dependency of more specialised divers. Any management controls that prevent or restrict access to specific dive sites are likely to affect more highly specialised divers who are more dependent on specific sites than less specialised divers. Other recreation specialisation studies have focused on the regulation of consumptive behaviours, for example fishing, and management actions supported have been reduced takes or other harvest-related restrictions that did not impinge on their freedom of access (Sorice et al., 2009).

Consistent with Todd et al.’s (2001) and Sorice et al.’s (2009) studies, Edney & Spennemann’s (2014, 2015) study of Australian wreck divers found that level of specialisation (dive experience and training) influenced wreck diver attitudes towards management controls. The more specialised wreck divers had significantly less support for management controls to protect shipwrecks than less specialised wreck divers. The findings of this study indicated that although wreck divers are a group of special interest divers, there is also heterogeneity within this group related to level of specialisation.

2.4.3 Application of recreation specialisation to recreation management

More effective policy development and decision-making can be achieved when managers understand stakeholder attitudes, motivations and behaviours (Salz & Loomis, 2005). However, often policies and management strategies that affect recreation activities, or are targeted at managing the impacts of recreational activities, treat participants of each recreational activity as a homogenous group. This approach can result in lack of acceptance and support for management rules, because participants have been disenfranchised due to their needs and aspirations being overlooked (Oh & Ditton, 2006; Salz & Loomis, 2005).

However, the studies of recreation specialisation and scuba divers outlined above have relied on self-reported behaviour, and it is not known how this correlates with actual diver behaviour. Nonetheless, recreation specialisation theory provides a useful framework for predicting and better understanding environmental attitudes, behaviour, motivations, and the physical, social and managerial setting preferences of participants of recreational activities (Bryan, 1977; Ditton & Oh, 2008; Hawkins et al., 2009; Oh & Ditton, 2006; Scott et al., 2005; Thapa et al., 2005; Virden & Schreyer, 1988). Policies and management strategies which address the variability in behaviours, motivations, preferences and attitudes that occur between recreationists with different levels of specialisation management strategies can be more effective. This is because they are able to achieve higher levels of acceptance and support, and in turn compliance (Oh & Ditton, 2006; Sorice et al., 2007).

2.5 Common-pool resources

Hardin's (1968) article 'The tragedy of the commons' stimulated much discussion and debate within the natural and social sciences, and still holds relevance today (Dietz, Dolšak, Ostrom, & Stern, 2002). Hardin used the example of a grazing common to illustrate the 'tragedy'. In general terms, Hardin was describing the problem that can occur when a natural resource is not owned by an individual and is open to all members of a community. In this context, individuals act as rational beings, in self-interest, and seek to maximise their short-term gains from the resource. Further, individuals do not invest in improvement of the resource. The tragedy that occurs in these situations is over-exploitation and degradation of the natural resource, and the negative effects of this use by individuals is spread to the broader community. The concept has been applied more widely than the natural resource context it was originally situated in, including tourism and cultural heritage (see for example, Briassoulis, 2002; Gonzalez, 2014; Healy, 1994; Moore & Rodger, 2010; Zhang, 2010), although there are considerably fewer examples in the literature from these fields compared to natural resource management (Briassoulis, 2002).

The intellectual interest and debate that occurred around concept of commons described by Hardin (1968) has seen the concept evolve and be refined in the decades following. Today the term 'common-pool resources' is more widely used, as Hardin's (1968) 'tragedy' was more accurately an issue of common property (Dietz et al., 2002). A common-pool resource can be defined as '…a valued natural or human-made resource or facility that is available to more than one person and subject to degradation as a result of over use' and '…for which exclusion from the resource is costly and one person's use subtracts from what is available to others' (Dietz et al., 2002, p. 18).

The ocean is a good example of a common-pool resource. It has been subjected to extractive overuse and used as a sink for disposal of pollutants (Dietz et al., 2002). Cultural heritage has also been described as a common-pool resource, as it is often a public resource, is subject to degradation, and subtractability can occur due to use and overuse. For example, congestion, crowding and removal of artefacts from a site (Gonzalez, 2014; Zhang, 2010). Therefore, underwater cultural heritage too can be considered a common-pool resource, and needs to be managed to prevent the tragedy described by Hardin (1968).

When divers remove artefacts from sites, or disturb sites when searching for items, they are optimising their own short-term gains at the expense of other divers, and the loss is shared by the diving community, and by humanity at a larger scale. Indeed, Sorice et al. (2009) have suggested that highly specialised divers' lack of support for management rules aimed at protecting a marine protected area may be attributed to the divers acting in self-interest. The divers may have been seeking to maximise their short-term gains in their use of a common-pool resource. This is a possible explanation, and should be taken into account when considering the management of sites visited by scuba divers. It has particular relevance to the removal of artefacts from wreck sites by divers.

2.6 Voluntary compliance with rules

The costs of surveillance and enforcement are high in in marine environments (Smith & Anderson, 2004), and the location of underwater sites can make monitoring of them challenging. Their location means they are generally out of sight from managers and the community (Edney, 2016; Edney & Spennemann, 2014, 2015; McKinnon, 2015; Scott-Ireton & McKinnon, 2015). Perceptions of benefits and disadvantages also play an important role in an individual's decision to comply with rules. Levels of compliance are generally lower when fear of being caught and prosecuted are low (Stern, 2008). Therefore, it is advantageous for heritage managers to develop management strategies that can attain high levels of voluntary compliance because they will be more effective in achieving their aims. To achieve this, managers need ways of encouraging voluntary compliance and incorporate these considerations when developing management strategies (Edney, 2016; Smith & Anderson, 2004; Stern, 2008).

An effective and simple way to encourage high levels of voluntary compliance is to explain the reasons rules are in place, and to educate divers about the effects of non-compliance on wreck sites they enjoy visiting (Gramann, Bonifield, & Kim, 1995; Lucas, 1983; Sirakaya, 1997). This would require educating divers about the consequences of non-compliance on the recreational and cultural heritage values of the wreck, and their continued enjoyment of the wreck as a dive site. An understanding of consequences can motivate divers to comply with rules to protect a site (Edney, 2016).

Managers are able to achieve greater levels of voluntary compliance with rules when both management and the rules are perceived to be necessary, justifiable, legitimate and fair (Read, West, Haste, & Jordan, 2011; Smith & Anderson, 2004; Stern, 2008). Other key factors in achieving voluntary compliance are legitimacy and trust. Legitimacy involves perceived procedural and distributional fairness. Perceptions of fairness are based on the equitability managers' exhibit when implementing rules and discretionary powers. Honesty, quality of decisions, ethics, equitable treatment, representation, and respectful communication between managers and recreationists are linked to perceptions of fairness, and in turn acceptance of the need for management controls and the motivation to comply with these controls (Hønneland, 2000; Stern, 2008; Sunshine & Tyler, 2003). Access to sites is also important, in particular, enabling visitors access to high quality experiences at heritage sites because these visitors are more supportive of, and compliant with, management rules (Hall & McArthur, 1996).

There are three key reasons heritage managers should aim to achieve high levels of voluntary compliance with management strategies. First, is due to the difficulty of monitoring underwater cultural heritage sites because of their location, the high cost associated with monitoring these sites, and the logistical challenges associated with monitoring them (Edney, 2016; Edney & Spennemann, 2014, 2015; McKinnon, 2015). Second, greater levels of voluntary compliance means management strategies will be more effective, and they can also be more efficient because higher compliance means fewer resources are required to implement them. The third reason relates to good recreation management. Freedom is a particularly important element of leisure and recreation, and less invasive management at sites usually results in higher quality recreation experiences (Edney, 2016; Lucas, 1983; Manning, 1999; Sorice et al., 2009).

2.7 Concepts central to this study

A key purpose of this study is to provide data that can assist heritage managers in developing and implementing more robust and effective management policies and strategies to protect underwater cultural heritage sites visited by divers, and enable divers to continue to enjoy high quality diving experiences at these sites. All of the concepts related to visitor behaviour discussed in sections 2.3, 2.4, 2.5 and 2.6 have relevance to understanding and influencing diver behaviour at underwater cultural heritage sites. As discussed in section 2.6 above, management of these sites can be challenging due to their location. This is because of the high costs of monitoring and surveillance, the logistical challenges associated with monitoring and surveillance, and because they are not visible to managers and the public (Edney, 2016; Edney & Spennemann, 2014, 2015; McKinnon, 2015; Scott-Ireton & McKinnon, 2015; Smith & Anderson, 2004).

A focus on maximising voluntary compliance with management rules is a practical, if not essential, approach to effectively managing underwater cultural heritage sites because it can help to overcome some of the management challenges associated with their location. Voluntary compliance offers a sustainable and cost effective approach to site management. Therefore, this study focuses on understanding divers and providing managers with information, based on empirical data, which can optimise voluntary compliance with management objectives and rules. This approach also has benefits for divers, as well as businesses and individuals dependent on the revenue generated by dive tourism at these sites. More sustainable diving practices at sites means more sustainable economic values for those reliant on the revenue generated by dive tourism at these sites. A benefit to divers, with flow on effects to the dive industry, is that a heavier reliance on voluntary compliance by managers provides a higher level of recreation freedom for divers (Lucas, 1983; Manning, 1999; Sorice et al., 2009), and therefore higher quality diving experiences.

Gaining an understanding of diver attitudes to management controls is an important aspect of achieving high levels of voluntary compliance with management objectives because it allows managers to understand which management controls are likely to be supported or opposed. Management controls supported by divers are likely to achieve higher rates of voluntary compliance. Heritage managers may avoid the use of management controls not supported by divers, or if used could better explain and justify their use to gain support, and therefore higher levels of voluntary compliance.

Understanding diver motivations is also important because it enables managers to understand the types of experiences divers are seeking, and their aspirations, which can be taken into account when developing management strategies to protect underwater cultural heritage. It also allows managers to better appreciate the effect of management decisions on diver needs and aspirations. Empirical data on wreck diver behaviour is also essential because it enables management strategies to be targeted at actual, rather than assumed, diver behaviour. This is also beneficial because it is more likely to achieve heritage management objectives for sites.

Additionally, higher levels of acceptance and support for underwater cultural heritage management policies and strategies are possible when the heterogeneity of the divers visiting these sites is taken into account (Oh & Ditton, 2006; Sorice et al., 2007). Management decisions based on an average participant can result in the needs and preferences of many in the group being overlooked, and can disenfranchise those overlooked. Those disenfranchised by management controls are also less likely to support protection of sites, and this may also lead to less political support for the management of underwater cultural heritage. Recreation specialisation, therefore, provides a useful framework for predicting and understanding motivations and management preferences because it deals with the variation within recreational user groups (Ditton et al., 1992; Ditton & Oh, 2008; Hawkins et al., 2009; Salz & Loomis, 2005). Although wreck divers may be considered a special interest group of scuba divers it is expected, consistent with recent studies of wreck divers, that within this group there will be differing levels of specialisation (see Edney, 2011b, 2012a; Edney & Spennemann, 2014, 2015).

2.8 Chapter summary

Heritage is important to individuals and society because of the role it plays in adding perspective and meaning to our lives, and defining individual and community identity. It also provides us with access to the past and a connection with history. Heritage is a culturally constructed concept and set of values, and as such, the value and importance ascribed to it differs between individuals and groups, and through time. Heritage is essentially things from the past we want to retain for present and future generations, and Western cultures generally compartmentalise heritage as either natural or cultural heritage. Cultural heritage is heritage resulting from human processes and activities, and is finite and non-renewable. The focus of this research is concerned with the enhanced integration of divers and underwater cultural heritage, which is an environmentally defined component of cultural heritage.

In addition to the discussion on heritage, this chapter also outlined and discussed factors that can influence diver behaviour at underwater cultural heritage sites. Environmentally responsible behaviour was discussed, and is relevant to this research because it can be increased through recreational experience, which is pertinent to the behaviour of wreck divers. The discussion of environmentally responsible behaviour included an outline of two theoretical models often used to predict environmentally responsible behaviour, the Theory of Planned Behaviour and Norm Activation Theory. However, these models were not used in this research because their application to actual behaviour is not known. Recreation specialisation theory and its application to scuba diving was discussed, particularly with respect to understanding the diversity of behaviour and preferences within the wreck diving community. Behaviour related to common pool resources was briefly discussed, as it has relevance to diver behaviour, particularly depreciative behaviour, where divers act in self-interest to maximise their short-term gains at the expense of other divers.

The chapter concluded with a discussion of voluntary compliance and its relevance to the challenges associated with managing underwater cultural heritage. Achieving high levels of voluntary compliance with management rules benefits heritage managers because it results in more effective management strategies that are more sustainable and less costly to implement. Benefits also flow to divers, as it results in higher quality diving experiences. Therefore, this study seeks to provide heritage managers with information, based on empirical data, which can optimise voluntary compliance with management objectives and rules.

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Chapter 3 – Recreational scuba and wreck diving

3.1 Introduction

This chapter begins with a brief description of the history of recreational scuba diving. This is followed by a description of the range of opportunities available to recreational divers and the factors that attract people to diving. An overview of the recreational diving literature and the key themes are presented, followed by a review of the literature pertaining to wreck divers. The review of wreck diver literature includes a discussion of the current state of knowledge, including wreck diver characteristics, motivations and attitudes, and gaps in this literature are identified.

3.2 Scuba diving as recreation

3.2.1 Brief history of recreational scuba diving

The term ‘scuba’ is technically an acronym for ‘self-contained underwater breathing apparatus’, but today is widely used as a noun because it is so well known. Scuba diving involves the use of a portable air supply (i.e. independent of surface supply) to remain underwater for extended periods of time (Garrod & Gössling, 2008; Lew, 2013). Recreational scuba diving refers to scuba diving that is undertaken as a leisure or recreational activity, and does not include, for example, commercial diving, military diving, public safety diving or scientific diving. Further, for the purposes of this study, recreational diving includes the use of traditional open circuit scuba equipment as well as semi-closed and closed circuit rebreathers, and using air, enriched air and mixed gases. It also includes a wide range of special interest types of diving, such as altitude, cave, deep, drift, ice, night, photography and videography and wreck diving.

Recreational scuba diving began in the mid-1940s when equipment became more readily available, affordable and reliable. The refinements made to the demand valve regulator by Jacques-Yves Cousteau and Emile Gagnan in 1943 made a significant contribution to this advancement (Dimmock, 2007; Dimmock & Cummins, 2013). Although Cousteau and Gagnan are often credited with inventing the single hose demand regulator used by recreational divers today, this was not the case. The regulator Cousteau and Gagnan refined was a twin hose regulator. The single hose regulator was actually invented by an Australian, Ted Eldred, in the 1940s. This regulator was called the 'Porpoise', and was produced commercially in Australia during the 1950s. The Porpoise came to international attention when it featured in Arthur C Clark's 1956 book 'The Coast of Coral' about the Great Barrier Reef in Australia. However, Eldred was not able to afford to patent his design. Eldred's company was purchased, and the Porpoise was patented, by the French company Le Spirotechnique and the single hose regulator rose to prominence (Maynard, 2002; Walters, Williams, Brown, & Gregory, 2009).

Along with the advances made in the safety and affordability of equipment, popular culture also had a significant role in developing public interest in recreational scuba diving, and the underwater environment. The release of television documentaries, movies and books by pioneers, such as Hans and Lotte Haas, and Jacques-Yves Cousteau and others, created international interest (Dimmock & Cummins, 2013; Garrod & Gössling, 2008). The United States based magazine *Skin Diver*, which was first released in the 1950s, also played an important role. It was the first magazine with a diving focus. *Skin Diver* had a wide audience in the past and is still widely read today. Magazines continue to play an important role in the promotion of scuba diving destinations, and it is estimated that there are now more than 60 scuba diving magazines available globally (Dimmock & Cummins, 2013).

In order to participate in recreational scuba diving, divers must first gain a dive certification (often referred to as a c-card). The dive industry is self-regulated and comprised of a number of independent, predominantly private sector, diver certification agencies. These certification agencies may be international or nationally based. The international agencies provide divers with internationally recognised certifications, which allow them to dive anywhere throughout the world.

The main international recreational diver certification agencies are the British Sub Aqua Club (BSAC), Confédération Mondiale des Activités Subaquatiques (CMAS, also known as the World Underwater Federation), National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI), Scuba Diving International (SDI) and Scuba Skills International (SSI) (Johansen, 2013; Lew, 2013). The certification organisations set the curricula for diver training programmes and standards for diver certifications, and member dive centres and instructors operate under their rules and standards. Dive centres and independent instructors then provide the training and certify divers (Johansen, 2013; Lindgren, Palmlund, Wate, & Gössling, 2008).

From its beginnings in the 1940s, recreational scuba diving did not become widespread until the 1980s. This was due to advances in equipment, particularly weight and ease of use, and training, which made scuba diving more accessible to a broader spectrum of society (Dimmock & Cummins, 2013; Lew, 2013). Recreational scuba diving became so popular that it was considered one of the world’s fastest growing recreational activities during the 1980s and 1990s (Davis, Harriott, MacNamara, Roberts, & Austin, 1995; Tabata, 1992). Today it is a popular and important multi-billion dollar industry (Andy et al., 2014; Edney & Spennemann, 2015; Orams, 1999).

Although diving is popular, and the importance of the industry is recognised, the number of active recreational divers is not known. Estimating the number of active recreational divers is difficult because the dive industry is self-regulated and dispersed, and estimates range from 3 to 28 million (Garrod & Gössling, 2008; Lew, 2013). With the exception of PADI, the diver certification agencies do not provide certification data (Lew, 2013). Therefore, it is not possible to determine exact numbers of divers certified globally. Recently, PADI announced that it had certified its 25 millionth diver (PADI, 2017), and has averaged around 900,000 certifications annually since its beginnings in 1967. These certifications include entry level and continuing education certifications (PADI, 2016), and therefore do not reflect the number of new divers certified. However, they give an indication of the size of the industry. PADI is the world’s largest diver certification agency, and in 2008 was reported to be responsible for certifying 60 percent of divers globally (Lindgren et al., 2008). Therefore, it is possible to estimate global certifications. Based on the assumption that PADI certifications account for 60 percent of global diver certification, the number of certifications issued globally since 1967 can be extrapolated to around 42 million.

3.2.2 The attraction of scuba diving

Recreational divers can explore a range of different underwater environments around the globe, from the polar-regions to the tropics and everything in between. They can dive in salt and fresh water, natural and human created water bodies, and at a range of different altitudes. Potential dive sites include oceans, bays, estuaries, lakes, rivers, springs, sinkholes, caverns, caves, submerged lava tubes, quarries, dams and even flooded mines. Although this means that almost any water body is a potential dive site, many divers are not fortunate enough to live in close proximity to premium diving locations, and must travel to participate in diving. Others travel to enjoy different types of diving experiences, and globally, coral reefs in tropical waters are the most popular diving destinations (Cater, 2009; Lew, 2013; Lindgren et al., 2008).

Scuba diving is considered a form of special interest tourism (Garrod, 2008; Musa & Dimmock, 2013; Tabata, 1992). Today, the size of the dive community is such that dive tourism associated with recreational scuba diving is now a significant and growing component of global tourism. It is particularly important to the economy of many local communities in the Asia-Pacific region (Dimmock, 2007; Dimmock, Cummins & Musa, 2013; Edney, 2012a; Garrod, 2008; Howard, 1999). For the purposes of this study, the term dive tourism refers to divers travelling to a location away from their usual place of residence and spending at least one night away from home to participate in recreational scuba diving (adapted from Garrod & Gössling, 2008).

The immense variety of settings for scuba diving offer divers' great diversity in the experiences they can enjoy (Edney, 2017). This may be to see diverse and abundant biodiversity or particular species, underwater geological formations, such as caverns and caves, or various forms of artificial reefs, such as shipwrecks, aircraft, piers, jetties and other structures. With the vast array of opportunities available it is not surprising that recreational scuba diving is such a popular activity, or that the dive community is an active and mobile one (Cater, 2009; Dimmock & Cummins, 2013; Edney, 2006, 2012a).

The reasons so many people are attracted to scuba diving are numerous and varied. Studies of recreational divers have found the most important factors that motivate people to scuba dive are to see marine life, including a high abundance of marine life (Augustine, Dearden, & Rollins, 2016; Bentz et al., 2016; Dearden et al., 2006; Ditton, Osburn, Baker, & Thailing, 2002; Edney, 2011b, 2012a; Fitzsimmons, 2009; Howard, 1999; Kirkbride-Smith, Wheeler, & Johnson, 2013; Meisel-Lusby & Cottrell, 2008; Musa, 2002; Musa, Sharifah , & Lee, 2006; Pabel & Coghlan, 2011; Tabata, 1992; Todd, Graefe, & Mann, 2002; Uyarra, Watkinson, & Côté, 2009); the social aspects of diving, such as spending time and bonding with friends and family and interacting with like-minded individuals (Bentz et al., 2016; Cater, 2008; Ditton et al., 2002; Fitzsimmons, 2009; Howard, 1999; Lucrezi, Saayman, & van der Merwe, 2013a; Meyer, Thapa, & Pennington-Gray, 2003; Tschapka & Kern, 2013); relaxation and enjoyment of the peace and tranquillity of the underwater environment (Ditton et al., 2002; Fuchs, Reichel, & Shani, 2016; Lucrezi et al., 2013a; Meyer et al., 2003; Shani, Polak, & Shashar, 2011; Todd et al., 2002; Tschapka & Kern, 2013); challenge and adventure (Augustine et al., 2016; Bentz et al., 2016; Dearden et al., 2006; Ditton et al., 2002; Howard, 1999; Meisel-Lusby & Cottrell, 2008; Tschapka & Kern, 2013); and, learning about the marine environment (Apps, Dimmock, Lloyd, & Huveneers, 2016; Augustine et al., 2016; Bentz et al., 2016; Cater, 2008; Dearden et al., 2006; Meyer et al., 2003; Todd et al., 2002).

Other popular reasons for diving are to see underwater geological formations (Bentz et al., 2016; Howard, 1999; Musa, 2002; Tabata, 1992); to have new experiences (Howard, 1999; Meyer et al., 2003); and, to see particular types of marine life including charismatic marine megafauna, such as sharks, rays and turtles (Apps et al., 2016; Augustine et al., 2016; Bentz, Dearden, Ritter, & Calado, 2014; Bentz et al., 2016; Cater, 2008; Fitzsimmons, 2009; Shackley, 1998; Topelko & Dearden, 2005; Vianna, Meekan, Pannell, Marsh, & Meeuwig, 2012), as well as cryptic species, such as pygmy seahorses and other syngnathids, nudibranchs and frogfish (Cater, 2008; Uyarra & Côté, 2007). Factors that increase divers' enjoyment of the diving experience have been found to include lack of crowding (Augustine et al., 2016; Bell, Needham, & Szuster, 2011; Bentz et al., 2016; Bentz, Rodrigues, Dearden, Calado, & Lopes, 2015; Davis & Tisdell, 1995; Tschapka & Kern, 2013; Zhang, Qiu, & Chung, 2015); good underwater visibility (Augustine et al., 2016; Bentz et al., 2016; Dearden et al., 2006; Fitzsimmons, 2009; Howard, 1999; Ince & Bowen, 2011; Kirkbride-Smith et al., 2013; Musa et al., 2006; Pabel & Coghlan, 2011; Tabata, 1992; Uyarra et al., 2009); and, warm water (Dearden et al., 2006; Fitzsimmons, 2009; Musa, 2002, 2003).

Much of what is known about diver motivations, preferences and satisfaction have been derived from quantitative studies. Qualitative studies of divers provide a deeper understanding of recreational scuba divers. These studies have reinforced the importance of the social aspects of diving, learning about the marine environment and good visibility (Cater, 2009; Dimmock, 2009; Kleur & Tribe, 2012). They have also found that other aspects of the dive experience, including physical comfort (often expressed as weightlessness), escape and freedom (Cater, 2009; Dimmock, 2009), skill competence, self-mastery and self-actualisation (Cater, 2009), being in the present moment and solitude (Dimmock, 2009), are important to participants. Interestingly, some qualitative studies have also demonstrated that diving can be both physically and emotionally demanding, and at the same time, relaxing (Cater, 2009; Dimmock, 2009).

Personal growth, development and well-being are other elements of the dive experience. These aspects of diving lead to long-term satisfaction, happiness and eudaimonia (Kleur & Tribe, 2012). Eudaimonia refers to happiness, pleasure, well-being and human flourishing, and differs from hedonism in that the goal of achieving a state of eudaimonia is for personal development and growth, attaining personal excellence and making a positive contribution to other people's lives (Deci & Ryan, 2008; Kleur & Tribe, 2012). In Kler and Tribe's (2012) study, personal growth included environmentally responsible behaviour, feelings of stewardship towards dive sites and the marine environment more generally, and sharing knowledge with and learning from others in the diving community. This study concluded that divers can achieve eudaimonia through their diving experiences, and it can lead to long-term happiness and satisfaction. Similarly, Fuchs et al.'s (2016) study concluded that divers are motivated to achieve eudaimonia.

Studies of divers have shown trends in the demographic and dive experience characteristics of recreational scuba divers. These include the predominance of males, high levels of education (Bentz et al., 2016; Davis, 1997; Ditton et al., 2002; Lucrezi et al., 2013a; Musa, 2002; Musa, Seng, Thirumoorthi, & Abessi, 2010; Thapa et al., 2005; Todd et al., 2001; Tschapka & Kern, 2013), and higher than average income (Anderson & Loomis, 2011; Davis, 1997; Stolk et al., 2005; Thapa et al., 2005; Tschapka & Kern, 2013). Although there are some variations in the age of divers between the different studies, the majority of divers tend to be aged between 35 and 45 years of age (Ditton et al., 2002; Musa et al., 2010; Musa et al., 2006; Stolk et al., 2005; Thapa et al., 2005; Tschapka & Kern, 2013; Uyarra et al., 2009). Some studies have included data on certification and dive experience levels, and although there is variation between studies, the majority of divers had five or less years of diving experience (Davis, 1997; Ditton et al., 2002; Jewell, 2004; Tschapka & Kern, 2013) and held open water or advanced open water dive certifications (Ditton et al., 2002; Jewell, 2004; Musa et al., 2010; Sorice et al., 2007; Stolk et al., 2005; Tschapka

& Kern, 2013). Studies have also revealed that the diving community is not homogenous, and divers vary greatly in their motivations, preferences, attitudes and levels of experience (Bentz et al., 2016; Dearden et al., 2006; Edney, 2012a).

3.2.3 Overview of the recreational diving literature

There is a considerable and growing literature concerning recreational scuba diving. There has been a focus in the literature on tropical coral reef diving and the environmental impacts of this type of diving (Bell et al., 2011; Bentz et al., 2016; Hammerton & Bucher, 2015; Szuster, Needham, & McClure, 2011). It is beyond the scope of this study to review all of the recreational diving literature, however, key examples are and the key themes relating to the research are listed in Table 2.

There is further discussion of relevant existing scuba literature in Chapter 10. Chapter 10 links this literature, particularly the literature relating to diver behaviour, with the outcomes of this research, and discusses similarities and contrasts.

Table 2 Examples from the literature of research into scuba divers

Publication	Theme							Data collected		Research Location
	Impacts[#]	Motivations[+]	Satisfaction, enjoyment, experiences[~]	Behaviour (including ERB[*])	Recreation specialisation	MPA[^]	Economic aspects	Demographics	Dive experience / training	
Anderson & Loomis, 2011; Young & Loomis, 2010			✓	✓	✓			✓	✓	Florida Keys, United States
Apps et al., 2015				✓				✓	✓	South West Rocks, Australia
Augustine et al., 2016		✓	✓		✓		✓	✓	✓	Andaman Coast, Thailand
Barker & Roberts, 2004	✓			✓		✓		✓	✓	Saint Lucia (Caribbean)
Bell et al., 2011			✓			✓		✓		Maui, Hawai'i, United States
Bentz et al., 2016; Bentz et al., 2015		✓	✓		✓			✓	✓	Azores, Portugal
Camp & Fraser, 2012	✓			✓		✓		✓	✓	Key Largo, United States
Cater, 2009		✓	✓			✓		✓	✓	Great Barrier Reef, Australia
Chung, Au, & Qiu, 2013	✓	✓		✓		✓		✓	✓	Hong Kong
Cottrell & Meisel, 2004; Meisel-Lusby & Cottrell, 2008; Meisel & Cottrell, 2004		✓	✓	✓	✓			✓	✓	Florida Keys, United States
Dearden et al., 2006; Dearden, Bennett, & Rollins, 2007		✓	✓		✓				✓	Phuket, Thailand
Dimmock, 2009; Dimmock & Wilson, 2009, 2011			✓					✓	✓	Australia
Ditton et al., 2002; Oh, Ditton, & Stoll, 2008; Thailing & Ditton, 2003		✓	✓			✓	✓	✓	✓	Texas, United States
Edney, 2011b, 2012a; Edney & Spennemann, 2014, 2015		✓	✓					✓	✓	Australia & Chuuk Lagoon, Federated States of Micronesia (FSM)
Ekberg, 2009			✓						✓	Sweden

Table 2 (continued)

Publication	Theme							Data collected		Research Location
	Impacts[#]	**Motivations[+]**	**Satisfaction, enjoyment, experiences[~]**	**Behaviour (including ERB[*])**	**Recreation specialisation**	**MPA[^]**	**Economic aspects**	**Demographics**	**Dive experience / training**	
Fitzsimmons, 2009			✓					✓	✓	Kadavu, Fiji
Fuchs et al., 2016		✓	✓					✓		Israel
Hammerton, 2017a, 2017b; Hammerton & Bucher, 2015	✓			✓		✓		✓	✓	Cape Byron & Solitary Islands, Australia
Holecek & Lothrop, 1980a, 1980b		✓	✓				✓	✓	✓	Great Lakes Region, United States
Kirkbride-Smith et al., 2013			✓					✓	✓	Barbados (Caribbean)
Kleur & Tribe, 2012			✓					✓		England, United Kingdom
Lucrezi et al., 2013a		✓	✓					✓	✓	Sodwana Bay, South Africa
Luna, Pérez, & Sánchez-Lizaso, 2009	✓			✓		✓		✓	✓	Sierra Helada Marine Park, Spain
Medio, Ormond, & Pearson, 1997	✓			✓		✓				Ras Mohammed National Park, Egypt
Meyer et al., 2003		✓			✓			✓	✓	Florida, United States
Musa, 2003			✓					✓	✓	Sipidan, Malaysia
Musa et al., 2006			✓					✓	✓	Layang, Malaysia
Ong & Musa, 2011				✓				✓		Malaysia
Pabel & Coghlan, 2011			✓		✓	✓		✓	✓	Great Barrier Reef, Australia
Poonian, Davis, & McNaughton, 2010	✓			✓		✓				Rock Islands – Southern lagoon area, Palau
Roberts & Harriott, 1995	✓			✓		✓			✓	Julian Rocks, Australia
Roche et al., 2016	✓			✓				✓	✓	Philippines

Table 2 (continued)

Publication	**Theme**							**Data collected**		**Research Location**
	Impacts$^{\#}$	**Motivations**$^{+}$	**Satisfaction, enjoyment, experiences**$^{\sim}$	**Behaviour (including ERB*****)**	**Recreation specialisation**	**MPA**$^{\wedge}$	**Economic aspects**	**Demographics**	**Dive experience / training**	
Rouphael & Inglis, 2001; Rouphael & Inglis, 1997; Rouphael & Inglis, 1995	✓			✓		✓		✓	✓	Great Barrier Reef, Australia
Salim et al., 2013				✓	✓			✓	✓	Perhentian Islands, Malaysia
Schuhmann, Cazabon-Mannette, Gill, Casey, & Hailey, 2013			✓				✓	✓	✓	Barbados & Tobago, Trinidad & Tobago (Caribbean)
Shani et al., 2011		✓	✓					✓	✓	Eilat, Israel
Sorice et al., 2007, 2009			✓		✓	✓	✓	✓	✓	United States
Stoeckl et al., 2010			✓			✓	✓	✓		Great Barrier Reef, Australia
Stolk et al., 2005			✓					✓	✓	Australia
Szuster et al., 2011			✓					✓	✓	Hawai'i, United States
Thapa et al., 2005, 2006				✓	✓			✓	✓	Florida, United States
Tibirica, Birtles, Valentine, & Miller, 2011			✓		✓			✓	✓	Tofo Beach, Mozambique
Todd, 2004; Todd et al., 2001; Todd et al., 2002		✓	✓		✓			✓		New York State, United States
Toyoshima & Nadaoka, 2015	✓			✓				✓	✓	Ryukyu Islands, Japan
Tschapka, 2006; Tschapka & Kern, 2013		✓	✓					✓	✓	New South Wales & Queensland, Australia
Uyarra & Côté, 2007	✓			✓		✓		✓	✓	Bonaire, Netherland Antilles
Uyarra et al., 2009			✓					✓	✓	Bonaire, Netherland Antilles

Table 2 (continued)

Publication	Theme							Data collected		Research Location
	Impacts#	Motivations+	Satisfaction, enjoyment, experiences~	Behaviour (including ERB*)	Recreation specialisation	MPA^	Economic aspects	Demographics	Dive experience / training	
Walters & Samways, 2001	✓			✓					✓	South Africa
Worachananant, Carter, Hockings, & Reopanichkul, 2008	✓			✓		✓		✓	✓	Surin Marine National Park, Thailand
Zakai & Chadwick-Furman, 2002	✓			✓					✓	Eilat, Israel

Note: The studies that have been grouped are those that used the same data sets.

Key:
\# Impacts on the marine environment (natural and cultural) and includes dive industry environmental management, includes self-reported behaviour
\+ Motivations for scuba diving
~ This category also includes attitudes, preferences and crowding
* Environmentally responsible behaviour
^ Study conducted in or about Marine Protected Area(s)

3.3 Wreck diving

3.3.1 Background

As divers' skill and experience levels rise, they tend to seek more diverse and challenging dive experiences, such as wreck diving (Cater, 2008; Edney, 2016). Wreck diving is a specialised type of scuba diving that typically involves the exploration of shipwrecks and submerged aircraft. It can also include the exploration of submerged vehicles, such as train carriages, cars and trucks, and machinery (Edney & Howard, 2013; PADI, 2008a). Wreck divers are considered special interest group of scuba divers.

Globally, wreck diving opportunities are numerous and varied. Shipwrecks and submerged aircraft occur in many different geographic regions, in both marine and freshwater environments (Edney & Howard, 2013). They provide divers with more challenging, unique and diverse diving opportunities (Delgado, 1988b; Edney 2006; 2011b, 2012a, 2016). Consequently, shipwrecks and submerged aircraft have become increasingly popular and important attractions for divers (Delgado, 1988b; Edney, 2006, 2011b, 2012a, 2016). Divers have the option of visiting different types of vessels, such as war ships passenger liners, cargo ships, fishing vessels, and different types of aircraft. They can also see vessels and aircraft of different construction and ages in a range of different environments and depths. Wreck diving gives divers' access to the past and allows them to connect with the history associated with the wrecks. This includes the wrecking event and the people who were associated with the ship and wrecking event (Delgado, 1988b; Edney, 2006; Scott-Ireton, 2005). Experiencing the diverse and abundant marine life that is attracted to shipwrecks are another popular aspect of wreck diving (Edney, 2012a, 2016).

There are some particular wreck diving hotspots popular with wreck divers, due largely to the quality and quantity of wrecks that occur there. These include Chuuk Lagoon in the Federated States of Micronesia, the Graveyard of the Atlantic off the coast of North Carolina in the United States, the Great Lakes in Canada and the United States, and Scapa Flow in the Orkney Islands in the United Kingdom (Edney & Howard, 2013). Divers learn about these destinations through television documentaries, movies, books, social media and the plethora of feature articles in dive magazines. The prolific advertising of dive travel opportunities in dive magazines, diving websites and at dive conferences and shows, also play an important role in the marketing and promotion of these and other wreck diving destinations.

Interest in wreck diving has been increasing in recent decades (Edney, 2016), due to the combined effect of a few different factors. These include improved technology, which has enabled divers to more easily explore wrecks (Hutchinson, 1996), the promotion of wreck diving destinations, and the maturation and growth in the size of the international diving community (Edney, 2016).

The growth in the popularity of wreck diving and the tourism associated with wreck diving is important to the local economies of popular wreck diving destinations in the Asia-Pacific region, such as Chuuk Lagoon in the Federated States of Micronesia, the Solomon Islands and Vanuatu (Drew, 1998; Edney, 2006, 2012a; Howard, 1999; Klint et al., 2012; Panakera, 2007). The growth and importance of dive tourism has seen the development of infrastructure to cater for the increase in visitation to these areas, such as new accommodation and upgrading of airports. For example, the airport at Luganville on Espiritu Santo (Santo) in Vanuatu was upgraded in 2007 from a domestic to an international airport to provide better access for tourism (Vanuatu Investment Promotion Authority, 2018). Santo is one of Vanuatu’s key dive tourism destinations, and the primary dive attraction at Santo is the wreck of the *SS President Coolidge* (Klint et al., 2012).

3.3.2 Overview of the wreck diving literature

In contrast to the now substantial and growing body of knowledge in the literature about scuba divers generally, there is a paucity of literature specific to wreck divers. Until recently, the literature only contained one example of research specific to wreck divers, Holecek and Lothrop’s (1980a, 1980b) study which examined the demographics, behaviour, expenditure patterns and attitudes towards government regulation of underwater resources of wreck divers in the Great Lakes region of the United States. This study found a predominance of young people (63% aged 21-30) and males (86%), with high levels of income. Observing wrecks was overwhelmingly the most important activity to these divers (85%), followed by ‘treasure/trophy’ (30%), photography (27%), and research (19%). There was a high level of support (around 85%) for the need for some level of management controls to prevent items being removed from the wrecks. The highest levels of support were, equally, for a ban on collecting from wrecks in certain areas and a requirement for permits to remove items from wrecks with recreational or historical values.

Almost all (97.6%) of the participants in a survey of Swedish recreational divers were wreck divers (Ekberg, 2009). Although the demographic or dive experience profiles of the divers were not reported, there was some data about the divers' awareness of management controls in place to protect wrecks reported. The majority (84%) of the divers were aware of the legislation in place to protect underwater cultural heritage in Sweden, and importantly, understood the implications of these laws to recreational divers. Interestingly, many of the divers indicated a desire for more information about these laws and appropriate underwater behaviour at underwater cultural heritage sites.

Other more recent studies of wreck divers are Edney's (2012a) study of wreck divers at Chuuk in the Federated States of Micronesia (survey administered in 2009), and Edney's study of Australian wreck divers (survey administered in 2010), reported in Edney (2011b, 2012b) and Edney & Spennemann (2014, 2015). These studies collected data about wreck diver demographics and dive experience, motivations for wreck diving, wreck diver attitudes to a range of management controls commonly used to prevent and mitigate diver impacts to shipwrecks, and opinions and preferences towards artificial reef wrecks. These studies found that wreck divers were predominantly male, middle-aged, with high levels of education and income, and were highly experienced divers. Their primary motivations for wreck diving were to see marine life, historically significant shipwrecks and artefacts, and to enjoy the peace and tranquillity of the underwater environment. Most wreck divers supported management controls, including invasive management controls. These included the use of penalties for taking things from wrecks, the need for permits and special certifications to dive certain shipwrecks, and the use of dive guides to control diver behaviour.

Gender, age, country of residence and level of dive specialisation moderated motivations and attitudes. Seeing marine life was more important to female divers. Searching for artefacts along with the more challenging, technical and mechanical aspects of wrecks, including wreck penetration, exploring machinery and fittings, and the size and complexity of a wreck, were of more importance to male divers. Older and more specialised wreck divers were less supportive of management controls generally, than younger and less experienced divers (Edney, 2011b, 2012a; Edney & Spennemann, 2014, 2015). These results were consistent with Todd et al.'s (2001) study of divers in the Great Lakes Region of the United States, which found the more highly specialised divers were less supportive of invasive management controls. It is also consistent with studies of divers visiting marine protected areas, which found more highly specialised divers less supportive of management controls and in-water supervision by dive guides or divemasters. This suggested that the divers were seeking more behavioural freedom in their activity (Sorice et al., 2009).

The recent wreck diver studies also found that wreck diver attitudes were moderated by country of residence and gender. Divers from North America considered it acceptable to move artefacts around on a wreck site, while Australian's did not. Australian wreck divers had higher levels of support for the use of special certifications and permits than their North American counterparts, and female divers were more supportive of the use of dive guides to control diver behaviour than were male divers (Edney, 2011b, 2012a; Edney & Spennemann, 2014, 2015).

Findings of the recent wreck diver studies demonstrate the heterogeneity that exists within the dive community, even within a special interest group of divers. It highlights the importance of taking into account within group differences. In this case, between genders, the origin of divers, the age of divers, and level of diver specialisation when offering wreck diving opportunities, and when developing management strategies. Each of these variables can affect diver motivations and diver preferences, as well as support for particular types of management controls (Edney, 2011b; Edney & Spennemann, 2014, 2015).

The review of this literature has provided some baseline data that can assist managers when developing management strategies for sites visited by divers. However, it is only a starting point. The recent studies highlight the need for more research to determine the characteristics, motivations and attitudes of a larger sample of the global wreck diving community. In the case of the Asia-Pacific region, there has been a focus on Australian wreck divers, and there is a need to better understand the range of wreck divers visiting underwater cultural heritage sites in the region. There is also an absence of empirical studies of the actual in-water behaviour of wreck divers. Empirical data on wreck diver behaviour is critical information for heritage managers to more effectively manage sites visited by divers.

3.4 Chapter summary

This chapter began with an outline of the history of recreational scuba diving and the relevant scuba diving literature. Recreational scuba diving was defined, for the purposes of this study, as scuba diving undertaken as a leisure or recreational activity, and includes the use of open circuit, semi-closed circuit and closed-circuit rebreathers using air or mixed gases. It began in the 1940s when affordable and reliable equipment became more readily available, but did not become widespread until the 1980s. In the 1980s and 1990s recreational scuba diving was considered one of the world’s fastest growing recreational activities. Although growth of the dive industry has tapered since the 1990s, diving continues to be popular, and the dive industry is large and important globally.

The chapter concluded with a discussion of wreck diving, which is a special interest form of recreational scuba diving. It has seen an increase in interest and demand as the dive industry has expanded and matured, offering divers more diverse and challenging diving experiences than general scuba diving. The wreck diving literature was reviewed and discussed. This review recognises gaps in the literature relating to wreck diver behaviour, and a comprehensive understanding of their motivations and attitudes. This research therefore seeks to contribute to closing these gaps by examining and critiquing wreck diver behaviour, motivations and attitudes.

Chapter 4 – Diver impacts on underwater cultural heritage

4.1 Introduction

This chapter focuses on the potential adverse impacts of recreational diving on shipwrecks, and management approaches used to prevent and mitigate these impacts. It is illustrated with examples from the Asia-Pacific region. Potential diver impacts discussed include those resulting from boat anchor and mooring damage, impairment of site integrity and stability, the effects of intentional and unintentional diver contacts, and exhaled air bubbles. These impacts are managed through a range of regulatory and non-regulatory management approaches used, or available, which are briefly outlined, along with a management framework that combines both approaches. An understanding of diver impacts and the ways in which they may be managed is important background and context for the outcomes of this research.

4.2 Background

The recreation and tourism values of shipwrecks relevant to divers were outlined in sections 2.2.1.2 and 3.3.1. In addition to these values, shipwrecks are also important for their cultural heritage values. The cultural heritage values of shipwrecks were outlined in section 2.2.1.2, and include anthropological, archaeological, historic, cultural and social values. Any disturbance to shipwreck sites can diminish their cultural heritage values and accelerate natural decay processes, including disturbance from human activities. There are a range of human activities that can disturb wreck sites, in particular, anchor damage from large ships, fishing activities, commercial salvage operations, looting by treasure hunters, dredging operations, and marina and port developments (Heritage Office, 1994; Kenderdine, 1997; MacLeod & Richards, 2011; Nutley, 1996).

Use of shipwreck sites by recreational scuba divers can also result in adverse impacts. In the overall scheme of impacts, those caused by divers are relatively minor in comparison to impacts from other human activities. However, with a large and increasing number of divers globally, and the growing interest in wreck diving, consideration needs to be given to the potential impacts associated with wreck diving. The cumulative effects of diver impacts can be acute, and the greatest concern for management where visitation levels are high, or where diver impacts are concentrated (Edney & Howard, 2013). Diver impacts can also combine with other impacts, resulting in higher levels of damage to sites. Although diver impacts are generally of a lower magnitude than other impacts they are able to be controlled, unlike natural events such as storms. Therefore, the mitigation of diver impacts can form an important component of heritage management strategies for shipwreck sites (Edney, 2016).

Drawing on examples from the Asia-Pacific region, this chapter discusses the causes and nature of potential adverse impacts on sites resulting from recreational diving, and the range of management actions used to prevent or mitigate such impacts. As most shipwrecks visited by divers in the Asia-Pacific region are iron shipwrecks in marine environments, this discussion largely focuses on the impacts of divers on the cultural heritage values of these types of shipwrecks. However, much of it is applicable to a wider range of shipwreck sites, and other types of underwater cultural heritage, in particular, submerged aircraft.

Diver impacts on shipwrecks were described by Edney (2006), and largely fall into four categories: boat anchor and mooring damage, impairment of site integrity and stability, the effects of intentional and unintentional diver contacts, and the effects of exhaled air bubbles coming into contact with wrecks (Edney, 2016). This section describes and provides examples of these impacts in the Asia-Pacific region. Table 3 summarises diver impacts, and was originally published in Edney (2016, p. 274).

4.3 Diver impacts on underwater cultural heritage

4.3.1 Boat anchor and mooring damage

Boat anchor damage is a major threat to wrecks, and is associated with a number of human activities, including recreational scuba diving. It is considered to cause higher levels of damage to wrecks than other types of diver impacts (NSW Heritage Office, 2000), and is the most easily managed diver impact. Boat anchor damage can occur when boat anchors and chains are dropped directly onto wrecks, when anchors and chains rub on and drag across wrecks, when anchors are dragged across the seabed to assist in locating a wreck, and when anchors are picked into a wreck (Edney, 2006, 2016). Another way anchors may damage wrecks is from the force exerted by dive vessels attached directly to wrecks by their anchors. Even a small vessel can cause significant levels of damage (NSW Heritage Office, 2000).

Dragging anchors to locate wrecks was a method widely used in the past. It is still in use in some areas, such as at Chuuk Lagoon in the Federated States of Micronesia (Jeffery, 2006), and the researcher has observed this practice at Chuuk as recently as 2014. The impact of anchors and chains, as well as the force exerted by anchor lines, can cause significant structural damage to, and breakage of, the wreck fabric. It can also damage and dislodge protective concretions and marine growth on wrecks, which in turn accelerates corrosion and natural decay processes (MacLeod & Richards, 2011; Viduka, 2011).

Some examples of boat anchor damage include the breakage of the smokestack of the *Fujikawa Maru*, at Chuuk Lagoon, after being hit by the anchor of a dive boat (Hezel & Graham, 1997) and observable physical damage to the *Gosei Maru* (Chuuk Lagoon) from boat anchors (Jeffery, 2006). There has also been observable physical damage to the *SS Yongala* in Australia from boat anchors (Illidge, 1996; Viduka, 2011), and the weakening and deterioration of its superstructure has largely been attributed to boat anchor damage (Cuthill, 1998).

Dive boats tying off to moorings that have been secured directly to wrecks can cause similar damage to that caused by boat anchors. This includes weakening and damage to wreck fabric from the force exerted by the dive vessel pulling on the mooring line, as well as damage to and removal of protective concretions and marine growth from mooring lines and chains chaffing on and dragging across wrecks (Edney, 2016). At Chuuk, moorings have commonly been attached to masts, king posts, lifeboat davits, bollards, and various parts of the superstructure of the wrecks. This practice has also resulted in observable damage to wrecks (Edney, 2006; MacLeod, 2006). Such practices are also common at many other shipwreck sites throughout the Asia-Pacific region and globally.

4.3.2 Impairment of site integrity and stability

In the past, it was common practice for divers to remove artefacts and fittings from wreck sites as personal mementos or souvenirs, and for profit. In Australia, even as early as the 1950s, the impact from divers visiting wrecks and removing artefacts was causing concern in the community and amongst some divers (Edney, 2006; Hosty, 2006).

There has been a substantial shift in diver attitudes and behaviour over the past 20-30 years. There is a growing appreciation and support for the protection of underwater cultural heritage by divers and dive operators. Today, most divers do not remove artefacts from historic shipwrecks (Edney, 2006, 2016; Hosty, 2006; Nutley, 2007). A more common practice is for divers to search for artefacts and move them around on wreck sites. Indeed, McKinnon's (2015) study in Saipan, in the Commonwealth of the Northern Mariana Islands, found that moving artefacts around at Saipan's underwater cultural heritage sites was both the most common and most damaging diver impact. In some cases, artefacts are moved to more accessible locations where they can be more easily viewed by other divers or photographed, or in preparation for their removal (Edney, 2006; Hezel & Graham, 1997; Jeffery, 2007). Figure 2 shows artefacts removed from the holds of the *Sankisan Maru*, at Chuuk, and displayed on the forecastle in shallow water.

Figure 2 **Artefact cluster on the forecastle of the *Sankisan Maru*, Chuuk**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The wrecks at Chuuk have had legal protection since 1971 (Hezel & Graham, 1997; Jeffery, 2004b) and have a high profile locally and internationally. Yet artefacts associated with these wrecks have and are being removed by recreational divers and dive guides, which in turn has greatly reduced the abundance of artefacts that could previously be found on these wrecks (Lindemann, 1991). For example, the *Fujikawa Maru,* one of the most popular wrecks, has had many of its artefacts removed by divers, including crystal glasses and silverware from the bridge, china from all parts of the wreck, a large etched porcelain water filter, medical kits, cooking pots, and a manufacturer's plate from the stern telegraph. Some other notable artefact theft by divers at other sites at Chuuk include pistols and deer antlers from the *Nippo Maru* and brass lanterns and china from the *Shinkoku Maru* (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2006).

Similarly, there are many reports of recreational divers removing artefacts from wrecks in Australia. For example, the wreck of the *SS Yongala*, ranked as one of the world's top 10 dive sites, is one of the most highly visited historic shipwrecks in Australia (Viduka, 2006, 2011). Divers began removing artefacts and fittings from the *Yongala* in the 1950s, such as navigation lamps, a safe, and the propeller (May, 1985; Viduka, 2011). In the past, other artefacts have been moved around the site or have been damaged, including another safe, navigation lamps, portholes and a fan (Cuthill, 1998; Illidge, 1996). The *Yongala* has had legal protection since 1981, and as a result of the active management of diver impacts on this wreck, today damage to the site largely results from natural factors, such as storms (Viduka, 2011).

A range of different techniques have been used by divers to find and remove artefacts at wreck sites. This has included the use of explosives to gain entry into wrecks, break open concretions, or to dislodge artefacts, particularly large artefacts such as anchors and canons (Edney, 2016; Green, 1995; Henderson, 1986; Hosty, 2006; Nutley & Smith, 1992); the use of different excavation techniques, such as airlifts, dredges (Hosty, 2006), propeller blasting and hand fanning; and, the use of various tools to remove artefacts and fittings from wrecks, such as hack saws, crow bars, sledge, claw, ball and chipping hammers. Indeed, with the exception of the use of explosives and dredges, many of these techniques were included in wreck diver training programs during the 1980s (Edney, 2011a, 2016).

Although not common today, as recently as 2011, the researcher has observed divers and dive guides at Chuuk hand fanning silt to search for and observe artefacts, which are then handled and often moved from their original location. Similarly, when diving in Chuuk in 2004, Jeffery (2007) reported observing divers in the hold of the *Unkai Maru No. 6* wreck pushing their hands down into the silt and pulling boots and shoes out. These artefacts were left exposed when the divers had finished looking at them. In 2007, the researcher observed a dive guide extract books and paper magazines from wooden crates that were buried in silt to show them to divers, also in a hold of the *Unkai Maru No. 6*. These objects were subsequently left exposed to environmental factors where they will be subject to accelerated and premature decay.

There are various factors that may motivate divers to remove artefacts and fittings from wrecks or to move them around on wreck sites. First, it may simply be because of the type of artefact that is available, or because it is highly desirable. For example, ships' bells are highly sought after as souvenirs and often one of the first artefacts removed (Edney, 2016). Ships' bells have been removed from all of the wrecks at Chuuk. In 2002, the wreck of the *Sapporo Maru* was located and still had its bell in place. However, within twenty-four hours of the discovery of the bell, the bell had been removed. There was a police investigation and a dive guide was found to have initially concealed it on the site, and later removed it from the wreck. The bell was reputedly held at one of the major dive shops. Although these actions are prohibited under legislation, no action was taken by the police in this matter, beyond interviewing the individuals involved (Jeffery, 2006). The researcher observed the *Sapporo Maru's* bell displayed in the Kimiuo Aisek Memorial Museum at Chuuk in 2014 (see section 6.5.5 for a description of museum).

Second, dive guides and divers may move artefacts and cluster them for a 'better' dive experience, by moving them to a more accessible location or to locations more favourable for viewing and photography (Edney, 2016). The researcher has dived many of the shipwrecks and submerged aircraft at Chuuk, and has observed artefact clusters on many of these sites. This is particularly the case at the more popular sites, where large aggregations of artefacts have been moved around the sites. For example, the *Gosei Maru*, *Sankisan Maru*, and *Shinkoku Maru*. The bridge of the *Shinkoku Maru* has a large artefact cluster, which includes items such as bottles, glassware, china, gas masks, light fittings, door handles and locks (Figure 3). The shallow depth, approximately 14 metres, makes it easily accessible to all levels of divers, and there is better light for photography (Hezel & Graham, 1997). The wreck of the *Saniksan Maru* at Chuuk contains rifle and machine gun ammunition, and the researcher has observed dive guides rearranging the ammunition to spell out their names (Figure 4) and greetings on one of the beams in the hold, and encouraging other divers to do the same. The bullets have been moved from within the hold to the hatch cover beam.

Not all artefacts clusters are located on the exterior of the wrecks at Chuuk. There is an operating table inside the forward superstructure of the *Shinkoku Maru* at a depth of around 24 metres, and it is another focal point for aggregating artefacts, including human remains. The Betty Bomber has had artefacts removed and placed on the seabed beside it. Items include a seat from the cockpit, oxygen cylinders, a radio, a propeller blade, a toilet, a gun, various metal containers and fittings. The less frequently dived wrecks at Chuuk, such as the *Oite* and the *Sapporo Maru*, do not contain artefact clusters.

Figure 3 **Artefact cluster on the bridge of the *Shinkoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 4 **Name spelt out using bullets in a hold of the *Sankisan Maru*, Chuuk**

Image © 2018 Joanne Edney. Screen shot from head-mounted camera.

Third, McKinnon (2015) has suggested that some artefact aggregations are created by divers as an act of memorialisation, particularly at sites where formal memorials are present. For example, the commemorative plaques on the *Fujikawa Maru* (Figure 5) and *Aikoku Maru* at Chuuk are focal points for aggregating artefacts (Bailey, 2000; Edney, 2006), and in the case of the *Aikoku Maru* the artefact cluster includes human remains. Likewise, McKinnon (2015) has attributed the cause of artefact clusters around memorial monuments at some of the underwater cultural heritage sites in

Saipan to memorialisation. Divers have also added artefacts to these sites, including sake bottles, a tea kettle, and a wooden stupa. This is similar to terrestrial memorial sites in Saipan observed by the researcher, where visitors place objects such as origami peace cranes, food and incense at the sites.

Figure 5 **Commemorative plaques and artefact cluster on the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot hand-held camera.

Fourth, artefacts may be moved, and in some cases concealed as dive guides seek to provide divers with what they perceive to be a better diver experience. Dive guides sometimes hide different artefacts on wrecks and bring them out to show to divers during dives, and possibly also to prevent the artefacts from being stolen (Hezel & Graham, 1997; Jeffery, 2006). In 2009, the researcher observed and recorded two human skulls at the artefact cluster around the commemorative plaques on the *Aikoku Maru* at Chuuk. However, in 2011 there was only one skull amongst the artefacts in this artefact cluster, and the researcher observed a dive guide pull a human skull from a place where it had been concealed near the plaques on the wreck (Figure 6). A fifth reason for concealing objects may be so that the objects can be sorted and concealed prior to removing them at a later time. This practice has been reported at Chuuk (Hezel & Graham, 1997; Jeffery, 2007).

Figure 6 **Skull concealed by dive guides and shown to divers on the *Aikoku Maru***

Image © 2011 Joanne Edney. Screen shot hand-held camera.

Sixth, in the past, there was a certain amount of kudos associated with owning artefacts recovered from wrecks due to the skill and knowledge levels required to recover the items, and the perceived risk and danger associated with wreck diving. Seventh, some divers remove artefacts as a tangible reminder of their dive experience, or their connection with the wreck and history (Edney, 2006; Fielding, 2003). Finally, some divers consider that collecting and removing artefacts better protects the artefacts than leaving them in situ (Philippou, 2004). There is also a perception amongst some divers that if they do not take the artefacts somebody else will. This perception is not currently as widely accepted amongst divers as it was in the past, however, the attitude does prevail to some extent (Edney, 2016).

Current causes of diver disturbance to and removal of artefacts may include lack of awareness of the impacts and consequences of these practices (Edney, 2011a); the personal motivation of divers to discover, touch, view and photograph artefacts and fittings; divers observing and copying the behaviour of dive guides; lack of awareness of relevant legislation (Edney, 2006); and, deliberate non-compliance with legislation. Searching for, disturbing and removing artefacts alters the equilibrium of sites. These actions can damage and remove protective coatings from artefacts, accelerating their corrosion, and leaving them exposed to other environmental decay processes, such as the effects of ultraviolet light and bio-decay. Searching for, disturbing and removing artefacts can also destabilise wreck sites, accelerate corrosion of the wreck fabric and leave the wreck exposed and more susceptible to damage from natural events such as storms, and subject it to further dispersal (Edney, 2016; Jeffery, 2006; Jeffery, 2007; MacLeod & Richards, 2011; Nutley, 1987, 1996).

Disturbance to artefacts also diminishes site integrity and the archaeological value of sites by altering the site context (Delgado, 1988b; Look & Spennemann, 1993; Nutley, 1996). When artefacts are removed from wrecks, their provenance is lost due to poor or no documentation, and the artefacts themselves are often lost due to inappropriate, if any, conservation treatment (Nutley, 1996; Philippou, 2004). Figure 7 shows corrosion damage to artefacts that have not had any conservation treatment. These items were removed from wrecks near Tulagi in the Solomon Islands. Disturbance to and removal of artefacts also diminishes the recreation values of wreck sites because divers are interested in seeing artefacts and fittings in place (Delgado, 1988b; Edney, 2006, 2011b, 2012a; Hosty, 1987). Wreck sites can be damaged when artefacts are moved or removed, and these actions can also diminish their aesthetic values, which in turn diminishes their recreation values (Edney, 2006).

Figure 7 **Corrosion on artefacts removed from wrecks near Tulagi, Solomon Islands**

Image © 2004 Joanne Edney.

4.3.3 Intentional and unintentional diver contacts

Divers can make contact with wrecks with any part of their body, most commonly with their hands and knees, or equipment. These contacts may be intentional or unintentional. Intentional contacts include holding onto, standing (Figure 8), sitting, and kneeling on wrecks, and commonly occur when divers stop to adjust equipment, steady themselves to look at something more closely, rest, or when taking or posing for photographs (Edney, 2006, 2016). Figure 9 shows a diver holding onto a wreck while taking photographs.

The wreck of the *SS President Coolidge* in Vanuatu, a popular and iconic wreck dive, has been damaged by divers holding onto parts of the wreck to steady themselves to look at and photograph features of interest, for example, the metal frame that was around 'the Lady and the horse' (Stone, 1997).

Figure 8 **Dive guide standing on the *Rio De Janeiro Maru*, Chuuk**

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera. Dive guide standing on the hull of the wreck while waiting for divers to descend.

Some other forms of intentional contact result from the use of certain wreck diving techniques. The first is a technique known as 'hand pulling', where divers use their hands as a method of propulsion to pull and glide instead of kicking. This technique is used by divers to minimise silting when moving around a wreck, particularly inside a wreck. It is also used to conserve energy when moving against a current (Edney, 2006, 2011a; PADI, 2008b). The other technique is the use of penetration lines, which are attached to wrecks, and used by divers to safely penetrate a wreck (PADI, 2008b).

Figure 9 **Diver holding onto Emily fuselage while taking photos, Chuuk**

Image © 2018 Joanne Edney. Screen shot from hand held camera.

Divers are also known to clean up particular features of wrecks, such as using wire brushes to clean concretions and marine growth from the name of wrecks. These practices have been reported in the past on the wreck of the *Yongala* in Australia (Viduka, 2011). At Chuuk, the Cousteau Society's 1971 documentary 'The Lagoon of Lost Ships' shows divers using wire brushes to clean growth from the name of the *Heian Maru* on the hull near the bow (Figure 10). The name of this wreck was still clearly visible to the researcher in 2014, as was the name on the stern of the *Rio De Janeiro Maru*. This indicates that the practice still occurs. Divers also clean concretions and marine growth from the manufacturer's plates on various pieces of machinery and guns. For example, the researcher has observed the cleaned plates with serial numbers on the bow guns of the *Fujikawa Maru* (Figure 11) and *Unkai Maru No. 6* at Chuuk Lagoon.

Vandalism also falls into the category of intentional contacts with wrecks. The researcher has observed examples of vandalism on some of the wrecks in Chuuk, for example, graffiti in a bathroom in the *Gosei Maru* (Figure 12). McKinnon (2015) described vandalism to an Emily Flying boat in Saipan, which had graffiti etched into its gun turret and one of its wings.

Figure 10 **Cleaned ship's name on the bow of the *Heian Maru***

Image © 2018 Joanne Edney. Screen shot hand-held camera.

Figure 11 **Name plate on the bow gun on the *Fujikawa Maru***

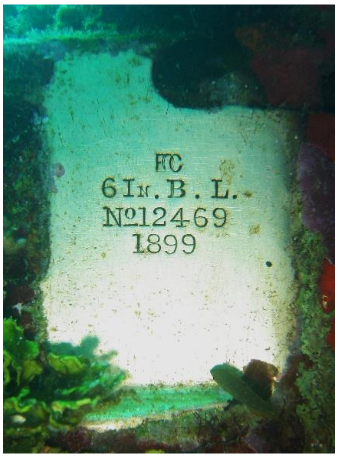

Image © 2011 Joanne Edney.

Figure 12 **Graffiti in a bathroom on the *Gosei Maru***

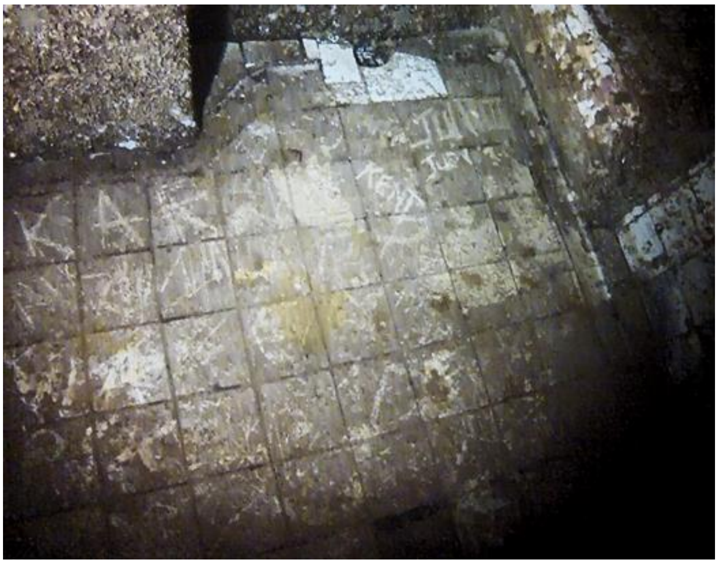

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Divers may also unintentionally make contact with wrecks with their fins (Figure 13) or dive cylinders, or unsecured gauges or other equipment (e.g. lights or other accessories), which may drag across and catch on parts of wrecks (Edney, 2006, 2016). Mechanical damage to the *SS President Coolidge* in Vanuatu is reported to have occurred as a result of being hit by divers' equipment, particularly tanks (Edney, 2006). Unintentional diver contacts with wrecks are due primarily to poor buoyancy control, which is often attributed to inexperience and incorrect weighting (Chung et al., 2013; Edney, 2006; Toyoshima & Nadaoka, 2015). The researcher has observed examples of poor buoyancy control resulting in unintentional diver contacts with wrecks at a number of different locations in the Asia-Pacific region, including Chuuk, Palau, Papua New Guinea, Solomon Islands and Vanuatu.

Figure 13 **Diver making an unintentional contact with a wreck with their fins, Chuuk**

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera.

Higher levels of impact on the marine environment, particularly from contacts, have been reported from training dives (Polak & Shashar, 2012; Zakai & Chadwick-Furman, 2002). Training dives are also likely to result in higher levels of impact on wrecks. It has been reported as an impact on the *Yongala* in Australia, and consequently training dives are no longer permitted at the site (Viduka, 2011). The incidence of intentional contacts are likely to be higher if dive leaders make contact with wrecks. This is because divers have been reported to copy the behaviour of guides and instructors (Barker & Roberts, 2004; Howard, 1999).

Sensory isolation (or deprivation) also plays a part in the incidence of diver contacts with wrecks. For example, night diving is also known to result in more diver contacts with reefs (Barker & Roberts, 2004; Chung et al., 2013), and has resulted in greater unintentional contacts and higher levels of damage to concretions on the wreck of the *Susuki* at Chuuk (MacLeod & Richards, 2011). Sensory isolation may also be experienced when penetrating shipwrecks, therefore, wreck penetration is expected to result in higher levels of unintentional contacts. The impairment of motor skills resulting from nitrogen narcosis is another type of sensory isolation that may cause higher rates of unintentional contacts by divers (Edmonds, Lowry, & Pennefather, 1983; Edney, 2016).

Any contact with wrecks by divers can damage and dislodge protective concretions and marine life. This accelerates natural corrosion and decay processes (Jewell, 2004; MacLeod & Richards, 2011). The cumulative effects of many intentional and unintentional contacts by divers can markedly accelerate wreck decay processes (Edney, 2006).

4.3.4 Exhaled air bubbles

Bubbles exhaled by divers using open circuit scuba can accelerate corrosion on wrecks when divers penetrate wrecks or swim beneath parts of wrecks (Garrett, Stein, Bigourdan, & Jeffery, 2006; Jeffery, 2007; Jewell, 2004; Viduka, 2011). The effects of increased corrosion from divers exhaled air bubbles can be visible on wrecks that have high levels of use by of divers. For example, it has been observed on the wreck of the *SS President Coolidge* in Vanuatu (S. Smith, personal communication, 29 March 2005). Interestingly, while this impact has not been quantified in the literature, it is widely recognised and accepted within the recreational dive community as an impact of diving. Figure 14 shows divers' air bubbles escaping from the hull of the *Yamagiri Maru* in Chuuk.

Figure 14 **Air bubbles escaping from inside the *Yamagiri Maru***

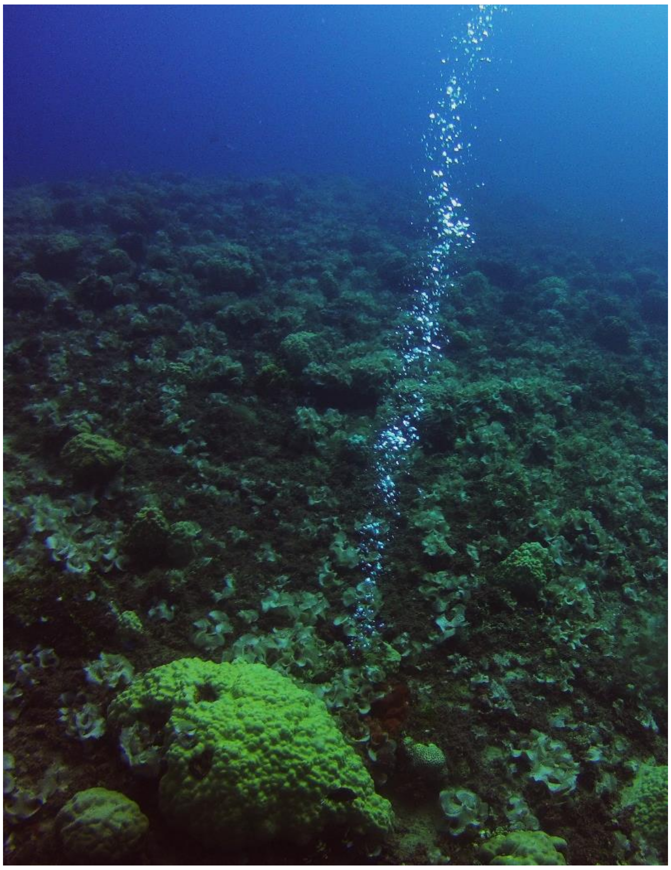

Image © 2018 Joanne Edney. Screen shot hand-held camera.

Table 3 Summary of potential diver impacts on underwater cultural heritage

Impact	**Description**	**Nature of impact**
Boat anchor and mooring damage	• Dropping boat anchors & chain onto, & picking anchor into shipwrecks • Anchor & chains continually hitting against shipwreck as boat goes over waves • Dragging anchor to locate wreck • Anchor & mooring lines rubbing against shipwreck as boat moves in the water • Force exerted on shipwreck from tying off boats to moorings secured to shipwrecks	• Considered to cause highest level of diver related impact • Mechanical damage to shipwreck structure (e.g. weakening or breakage of the structure) & accelerated decay (e.g. corrosion) of exposed surfaces • Damage to and removal of marine growth & protective coatings, accelerating corrosion • Diminished aesthetic appeal
Impairment of site integrity &stability	• Removing artefacts, fittings & parts of shipwrecks from a site, for profit or as souvenirs, memorialization, or vandalism • Divers searching for, disturbing & handling artefacts • Moving artefacts around a site to view, photograph, or for later removal • Adding materials to a site for memorialization	• Any form of disturbance impairs site integrity due to change on context (i.e. loss of archaeological & historical values) • Site equilibrium altered leading to accelerated decay of shipwreck & contents (e.g. corrosion, bio-decay & effects of UV light) • Mechanical damage & destabilization of site from methods & equipment used to find & remove objects • Loss of provenance & often loss of objects removed due to insufficient conservation • Diminished recreation & cultural heritage values
Intentional contact with shipwrecks Unintentional contact with shipwrecks	• Contact with shipwrecks by divers with their body (e.g. kneeling, standing, sitting, holding onto) • Attaching dive equipment to shipwreck (e.g. use of a penetration line) • Contact with shipwreck by body (e.g. hands, knees) or equipment (e.g. tank, gauges) due to poor buoyancy control, poor situational awareness, poor or impaired motor skills & unsecured equipment	• Mechanical damage & accelerated decay of exposed surfaces. • Damage to and removal of marine growth & protective coatings, accelerating decay of shipwreck & contents • Diminished aesthetic appeal
Exhaled air bubbles	• Bubbles exhaled by divers using open circuit scuba when inside or beneath parts of shipwrecks	• Accelerated corrosion from exhaled air bubbles coming into contact with shipwrecks

Table published in Edney (2016, p. 274)

4.4 Management of diver impacts on underwater cultural heritage

There a number of different strategies used by managers to mitigate and prevent diver impacts on underwater cultural heritage in the Asia-Pacific region (Edney, 2006; Smith, 1999). The variety of approaches taken can be the result of the management aims for particular sites, different values associated with sites, the attitudes of communities and governments involved in the protection of underwater cultural heritage sites, and the resources available to manage sites (Edney, 2006; Jeffery, 2004a, 2004b). Management actions used to prevent or mitigate diver impacts on underwater cultural heritage essentially fall into two categories: regulatory and non-regulatory. Most site management strategies use a combination of both regulatory and non-regulatory approaches.

This section outlines the various management actions and tools used to prevent and mitigate diver impacts on underwater cultural heritage throughout the Asia-Pacific Region. A summary of these management approaches is at Table 4, and was originally published in Edney (2016, p. 278). A management framework that combines the various management approaches is also presented in this section.

4.4.1 Regulatory approaches

4.4.1.1 Laws

Today most nations throughout the world have legislation in place to protect underwater cultural heritage. It is a requirement for those nations who have ratified the UNESCO Convention on the Protection of the Underwater Cultural Heritage (section 2.2.1), to have such legislation in place to protect underwater cultural heritage within their jurisdictional boundaries. The management of underwater cultural heritage in nations that have not ratified the Convention is often guided, in varying degrees, by the Convention and its Annex (Staniforth et al., 2009; UNESCO, 2001).

The various types of legislation in place throughout the Asia-Pacific region make it illegal to disturb or damage underwater cultural heritage sites, including prohibition on the removal of artefacts and fittings from wrecks (Edney, 2006, 2016). Legislation is essential because it provides the legal framework for managing underwater cultural heritage sites (Green, 2004). It sets the policy framework required to prescribe rules and the various regulatory measures that can be used to protect sites from a range of human threats, including scuba diving. Laws can include provisions that prevent or regulate diver and other human impacts, such as access, anchoring and disturbance. They can also include sanctions, such as penalties, for breaching these provisions (Edney, 2016). A range of regulatory measures used throughout the Asia-Pacific region to avoid and mitigate diver impacts are discussed below. Many of these measures are also used globally.

4.4.1.2 Restrictions on anchoring

The greatest impact associated with recreational scuba diving is caused by anchoring vessels at dive sites. Therefore, prohibiting anchoring is an effective way of preventing and reducing diver impacts on wreck sites, and these restrictions can be put in place while still allowing diving at the site. Although anchoring is prohibited at a number of sites throughout the Asia-Pacific region, anchor damage often continues to occur. This is may be because divers generally do not favour anchoring off-site due to safety considerations, and diver safety must be taken into account when putting anchoring restrictions in place (Edney, 2016).

Providing moorings at sites where anchoring is not permitted is an effective method of achieving higher levels of compliance (Edney, 2016). For example, in Australia anchoring on historic shipwrecks is prohibited under the *Historic Shipwrecks Act 19*76. However, anchor damage has continued to occur at some wreck sites. Compliance with the Act was improved at some sites, including the *Yongala* and the *Lady Darling*, after moorings were installed (Smith & Nutley, 1998; Viduka, 2011). In other cases, dive operators have voluntarily installed moorings to protect wreck sites. For example, at Chuuk some of the live-aboard dive boat operators cooperatively installed moorings at a number of the more popular wreck sites to prevent anchor damage to the wrecks (Jeffery, 2004a). There was initial reluctance by some individuals to the use of moorings due to concerns that moorings make the wrecks more visible and easily accessible, leaving them more prone to damage from divers seeking to recover artefacts (Hezel & Graham, 1997).

4.4.1.3 Restrictions on access

In certain situations, prohibiting access to sites, or parts of sites, may be appropriate. This includes circumstances where other strategies to prevent diver impacts have not been effective, and the wreck is fragile, significant or culturally sensitive (Delgado, 1988a; Edney, 2016). In many parts of the world, it is common to prohibit diving at wreck sites that are war graves. For example, in Australia diving is not permitted on the wreck of the *I-124* Japanese submarine near Darwin because it is a war grave. In addition to the prohibition on diving, there is an 800 metre protection zone around the wreck (McCarthy, 1998; Smith, 1999).

4.4.1.4 Permit systems

Permits can be used to regulate the use of sites and manage diver impacts. They can be a requirement for individual divers, or dive operators, or both. Permits can restrict certain activities, such as not allowing training dives on a wreck, and may stipulate certain behaviours. They also provide scope for managers to set limits on group size or numbers of divers permitted on a site. Setting limits on group size and the number of divers permitted at a site are common approaches used for managing impacts on marine environments (Barker & Roberts, 2008; Edney, 2016; Rouphael & Hanafy, 2007; Smith, Scarr, & Scarpaci, 2010), and may be applied to the management of certain wreck sites.

Permits issued to divers could also contain requirements for divers to hold certain levels or types of dive certification, such as a wreck diver certification, or demonstrated level of competency in skills, such as buoyancy control, to dive a wreck. Permits issued to dive operators can require appropriate pre-dive briefings be given to divers, and can also prescribe the types of messages to be given in these briefings.

Dive operators are required to obtain permits to conduct dives on the *Lady Darling* and *Yongala* wrecks in Australia (Edney, 2006, 2016). Permits for diving the *Yongala* include a requirement to comply with a 'code of diving practice'. This code prohibits removal of artefacts and penetration of the wreck, and does not permit training dives to be conducted on the wreck. It also requires that divers maintain buoyancy control and stay above the wreck (Viduka, 2011). In other cases, individual divers may be required to obtain permits to dive certain wrecks, such as the *SS Glenelg* in Australia (Heritage Victoria, 2012).

At Chuuk, divers are required to purchase a permit (Figure 15) to dive the wrecks, and these permits are obtained from the dive operators. Unfortunately, these permits do not contain any conditions to manage diver impacts and are merely an administrative requirement. Chuuk diving permits also appear to be a means of generating revenue. It has been reported in the past that these permits have raised around US$90,000 annually (Jeffery, 2004a), and more recently average around US$66,000 annually (D. Strong, personal communication, 8 March 2016). This revenue could be used for site management. However, it appears to be used to create government employment for Chuukese people (Jeffery, 2012).

Figure 15 **Chuuk State dive permits**

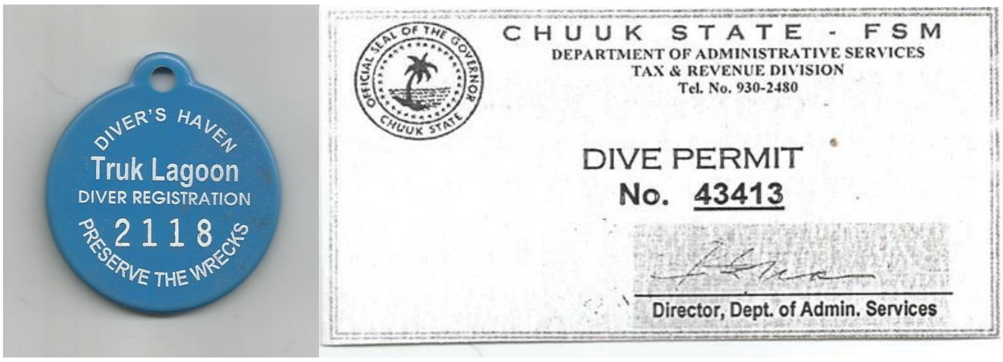

Image © 2018 Joanne Edney. The blue permit was issued in 2007, and the white one in 2014.

4.4.1.5 Codes of conduct

Codes of conduct may be mandatory codes or voluntary. Mandatory codes of conduct can require and prescribe appropriate dive behaviour at shipwreck sites to assist in eliminating or reducing diver impacts. An easy method of implementing a mandatory code of conduct is to include the requirement to comply with a code of conduct as part of a permit to dive a wreck site. The permit needed under the *Historic Shipwrecks Act 1976* (Cth) to dive the *Yongala* in Australia, referred to above (section 4.4.1.4), includes a requirement that divers comply with minimum impact 'code of diving practice' (Viduka, 2011).

4.4.1.6 Dive guides

Diver behaviour can be managed by having dive guides accompanying divers underwater. This is most effective when the guides demonstrate appropriate behaviour, and intervene when they observe divers displaying inappropriate behaviour (Barker & Roberts, 2004; Hammerton & Bucher, 2015; Lindgren et al., 2008; Roche et al., 2016). At Chuuk, it is a legal requirement for all divers to be accompanied by a licensed dive guide when diving the wrecks (Hezel & Graham, 1997). However, it is not necessarily effective in managing diver impacts because it is contrary to Chuukese cultural norms to confront another person, particularly a visitor (Hezel & Graham, 1997). Therefore, dive guides may be reluctant to intervene if they observe inappropriate behaviour. This highlights the importance of taking any potential cultural barriers or considerations into account when proposing to use this type of management approach (Edney, 2016).

4.4.1.7 Rescue or salvage archaeology

Presently, in situ conservation of underwater cultural heritage is the preferred management approach (Green, 2004; Jeffery, 2004b). It is listed as the first option for the management of these sites by the UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001). However, there are circumstances where the in situ conservation of a wreck site is not possible or effective, and in these cases, rescue or salvage archaeology may be the management action used.

In the past, rescue or salvage archaeology was a more commonly used management approach for underwater sites than it is today (Delgado, 1988a). However, it is still used and relevant in some circumstances. Rescue archaeology has been used to protect historic shipwrecks in Australia, for example, in Western Australia it was used to protect the *Vergulde Draeck* (1656), *Batavia* (1629) and *Cumberland* (1830) (Henderson, 1986), and was part of the management strategy for the *Yongala* from 1981 until the early 2000s (Viduka, 2011).

4.4.1.8 Creation of marine protected areas

In addition to specific heritage legislation, marine protected areas may be put in place to protect underwater cultural heritage, as they can provide another level of protection. There are a range of types of marine protected areas that are relevant to the management of underwater cultural heritage, including marine parks, shipwreck parks and archaeological preserves. Public access is generally allowed at these protected areas, and visitor activities may be regulated to prevent or mitigate negative impacts. Interpretive programs and educational materials often form an important element of management strategies for these areas (Edney, 2016; Hannahs, 2003; Scott-Ireton, 2007).

In Australia, many marine protected areas, such as marine parks, contain and afford protection to underwater cultural heritage. However, reserve selection criteria are typically based on biodiversity values rather than cultural heritage values. Marine protected areas have also been declared around some of the ex-navy vessels sunk as dive attractions, such as the ex-*HMAS Brisbane* in Queensland and the ex-*HMAS Adelaide* in New South Wales (Cole & Abbs, 2011; Department of Environment and Resource Management, 2011).

4.4.2 Non-regulatory approaches

Heritage managers throughout the Asia-Pacific region also use a range of non-regulatory management approaches to avoid and mitigate diver impacts on underwater cultural heritage. These approaches are discussed below and have been divided into two categories: education and other approaches. A range of forms of education are discussed, along with other approaches which include artificial reefs and sacrificial wrecks.

4.4.2.1 General education and public outreach

Education plays an important role in the protection of underwater cultural heritage. It is often used to support regulatory management approaches because laws can be more effective when combined with education. Education can also achieve greater levels of compliance with management strategies (Cottrell & Meisel, 2004; Edney, 2011a, 2016; Lindgren et al., 2008), highlighting the important role education plays in the effective management of wrecks. Higher levels of compliance with laws can be achieved when formal sanctions and education are used to support each other (Edney, 2016; Gramann et al., 1995; Nutley, 2007; Scott-Ireton, 2005).

Education is also used as a stand-alone non-regulatory management measure. Although when education is used on its own it is generally ineffective due to being unenforceable (Flatman, 2003). It can be targeted or general and takes a range of forms, for example, academic publications, articles in popular magazines, books, brochures, guest speaking at schools, clubs and community groups, newsletters, radio interviews, television documentaries and interviews, and information provided on websites (Edney, 2016).

Studies have found that education can effectively reduce diver impacts on the marine environment (Barker & Roberts, 2004; Hammerton & Bucher, 2015; Medio et al., 1997; Townsend, 2008). Education may be used in the same way to reduce diver impacts on wrecks. Education has direct benefits to divers as well, for example, site interpretation can enhance enjoyment of the wreck diving experience (Jewell, 2004; Pearson & Sullivan, 1995).

For education to be most effective in reducing diver impacts, it is essential that divers are given an understanding of their potential impacts on wrecks and the consequences of these impacts (Edney, 2011a; Lindgren et al., 2008). An awareness of the consequences of actions which negatively impact wrecks is critical because awareness of consequences leads to more socially responsible behaviour (Gramann et al., 1995). Divers also need to be educated about practical ways they can avoid or minimise their impacts on wrecks (Edney, 2016).

Another important component is providing divers with an understanding of the importance and relevance of underwater cultural heritage, the laws in place to protect it and the implications these laws have for divers. When divers understand more about a wreck's history and cultural heritage values, and why these values are important, they are better able to appreciate and value a site (Edney, 2006; Jewell, 2004; Scott-Ireton, 2007). Knowledge of laws and management rules are crucial in achieving compliance.

Education plays an important role in preventing non-compliance with laws and management controls due to ignorance (Smith & Anderson, 2004). Key opportunities for educating divers, include during diver training (Edney, 2011b; Lindgren et al., 2008; Scott-Ireton, 2008), pre-dive briefings (Barker & Roberts, 2004; Camp & Fraser, 2012; Medio et al., 1997; Townsend, 2003), as well as through the provision of interpretive material, such as the interpretation of particular sites and interpretive materials produced for shipwreck or maritime trails (Edney, 2016; Jewell, 2004; Philippou & Staniforth, 2003; Scott-Ireton, 2007).

Education also plays a role in reducing both intentional and unintentional contacts with wrecks. Intentional diver contacts are deliberate actions, and education can reduce these contacts by raising awareness of the consequences of these actions and helping change diver attitudes, and in turn their behaviour. Raising awareness is also important for reducing unintentional contacts. However, the main gains to be made in reducing unintentional contacts are using education to improve divers' skills and techniques (Hammerton & Bucher, 2015).

4.4.2.2 Diver training programs

An ideal way to educate divers about the values and importance of underwater cultural heritage, the laws in place to protect it, potential diver impacts and measures to avoid or minimise these impacts, is to integrate this information into diver training programs. This can have a positive influence on diver behaviour (Edney, 2011a, 2016). Diver certification organisations set the curricula for dive courses and can include information about diver impacts and responsible diver behaviour in their training courses. They can also ensure divers are taught about, and are competent in, the practical skills needed to avoid or minimise these impacts. Importantly, these can include buoyancy control and trim (swimming in a horizontal position), correct fin kicking techniques and keeping a tidy profile (i.e. securing loose equipment) (Edney, 2011a; Lindgren et al., 2008).

A review was undertaken of the wreck diver training programs from three major diver certification organisations operating in Australia. This review found that current wreck diver training programs incorporate, to varying degrees, information supporting the protection of wrecks and encourage appropriate diver behaviour at these sites. However, more could be included to educate divers about the nature and causes of diver impacts, and what divers can do to avoid or minimise these impacts (Edney, 2011a, 2016).

To facilitate inclusion of appropriate information in diver training programs, heritage managers could work with certification organisations at the corporate level, and with local dive schools. They could assist in the development of new courses that can promote heritage conservation to divers. Non-government organisations can also play a part in this regard, and a good example of this is the PADI (Professional Association of Diving Instructors) Wreck Detective specialty diver course developed by the Nautical Archaeology Society in the United Kingdom. This course provides divers with skills to identify wreck sites, their features, and how to use this information to research wreck sites and uncover the stories associated with these sites (Edney, 2016; Nautical Archaeology Society, 2016).

4.4.2.3 Appropriate pre-dive briefings

Pre-dive briefings present the opportunity to provide divers with site-specific information, and ways they can avoid or minimise their impact while diving (Hammerton & Bucher, 2015; Johansen, 2013). Appropriate pre-dive briefings have been demonstrated to be effective in reducing diver impacts on the marine environment (Barker & Roberts, 2004; Camp & Fraser, 2012; Hammerton & Bucher, 2015; Krieger & Chadwick, 2013; Medio et al., 1997; Toyoshima & Nadaoka, 2015). Pre-dive briefings could achieve similar results in reducing impacts on underwater cultural heritage.

A study carried out in Australia found pre-dive briefings effective for raising awareness of the *Yongala*'s cultural heritage values, and influencing diver attitudes, particularly in regard to the prohibition on penetrating the wreck (Jewell, 2004). The findings from this study are encouraging, and suggest more use could be made of pre-dive briefings to encourage appropriate diver behaviour at wreck sites. Heritage managers could pro-actively assist dive operators by providing appropriate information for use in dive site briefings (Edney, 2016).

4.4.2.4 Underwater interpretive trails and site interpretation

Interpretive trails are used widely to educate the public about cultural heritage above and below the water, and to help garner support for protection of these areas. Underwater interpretive trails are one of the most commonly used educational strategies. They have been established to attract divers to wreck sites, increase appreciation of the cultural heritage values of sites and to reduce the pressure on more significant or fragile sites by publicising certain wrecks (Green, 1995; Hosty, 1987; Leshikar-Denton & Scott-Ireton, 2007; McCarthy & Garratt, 1998; Philippou & Staniforth, 2003; Scott-Ireton, 2005; Scott-Ireton & McKinnon, 2015). In Australia, there are underwater and shore-based shipwreck interpretive trails in most states, particularly in South Australia, Victoria and Western Australia.

Traditionally interpretive resources associated with these trails have included brochures, signs (above and below water), booklets (including waterproof booklets for divers to take underwater), posters and books (Philippou & Staniforth, 2003), and now interpretive materials are also accessible online. At Saipan, an underwater interpretive trail was developed to assist in the protection of World War II underwater cultural heritage sites that have sustained damage from dive tourism. Products, including waterproof underwater guides with site plans, and posters which contained information about their cultural heritage values and conservation messages were produced for the trail. These materials are reported to have been well received and popular with dive and tourism operators (McKinnon, 2011).

Other types of site interpretation are also popular and effective, such as booklets, posters, brochures, information sheets, guidebooks, interpretive underwater slates and web-based information. These interpretive materials can be used to enhance divers' understanding and appreciation of wreck sites and in doing so, increase their enjoyment of the dive experience. This can positively influence diver behaviour at wreck sites (Edney, 2006, 2016; Jewell, 2004).

Jewell's (2004) study at the *Yongala* in Australia highlighted the benefits of site interpretation. The study used an underwater slate that included a diagram of the wreck showing points of interest on one side and information about the wreck, including a brief history, its archaeological significance. The marine life found at the site was included on the other side of the slate. Jewell's (2004) study found that the slate was effective in raising awareness of the *Yongala's* cultural heritage values and enhancing the dive experience. Further, it positively influenced attitudes towards certain management controls on the wreck. Interestingly, the study also found the slate was more influential as diver experience and levels of qualification increased.

4.4.2.5 Influencing diver behaviour – dive guides and instructors

Dive instructors and dive guides can play an important, yet often underestimated, role in positively influencing the behaviour of divers. This is because divers' are known to copy the behaviour of instructors and guides (Howard, 1999; Lindgren et al., 2008). Therefore, it is important that dive instructors and guides set a good example by displaying appropriate behaviour and dive techniques. In some cases, it may be necessary to educate instructors and guides to lead by example as they may not be aware of the importance of doing so.

In-water intervention by dive leaders to correct inappropriate behaviour at the time it occurs is an effective method of reducing diver impacts on the marine environment (Barker & Roberts, 2004; Hammerton & Bucher, 2015). Hammerton and Bucher's (2015) study found a 30 percent reduction in diver contacts with reefs when in-water intervention by dive leaders occurred. Therefore, it is beneficial to also educate dive leaders to intervene and correct inappropriate behaviour when they observe it occurring (Barker & Roberts, 2004; Hammerton & Bucher, 2015; Lindgren et al., 2008).

The location of training dives can also play a role in reducing diver impacts on underwater cultural heritage. Dive instructors are primarily responsible for deciding where training dives will be conducted, and can avoid conducting training dives at fragile and culturally significant wreck sites (Edney, 2016). Educating instructors and dive schools about the potential impacts of training dives and the importance of avoiding certain sites during diver training can help reduce impacts on shipwrecks.

It was noted above that having dive guides accompany divers on wreck sites can be a statutory requirement, as is the case at Chuuk (section 4.4.1.6). However, at most wreck sites throughout the Asia-Pacific region there are no legal requirements for this to occur. However, dive guides are commonly used by dive operators at many wreck diving destinations, such as Palau, the Solomon Islands and Vanuatu (Edney, 2016). Their presence no doubt assists in reducing diver impacts, as well as providing divers with a better dive experience because they direct divers' to the most interesting features of dive sites (Andy et al., 2014; Edney, 2016).

4.4.2.6 Codes of conduct

Codes of conduct can help promote responsible diver behaviour by clearly identifying and describing appropriate behaviour and diving techniques. As outlined in the regulatory section (4.4.1.5) above, codes of conduct may be mandatory or voluntary. A good example of a voluntary code of conduct is the Project AWARE 'Respect our wrecks' responsible diving guidelines (Project AWARE Foundation, 2008). It formed part of Project AWARE's 'Respect our wrecks' campaign, which promoted the protection of wrecks. In addition to the responsible diving guidelines, it provided information that explained cultural heritage values of wrecks and their importance. The information is available on the Project AWARE website and is linked to the Professional Association of Diving Instructor's (PADI) wreck diver training materials (Edney, 2011a; Scott-Ireton, 2005). The Project AWARE guidelines could be could be more widely adopted by the dive industry to promote appropriate behaviour at wreck sites (Edney, 2016).

4.4.2.7 Engagement and partnership programs

Engaging with and developing partnerships with the dive community is an important element of underwater cultural heritage management strategies. This is because they can result in divers developing ownership and a sense of stewardship towards wreck sites (Delgado, 1988a; Edney, 2016; Nutley, 2007; Scott-Ireton, 2007). Globally, the diving community has been responsible for locating, recording and protecting many wreck sites. In Australia, for example, there have been a number of engagement programs that have developed successful partnerships between governments and the dive community. These underwater cultural heritage citizen science programs have encouraged dive shops, clubs and individual divers to research, record and interpret wreck sites (Edney, 2016; Hosty, 2006; Kenderdine, 1997; Nutley, 1996).

Partnerships between heritage managers and divers in Australia began with the formation of amateur maritime archaeology associations in the 1970s and 1980s (McCarthy & Garratt, 1998), and then the various volunteer programs that followed. These associations and programs have assisted heritage managers by providing them with information about wrecks. The stewardship for these wrecks the divers developed as a result of their involvement has also assisted in site management. Some examples of volunteer programs include the New South Wales 'Wreck Survey Project' (1982-1985), the 'Wrecks Alive' program that began in 1999, and the current 'Wreck Spotters' program which began in 2000 (Coroneos, 1997; NSW Office of Environment and Heritage, 2012; Nutley, 2007). The limited resources available for the management of underwater cultural heritage makes it very important for heritage managers to engage divers and garner support for the protection of underwater cultural heritage (Edney, 2006, 2016).

Additionally, many wrecks visited by recreational divers are located in depths beyond those professional archaeologists are permitted to dive, to due to work health and safety requirements. They are also beyond the limits of air diving that the large majority of divers use. Therefore, it is important for heritage managers to engage with the technical diving community, who have access to wrecks that managers do not. Fortunately, many technical divers have an interest in the history of the wrecks they are visiting and appreciate the need to protect the cultural heritage values of these sites. In Australia, this has resulted in a number of groups assisting heritage managers by actively locating, researching and recording these wreck sites, and providing the data they have collected to managers (Edney, 2016; Hosty, 2006; Nutley, 2007; Smith, 2006).

4.4.2.8 Maritime archaeology training for divers

Divers are able to participate in maritime archaeology courses, such as the four-part course developed by Nautical Archaeology Society in the United Kingdom. The Nautical Archaeology course aims to provide divers with an understanding of the methods and procedures used in maritime archaeology, and practical application of this information. It also aims to develop awareness of the need to protect underwater cultural heritage.

The course is recognised internationally. Successful completion of the course enables divers to participate in projects and fieldwork around the world, and to undertake their own projects. The course has been licensed to organisations in other countries, such as Australia (through the Australasian Institute of Maritime Archaeology) and the United States (through the National Parks Service, some universities and archaeological associations), making it available to divers outside of the United Kingdom (Australasian Institute of Maritime Archaeology, 2013; Nautical

Archaeology Society, 2013). Many of the divers who participate in partnership programs (section 4.4.2.7) have completed the Nautical Archaeology Society course (Edney, 2016).

4.4.2.9 Artificial reef wrecks

In this study, the term artificial reef wreck is used to describe vessels sunk intentionally for recreation (e.g. diving, fishing or surfing) and other purposes (e.g. marine engineering, disposal or environmental restoration), consistent with Edney and Spennemann (2014, 2015). The growth in the popularity of wreck diving has resulted in more and more governments and non-government organisations around the world sinking vessels to create new dive sites and attract tourists. This is largely due to the recognition by governments and communities of the potential economic benefits of artificial reef wrecks (Edney, 2012a, 2016; Morgan, Massey, & Huth, 2009; Stolk, Markwell, & Jenkins, 2007).

Artificial reefs have been used to reduce diving pressure on natural reefs (Kirkbride-Smith et al., 2013; Leeworthy, Maher, & Stone, 2006; Polak & Shashar, 2012). For example, the *USS Spiegel Grove* was sunk in the Florida Keys National Marine Sanctuary in 2002. It was found to have reduced the use of natural reefs by divers, although total numbers of divers to the area increased (Leeworthy et al., 2006). Artificial reef wrecks may achieve the similar results for underwater cultural heritage by taking the pressure off culturally significant wrecks (Edney & Spennemann, 2014, 2015; McCarthy & Garratt, 1998). For example, in Western Australia, a wreck scuttling strategy was implemented to manage diver impacts on historic shipwrecks by providing alternative wreck diving opportunities, and was considered successful (McCarthy & Garratt, 1998).

Edney and Spennemann's (2014, 2015) study into the attitudes and preferences of Australian divers towards artificial reef wrecks found most divers supported the use of artificial reef wrecks to reduce pressure on historic shipwrecks, which is encouraging. However, although the concept was supported, most wreck divers were interested in diving historic shipwrecks and seeing artefacts, and artificial reef wrecks generally do not provide these experiences. The study concluded that artificial reef wrecks can form an important component of underwater cultural heritage management strategies. They could assist in managing diver impacts when used for training dives, and as dive sites for more inexperienced divers, because this is where higher rates of intentional and unintentional diver contacts with wrecks are likely to occur. Artificial reef wrecks may also reduce the volume of divers visiting historic shipwrecks. This is particularly the case if artificial reefs are located appropriately, and where they are able to provide experiences better or at least commensurate with the historic shipwrecks accessible to divers in that area. Therefore, artificial reef wrecks have the potential play a role in reducing diver impacts on culturally significant wrecks.

4.4.2.10 Sacrificial shipwrecks

Another strategy, along similar lines to artificial reef wrecks, is to manage selected wrecks primarily as recreational resources to reduce pressure on more culturally significant wrecks or wrecks that cannot, for various reasons, be effectively managed (Edney, 2006, 2016). This type of approach is commonly adopted in terrestrial and marine protected area management, and these locations are referred to as sacrificial areas or sites (Agardy, 2010; Cheung, 2013; Pickering & Buckley, 2003; Zeppel & Hall, 1992). The rationale for the use of sacrificial areas is that by concentrating recreational use to certain sites and accepting that impacts will be more intense, impacts can be confined to these areas. This strategy can reduce impacts at more important or sensitive sites (Eagles, McCool, & Haynes, 2002).

The types of wrecks that would be suitable to be used as sacrificial wrecks would be those with low cultural heritage values, or those with high visitation levels and high levels of diver impacts, where conservation is not possible or justifiable due to the level of resourcing required to manage the impacts (Agardy, 2010; Edney, 2016). Key advantages of using sacrificial wrecks are that they enable management resources to be targeted to more significant or sensitive sites, they provide recreation opportunities for divers, and allow management resources to be used more effectively because impacts are confined to a particular site (Edney, 2016; McCool & Lime, 2001).

4.4.2.11 Consultation with divers

The management of historic shipwrecks occurs within legal, political and social frameworks that differ between jurisdictions. Divers will have different values and expectations regarding access to these sites and the extent of their participation in management decision making. Managers should consider which organisations and individuals can best represent the interests of divers visiting the site(s) in question when deciding who to engage with regarding management strategies. Managers also need to be aware that one individual cannot represent the views of a user group that is not homogenous, as is the case with wreck divers (Dovers et al., 2015; Edney, 2012a).

The scope and level of engagement with divers and the dive industry may vary between sites, depending on the type and level of visitation a site receives. It may be appropriate to consult only with local divers, clubs and operators in some cases, while at other sites consultation will need to be more inclusive of a wider range of divers, clubs, organisations and the broader dive and tourism industries. This approach is advantageous because management decisions will gain wider acceptance, higher levels of compliance and achieve more stable outcomes when managers seek and accurately interpret the views of various stakeholders (Salz & Loomis, 2005).

Consultation is a key to the success of management strategies, regardless of location or jurisdiction. When managers implement strategies without consultation they are unlikely to understand the effects it may have on user groups. Consultation gives divers the opportunity to have input into management, and it gives managers the opportunity to understand how different management approaches may affect divers. When managers understand the effects management strategies have on divers they are better placed to balance protection of cultural heritage values of shipwrecks with use that meets divers' needs or aspirations (Sorice et al., 2007).

A combination of meaningful consultation and a receptiveness of management to input from stakeholders is essential for achieving high levels of voluntary compliance (Stern, 2008). Therefore, it is crucial that strategies designed to manage diver impacts on underwater cultural heritage are developed in consultation with, and ideally collaboratively, with divers and the dive industry. A collaborative approach is preferred because it can achieve higher levels of voluntary compliance with management strategies than consultation. This is because voluntary compliance is reliant upon the acceptance of rules, and acceptance is best achieved through negotiation, rather than imposing rules on user groups, and expecting compliance (Edney, 2016; Smith & Anderson, 2004).

Ownership and acceptance of a management strategy by divers and the dive industry is more likely to be achieved through a collaborative approach (McCool & Guthrie, 2001; Thomas & Middleton, 2003; Worboys, Lockwood, & De Lacy, 2001). Collaboration allows divers to become an important part of solving management problems, rather than being considered the problem. This type of approach can achieve management goals, and meet the aspirations of the divers who use the site (Dovers et al., 2015). Although collaboration can be more resource intensive during the planning stage of the process, less management input is generally required during implementation, and in the longer term (Dovers et al., 2015; Spoelder, Lockwood, Cowell, Gregerson, & Henchman, 2015; Worboys et al., 2001). This is because these management strategies are more likely to be perceived to be fair, necessary, reasonable, justifiable and legitimate, and therefore more likely to gain higher levels of voluntary compliance (Read et al., 2011; Smith & Anderson, 2004; Stern, 2008). Divers are much more likely to perceive this when they are involved in the development of the management strategy.

In cases where it is not possible to develop management strategies collaboratively with divers, consultation should be meaningful and engaging, and should occur early in the process (Dovers et al., 2015; Spoelder et al., 2015). For example, when managers prepare a draft management strategy and then ask divers for comments is not an ideal way to consult, as it will often be perceived to be the final product. Therefore, divers may not perceive that their input will be properly taken into account. The consultation process needs to be more iterative to gain wider acceptance (Edney, 2016).

Table 4 Approaches to the management of diver impacts

Regulatory	Non-regulatory	
	Education	Other
Appropriate laws and regulations in place to protect sites	General education and public outreach programs	Creation and promotion of artificial reef wrecks
Surveillance of sites	Diver training programs	Use and promotion of certain shipwrecks as 'sacrificial' sites
Compliance with legislation enforced (e.g. fines or sanctions for damage to sites)	Appropriate pre-dive briefings - voluntary	Rescue or salvage archaeology
Anchoring restrictions	Education of dive guides and instructors – demonstrate appropriate behaviour	
Access restrictions	Codes of conduct - voluntary	
Code of conduct - mandatory	Underwater interpretive trails	
Dive guides to control diver behaviour	Site interpretation	
Permit systems • Restrictions on certain activities/behaviours • Limits on numbers of divers • Limits on group size • Requirement to comply with a code of conduct • Requirement for appropriate pre-dive briefings • Requirement for special certification • Requirement to demonstrate skill competency • Requirement for dive guides to accompany divers and appropriately manage diver behaviour	Engagement and partnerships with divers and the dive industry Maritime archaeology training for divers	
Create a marine protected area		

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4.4.3 A framework for managing diver impacts on shipwrecks

4.4.3.1 Background

A framework for managing diver impacts on historic shipwreck sites was developed by Edney (2016), and this section provides a brief overview of this framework. The framework combines the regulatory and non-regulatory management approaches used to protect underwater cultural heritage, discussed in sections 4.4.1 and 4.4.2 above. It applies the findings regarding wreck diver characteristics, motivations and attitudes from recent research into wreck divers by Edney (2006, 2011a, 2011b, 2012a) and Edney and Spennemann (2014, 2015) to management of diver impacts on underwater shipwrecks.

The framework focuses on managing diver impacts on historic shipwrecks, however, it is relevant to the management of a range of underwater cultural heritage sites, including submerged aircraft. It was designed to be applied in any jurisdictional setting, and is therefore not prescriptive or reliant on any specific jurisdictional regime. The types of management measures used should be capable of effectively achieving management goals, and be commensurate with the nature and severity of the impacts they are intended to manage (Edney, 2016).

When developing a management strategy, it is important to consider the relative proportions of regulatory and non-regulatory measures. Non-regulatory approaches should be used as much as possible at sites visited by divers, and regulatory approaches should be kept to the minimum level required to solve the management issue in question. Recreationists prefer non-regulatory approaches over regulatory approaches. The primary reason being that regulatory approaches often reduce enjoyment of a recreation activity by restricting freedom of choice. Recreation should be enjoyable and rewarding for the divers visiting underwater cultural heritage sites, and managers seeking to provide high quality diving experiences will take this into account when developing management strategies. Placing emphasis on non-regulatory approaches also has benefits for heritage managers, as they are generally less costly than regulatory approaches (Edney, 2016; Lucas, 1982, 1983; Manning, 1999; Sorice et al., 2009).

The framework is a matrix-based decision support tool. It uses the level of cultural heritage significance and the level of diver impacts occurring (or expected to occur) at sites to guide management priorities and actions. The aim and rationale is to target resources to the sites where management intervention is most needed, and where there is a better likelihood of management efforts being able to achieve the heritage conservation aims for a given site.

The framework focuses on site-specific management actions, and to be most effective should be underpinned by a legal framework and more general types of education. Other important principles that apply to the framework in include:

- ‘Any management strategy adopted for a site should be largely dependent on the level of cultural heritage significance of the site and the level and nature of diver impacts;
- Management strategies should be tailored to and unique to each site;

- Management strategies should ideally be based on quantifiable and or empirical data rather than assumptions, personal opinions or beliefs, so that the management action selected targets actual behaviours that cause impacts; and
- Management strategies should be developed in consultation with divers and dive operators. This is essential to the development of effective strategies, as it ensures more acceptance and ownership, and therefore voluntary compliance' (Edney, 2016, p. 287).

4.4.3.2 Framework description

The framework matrix is presented in Table 5, and was originally published in Edney (2016, p. 289). There are three categories of management actions used in the framework: regulatory, education, and other (artificial reef wrecks and sacrificial wrecks). Each cell of the matrix contains suggested management actions and priorities for the suggested management options.

Sites with high cultural heritage significance and high levels of diver impacts have a heavier reliance on regulatory management actions. Non-regulatory management approaches are given more emphasis at sites with lower heritage significance and where diver impacts are lower. The framework may be applied reactively, with decisions based on observed impacts and trends occurring at a site, or proactively, with decisions based on expected diver impacts using information from similar sites or circumstances (Edney, 2016).

Table 5 Diver impact management decision support framework

Diver impacts	Cultural significance of wreck: Low	Cultural significance of wreck: Medium	Cultural significance of wreck: High
High	OTHER – MEDIUM PRIORITY • Designate & promote site as a sacrificial wreck EDUCATION – LOW PRIORITY • Code of conduct (voluntary) • Site interpretation - focusing on diver impacts on the site	REGULATION – HIGH PRIORITY • Enforcement of laws • Restrictions on anchoring • Permits • Requirement for dive guides EDUCATION – HIGH PRIORITY • Promote / encourage use of moorings • Pre-dive briefings (voluntary) • Code of conduct (voluntary) • Site interpretation • Public outreach programs and partnerships OTHER APPROACHES – LOW PRIORITY • Deploy new / promote existing artificial reef	REGULATION – HIGH PRIORITY • Enforcement of laws • Restrictions on anchoring • Provision of moorings • Restrictions on access and/or numbers • Permits • Requirement for dive guides EDUCATION – HIGH PRIORITY • Site interpretation • Public outreach programs and partnerships OTHER APPROACHES – LOW PRIORITY • Deploy new / promote existing artificial reef wreck
Medium	OTHER – MEDIUM PRIORITY • Designate & promote site as a sacrificial wreck EDUCATION – LOW PRIORITY • Code of conduct (voluntary)	EDUCATION – HIGH PRIORITY • Promote / encourage use of moorings • Pre-dive briefings (voluntary) • Code of conduct (voluntary) • Dive guides influencing diver behaviour • Underwater interpretive trails • Public outreach programs and partnerships REGULATION – MEDIUM PRIORITY • Enforcement of laws • Restrictions on anchoring	REGULATION – HIGH PRIORITY • Enforcement of laws • Restrictions on anchoring • Permits EDUCATION – HIGH PRIORITY • Promote / encourage use of moorings • Public outreach programs and partnerships • Site interpretation OTHER APPROACHES – MEDIUM PRIORITY • Deploy new / promote existing artificial reef
Low	OTHER – LOW PRIORITY • Designate & promote site as a sacrificial wreck	EDUCATION – MEDIUM PRIORITY • Public outreach programs and partnerships • Underwater interpretive trails • Code of conduct (voluntary) REGULATION – LOW PRIORITY • Enforcement of laws	EDUCATION – HIGH PRIORITY • Promote / encourage use of moorings • Public outreach programs and partnerships • Code of conduct (voluntary) • Underwater interpretive trails REGULATION – MEDIUM PRIORITY • Enforcement of laws

Published in Edney (2016, p. 289)

4.4.4 Conclusion

In the Asia-Pacific region, and indeed globally, different management measures are used to protect underwater cultural heritage. Different nations take different approaches to the protection of underwater cultural heritage, due to the attitudes of communities and governments vested with responsibility for managing sites, different values associated with sites, and the level of resources available. Most underwater cultural heritage management strategies combine a range of the regulatory and non-regulatory measures described in this section. (Edney, 2006, 2016; Jeffery, 2004a, 2004b; Smith, 1999). The framework described in section 4.4.3 above demonstrates how the two approaches can be combined.

The growing demand for wreck diving opportunities and the potential impacts of divers visiting shipwreck sites described above presents a major challenge for managers: allowing access to sites whilst protecting and maintaining their cultural heritage values (Edney, 2016). Although the focus of this discussion has been on managing diver impacts on cultural heritage values, there are broader benefits when cultural heritage values of these sites are protected.

Protecting a site’s cultural heritage values has other flow on effects because it also protects its recreation and tourism values. It can mean better dive experiences because the aesthetic values of sites are also protected, and because the artefacts, machinery and fittings divers enjoy seeing and prefer seeing in situ are protected (Edney, 2006). The dive and tourism industries, and local communities that are reliant on the revenue generated by these sites also stand to benefit because the use of the sites is more sustainable. Therefore, they can remain valuable in the longer term, because divers continue to be attracted to these sites (Edney, 2016). For example, Edney’s (2012a) study of divers at Chuuk found that the divers enjoyed seeing artefacts on the wrecks in situ, and that artefacts clusters and removal of artefacts detracted from their enjoyment of their wreck diving experience. Seeing artefacts in situ connected these divers with the human aspects of the wrecks and the events that led to their wrecking. These divers expressed concern about the moving of and removal of artefacts, and for some it detracted from their enjoyment of diving the wrecks to such an extent that they were disinclined to visit again (Edney, 2012a).

4.5 Chapter summary

The potential impacts of recreational scuba diving on shipwrecks were described in this chapter, focusing on examples from the Asia-Pacific region. The potential impacts discussed included those resulting from boat anchor and mooring damage, impairment of site integrity and stability, the effects of divers intentional and unintentional contacts with wrecks, and divers exhaled air bubbles coming into contact with wrecks.

A range of regulatory and non-regulatory management approaches applicable to managing diver impacts on shipwrecks the Asia-Pacific region were described and discussed. Key regulatory approaches included laws, access restrictions, permits, codes of conduct and the use of dive guides. Some of the key non-regulatory approaches described included various forms education, such as pre-dive briefings, the inclusion of specific information in diver training courses and site interpretation and influencing diver behaviour through the use of dive guides. Significantly, three opportunities to enhance the integration of divers and the management of underwater cultural heritage were also identified and discussed: engagement and partnership programs, maritime archaeology training for divers and collaboration and consultation with divers regarding site management. Effective site management is achieved through the use of a combination of regulatory and non-regulatory management approaches. The chapter concluded with an outline of a management framework for managing diver impacts on shipwrecks that combines the two approaches and uses level of cultural heritage significance and level of diver impacts to guide management priorities and actions.

Chapter 5 – Research methodology and methods

5.1 Introduction

The research methodology underpinning this study is presented in this chapter. The pragmatic inquiry research paradigm and mixed methods research approach used in this research are described, and their relevance to this research is justified. The methods used to address the research objectives are described, and a justification for the use of both quantitative and qualitative methods is provided. The chapter contains an outline of the study's research strategy, which included a self-completed survey and video observations of wreck divers. The purpose, structure, content and recruitment strategy of the survey is described and justified. Similarly, the techniques, protocols and recruitment strategy of the video observations are described and justified. This is followed by a description of the data analysis techniques used for both data sets. The chapter concludes with a discussion of the ethical considerations and framework that applied to the study.

5.2 Research approach

5.2.1 Research paradigm

A research paradigm can be described as an interpretive framework used to organise observations and reasoning. It is the worldview or conceptual framework that guides research and represents the researcher's philosophical or theoretical perspective (Babbie, 2010; Denzin & Lincoln, 2000; Nastasi, Hitchcock, & Brown, 2010). More specifically, paradigm '…refers to an integrated set of assumptions about the nature of the social world, about the character and knowledge we can have about the social world, and about what is important to know' (Greene, 2008, p. 15).

There are a number of different paradigms commonly used in social research, such as constructivism, interpretivism, positivism and pragmatism (Creswell, 2009; Henderson, 2006). Pragmatism is one of the most widely accepted and popular paradigms used for mixed methods research, and provides a sound foundation for this type of research (Creswell, 2010; Greene, 2007; Johnson & Onwuegbuzie, 2004; Johnson, Onwuegbuzie, & Turner, 2007; Nastasi et al., 2010; Onwuegbuzie & Leech, 2005; Teddlie & Tashakkori, 2011). Pragmatism '…advances mixing multiple sources of evidence to attain and modify knowledge, which in turn is used to inform potential solutions or varying lines of action and to consider their consequences' (Greene & Hall, 2010, p. 132).

Pragmatic inquiry is guided by a consequential action-knowledge framework, placing emphasis on interactions between humans and their natural and social environments, and what is most appropriate in a given context. The research question is of fundamental importance to the pragmatic paradigm and determines the methods used in a study. Pragmatism fits well with mixed methods research because it primarily focuses on practicality, i.e. using the research approach that best addresses the research objectives, problem solving and results (Biesta, 2010; Creswell & Plano Clark, 2011; Greene, 2007; Greene & Hall, 2010; Johnson & Onwuegbuzie, 2004; Morgan, 2007; Nastasi et al., 2010; Onwuegbuzie & Leech, 2005).

Pragmatism is a practical, result-oriented method of inquiry, with a focus on workable solutions to problems. It produces results that are more flexible and transferable to other settings (Greene & Hall, 2010; Johnson & Onwuegbuzie, 2004; Morgan, 2007). Pragmatists consider the use of both quantitative and qualitative methods desirable because it allows researchers to capitalise on the strengths of each method. Quantitative methods can provide greater empirical precision, and qualitative methods offer descriptive precision. Therefore, combining both methods can provide a more holistic approach to research and can achieve better results (Denscombe, 2008; Johnson & Onwuegbuzie, 2004; Onwuegbuzie & Leech, 2005).

Pragmatism is appealing to applied scientists because it is results-focused and action-oriented. It ties research to practical ends by providing solutions to practical problems and solutions that can be used in other applications (Greene & Hall, 2010; Johnson & Onwuegbuzie, 2004; Maxcy, 2003; Teddlie & Tashakkori, 2011). This study is applied in nature, seeks to address practical issues, and provide guidance that can be applied in other situations. Therefore, pragmatism was the most appropriate research paradigm to guide this study.

5.2.2 Mixed methods

There are three principal approaches used in social research, quantitative, qualitative and mixed methods. The research approach used in this study was mixed methods, which combines elements of quantitative and qualitative approaches to address a research problem (Denscombe, 2008; Johnson & Onwuegbuzie, 2004; Johnson et al., 2007). Johnson and Onwuegbuzie (2004, p. 17) define mixed methods research as 'the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study'.

A quantitative approach is usually associated with the positivist paradigm and focuses on objectivity in the research process. It assumes that the observer is separate and emotionally detached from the phenomena under investigation. The quantitative approach is deductive and works from the general to the specific, and usually involves the testing of theories and hypotheses. Qualitative research, on the other hand, is interpretive and subjective. It focuses on induction, working from the specific to general by focusing on patterns in the data, and acknowledges that research is affected by values. Qualitative research deals more with exploratory questions and seeks to understand, while quantitative research is more about confirmatory questions and seeks to explain (Babbie, 2010; Creswell, 2009; Denzin & Lincoln, 2000; Henderson, 2006; Johnson & Onwuegbuzie, 2004; Teddlie & Tashakkori, 2011).

A mixed methods approach recognises that social phenomena are complex, and is based on the assumption that there are multiple legitimate approaches to social research. Greene (2008, p. 20) described a mixed methods way of thinking as one '…that actively invites to participate in dialogue – at the large table of empirical inquiry – multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished'. It recognises that quantitative and qualitative approaches are compatible, important and useful, and that a mixed methods approach can complement both qualitative and quantitative research. Prior to wide acceptance of mixed methods, quantitative and qualitative approaches were seen to be distinct and incompatible. Now they are more commonly considered to form a continuum, with quantitative and qualitative approaches located at each end and mixed methods in the centre (Alasuutari, Bickman, & Brannen, 2008; Johnson et al., 2007; Onwuegbuzie & Leech, 2005).

Qualitative research provides a detailed understanding of social phenomena, and quantitative research provides a broader, more general understanding. Therefore, by combining elements of quantitative and qualitative approaches, it is possible to broaden and deepen understanding of a research problem. The goal of a mixed methods approach is to utilise the strengths of quantitative and qualitative approaches and minimise their respective weaknesses (Creswell & Plano Clark, 2011; Greene, 2007, 2008; Johnson & Onwuegbuzie, 2004; Johnson et al., 2007; Teddlie & Tashakkori, 2011).

A mixed methods approach is characterised by a range of philosophical paradigms, assumptions, methods, data collection and analysis techniques, and reporting styles (Greene, 2007). Although there are no prescriptive guidelines, or specific formulae, to follow for mixed methods research (Greene, 2007), the literature describes a number of factors that characterise a mixed methods approach. Mixed methods research is distinguished by the following characteristics, compiled from Creswell and Plano Clark (2011), Greene (2008), Johnson and Onwuegbuzie (2004), Johnson et al. (2007), and Teddlie and Tashakkori (2011):

- The research problem is central to, and determines, the methods and techniques used in the study and the status and priority given to qualitative and quantitative methods and results.
- The design of the study is determined by the purposes of the study, and is influenced by context and level of resources.
- Acceptance of the compatibility across seemingly diverse research paradigms, and acceptance that various research paradigms may frame a study.
- Acceptance of multiple ways of knowing, and acceptance and inclusion of diversity and multiple viewpoints and perspectives at all levels of the research project.
- Acceptance of the legitimacy of using multiple approaches to address a research problem.
- The use of a combination of quantitative and qualitative approaches in the same study, which may be mixed at any or all stages of the study.
- The logic of inquiry may include deductive and inductive logic, and abductive reasoning, i.e. making inferences of the best possible explanation based on available information.

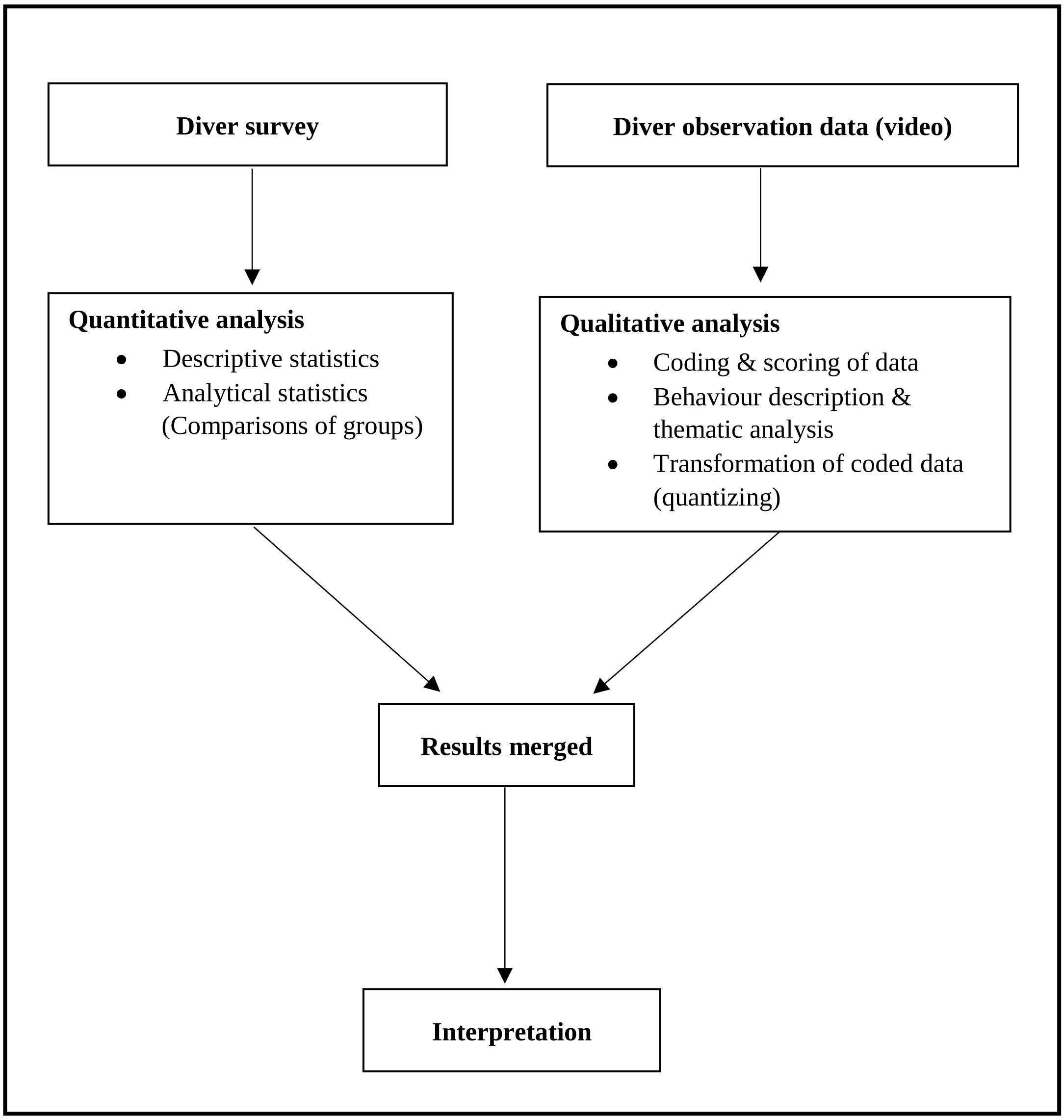
There are number of reasons for choosing to use a mixed methods approach for social research. It can provide broader and deeper understandings of the social phenomena under investigation, particularly complex, multifaceted phenomena. A mixed methods approach can address a broader range of research objectives and add insights that can address a research problem more effectively, by integrating quantitative and qualitative data. It can also improve the accuracy of the data and produce higher quality results than a single method can achieve.

Eight specific justifications for using a mixed methods approach are identified in the literature. These are: triangulation, complementarity, development, initiation, expansion, offsetting, completeness, and explanation (Greene, 2007, 2008; Johnson & Onwuegbuzie, 2004; Johnson et al., 2007). The following justifications were compiled from Creswell and Plano Clark (2011), Greene (2007), Johnson and Onwuegbuzie (2004), and Teddlie and Tashakkori (2011):

- **Triangulation** refers to convergence and corroboration of findings from different methods to provide greater certainty and stronger support for conclusions, i.e. greater validity of findings.
- **Complementarity** is the most common reason for using mixed methods because the results of one method can enhance and clarify understanding of the results from the other method. In doing so, it can broaden and deepen understanding of the social phenomena under investigation.
- **Development** is where the findings of one method are used to help inform the findings of the other method.
- **Initiation** is the opposite of complementarity, as it seeks divergence by using different methods to assess various dimensions of the same phenomenon to provide a greater insight and a more complex understanding.
- **Expansion** can broaden the scope of a study because different methods are used to assess different phenomena.
- **Offsetting** means drawing on the strengths of each method and offsetting their weaknesses.
- **Completeness** refers to the creation of a more comprehensive and credible understanding of the phenomena under investigation by combining quantitative and qualitative methods.
- **Explanation** is the use of the results from one method to assist in explaining the results of another.

The design of a mixed methods study can be fixed or emergent. This study used a fixed design, meaning that the use of quantitative and qualitative methods was decided and planned at the inception of the research project, and was implemented the same way in which it was planned. The study also took a convergent design approach to the mixing of quantitative and qualitative methods. This meant that implementation of the quantitative and qualitative components of the study occurred concurrently and equal status was given to each method. With a convergent design, mixing can occur during the initial data analysis, such as transformation of data, and after separate data analysis. A convergent design is recommended when a more complete understanding of the research problem is required, as was the case for this study. This design also typically pairs with pragmatism. (Creswell & Plano Clark, 2011). Figure 16 provides a diagrammatic representation of the study components and the mixing of quantitative and qualitative methods in this study.

Figure 16 **Diagram of the study components and mixing of methods**



5.2.3 Research strategy rationale

A key element of mixed methods research is the integration of data. This study used a mixed methods approach, and integrated qualitative and quantitative data to enable all research objectives to be addressed. A mixed methods approach was also applied for the purposes of triangulation, offsetting, initiation and explanation.

A quantitative approach was required to address part of research objective one – examine and critique diver motivations and attitudes, because a broad understanding of a large sample of wreck divers was required. The quantitative data was collected by a self-completed survey. It is possible to predict some behaviour from self-reported attitudinal studies (Ajzen, 2001; Baumeister, Vohs, & Funder, 2007). Therefore, inferences about behaviour can be made from participants responses to questions about motivations for wreck diving and attitudes to management controls.

However, this method of data collection has a potential limitation that needs to be considered. Responses may be affected by social desirability bias (Fisher & Katz, 2000; King & Bruner, 2000), and therefore may not accurately reflect actual behaviour. Ideal research combines self-report questionnaires with actual observations (Baumeister et al., 2007), and comparison of the findings from each can give a better understanding. Therefore, the most feasible means of understanding diver behaviour was to combine the survey data with behavioural observations. The observation of diver behaviour was required to address the remaining part of research objective one – examine and critique diver behaviour. The diver observations were analysed using both quantitative and qualitative methods.

A mixed methods approach was taken to address research objective two. This objective was addressed in part through the review of literature on the management of diver impacts on underwater cultural heritage. The outcomes of the survey were also used to address this objective. Specific methods used in this study are described in the following sections.

5.3 Survey methods

5.3.1 Sampling

Recreational scuba divers were surveyed between 9 October 2013 and 3 December 2015 using a self-completed web-based questionnaire administered via SurveyMonkey® and Qualtrics. The reason for using two different survey platforms for the same survey was due to the different survey software used at the universities where this research was conducted. The survey was initially launched on SurveyMonkey® and later on Qualtrics. The SurveyMonkey® link remained active for the entire duration of the survey data collection, which allowed continued collection of data from the links initially publicised. The Qualtrics survey link was active between 25 March 2015 and 3 December 2015. The survey took approximately 10-15 minutes to complete.

The target population for this survey were the significant source populations of wreck divers known to visit wreck diving destinations in the Asia-Pacific region. This included Australia, China, Japan, Korea, Russia and the United States. As such, the survey was available in five languages Chinese, English, Japanese, Korean and Russian. However, wreck divers from other nations were not prevented from participating.

The sampling strategy used in this study took into account the difficulties other researchers, such as Davis (1997), Ditton et al. (2002), and Stolk et al. (2005) identified in obtaining representative samples of scuba divers for surveys. Recreational scuba diving is a self-regulated industry and is not licensed by a single central authority. In order to participate in recreational scuba diving, divers must obtain a dive certification from one of the private sector (for-profit or not-for-profit) internationally and nationally based diver certification organisations (section 3.2.1). In most parts of the world, once a diver has attained their dive certification no other licenses are required to participate in the activity (Ditton & Baker, 1999; Ditton et al., 2002; Johansen, 2013; Lew, 2013; Lindgren et al., 2008). As a result, there is no single register of divers and the international recreational diver population is not able to be quantified. Therefore, for the purposes of research participation, the population is unknown.

Non-probability sampling techniques were used in this research. The use of these techniques are necessary and justifiable when it is not possible to obtain random samples of the target population. This occurs when the target population is not known or cannot be quantified, or when individuals cannot be accessed directly by the researcher (de Vaus, 2014; Sexton, Miller, & Dietsch, 2011). In this study, the target population was unknown, and therefore could not be quantified. Additionally, individuals could not be accessed directly by the researcher (section 5.5.1).

The use of web-based surveys for recreation research has increased in recent years for a number of reasons. Web-based surveys can reach larger audiences and be completed in shorter timeframes. They are able to gather large amounts of data, and are less expensive and less labour intensive than traditional survey data collection methods. Web-based surveys are also more convenient for respondents than traditional methods of administering surveys (Evans & Mathur, 2005; Graefe, Mowen, Covelli, & Trauntvein, 2011; Keillor, Owens, & Pettijohn, 2001; Sexton et al., 2011; Vaske, Jacobs, Sijtsma, & Beaman, 2011).

The main justifications for choosing a web-based platform to administer this survey were because it was not possible to obtain mailing lists for divers due to privacy laws and proprietary issues, and logistical considerations when obtaining survey data globally. It allowed a large number of international participants to be reached. Web-based surveys are also a cost effective method of data collection. The success of online surveys in previous studies of recreational divers, such as Edney (2011b, 2012a), Edney & Spennemann (2014, 2015), Stolk et al. (2005), Tschapka & Kern (2013) also justified this approach.

5.3.2 Potential limitations of web-based surveys

It is acknowledged that there can be some disadvantages in the use of web-based surveys compared to traditional survey methods. The most notable reason is that it is not always possible to determine response rates using web-based methods (Sexton et al., 2011). Response rate is one indicator of the representativeness of the sample, and can be determined and reported on when traditional methods of administering surveys are used. Low response rates can be a concern to researchers, as it can result in an unrepresentative sample of the target population (Babbie, 2010).

The literature lacks consensus regarding comparative response rates of traditional survey methods and online surveys. Some contend that the response rate to online surveys is lower than traditional survey methods (Sexton et al., 2011), while others hold that online surveys receive higher response rates, particularly where the survey is of interest and relevant to the respondents targeted (Evans & Mathur, 2005). It is not clear from the literature which method should be given more emphasis. However, when using online surveys it is important to design them in a way that maximises response rates. This can be achieved by assuring potential participants that they will remain anonymous and that the data collected will be treated with confidentiality, and by communicating the public value of the survey (de Vaus, 2014).

Another potential limitation of online surveys is the potential for ‘poll-crashing’ or ‘ballot-stuffing’. This occurs when one respondent provides multiple responses to a survey, and can skew results. The most common method of preventing poll-crashing is to provide a unique identifier to each potential respondent, which only permits one response per identifier (de Vaus, 2014; Sexton et al., 2011). Another method of preventing ‘poll-crashing’ is to set the survey up in a way that only allows one response per computer or device. It was not feasible to use unique identifiers in this study due to the recruitment methods required to obtain participants. Allowing one response per device was also deemed unsuitable for this study, as it had the potential to limit the number of responses per household. Instead, internet protocol (IP) addresses were collected and analysed to ensure that there were not excessive responses from a single device. If this was detected, these responses could be excluded from the analysis.

Social desirability bias is the most common bias affecting survey data in the social sciences, and can potentially skew results (King & Bruner, 2000). Social desirability bias can occur because of a human tendency to give responses to survey questions that participants perceive to be most consistent with what is socially acceptable or desirable, rather than providing an accurate response. It is most relevant to survey questions about behaviour and attitudes, and most likely to occur when the topic is sensitive, controversial or culturally important, or when strong social norms apply (Ajzen, 2005; de Vaus, 2014; Fisher & Katz, 2000; Keillor et al., 2001; King & Bruner, 2000).

The result of social desirability bias can be the over-reporting of ethical or socially desirable behaviours and actions, and the under-reporting of behaviours and actions considered unethical or socially undesirable (Ajzen, 2005; Chung & Monroe, 2003; Gordon, 1987). The under-reporting of undesirable or unethical behaviours and actions occurs more often than the over reporting of ethical or desirable behaviours and actions (Sullmann & Taylor, 2010). Social desirability bias has been found to be higher in women, and is known to decrease with age (Chung & Monroe, 2003; Fisher & Katz, 2000; King & Bruner, 2000).

Reducing the potential for social desirability bias to affect survey responses is, therefore, an important consideration in survey design. Self-administered surveys are less affected by social desirability bias than those administered by an interviewer. Anonymity further reduces the potential for social desirability bias to affect a survey (Dillman et al., 2009; Fisher & Katz, 2000; Milfont, 2009; Nederhof, 1985). Another method of reducing social desirability bias is by presenting questions as non-threatening, or as neutrally as possible (Dillman et al., 2009; Fisher & Katz, 2000; Gordon, 1987; Milfont, 2009; Nederhof, 1985). Encouragingly, the few empirical studies that have measured social desirability bias have found the effect to be low or non-existent (Milfont, 2009; Sullmann & Taylor, 2010). Nevertheless, it does need to be considered and taken into account. Therefore, this study was designed to minimise the potential for social desirability bias.

Self-selection bias is another consideration. Web-based surveys are known to be more prone to self-selection bias than traditional methods of administering surveys (Bethlehem, 2008, 2010). Concerns have been raised that segments of the general population are not covered by web-based surveys, such as people with lower incomes and education, and the elderly (de Leeuw, 2008). This was not a factor in this study, as previous research into wreck divers has shown that wreck divers are highly educated and affluent, and the majority are middle-aged (Edney, 2011b, 2012a; Edney & Spennemann, 2014, 2015). Furthermore, Edney's survey of Australian divers, reported in Edney (2011b) and Edney and Spennemann (2014, 2015), provided the option of a web-based or hard copy survey. There were only two requests for hard copy versions of this survey and they were sent out with a reply paid envelope. One hard copy response to the survey was completed and returned. In comparison, 1095 respondents completed the survey online.

Survey self-selection produces results that are biased in favour of participants with higher motivation. Therefore, responses may not be representative of the whole population of potential participants (Brandes, Godes, & Mayzlin, 2013; Oberski, 2008). This leaves the potential for unanticipated outcomes, unless it is accounted for (Jacobs, Hartog, & Vijverberg, 2009).

Any effect of self-selection bias in this study is considered negligible because the survey was promoted to recreational scuba divers generally. It did not specifically target wreck divers. The aim of the study was not to determine motivations, attitudes or preferences about wreck diving held by the recreational diving population as a whole, but a specific subset (i.e. those who dive shipwrecks) from the source populations of wreck divers who visit wreck diving destinations in the Asia-Pacific region. However, it is recognised that participants are likely to be committed divers who were prepared to voluntarily spend time responding to the survey, and are therefore likely to be individuals who hold strong opinions about diving. While this may have the potential to create some degree of self-selection bias in the results, it is the committed and opinionated divers who can present the greatest challenges to managers (Eddington & Eddington, 2008), and therefore this is the group who are most needed to be understood.

5.3.3 Survey structure and content

The survey questionnaire was divided into seven sections. These were: diver profiles which included demographics (six questions), and dive experience and certification (three questions); motivations for scuba diving (one question with 16 items); wreck diving frequency (one question) and motivations (one question with 14 items); attitudes to management controls (one question with nine items); preferences for the protection of shipwreck sites with cultural values (two questions with six items each); opinions about artificial reef wrecks (one question with 12 items); and, attitudes to management controls on shipwreck sites regularly visited by the participant (one question with nine items). Closed questions with multiple-choice checklists were used for the diver profile and wreck diving frequency questions. Five point Likert-type scales were used to rate relative importance or level of agreement with the statements in the questions in the remaining four sections of the survey. These questions also had a ‘don’t know’ option, which was included to prevent false or unreliable responses from participants who did not hold an opinion. Without this option, participants may be forced to express a preference when they do not have one. Closed dichotomous questions were used to screen non-wreck divers from wreck divers, and wreck divers who had or had not dived artificial reef wrecks. A copy of the survey questionnaire is at Appendix 1. The survey was open to all divers, however, divers who had never dived on a shipwreck only completed the first two sections of the survey (i.e. demographics and dive experience, and motivations for scuba diving). Divers who had not dived on artificial reef wrecks did not complete the final two sections. This was achieved using the skip logic function of SurveyMonkey® and Qualtrics. Skip logic sent non-wreck divers to the end of the survey after completion of section two of the survey, and non-artificial reef wreck divers to the end of the survey following completion of section five.

The survey was structured so the most important questions were earlier. In most studies the more interesting questions would be placed at the start of the questionnaire, and the diver profile information would be collected near the end. Placing demographic questions at the start of the survey can reduce the number of responses to a survey because these questions may be perceived as routine and uninteresting (Babbie, 2010; de Vaus, 2014). However, in this survey the diver profile questions were deliberately collected first because this information was critical for addressing the original research objectives, and was therefore considered the most appropriate place for these questions at the time the survey was launched.

The demographic data collected included country of residence, and country of birth or nationality. The countries specifically listed in the survey were Australia, China, Japan, Korea, Russia and the United States. These countries were included because they represented key source populations of wreck divers visiting the Asia-Pacific Region. For Korea, the option was 'Korean', although the translator wrote this as South Korean on the Korean language version; all the English versions went out as 'Korean'. On reflection post-survey, it is clear the survey should have differentiated North Korea and South Korea. While this minor error may have influenced responses, there were no responses to the Korean language version of the survey, and only a small number (four) of Koreans who responded to the English version. It is most likely these would have been South Koreans, although this cannot be tested. The survey results list any Koreans as South Korean.

The majority of the survey questions were very similar to those used in previous research undertaken by the researcher. This was to allow comparison between the data sets. Therefore, because these questions had been piloted and refined previously, (see Edney 2011b, 2012a; Edney & Spennemann 2014, 2015), there was no need to repeat piloting of these parts of the survey. Additional questions were added to this survey in order to address the original research objectives of this study. This included the questions dealing with preferences for the protection of shipwreck sites based their cultural values, and the respondent’s relationship to the shipwreck. These additional questions were pretested by a small group of colleagues prior to finalisation and release of the survey.

The questions used in the diver profile, and motivations to scuba dive sections of the survey were derived and adapted from other surveys conducted on scuba divers. These included Davis (1997), Ditton et al. (2002), Holecek & Lothrop (1980a, 1980b), Jewell (2004), Meisel & Cottrell (2004), Stolk et al. (2005), Thapa et al. (2005), Todd et al. (2002), and the personal experience of the researcher. The management controls listed in the survey were derived from a range of management strategies commonly used or proposed by heritage managers and dive operators throughout the world. Some statements were adapted from Holecek & Lothrop (1980a, 1980b) and Todd et al. (2001). The elements of the questions about the importance of protecting various cultural values of shipwrecks were developed from the researcher's experience in heritage management and wreck diving. The artificial reef wreck section of the survey was developed from Stolk et al. (2005), and based on the experience of the researcher.

For the purposes of this study, motivation refers to internal processes that drive and govern human behaviour (Kanfer, 1990; Roberts, Treasure, & Conroy, 2007), and attitude is defined as '…a disposition to respond favourably or unfavourably to an object, person, institution, or event' (Ajzen, 2005, p. 3).

As outlined in section 1.1, this research commenced at Charles Sturt University and had a different focus. One previous area of inquiry was to examine whether cultural background influenced diver motivations, attitudes and behaviour. Cultural factors, or cultural markers, have be used to explain differences in the behaviour of tourists. Many factors can determine cultural identity, and a range of factors are used for cross-cultural comparisons in recreational and tourism contexts, including nationality and country of residence, age, gender and education, as many factors determine cultural identity (Cohen, 2009; Dann, 1993; Ladhari, Pons, Bressolles, & Zins, 2011; Maoz, 2007; Pizam & Sussman, 1995; Sasidharan, 2002; Sørensen, 2003). Therefore, the survey collected this range of data to enable the effect of culture to be examined. However, as the researcher's thinking evolved, the focus also evolved and was refined. Therefore, some of the data collected in the survey was to serve another purpose and is no longer relevant. The data this applies to is clearly identified in Chapter 7.

5.4 Video methods

5.4.1 Background

Observation has played an important and central role in social research data collection. This is because self-reported behaviour can be limited in its validity and reliability, due to issues of social desirability, comprehension and accurate recall or prediction (Kelly et al., 2014; Prosser & Loxley, 2008). This means that self-reported behaviour may differ from actual behaviour, and is not necessarily accurate. Therefore, it is both necessary and advantageous to study actual behaviour (Baumeister et al., 2007).

Traditional methods of participant observation have some limitations due to their reliance on memory, which can be fragmentary and subject to reconstruction. In addition, some of the events or actions under observation can be missed. Importantly, the presence of an observer, or the knowledge that they are part of a research study, can alter the behaviour of participants. This phenomenon is often referred to as the 'Hawthorne effect' or 'observer effect'(Adair, 1984; Babbie, 2011; Wickström & Bendix, 2000), and may also be referred to as 'reactivity' (Babbie, 2011).

It is not possible to completely eliminate the impact of the observer on the behaviour of those being observed. This is because anything the observer does, or does not do, has some type of effect on the behaviour of those under observation (Babbie, 2011). However, it is important that observations of behaviour are undertaken in a way that reduces the possibility of the observer effect, so that the participant and other divers present behave as they would if an observer was not present (Angrosino & Mays de Perez, 2000).

5.4.2 Video observations

An effective means of reducing the observer effect is to use video to record observations. Video observation can reduce behavioural modification of subjects under observation, in comparison to traditional methods of observation (Pringle & Stewart-Evans, 1990). There are a number of other benefits of video observation. It is less distracting and more reliable than traditional methods of observation. It relies on relatively inexpensive technology that provides a novel, effective and unprecedented opportunity to observe human behaviour in natural settings (Asan & Montague, 2014; Browning, Benckdorff, & Bidwell, 2008; Chalfen, 2014; Heath, Hindmarsh, & Luff, 2010; Heath & Luff, 2008).

Other significant advantages of using video over traditional observation methods are that it improves the trustworthiness and quality of the data and analysis. Video is a more accurate method of observation because it can be viewed several times, analysed repeatedly, checked and verified. It also permits the fine details of behaviour to be studied, and allows behaviour to be recorded and analysed in real-time (Asan & Montague, 2014; Heath et al., 2010; Prosser, 2011; Signal et al., 2017). Additionally, video observation provides more comprehensive information about the observation environment than the notes made on the environment using traditional methods of observation (Asan & Montague, 2014). It also offers opportunities for enhanced insights into behaviour. For these reasons, the use of video observation in the social sciences has become more widespread (Prosser & Loxley, 2008)[1].

5.4.3 Wearable cameras

The use of wearable cameras for video observation can further reduce the potential for the observer effect because they are less obtrusive (Lahlou, 2011; Signal et al., 2017). This was demonstrated by Wiener (2016), who used head-mounted cameras to study human-dolphin interactions in Hawai'i. This study included an assessment of behaviour of participants wearing cameras and non-participants who were not. When the behaviour of the two groups were compared no significant difference was found between the two groups.

Wearable cameras offer new and innovative ways of enhancing knowledge in the social sciences, and can allow things to be studied that were not possible in the past due to their inaccessibility. This technology can be used to provide reliable and valid methods of observation, and insights into behaviour not previously possible. It can also record detail that is often missed by observations made without cameras (Browning et al., 2008; Chalfen, 2014; Gemming, Doherty, Utter, Shields, & Ni Mhurchu, 2015; Lahlou, 2011). Wearable cameras provide an effective means of collecting participant-generated data. They are being used increasingly to study health behaviours, such as diet and exercise (Asan & Montague, 2014; Doherty et al., 2013a; Doherty et al., 2013b; Kelly et al., 2014; Signal et al., 2017), but have been underutilised in the social sciences (Brown, Dilley, & Marshall, 2008; Kelly et al., 2013). However, there is increasing interest in the use of participant-generated data in the social sciences. The use of wearable cameras are particularly relevant to

[1] The references cited regarding video methods and the use of video for observational studies may seem dated. However, there appears to be a paucity of scholarly literature in this area since 2008. Communication with another independent researcher using similar video methods confirmed this observation.

leisure activities because the images capture focus on personal experiences (Browning et al., 2008; Prosser & Loxley, 2008).

When a participant wears a camera that captures their view it means the observations are not a researcher-centric view of participant behaviour. Wearable cameras allow the point of view of the participant to be observed by providing a first-person perspective. A first-person perspective captures the participant's environment and how the participant sees it, giving researchers an understanding of the participant's visual environment and situation. This perspective is difficult to perceive from researcher observations of the participant, and is one of the biggest advantages of using wearable cameras. It also provides an opportunity for researchers to see aspects of a participant's behaviour they may not otherwise gain access to (Brown et al., 2008; Browning et al., 2008; Chalfen, 2014; Kelly et al., 2013; Kindt, 2011; Lahlou, 2011; Lee, Bahn, Kim, & Yun, 2010; Prosser & Loxley, 2008).

The device used to collect participant-generated data should not alter the behaviour under observation. A camera that is small, light-weight and does not require the participant to use their hands can achieve this (Lahlou, 2011). Hands free operation is particularly desirable because it allows the participant to focus on their activity rather than the camera (Brown et al., 2008). Head-mounted cameras have become feasible as wearable cameras and video cameras have become smaller and lighter (Chalfen, 2014). They give a dynamic view of the participant's visual environment, are unobtrusive, inexpensive, and are able to capture data over a significant period of time (Mausner, 2005; Yoshida & Smith, 2008).

Some consider that particular behaviours may be encouraged by participant-recorded video, such as the exciting elements of an activity. Other behaviours, such as the mundane aspects of an activity, may be discouraged by participant recorded video (Brown et al., 2008). However, camera users get used to the presence of the camera and forget about their existence quickly, usually within a few minutes (Brown et al., 2008), and Heath et al. (2010) contend that this effect is often overestimated.

Over the past 15 years a plethora of small, robust, relatively inexpensive wearable action cameras have become readily available, and many are able to be head-mounted (Chalfen, 2014). Surprisingly, there are limited published examples of the use of wearable cameras in the recreation literature. Brown et al. (2008) used head-mounted cameras to study the embodied experiences of walkers and mountain bikers in

Cairngorms National Park and the countryside of north-east Scotland. Browning et al. (2008) used hat-mounted cameras to record bodily experience data of walkers visiting Bowling Green National Park and the Townsville Town Common in Queensland, Australia. Mausner (2005) used head-mounted cameras to study hikers on the Appalachian Trail in Sterling Forest State Park, in New York State in the United States.

Recently, Wiener (2016) used head-mounted GoPro® cameras to determine the effect of human behaviour on wild Hawaiian spinner dolphins. Participants in this study wore head-mounted GoPro® cameras while snorkelling with spinner dolphins at Oahu and Maui, in Hawai'i. The human behaviours examined were those considered aggressive towards the dolphins, such as arm movements, diving down to be closer to the dolphins, deliberately approaching them and chasing them. The study was focused on the effect of these behaviours on the dolphins.

Brown et al. (2008) consider head-mounted video cameras well suited to spatially constrictive, highly mobile and equipment intensive activities. These are situations where it is difficult for the researcher to undertake observations, and is highly relevant to this research. Participants in this study were wreck diving at sites where they were able to swim inside the wrecks, known as wreck penetration, and this often means low or no ambient light and confined spaces. In these situations, it would be difficult, at best, to use traditional observation methods. Additionally, scuba diving is an equipment intensive activity and divers need their hands free to operate their equipment throughout the dive. Therefore, the use of head-mounted video was an appropriate, if not necessary, choice for this study.

The use of head-mounted cameras meant participants in this research were not required to operate the cameras or use their hands, leaving participants to focus on their activity rather than the camera. This was particularly important for use in the diving context for two reasons. The first was diver safety. Holding a camera has the potential to impact on diver safety because it may contribute to task loading, or could impede the participants' ability to operate their dive equipment. The prevention of task loading was a particularly important consideration in this study because many of the dives in Chuuk are deep, and most of the dives involve some amount of time inside the wrecks. There are additional safety factors that must be taken into account when deep diving and when diving in overhead environments. The second reason was so that the participant's enjoyment of the dive was not constrained.

In addition, the use of a hand held camera may have resulted in divers using it to capture particular images, or particular perspectives, because they were more aware of the presence of the camera. It was essential that the video recorded natural behaviours of the divers, and all of what they spent their time looking at and doing, rather than specific highlights of their dive. Using a head-mounted camera meant the video data was an accurate reflection of the participants' visual environment, and they were considerably less able to choose to capture particular images.

Small wearable action cameras, in particular GoPro® cameras have become very common place, if not ubiquitous, in recreational scuba diving. This popularity is probably due to their small size, their ability to be taken to depths of up to 60 metres, the high quality of the video and their ease of operation. A large proportion of divers have GoPro® cameras and operate them in a variety of ways. This includes hand-held, head-mounted, on a pole, attached to their gear or wrist, or mounted on a frame with another camera or with movie lights. Their size and weight, ability to be head-mounted for diving, the high quality of the video and their popularity, made GoPro® cameras ideal to use in this study. Divers are accustomed to GoPro® cameras and pay little, if any, attention to them, or indeed other cameras, and as such, concerns around the issue of the capture of video images of third parties do not appear to arise.

In addition to the participant-generated data collection, researcher video observations were also undertaken using the same GoPro® camera as the participants. This was done because third-person video observations are also beneficial because they provide additional information, including related contextual environmental factors and other influences (Lee et al., 2010). For example, the behaviour of dive guides and other divers. Head-mounted cameras are less intrusive and the role of the researcher is less pervasive than traditional methods (Brown et al., 2008). This study used a combination of both participant and researcher-generated data collection to enable data collection to be optimised by obtaining the benefits of both methods. However, the focus was on the participant-generated data.

5.4.3.1 Potential limitations of head-mounted cameras

Along with the benefits, there are also challenges associated with the use of video for observations. Video observations create large amounts of data to store and analyse, more so than other methods of observation (Browning et al., 2008; Chalfen, 2014), and analysis of the data takes a considerable amount of time (Browning et al., 2008). There is also the risk of equipment failure or malfunction, and the potential for loss of data when this occurs. There are privacy issues to deal with, and ethical standards must be complied with to avoid any unintended consequences for participants (Chalfen, 2014). Ethical considerations are discussed in section 5.7.

A possible limitation of the use of head-mounted cameras is that they may not capture everything the participant is looking at if the camera is not correctly positioned, for example, aimed too high or too low (Mausner, 2005). In addition, if the participant does not move their head the camera will not detect the subtleties of the participant shifting their eye gaze but not moving their head (Yoshida & Smith, 2008). However, head and eye movements are closely linked, and this suggests that video captured by participants wearing head-mounted cameras fairly accurately reflects the participant's view (Browning et al., 2008; Land, 1992). Further, in a diving context, the divers' face mask narrows their peripheral vision to a certain extent, so this potential limitation is expected to be even less of a concern when used on divers because they have to turn their head to look at things more than is normally the case. Nevertheless, it must be considered because there is the potential that the video recordings may not capture everything the diver was looking at.

Another potential limitation in the use of head-mounted cameras to record diver behaviour is that not all contact behaviours may be recorded. For example, lower body contacts, such as standing and kneeling, hitting the wreck with fins or other equipment, such as gauges, accessories or tanks. However, the use of head-mounted cameras in this study was justified because the recording of these types of contact behaviours were not the focus of this study. Head-mounted cameras were also more suited to this study because many of the observations were expected to occur inside wrecks. In confined spaces, such as these, it would be very difficult to undertake third party observations. First, the person under observation may be obscured, for example by silt or the wreck structure. Second, in order to record the behaviour of the diver under observation the observer would need to stay close behind them and it would be difficult to remain unobtrusive when observing under these circumstances. Had the primary objective of this study been to quantify contacts made by divers' lower body and equipment, third-person observation methods would have been the primary method of data collection.

5.4.4 Video protocol

GoPro® HERO 3^{+} Silver Edition cameras were used to collect the video data (Figure 17). The cameras were mounted on participants' heads using the GoPro® head-mount strap. A thin, soft and flexible neoprene hood with a chin-strap was then placed over the head-mount straps to prevent the camera from being dislodged during entry into the water or during the dive. Figure 18 shows a diver wearing one of the cameras.

Figure 17 **GoPro® HERO 3^{+} Silver Edition camera used in study**

Image source: Ted's Cameras (2018).

In cases where the researcher was present on the boat with the participants, the researcher assisted participants by fitting and switching the cameras on for them. If the researcher was not present, the participant and their dive buddy were shown how to properly fit the camera and neoprene hood, and how to operate the camera. The cameras were switched on just prior to entry, and left on for the entire duration of the dive.

The cameras were switched off once the diver got back onto the boat. The video resolution setting used was 960p (1280 x 960) pixels, giving an aspect ratio of 4:3, and the frame rate used was 60 frames per second. This setting was used because it gave the widest field of view (ultra-wide field of view), and was the setting recommended in the GoPro® HERO 3^{+} user manual for body-mounted video recordings (GoPro, n.d.).

By placing wearable cameras on participants, the participants chose what they looked at, what they did, the duration, where they went and what parts of the wreck they explored (to varying extents subject to where the dive guide led them). The researcher controlled the conceptual framing of the data collection by choosing the time and location of the recording. Due to the research objectives of this study, participants were not involved in the framing of the study, its analysis or dissemination.

Figure 18 **Study participant wearing a head-mounted GoPro® HERO 3+ Silver Edition camera**

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera.

The researcher used the same GoPro® HERO 3+ Silver Edition camera as the participants, mounted in the same way, and the same video settings used for the participant-generated data collection. This enabled the researcher to carry out third-person perspective observations of divers and dive guides. The purpose of the researcher observations were to provide a different perspective to the first-person perspective data collected by the participants, and to supplement, and in some cases provide context for, the participant-generated data. However, the researcher also needed to be unobtrusive, and therefore had to appear to be participating in the diver in a similar manner to other divers present.

The researcher wore a camera on all dives that she undertook, regardless of whether participants wearing cameras were present on the dive or not. The researcher also carried a GoPro® HERO 2 hand-held camera with her on all the dives, and recorded particular aspects of most of the dives. This camera was only turned on when the researcher wanted to record something of interest, and its use was balanced with the need to minimise any alteration in behaviour of the divers and dive guides present on the dive.

In addition to the video recordings, the researcher also made notes following each dive about any relevant observations that may assist in the analysis of the data. For example, the content of dive briefings given by the dive guides prior to a dive, and other contextual information. In some cases, notes were made about observed dive guide or diver behaviour on the dives when the camera did not operate. This information was included in the data analysis.

The video observation methods used in this study were trialled by the researcher and some of her colleagues and dive buddies prior to undertaking the fieldwork. The cameras were found to be comfortable and unobtrusive, so much so, that users quickly forgot the camera was present. This was particularly the case with divers who usually wear a dive hood when diving.

The researcher was a participant observer, but did not fully participate. For example, the researcher did not touch artefacts. The researcher took this approach for ethical reasons and to minimise the possibility of influencing the behaviour of other divers, which may have biased the results. There was one exception to this, which is discussed in the video results chapter (section 8.3.2.3). It is recognised that not touching artefacts may also have affected the behaviour of the participants.

5.5 Data collection

5.5.1 Survey recruitment

Non-probability sampling techniques were used to recruit participants for this study because it was not possible to use random sampling techniques. The reasons were because the population was not known and could not be quantified, the researcher was not able to directly access individuals, and it was not possible to obtain mailing lists due to privacy laws and proprietary issues. There were also significant logistical challenges to conducting the survey globally using traditional methods. Other online surveys of divers were reviewed and considered when developing the recruitment strategy for this survey, in particular studies carried out by Edney (2011b), Edney and Spennemann (2014), Stolk et al. (2005) and Tschapka (2006).

Survey participants were recruited using a number of different methods. Links to the survey and information about the research were sent to dive operators, dive clubs and individuals, who were encouraged to participate and requested to forward the link to other divers. Dive operators and clubs were identified through internet searches and word of mouth referrals. The survey was also promoted by word of mouth to divers and other dive researchers, who were encouraged to participate and forward the survey link to other divers. Information about the survey and links were posted on a number of international online dive forums, including Deeper Blue, Good Dive, Scuba Board, Scuba.com, Scuba Diving, Scuba SC, and three Australian dive forums: DiveOz, Underwater Australasia and the Western Australian Divers Forum. Information and links to the survey were also posted on diver related Facebook pages. Follow up reminders were posted on these forums and pages to encourage more responses to the survey.

In addition, the researcher attended the 2015 Asian Dive Expo (ADEX) in Singapore to promote the survey to an Asian audience. The researcher gave a presentation about wreck diving and her previous wreck diving research on the main stage at the show. Survey flyers were also distributed by a number of the exhibitors at the show. The researcher also arranged for colleagues to distribute survey flyers at the 2014 Birmingham dive show in the United Kingdom and the 2014 Dive Equipment and Marketing Association (DEMA) dive trade show in the United States, one of the world's largest dive industry exhibitions.

Articles publicising the survey were prepared for a number of international dive magazines, although the success rate of achieving publication was low. However, it was published by the online 'Undercurrent', a United States based online dive publication that has a wide international circulation. Articles were also prepared for other magazines, such as 'Russian Diver', and the editor of Russian Diver agreed to send links to the survey to divers in Russia.

5.5.2 Video recruitment

The video data collection was undertaken at Chuuk Lagoon in the Federated States of Micronesia, a world renowned wreck diving destination featuring over 50 accessible shipwrecks and around 13 submerged aircraft. A description of the study site and a justification for carrying out the study at that location is provided in Chapter 6.

Non-probability sampling was used in the recruitment of participants for the participant-generated video data collection. It included a combination of convenience and purposive sampling. Convenience sampling refers to the recruitment of people available to participate, and purposive sampling is the sampling of cases that are of interest to the researcher (de Vaus, 2014).

Divers visiting the Blue Lagoon Dive shop, or who were staying at the Blue Lagoon Dive Resort, were approached. The researcher explained the study to potential participants and invited them to participate. Those who expressed interest were given an information sheet, which provided more details about the study. This included details of the ethics approval, and who to contact if they had any concerns about the study or the manner in which it was conducted (Appendix 2). Participants were advised that the focus of the study was to determine what wreck divers most liked to see and what they spent most of their time doing while wreck diving. Participants were not advised that the researcher was carrying out semi-covert observations. The information was given in this way to minimise the potential for the divers to modify their natural behaviour.

The divers who agreed to participate were given a verbal briefing, asked if they had read, and understood, the information sheet and were required to sign a consent form (Appendix 3). Participants were also offered a copy of the video data they collected. The divers were asked to do things they would normally do on a dive, in other words to go about the dive as though the camera was not present.

Diver safety was paramount in this aspect of the study, and the recruitment of study participants reflected this consideration. Potential participants were not approached when they first arrived. They were only approached after they had completed some dives, and appeared comfortable with their diving. This meant that some potential participants were not approached, as they only stayed for a short period of time and there was not enough time for them to get through their ‘shake-down’ dives, or did not appear comfortable enough with their diving. It is not uncommon for divers to go away on dive trips and not have dived for some time prior to the trip. Therefore, it was essential to allow potential participants to get familiar and comfortable with diving again before they participated in the study. Also, divers who are used to diving in colder water may require a few dives to get their equipment sorted out and be totally comfortable diving in tropical conditions. This approach ensured the safety of the divers was given primary consideration, and the enjoyment of their dive holiday was not impacted upon by participating in the study. The result of this decision, however, was that the whole range of divers visiting Blue Lagoon Dive Shop and Resort at the time of the fieldwork were not sampled, and therefore some behaviours may not have been observed. The potential limitation was outweighed, in practical terms, by the need to ensure the safety of all divers, and methodologically in understanding that the extent of observation will never observe every behaviour, and that the dominant behaviours are likely to have been captured by the process described in this thesis.

Some participants saw other divers taking part in the study and requested to participate before the researcher had the opportunity to approach them. Recruitment also occurred as a result of some participants promoting participation in the study to other divers, and suggesting other members of their group participate.

5.6 Data analysis techniques

5.6.1 Survey

The survey data was exported to the Statistical Package for the Social Sciences (IBM SPSS Statistics 24), and this software was used to analyse the data. Data analysis included descriptive statistics of diver profiles, frequency of wreck diving, motivations and attitudes. Inferential statistics were used to investigate associations between diver profile variables and wreck diving frequency on motivations to wreck dive and attitudes towards heritage protection. Chi square analysis was used to investigate differences between two groups. The Kruskal-Wallis test was used to investigate differences between more than two groups, and pairwise comparisons were used for the follow up analyses.

The Kruskal-Wallis test is the non-parametric equivalent of the analysis of variance (ANOVA) and was used because the assumptions of ANOVA could not be met. It is recognised that non-parametric techniques are less sensitive in detecting differences between groups than parametric techniques (Field, 2013). Therefore, it is acknowledged that in some cases there may be differences between groups that are not detected by these techniques. However, this was preferable to using parametric tests because the assumptions could not be fully met, which would have the potential to generate invalid results.

The significance threshold for Chi square analyses and the Kruskal-Wallis tests were set at .05. Actual p values that were $< .05$ were reported, unless they were below .001, and in these cases it was reported as $p < .001$. Results above the .05 threshold were not reported. Other results that were not reported were cases where the results of the Kruskal-Wallis test p values were significant (i.e. $< .05$) but the pairwise comparison follow up analyses showed no significant differences.

The statistics used to analyse the survey data are consistent with those used in other studies of wreck divers, including Edney (2011b, 2012a, 2012b), Edney and Spennemann (2014) and Holecek and Lothrop (1980a, 1980b). Similar statistical analyses have been used in a number of studies of general scuba divers (see for example Chung et al., 2013; Krieger & Chadwick, 2013; Roche et al., 2016; Rouphael & Inglis, 1997; Stolk et al., 2005; Worachananant et al., 2008).

Data used to analyse recreation specialisation included number of dives completed, number of years diving, level of certification and frequency of wreck diving. The reason these variables were used to assess recreation specialisation of the wreck divers was because, with perhaps the exception of frequency of wreck diving data, much of this data is routinely collected by dive operators when divers sign liability release or waiver forms prior to going diving. This information is therefore easily collected and readily accessible to the dive industry, and potentially heritage managers.

Some data was grouped for these analyses due to the need to obtain a sufficient sample size to meet test assumptions. In the demographic data, ages 65 years and above were grouped. In the dive experience data, ≤ 5 dives and 6-20 dives were grouped as ≤ 20 dives, and in the certification levels, instructor and master instructor categories were combined into a single group. Also, due to small sample size, three of countries of residence were excluded from the inferential statistical analyses. Those excluded were China ($n = 4$), Korea ($n = 4$) and Russia ($n = 10$).

Additionally, due to the change in focus of the study (section 1.1), some of the survey questions collected data that was not directly relevant to the current research objectives. The results section reports on all data collected and provides descriptive analysis of this data, but does not further analyse the data. The data this applies to is clearly identified in Chapter 7.

5.6.2 Video

The head-mounted cameras recorded video for the duration of each dive. Following the dive, the researcher collected the cameras from participants. The video data was downloaded onto the researcher's laptop computer, then backed up on a portable hard drive. The video files were copied for participants who requested a copy of the video they had recorded. Batteries and the micro SD cards were replaced following each dive, ready for the next use.

Although the cameras recorded the whole dive, the data was not contained in one file. The GoPro® cameras divide the video into separate files, and depending on the dive duration, a single dive would typically consist of between three and five files. Therefore, prior to analysis of the video data, the video files needed to be stitched together so that each participant's video data was contained in a single video file. In addition to stitching the files together, some editing was carried out to remove unnecessary data recorded prior to entry and following ascent. No other editing of the data was undertaken prior to analysis. Pinnacle Studio 15 video editing software was used to edit the video data. The video data was recorded as MPEG4 (.mp4) files, and this format was retained when the files were edited.

Following editing, the video files were viewed by the researcher. This allowed the researcher to familiarise herself with the observational data, determine a suitable coding scheme for analysis of the behavioural observations of the participant-generated data, and to identify themes for qualitative analyses. The participant video files were then exported to The Observer® XT 12.5, for coding and analysis of the data. The Observer® XT is a software package designed for human and animal behaviour studies, and has been used in a variety of research areas. For example, psychology, sport science, zoology and ethology, neuroscience, and human-computer interactions (Grieco, Loijens, Krips, Zimmerman, & Spink, 2015; Zimmerman, Bolhuis, Willemsen, Meyer, & Noldus, 2009). The Observer® XT 12.5 is a '…professional and complete manual event recorder for the collection, management, analysis and presentation of observational data.' (Grieco et al., 2015, p. 14).

The behaviours recorded are described in Table 6. These were the behaviours relevant to the study, because they are either associated with diver impacts on underwater cultural heritage, such as touching a wreck or artefacts, or are behaviours of interest because they show what the diver was looking at or activities they were engaged in. Five of the behaviours had modifiers attached to them (Table 6). Modifiers further define a particular behaviour, for example, touching an artefact had six modifiers attached. These included 'pick up and inspect', 'pick up and move', 'pick up and clean', 'pick up and hold up', 'pick up and pass to other' and 'clean'. The coded behaviours were able to overlap, if this what was observed. For example, a diver could be looking at a feature of a wreck, while at the same time using a camera. Most of the coded behaviours had durations with the exception of using a

Table 6 Coded diver behaviours

Behaviour	Description	Type	Modifiers
Complete descent	Diver had completed their descent either to the seabed or to the wreck. This is when observations commenced.	Point	
Start ascent	Diver began their ascent to the surface. Many divers technically started their ascent while on a wreck, for example ascending masts or king posts, but essentially were still engaged in wreck diving, in these cases the start of ascent was when they ascended from the shallowest part of the wreck. This is when observations ceased.	Point	
Inside wreck	Diver entered an overhead environment. In the holds of upright ships, this included holds that had the hatch cover beams in place.	Duration	
Look at feature of wreck	Diver was actively engaged in looking at a feature of a wreck, either some part of the wreck fabric or an artefact.	Duration	
Touch artefact	Diver deliberately touched an artefact.	Duration	Pick up & inspect Pick up & move Pick up & clean Pick up and hold up Pick up and pass to other Clean
Use camera	Diver actively engaged in using some type of camera. No distinction was made between video and photographs, as most action cameras are capable of taking both videos and photographs. Likewise most other cameras primarily used to take 'still' photographs also have the capability of taking video images. In most cases it was not possible to distinguish between the types of images being captured. Additionally, many divers with large SLR cameras have both the SLR camera and an action camera attached to the camera mounting.	Duration	Artefact Wreck fabric Marine life People People & wreck People & artefacts People & marine life Other Undetermined
Hand pulling - wreck	Diver uses their hands on a wreck to pull (or push) for propulsion. It is a wreck diving technique used by to move around wreck sites, as it minimises silting and for moving against a current because it is more effective than kicking against a current.	Point	
Sit on wreck	Diver sits on wreck or artefact (for example, the armoured battle tank on the deck of the *Nippo Maru*).	Duration	
Stand on wreck	Diver stands on fins (including fin tips) on a wreck.	Duration	
Kneel on wreck	Diver kneels on wreck.	Duration	
Hold onto wreck	Diver uses hands or other body part to hold themselves on a wreck.	Duration	
Unintentional contact with wreck Unintentional contact with artefact Unintentional contact with marine life	Unintentional contacts are those contacts made accidentally. This often occurs when divers do not have their equipment secures, due to poor buoyancy and lack of situational awareness.	Duration	Fins Knee Elbow Other body part Tank Gauges Other equipment (e.g. light, BCD#, camera, accessories)
Touch marine life	Diver deliberately touches marine life.	Duration	
Hand pulling – marine life	Diver uses their hands on marine life (typically coral) to pull (or push) themselves for propulsion.	Point	

\# Note BCD is an abbreviation for buoyancy control device

camera. Most of the coded behaviours had durations with the exception of 'hand pulling' (both on a wreck or marine life), complete descent and start ascent.

Behaviours with durations are referred to as ‘state events’ and those without ‘point events’ in The Observer® XT (Grieco et al., 2015). Table 6 identifies behaviours with duration, as ‘duration’ and those without as ‘point’. Each of the participant-generated video observations also had independent variables attached to them, these were: participant gender, dive experience category, country of residence, the dive site (name of wreck), the presence or absence of the researcher on the dive, and the name of the dive guide (if known). Independent variables are factors which may help contextualise the observation, and some may have an influence on diver behaviour. The observational method used was continuous sampling, which means that all occurrences of behaviours of interest were scored. This enabled duration and frequency statistics to be generated (Grieco et al., 2015). The recording of behaviours commenced at the completion of the divers’ descent and ended when the diver commenced their ascent.

Independent variables were also recorded for the observations based on the researcher-generated video. These included the dive site (name of wreck), name of the dive guide (if known), presence or absence of participants wearing cameras on that dive, number of participants present, and the number of other divers present on the dive. All dive guides present during the study were Chuukese males, therefore dive guide gender data was not included as an independent variable in the researcher-generated data analysis.

Qualitative analysis of the participant video data was also undertaken. Where appropriate the video data was annotated and comments were inserted, and are shown in real time in the event log. Comments are able to be added to the video in The Observer® XT event log (Grieco et al., 2015). The qualitative analysis provided context for the quantitative analysis of the participant-generated video data.

Similar to the participant-generated data, the video data collected by the researcher was exported to The Observer® XT 12.5. The purpose of this data was to provide a different perspective to the participant-generated data, supplement participant-generated video data and to observe dive guides, participants and non-participant divers. The aim was for the researcher to remain as unobtrusive as possible when undertaking these observations to avoid or reduce the potential of modifying the behaviour of the dive guides and other divers present on the dive. This meant it was not possible to follow a particular diver or dive guide for an entire dive. The result was that the data collection was less structured and more opportunistic than the participant-generated data. The data analysis was a descriptive qualitative analysis. The analysis of the researcher-generated data focused on describing any notable dive guide behaviour, and if relevant, any notable influence this may have had on the behaviour of the divers present. Visible behaviours of other divers were also noted, and any other relevant contextual information was noted. For example, the content of the dive guide briefing, or whether the dive guide was seen touching artefacts. The Observer® XT software was used to record comments in the event log, and this was used in the qualitative analysis of the data, along with notes made by the researcher following each dive.

Following each analysis of the participant and researcher-generated video data, the event log in The Observer® XT was checked for errors, and any errors found were corrected. The video data was checked a minimum of two times by the researcher to verify the accuracy of the analyses. Coding of the observational data was also verified by another person not involved in the study. This verifier was briefed on the behaviours recorded and shown examples of each. The verifier then reviewed a random selection of the analyses of three complete participant-generated and three researcher-generated recordings of dives, and scanned the analyses and video of the remaining recordings. The verification process used was consistent with the literature (Elo, Kääriäinen, Kanste, Pölkki, Utriainen & Kyngäs, 2014; Morse, Barrett, Mayan, Olson, & Spiers, 2002).

5.7 Ethics statement

This study was commenced at Charles Sturt University, and the initial ethics approval was granted by that institution. Ethics approval was then granted by Southern Cross University when the researcher changed institutions. The research was conducted in accordance with the Charles Sturt University Human Research Ethics approval (2012/202) and Southern Cross University Human Research Ethics approval. The initial Southern Cross University ethics approval number was for one year (ECN-15-005), and was renewed for the remainder of the study (ECN-16-008).

The ethics approval covered administration of the survey instrument, the collection of moving images by divers, moving image recordings by the researcher, including covert diver observations, and data storage and handling. The ethics approval required all data to be collected and treated with confidentiality, securely stored, and the anonymity of participants.

A requirement of participation in the survey and the participant-generated collection of moving images was that participants were 18 years of age or older, their participation was voluntary, and their informed consent was obtained. The introductory pages of the survey contained information about the study. It also included a declaration that they were 18 years of age or older, had read and understood the information provided about the study, and gave their consent to participate in order to progress on to the questionnaire (Appendix 1).

The ethics approval permitted the researcher to collect IP addresses of survey respondents. This was to enable to researcher to determine whether there had been any incidences of multiple survey responses from a single IP address, known as 'poll-crashing', which would suggest a single individual had made multiple responses to the survey. If this occurs it has the potential to distort survey results, and if detected would need to be excluded from the data analysis. The IP address collection did not allow the identification of individuals.

The use of visual methods in the social sciences is still relatively novel, and as a result there is limited agreement on practices and guidelines or protocols (Prosser & Loxley, 2008). In regards to the use of video, technology has been evolving rapidly and outpacing legal and ethical systems (Kelly et al., 2013). Consequently, there are few guidelines available for the use of participant-generated video (Heath et al., 2010).

The British Sociological Association (2006) and Economic and Social Research Council guidelines provide a useful ethical framework for visual research (Prosser & Loxley, 2008). These guidelines formed the basis of Kelly et al.'s (2013) ethical framework for using wearable cameras in health research. Recent studies using wearable cameras, for example Castro et al. (2015) and Signal et al. (2017), adopt the ethical framework described by Kelly et al., which indicates the ongoing relevance of the British Sociological Association and Economic and Social Research Council guidelines.

This study applied the British Sociological Association and Economic and Social Research Council guidelines, along with procedures used in other studies that used wearable cameras, to the collection of video data. Key issues include the need to obtain written informed consent from participants, voluntary participation, and provision of information about how images will be used (British Sociological Association Visual Sociology Group, 2006; Doherty et al., 2013a).

It is imperative that any images that are disseminated protect the anonymity of the participants, and confidentiality is maintained (British Sociological Association Visual Sociology Group, 2006; Heath et al., 2010; Prosser & Loxley, 2008). It is particularly important that faces are obscured to maintain anonymity, due the easy availability of facial recognition software and the use of this software in social media, such as Facebook©. Participants must also be advised about how data will be stored and any secondary analyses that may be carried out (Kelly et al., 2013).

Third parties who are in range of the camera and images captured do not have opportunities for informed consent, and some participants and third parties may find this intrusive (Kelly et al., 2013). However, the British Sociological Association (2006) and Economic and Social Research Council guidelines do not require consent of any third parties, and acknowledge that this is not practical. Consent would only be required for third parties if images published or made publicly available allowed individuals to be recognized (Heath et al., 2010; Kelly et al., 2013; Prosser & Loxley, 2008; Wiles et al., 2008).

Ethics approval for the collection of the participant-generated video data for this research required the participants to sign an informed consent form prior to participating, and for the researcher to provide participants with an information sheet that explained the study (Appendices 3 and 2 respectively). In addition, the participants were given a briefing about the study by the researcher, which included ethical considerations such as confidentiality, anonymity and secure storage of the data. The researcher also answered any questions participants and potential participants had about the study. Participants were clearly advised about possible uses of the data in presentations, academic and popular publications, and that if required, images would be altered so that individuals could not be identified. This was not expected to be a problem in this study because dive gear obscures individuals and the mask obscures facial recognition.

The ethics approval also permitted the researcher to undertake covert observations, the use of video to record these observations, and the non-disclosure of the true nature of the study. Therefore, there was no requirement to gain consent or to fully disclose the details of this aspect of the study to participants. This was done to minimise the potential for prior knowledge to influence diver behaviour.

The ethics approval required participants to sign a consent form prior to taking part in the study. This consent included confirmation the participant was 18 years of age or older, confirmation they were giving their informed consent to participate in the study, and signed copyright of the video to the researcher. Additionally, ethics approval required a statement on the information sheet and consent form about what action would be taken in the event of any illegal activities recorded during the research, as negotiated with the relevant site manager. However, the Federated States of Micronesia government did not require the reporting of any illegal activities that may have been recorded during the study, therefore, this information was not included on the forms.

5.8 Chapter summary

This chapter provided a description of, and justification for, the methodological approach and research methods applied to this research. The methodological approach used was pragmatism because it provided a sound foundation for the methods used in this research. Pragmatic inquiry is a practical results-oriented approach that places emphasis on interactions between humans and their environment, focuses on workable solutions, and produces results that are more flexible and transferable to other settings. This research is applied in nature, seeks to address practical issues and provide outcomes that can be applied in other situations. Therefore pragmatism was an appropriate methodological approach. A mixed methods approach was used for this research. This approach recognises the complexities of social phenomena, and combines quantitative and qualitative methods to address a research problem. Qualitative methods provide a detailed understanding of social phenomena, while quantitative methods provide a broader and more general understanding. Therefore, when qualitative and quantitative methods are used together it can broaden and deepen understanding of a research problem, and improve accuracy of the data. Understanding diver behaviour, motivations and attitudes is complex, therefore, a mixed methods approach was most appropriate for this research. Quantitative methods were applied to the diver survey, and both quantitative and qualitative methods were used to analyse diver behaviour.

A qualitative approach was taken to on explore possibilities for enhanced integration of divers and the management of underwater cultural heritage.

The research strategy used in this study was described. It included a self-completed web-based survey of the key source populations of wreck divers who visit the Asia-Pacific region, and observations of divers and dive guides at Chuuk, a major Asia-Pacific wreck diving destination. Sampling and recruitment strategies for the survey and observations were described and justified, and data analysis techniques were outlined. The chapter concluded with a discussion of the ethical considerations applicable to the study.

Chapter 6 – Study site

6.1 Introduction

The study site was within Chuuk Lagoon in the Federated States of Micronesia. It is an idyllic tropical paradise, with its warm, clear waters, lush tropical vegetation and tropical climate (Figure 19). Yet many people have never heard of Chuuk, with the exception of people interested in military history or World War II and scuba divers. Chuuk is very well known to these groups, due to the major role it played in Japan's expansion into the Pacific during World War II, and its 'ghost fleet', a legacy of the war (Jeffery, 2004a, 2012). Chuuk was referred to as Truk from the late 1890s until 1986, when it reverted back to its traditional spelling and pronunciation. However, many people, including some Chuukese, still refer to Chuuk as Truk, particularly when referring to the lagoon (Jeffery, 2004b). Many divers also still refer to Chuuk as Truk.

Figure 19 **View across Chuuk lagoon from Blue Lagoon Dive Resort**

Image © 2018 Joanne Edney.

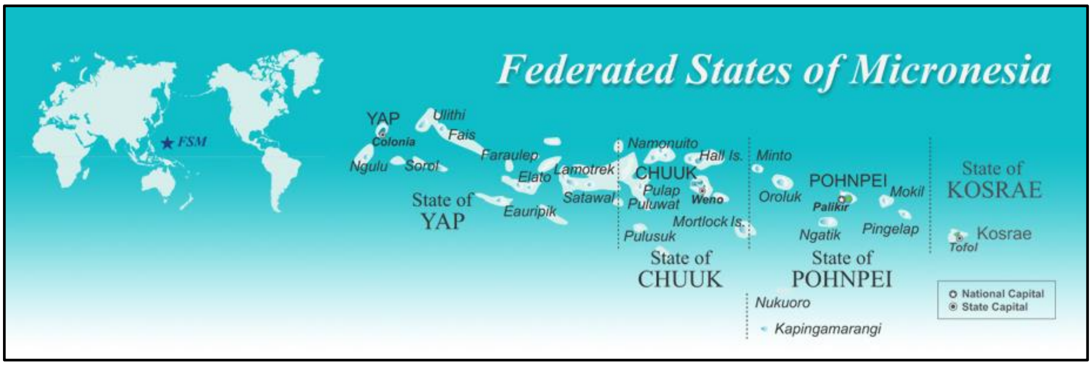
This chapter provides an overview of the geography, economy and historical background of Chuuk, to provide context for the diving environment and associated management issues. This is followed by a description of the history of diving at Chuuk, a dive industry profile, and the values and legal framework of Chuuk's underwater cultural heritage. Then an outline of diver and other human impacts on the underwater cultural heritage at Chuuk and the management of these impacts is provided. The chapter is rounded off with a justification of this site for the fieldwork component of this research.

6.2 Geography

Chuuk is located in the region known as Micronesia, which is located in the western Pacific. Micronesia includes the Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of Kiribati, Republic of the Marshall Islands, Republic of Nauru, Republic of Palau and Wake Island (Government of the Federated States of Micronesia, 2016b; Jeffery, 2004a). The name Micronesia is derived from Greek terms meaning ‘small islands’ (Jeffery, 2007).

Chuuk is one of the four states of the Federated States of Micronesia (FSM) and is located approximately in the middle of the FSM. The other states are Kosrae, Pohnpei and Yap (Smith, 2008). The FSM comprise the western and eastern Caroline Islands, and cover a land area of around 702 square kilometres (Government of the Federated States of Micronesia, 2016b). The FSM is approximately 5,000 kilometres south west of Hawaii, 4,000 kilometres south east of the Philippines and 2,000 km north east of Papua New Guinea (Figure 20).

Figure 20 **Map of the Federated States of Micronesia**

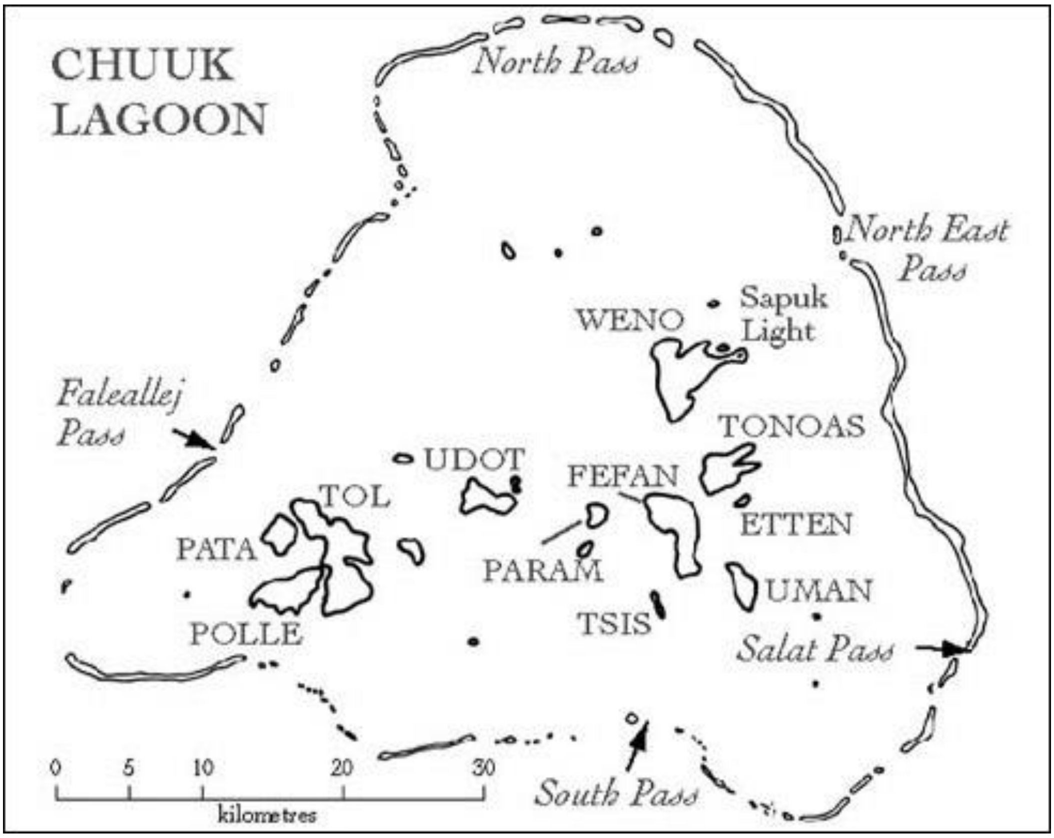


(FSM Visitors Board, 2018)

Chuuk State has a total land area of approximately 127 square kilometres (Government of the Federated States of Micronesia, 2016b), and includes five major island groups, Chuuk Lagoon group, Hall Islands, Namonuito Atoll, Mortlock Islands and the western Islands (Smith, 1992). Chuuk consists of 290 islands, and 40 of these islands are inhabited. Around 98 percent of the land in Chuuk State is privately owned (Government of the Federated States of Micronesia, 2008; W. J. Smith, 2008).

Chuuk Lagoon is approximately 2125 square kilometres in area, 64 kilometres in diameter (Figure 21), and consists of 19 high volcanic (basalt) islands (Figure 22) surrounded by a 225 kilometre long barrier reef (Figure 23) with 87 small and low coral atolls. Mangroves fringe the larger islands, which are largely covered in tropical vegetation. Chuuk means 'mountains' or 'hills' in Chuukese (Goodenough, 1966; Hezel & Graham, 1997; Jeffery, 2004a, 2004b; Smith, 2008).

Figure 21 **Map of Chuuk Lagoon**



(Jeffery, 2004a, p. 54)

There are only a few passages into the lagoon suitable for shipping (Jeffery, 2007). Water depth in the lagoon is relatively shallow, although it can reach up to 70 metres. Outside the lagoon the water is relatively deep, and drops to 1,000 metres within one kilometre of the fringing reef (Jeffery, 2007; Lindemann, 1991).

The administrative centre of Chuuk State is on the island of Weno, the most urbanised of the Chuuk islands (Craib, 1997; Smith, 2008). Close to the equator, Chuuk has a tropical climate with warm year-round temperatures which average 27 degrees Celsius, and an average annual rainfall of 358 centimetres (Government of the Federated States of Micronesia, 2008, 2016b). Chuuk Lagoon's water temperature is 27-30 degrees Celsius year round (Jeffery, 2007). The latitude and longitude coordinates for Weno international airport are 7.4618925 N and 151.8430214 E (7° 27' 43" and 151° 50' 35") (Division of Civil Aviation, 2016).

Figure 22 **View of some of Chuuk Lagoon's high volcanic islands**

Image © 2018 Joanne Edney.

Figure 23 **View of Chuuk Lagoon's barrier reef and passages**

Image © 2018 Joanne Edney.

Population

At the 2010 census, the FSM had a population of around 103,000 people, with an almost balanced gender ratio (50.8% males and 49.2% females). The population is relatively young, with a median age of 21.5 years. The population decreased by 0.4 percent in the decade since the last census, primarily due to migration out of FSM (Division of Statistics, n.d.).

Almost half of the population of FSM reside in Chuuk State. The population of Chuuk State is around 49,000 people, and the gender ratio is almost identical to that of the whole of FSM. The median ages of the population of Chuuk is slightly lower than the FSM as a whole, at 20.7 years. Chuuk State has the highest population density of the four FSM states. Approximately 29 percent of the population of Chuuk State live in urban areas, slightly higher than the FSM average of 22 percent (Division of Statistics, n.d.). Around 94 percent of the population of Chuuk State are Chuukese. Another 0.2 percent are from other parts of the FSM, while the remainder are from other parts of the world (Division of Statistics, 2008).

English is the official language of FSM. Over three quarters of the population of FSM are literate in the English language, although in Chuuk State this is slightly lower at around 70 percent. Local language literacy in Chuuk is approximately 91 percent (Division of Statistics, n.d.).

6.3 Economy

The real GDP for the 2014 financial year was just under $US250 million (Government of the Federated States of Micronesia, 2014b) and the GDP per capita is around $US2,000 per person (Division of Statistics, 2008). The FSM are reliant on support from the international development community and will remain this way for the foreseeable future (Government of the Federated States of Micronesia, 2015). The United States government provides economic assistance under the ‘Compact of Free Association’ (Compact). This agreement originally came into effect in 1986. It was amended in 2003 and runs until 2023 (Government of the Federated States of Micronesia, 2016c). Compact grants are a major source of revenue for FSM, and amounted to $US56.6 million in the 2014 financial year (Division of Statistics, 2008; Government of the Federated States of Micronesia, 2014b).

The most important industries in FSM are agriculture, hunting, forestry, fishing and tourism. Offshore fish is the major export commodity, representing more than half of FSMs exports (Government of the Federated States of Micronesia, 2014b). FSM has an exclusive economic zone of around 6.7 million square kilometres which contains the world's most productive tuna fishing grounds worth around $US200 million dollars. In recent years, FSM has received between $US18-24 million annually for licensing fees for foreign fishing vessels (Government of the Federated States of Micronesia, 2016a).

Agriculture is the most important primary activity, producing approximately 60 percent of the food consumed in FSM. Copra is FSM's biggest cash crop (Government of the Federated States of Micronesia, 2016d). The coconut industry is being significantly increased to meet local and global demands for copra and other coconut tree products, including coconut oil and coconut water (Government of the Federated States of Micronesia, 2014b).

Tourism is another major source of income, and the shipwrecks at Chuuk Lagoon are the major tourist attraction (Jeffery, 2004a). Forty percent of visitors come from the United States, 17 percent from Japan, 13 percent from Europe and just under 6 percent from Australia (Government of the Federated States of Micronesia, 2014b).

FSM receives an average of around 13,500 visitors per year, and in 2014 received 14,811 visitors. Chuuk State receives around 35 percent of this number, with an average of around 4,700 visitors per year, and 4,403 in 2014 (Government of the Federated States of Micronesia, 2016e). Visitor arrivals to FSM grew by almost 3 percent in 2013, after three years of decline. They increased by 7.8 percent in 2014, largely due to the Micronesian games in Pohnpei in July 2014. The largest proportion of tourists originate from the United States (40%), followed by Japan (17%) and Europe (13%). Australia accounts for around 5.7 percent of visitors to FSM (Government of the Federated States of Micronesia, 2014b).

There is a high reliance on imports, which exceed exports by an average of $US123 million. The United States is FSM's main trading partner (Division of Statistics, 2008; Government of the Federated States of Micronesia, 2014b). The FSM unemployment rate is just over 16 percent (Division of Statistics, n.d.). More than half (55%) of employment in the in FSM in the public sector (Division of Statistics, 2008).

6.4 Brief historical background

6.4.1 Indigenous history

Humans first arrived in Micronesia around 3,500 years ago, most likely from Melanesia, and first inhabited Chuuk around 2,000 years ago. (Craib, 1997; Young, Rosenberger, & Harding, 1997). There is some debate about whether people arrived in Chuuk first then settled in Kosrae and Pohnpei or whether people came to Chuuk after settling in Kosrae and Pohnpei. Local tradition and linguistics support the later. The early inhabitants of Chuuk inhabited coastal areas, and evidence of hilltop habitation dates from 500 years ago until European contact (Craib, 1997; Jeffery, 2007).

Matrilineal clans are the basis for social structure in Chuuk. These clans were ranked according to the time of their settlement in Chuuk, amount of land they owned, population size, skills and knowledge, and their battle success. Following marriage, the husband moved to live close to his wife's family, and had labour obligations to both his wife's and his own lineage (Young et al., 1997).

Clans were headed by chiefs, and each village was headed by a village chief, who was the chief of the highest ranking clan. Unlike clan chiefs, village chiefs inherited their title, which was passed to the chief's brothers in age order, then to their sisters' sons also in age order. The role of the village chief was to organise social and economic activities, provide leadership in battles and act as a decision maker in legal issues. The village chief also had spiritual responsibilities, acting as the island's protective spirit representative. Clan chiefs were custodians of the land, were members of the village chief's council and represented clan members. (Young et al., 1997).

This social structure was altered and undermined when Chuuk was colonised by Europeans. First by the Germans and later by the Japanese and Americans. The German's appointed island chiefs, who had the power to remove village chiefs from office. Island chiefs were selected for appointment based on their ability to speak German and their willingness to cooperate. The Japanese and American's retained the role of island chief and gave them increased powers over the village chiefs. The role of island chiefs still exist, and these chiefs perform traditional functions (Young et al., 1997).

6.4.2 Colonialism

6.4.2.1 Spanish period 1521 – 1898

Spain's first claim to Chuuk occurred when Pope Alexander VI divided the 'new world' between Portugal and Spain in 1493-94, bestowing the west to Spain and the east to Portugal. The demarcation line was placed at 370 leagues west of the Cape Verde Islands, at approximately 46°30' W. The Spanish first visited Micronesia in 1521 when Magellan discovered a new route to the Spice Islands (the Moluccas in modern Indonesia) through the Pacific. Magellan stopped in Guam and replenished supplies on his way to the Spice Islands (Bergreen, 2003; Jeffery, 2007). This was the start of Spain's forays into Micronesia.

The date of the first contact between Chuukese and Europeans is not certain. The Spanish ship *San Lucas* is known to have entered the lagoon in 1565, and was possibly the first contact. However, this contact was brief and the ship left the day following its arrival due to the hostile reception they received from the Chuukese. The next vessel to enter the lagoon was the Spanish brig *San Antonio* in 1814, and the Spanish did not visit Chuuk again until 1895. The Spanish gained sovereignty over the Caroline Islands in 1886 and established administrative centres on Yap and Pohnpei. However, Spain did not establish a permanent presence in Chuuk (Craib, 1997; Jeffery, 2007).

During the 19th century there were other foreign contacts with Chuuk. Amongst these were the French explorer Dumont D'Urville. D'Urville provided the first detailed description of Chuuk and its people in 1838, when he visited Chuuk for a week with his ships the *Astrolabe* and *Zelee* as part of his scientific expedition. The first missionaries arrived in Chuuk in 1874 (Craib, 1997). Other foreign contacts during this time included American and British whaling vessels, British, French, German and Russian explorers, traders, shipwreck survivors, and British and German warships (Craib, 1997; Jeffery, 2007). The Japanese navy were also present. They had been making semi-regular visits to Micronesia during training exercises since 1884 (Bailey, 2000).

6.4.2.2 German period 1898 – 1914

Germany first claimed Chuuk in 1885, but revoked the claim a year later. The Germans were permitted to continue to trade and establish naval and coaling stations throughout these islands after Spain gained sovereignty (Craib, 1997; Jeffery, 2007).

Germany purchased the Caroline Islands in 1899 from the Spanish. The German's retained Pohnpei as its administration headquarters for islands, and established an administrative centre for Chuuk on the island of Tonoas (Craib, 1997; Young et al., 1997).

It was during the German period that Chuuk began to be referred to as Truk (Jeffery, 2004b). To facilitate German rule, the German's changed and undermined Chuukese social structures by appointing island chiefs (Young et al., 1997). During this period there were also German scientific expeditions to Chuuk as part of their Western Pacific scientific program (Craib, 1997).

6.4.2.3 Japanese period 1914 – 1939

Japanese traders also had a presence in Chuuk during the Spanish period. The Japanese first visited Chuuk in 1891 with trade goods, and some of the men on board that ship stayed in Chuuk to establish trading businesses. In 1892, the Japanese had a trading store in Chuuk, probably on Weno. By the turn of the century there were around 30 Japanese traders living in Chuuk. However, most Japanese people were expelled immediately following Germany's acquisition of Chuuk in 1899 (Craib, 1997; Hezel & Graham, 1997). Around seven years later Japanese traders, farmers and fishermen were permitted to return to Chuuk, and their trading interests grew (Craib, 1997; Hezel & Graham, 1997).

In October 1914, less than two months after declaring war on Germany, the Japanese seized all German interests in the Pacific north of the Equator. For the following eight years, Micronesia was administered by a Japanese naval unit, the Provincial South Seas Island Defence, from its headquarters in Chuuk (Hezel & Graham, 1997). Then, in May 1919, a League of Nations Mandate awarded the German islands located north of the equator to Japan. Conditions of this mandate prevented Japan from fortifying the islands or establishing military bases. It also required them to submit reports to the League of Nations on their administration of the islands (Craib, 1997; Hezel & Graham, 1997; Jeffery, 2007). In March 1922, the Japanese navy handed administration of the mandated islands to a civilian administration, the *Nan'yō-chō* (South Seas Government), who based their administrative headquarters in Palau (Hezel & Graham, 1997; Jeffery, 2007).

Although this period commenced with military rule, this first Japanese period was characterised by economic development (Craib, 1997). Hospitals were built and health care was provided to outer islands. A public education system was established, and five years of education was made available to the local residents of the islands (Hezel & Graham, 1997). However, this period also saw the start of the Chuukese being alienated from their land and the break-down of traditional practices (Jeffery, 2004b). At Chuuk, agriculture, predominantly a copra industry, was developed along with a major and lucrative fishing industry, principally tuna. Wage labour was introduced during this time (Craib, 1997; Young et al., 1997).

In 1935, Japan withdrew from the League of Nations and commenced building military installations, although this was concealed from other nations (Hezel & Graham, 1997; Young et al., 1997). By 1937, installation of these installations had become the responsibility of the Japanese navy (Hezel & Graham, 1997).

6.4.3 World War II

6.4.3.1 Japanese military period 1939 – 1945

This period of Japanese rule was characterised by the complete military take-over of all activities in Chuuk (Craib, 1997). In 1939, the development of military installations intensified and a Japanese naval unit, the Fourth Fleet, was assigned to the Pacific Islands and moved its anchorage to Chuuk (Hezel & Graham, 1997; Stewart, 1985). Then, in 1941, the Fourth Fleet established its headquarters at Chuuk on Tonoas (Bailey, 2000; Jeffery, 2007).

Japanese prisoners and around 12,000 Korean labourers were brought to Chuuk to construct Japanese military facilities. Many Chuukese were also conscripted to undertake heavy construction work. Chuukese children were also forced to work on farms and the construction of military facilities. By May 1944, there were almost 40,000 Japanese military personnel, construction workers and civilians at Chuuk (Hezel & Graham, 1997; Jeffery, 2007).

Chuuk was considered one of the best and safest anchorages in the world, by both the Japanese and Americans. Strategically located, the large lagoon is surrounded by a barrier reef with only four main entrances. The lagoon also contains mountainous islands which provide protection and easily defended natural fortifications, and water depths suitable for shipping (Bailey, 2000; Craib, 1997; Hezel & Graham, 1997; Jeffery, 2004b; Jeffery, 2007). As a result, Chuuk was considered the strongest naval base outside of Pearl Harbour. It was known as the ‘Gibraltar of the Pacific’.

However, the reality was very different, and the strength of the Chuuk 'fortress' was over emphasised by the Allies (Bailey, 2000; Hezel & Graham, 1997).

Chuuk was a key strategic advance fleet and air base, and its south east push in the Pacific during World War II (Bailey, 2000; Craib, 1997; Hezel & Graham, 1997; Jeffery, 2004b; Jeffery, 2007; Lindemann, 1991). From July 1942 until February 1944 the Japanese Combined Fleet was based at Chuuk. The Combined Fleet was made up of components of the First, Second and Third Fleets, and the Sixth Submarine Fleet. It was the largest fleet in the Japanese navy (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2004b). Chuuk provided a base for Japanese navy vessels, merchant vessels and aircraft (Jeffery, 2004b; Jeffery, 2007).

In February 1944, 365 aircraft, around 60 large ships and more than 80 smaller vessels were located in Chuuk. Most of these were located at the two main anchorages, the Combined Fleet Anchorage between Weno and Tonoas and the Fourth Fleet anchorage south of Tonoas for the merchant vessels (Bailey, 2000; Jeffery, 2006; Jeffery, 2007). There was a third anchorage for the Sixth Fleet around Uman Island (Bailey, 2000).

The Chuukese were most affected on Tonoas, where people were moved from their villages to other villages or islands due to the navy headquarters and military facilities on the island. Similar things happened on other islands. The Chuukese also lost access to their food sources on the islands, which were cleared to make way for military facilities or taken over by the Japanese. However, the greatest impact came with the arrival of the army on Chuuk. Chuukese homes were taken over and demolished to make way for military facilities (Jeffery, 2007), and Army personnel were located on all of the major islands in the eastern part of the lagoon to strengthen defences (Hezel & Graham, 1997; Jeffery, 2007).

Operation Hailstone and other bombing raids

The Japanese had anticipated an Allied attack on Chuuk in early 1944, following the loss of Kwajalein, and after spotting at least one of the two American PB4Y photo reconnaissance aircraft that flew over Chuuk on the 4th February 1944. As a result, most of the warships in Chuuk Lagoon were evacuated between the 3-10 February (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2007; Lindemann, 1991; Stewart, 1985). However, the merchant fleet remained and more merchant vessels arrived because they required repairs, and it was considered too risky to put them to sea until the repairs had been completed. Many of these vessels contained their cargoes due to delays in unloading resulting from strong winds. Although the Japanese had anticipated an attack, they did not expect it to occur prior to 21st February (Bailey, 2000; Hezel & Graham, 1997; Lindemann, 1991). This was to be a grave error in judgement.

'Operation Hailstone' took place on 17-18 February 1944. It was carried out by Task Force 58, which was created for this operation. 'Hailstone' was a carrier-based attack consisting of five large aircraft carriers, 13 light carriers, six battleships, 27 destroyers, six heavy cruisers, ten submarines and a number of other support vessels. The fleet were based approximately 160 kilometres north east of Chuuk (Jeffery, 2007; Lindemann, 1991). The Japanese radar operators did not detect the aircraft leading the strike until about 30 minutes before the attack. Then poor communication, lack of preparedness and confusion meant that the Japanese failed to use the time prior to the attack to respond properly (Hezel & Graham, 1997; Lindemann, 1991). The first attack occurred at around 0600 hours, and following the initial strike, further airstrikes continued at two hour intervals on the 17 February and half of the 18 February (Hezel & Graham, 1997).

The initial focus of the airstrikes were aircraft, airstrips and fuel storage. The focus then shifted to the secondary targets, the ships (Hezel & Graham, 1997; Jeffery, 2007). In addition to the airstrikes from Task Force 58, American warships of Task Force 50 patrolled outside of the lagoon and sank four vessels attempting to leave the lagoon (Bailey, 2000; Lindemann, 1991). In all, as a result of Operation Hailstone, over 200 Japanese aircraft were destroyed and around 100 were damaged. More than 50 ships and submarines were sunk or destroyed inside and outside Chuuk Lagoon, and approximately 27 were damaged. In comparison, the Allies lost 25 aircraft, and one ship was damaged during the operation (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2007).

Although Operation Hailstone destroyed the air strength and naval facilities of Chuuk and cut its supply lines, there were more attacks designed to neutralise Chuuk. There was another carrier-based attack of Chuuk on 30 April and 1 May 1944 by Task Force 58. Although the main targets were aircraft, airstrips and hangers, some ships were also sunk during this operation. This raid destroyed the last of Japan's airpower in Chuuk (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2007). There were also land-based B-24 air attacks carried out at during the night and day from on 14 March until 30 April 1944 (Bailey, 2000; Hezel & Graham, 1997). From May 1944 until August 1945 there were further raids, predominantly by land-based B-24s (Bailey, 2000). There was also a surprise British carrier strike against Chuuk on 14-15 June 1945, which caused little damage but served as a training exercise (Bailey, 2000; Jeffery, 2007).

It has been estimated that around 6,300 tonnes of bombs were dropped on Chuuk during Operation Hailstone and the following operations, which effectively neutralised the ‘Gibraltar of the Pacific’ (Hezel & Graham, 1997; Jeffery, 2004a; Jeffery, 2007). Around 5,000 Japanese navy and army service personnel were killed or wounded at Chuuk as a result of these attacks. Others killed included approximately 120 Chuukese, 30 Americans, and others from several other nations (Jeffery, 2003b, 2004b, 2012). Many more Chuukese, possibly around 1,000, died as a result of the war from starvation and disease (Jeffery, 2012; Poyer, 2008).

Japan announced its surrender on 15 August 1945. The Japanese surrender of Chuuk occurred on the 2 September 1945 on board the *USS Portland* (Bailey, 2000; Stewart, 1985). This was the same day as the instrument of surrender, the document which formalised Japan’s surrender, and marked the official end to World War II was signed in Tokyo Bay on board the *USS Missouri* (Stewart, 1985). At the time of surrender, there were more than 38,000 Japanese military personnel in Chuuk and over 1,500 Japanese civilians. Other civilians included around 9,000 Chuukese, almost 800 Nauruans, and just over 20 civilians from other nations (Jeffery, 2007).

6.4.4 Post World War II

6.4.4.1 American period 1945 – 1979

On 25 November 1945, the American flag was raised on Weno when occupation forces took control of Chuuk. This was the start of cleaning up the island and repatriation of the Japanese remaining in Chuuk (Stewart, 1985). The United States (US) Navy established its headquarters at Weno and administered Chuuk until July 1951. After this Chuuk came under US civilian administration (Craib, 1997; Stewart, 1985; Strong, 2013). In 1947 the United States was made Trustee of Chuuk by the newly formed United Nations. As a result, Chuuk was administered by the United States Trust Territories of the Pacific Islands, through the United Nations Security Council (Jeffery, 2004a; Stewart, 1985).

6.4.4.2 Self-government the Federated States of Micronesia

In 1978, Chuuk, along with Kosrae, Pohnpei and Yap, ratified a constitution for the Federated States of Micronesia. They gained their independence in 1986. Independence occurred when the FSM entered into a political treaty with the US government, the Compact of Free Association. This agreement requires the US government to provide aid to FSM, and permits the US to have military bases in FSM. The Compact also sees FSM treated as a State or territory with respect to receiving US appropriation for historic preservation. In 2003, an Amended Compact of Free Association was formalised, and guarantees financial aid until 2023 (Browne, 2014a; Jeffery, 2004b). Another significant milestone in FSM's independence was securing membership to the United Nations in 1991 (Bailey, 2000).

6.5 Context

The 'ghost fleet' of Chuuk Lagoon, comprising more than 50 shipwrecks and around 13 submerged aircraft, is a legacy of the bombing raids that occurred during World War II, primarily Operation Hailstone (Bailey, 2000; Jeffery, 2003a, 2004a, 2004b). These wrecks now form one of the largest collections of artificial reefs in the world (Bailey, 2000; Earle & Giddings, 1976). Juxtaposed against the horror and tragedy of the events that created the 'ghost fleet', is their beauty, largely due to the abundant and diverse marine life covering them. Their beauty was noted by marine biologist Sylvia Earle when she visited the wrecks in the mid-1970s, who commented 'Give nature time, and a sunken warship resembles a place of worship' (Earle & Giddings, 1976, p. 578).

6.5.1 History of diving at Chuuk

Charles Hillinger, a columnist for the Los Angeles Times, was taken diving on the shipwrecks in Chuuk Lagoon in 1969. Hillinger then published a feature article about the shipwrecks in Chuuk Lagoon. This article made the front page of Los Angeles Times in May 1969, and was syndicated to the Washington Post. Hillinger's piece was the first newspaper article about these shipwrecks, and it caught the attention of Jacques-Yves Cousteau (Strong, 2013).

Cousteau was interested in making a documentary about the sunken Japanese fleet, and less than two months after reading Hillinger's story the documentary had become a reality. The Cousteau Expedition spent around two months in Chuuk filming the documentary, the 'Lagoon of Lost Ships'. This documentary was broadcast for the first time on American television in January 1971 (Strong, 2013). The Lagoon of

Lost Ships brought Chuuk's shipwrecks to the attention of divers (Bailey, 2000; Hezel & Graham, 1997).

Shortly after the Cousteau documentary was aired, an article on Chuuk's shipwrecks was published *Skin Diver* magazine. At the time *Skin Diver* was the most read diving magazine globally (Strong, 2013). Following the publicity from the Lagoon of Lost Ships, and the articles about Chuuk in the press, publicity and interest in the 'ghost fleet' rapidly grew. Chuuk became a very popular diving destination in the 1970s (Bailey, 2000; Hezel & Graham, 1997). Since this initial publicity, many magazine articles and documentaries have been, and continue to be, produced about Chuuk. As a result of the media attention, and word of mouth communication amongst divers, there was considerable growth in the numbers of divers visiting Chuuk between the 1970s and 2000 (Edney, 2012a; Jeffery, 2004a).

The 'ghost fleet' of Chuuk Lagoon has become an internationally renowned dive site, attracting divers from around the world to what is arguably one of the world's best and most famous wreck diving destinations (Edney, 2012a; Jeffery, 2004a, 2004b). Chuuk is popular with divers for a number of reasons. It offers an experience unsurpassed at any other wreck diving location because of the warm, clear and generally calm waters; the number, condition and variety of the wrecks available; the easy accessibility of the wrecks; the history and stories associated with the wrecks; and, because they contain much of the cargo they were carrying when they were sunk (Bailey, 2000; Edney, 2012a; Jeffery, 2004a, 2004b). The shipwrecks are easily accessible to recreational divers. Many are located in depths between six and forty metres, and many of the deeper wrecks enable divers to 'off-gas' while exploring the shallower parts of the shipwrecks (Bailey, 2000; Jeffery, 2004a, 2004b; Macdonald, 2014).

6.5.2 Dive industry profile at Chuuk

The potential for tourism at Chuuk began in May 1968, when Continental Air-Micronesia, a subsidiary of Continental Airlines, commenced the first regular passenger services to Chuuk (Strong, 2013), followed by the opening of the Truk Continental Hotel in 1970. The opening of the hotel and the publicity from Cousteau's Lagoon of Lost Ships documentary, the newspaper feature article by Hillinger and various articles in *Skin Diver* magazine inspired divers to visit Chuuk.

In doing so, this created a large increase in dive tourist visitation to Chuuk in the 1970s, and an increased demand for dive services (Bailey, 2000; Strong, 2013).

However, initially Chuuk did not develop as a dive tourist destination because it was difficult to obtain boats. Boats that were obtained could be taken from divers at any time, and divers had to rely on Fisheries staff to provide air fills in the evenings after work (Strong, 2013). Additionally, the wrecks had to be located. A hydrographic survey of Chuuk Lagoon was undertaken by the US Navy from 1968-1969 to find and chart the shipwrecks in the lagoon (Strong, 2013). This chart was used by the Cousteau expedition to locate the shipwrecks for their Lagoon of Lost Ships documentary. Although 30 of the shipwrecks were dived during the making of the documentary, information about the exact location of the wrecks was not shared and the wrecks had to be found again when divers became interested in diving (Bailey, 2000; Strong, 2013).

The dive industry at Chuuk was pioneered by Chuukese diver Kimiuo Aisek. Kimiuo Aisek lived on Tonoas. He was seventeen years old when Operation Hailstone occurred. Kimiuo witnessed the bombing raids from Tonoas and saw many of the vessels get hit and sink in the lagoon (Lindemann, 1991; Strong, 2013).

Kimiuo learned to dive in 1960, as part of his Trust Territory Government Fisheries training. In 1969, he was hired by the Truk District Fisheries Office to work as the Team Leader of the Starfish Control Team, a program aimed at controlling a crown of thorns starfish (*Acanthaster planci*) bloom throughout Micronesia (Strong, 2013). It was during his time on the Starfish Control Team that Kimiuo got the opportunity to dive on some of the wrecks, and later helped to locate and identify many of the wrecks. While in this job, Kimiuo filled tanks for divers in the evenings and would help supply dive boats for visiting divers (Bailey, 2000; Strong, 2013).

The first dive shop in Chuuk, was opened by Kimiuo Aisek in late 1973. There was mounting pressure for Kimiuo to open a dive shop from dive travel companies, renowned underwater cinematographer Al Giddings and the Trust Territory office economic development staff. A loan from the Trust Territory government made it possible for Kimiuo to open the Blue Lagoon Dive Shop. This shop is still operating today, and is still owned by the Aisek family (Strong, 2013). In 1998, the Aisek family purchased the Truk Continental Hotel and renamed it Blue Lagoon Resort (Figure 24), and the dive shop moved to its current location at the resort on the southern tip of Weno (Bailey, 2000; Strong, 2013). Today there are two main dive shops in Chuuk Lagoon, Blue Lagoon Dive Shop (Figure 25) and the Truk Lagoon Dive Center, along with three live-aboard dive vessels, *Odyssey* (Figure 26), *SS Thorfinn* and *MV Truk Master*.

Figure 24 **Blue Lagoon Dive Resort, Weno**

Image © 2011 Joanne Edney.

Figure 25 **Blue Lagoon Dive Shop, Weno**

Image © 2018 Joanne Edney.

Figure 26 **Odyssey live-aboard, Chuuk**

Image © 2018 Joanne Edney.

Dive tourism continued to expand from 1970-2000 (Jeffery, 2004a). It was estimated that Chuuk was attracting around 6,000 divers per year during the 1990s (Bailey, 2000). Exact numbers of divers visiting Chuuk presently is not known, however, it is recognised that a large proportion of Chuuk's tourists are divers. Tourism to Chuuk peaked in 1996, with almost 10,000 visitors (Jeffery, 2007). In recent years, an average of around 4,700 tourists visited Chuuk each year (Government of the Federated States of Micronesia, 2016e). Dive tourism is recognised by the government, and even acknowledged on vehicle licence plates (Figure 27).

Figure 27 **Chuuk State vehicle licence plates**

Image © 2018 Joanne Edney.

The economic value of dive tourism has not been quantified (Edney, 2012a). The permits divers are required to purchase to dive in Chuuk have been estimated to have raised as much as US$90,000 annually in the past (Jeffery, 2004a), and more recently around US$66,000 each year (D. Strong, personal communication, 8 March 2016).

However, this revenue represents a minor portion of diver expenditure. Other more significant expenditure includes the costs of diving, transport, accommodation and meals (Edney, 2012a).

Since coming to the attention of divers in the 1970s, a dive trip to Chuuk Lagoon is still very much on the ‘must do’ list of many divers, and a highlight for those who have experienced it (Edney, 2012a; Lindemann, 1991). Yet there is little information in the literature about the divers visiting Chuuk. One study by Edney (2012a) found that divers visiting Chuuk were primarily male, middle-aged, affluent, well-educated, and were experienced divers with high levels of diver certification. These divers were most interested in seeing historically significant shipwrecks, artefacts and marine life, and penetrating wrecks. The majority of participants in this study were from North America (67%). Fourteen percent from Australia/New Zealand, seven percent from Europe, two percent from Asia and the remaining two percent from other parts of the world. This broadly similar to general tourism statistics reported for Chuuk in section 6.3.

Most divers travel to Chuuk by air, typically through Guam or Honolulu, in Hawai’i. A typical trip on a live-aboard dive vessel is for seven nights. The *Odyssey* and *MV Truk Master* live-aboards cater for a maximum of 16 guests. A seven day trip on the *Odyssey* costs around $AUD 4,700.00, and costs are similar for trips on the *MV Truk Master*. Both include up to five dives per day, meals, drinks and transfers to and from the airport. Airfares are not included in the price (Master Liveaboards, 2018; Odyssey Diving Adventures, 2018). A similar trip on the other live-aboard, the *SS Thorfinn*, which caters for 20 guests, costs around $AUD 3,400.00. Return airfares from Brisbane, in Australia, to Chuuk generally cost around $AUD 1,600.00 (Air Niugini, 2018). Return flights from Los Angeles, in the United States, generally cost around $AUD 2,500.00 (United Airlines, 2018). Typical land based dive trips (Blue Lagoon Dive Resort) cost around $AUD 3,400.00 and include return airfares from the east coast of Australia, accommodation, two dives per day and airport transfers (Dive Adventures, 2018). A similar stay at Truk Stop and diving with the Truk Lagoon Dive Center costs around $3,500 (Diversion Dive Travel, 2018).

6.5.3 Ghost fleet values

The ‘ghost fleet’ comprises 50-60 shipwrecks and around 13 submerged aircraft, which sank during World War II. They are of exceptional quality, containing much of the cargo they carried when they sank, and are still relatively intact. The majority of the larger shipwrecks have been located and are being dived, but not all of the smaller vessels have been located (Bailey, 2000; Jeffery, 2004a, 2004b, 2006, 2012). A brief description of the main shipwrecks visited by divers is provided at Appendix 4, and the submerged aircraft visited by divers are at Appendix 5.

The shipwrecks and submerged aircraft in Chuuk Lagoon are a tangible reminder of World War II (Jeffery, 2004a). They have a range of values, including cultural heritage, tourism and recreation, scientific, economic and livelihood values (Edney, 2006, 2012a; Jeffery, 2004b; Jeffery, 2007). The cultural heritage values of the shipwrecks and submerged aircraft include their archaeological, historic, anthropological, cultural and social values (Delgado, 1988b). However, the significance and value placed on cultural heritage by individuals and communities are dependent on the values and attitudes held by these people or groups, and the nature of the heritage resource (Hall & McArthur, 1996). This is certainly the case at Chuuk, where different groups place different values on the 'ghost fleet', and some of these values conflict (Jeffery, 2012).

From a Western perspective, the shipwrecks and submerged aircraft in Chuuk Lagoon have historic significance, due to their role in World War II. Chuuk is of particular interest to military historians, due to its association with the development of aircraft carriers in naval warfare (Jeffery, 2004b, 2012). The submerged sites have important archaeological values, as they form the most complete example of relatively unsalvaged World War II ships in the world (Hezel & Graham, 1997). Many of the ships were at anchor unloading supplies, or waiting to unload, when the attacks occurred. Therefore, they contain much of the cargo they had on board at the time of the attacks. This includes equipment and supplies used during World War II, such as food, alcohol, medical supplies, ammunition, beach mines, aircraft and other machinery. These shipwrecks provide important information about how a major Japanese military base was equipped, and how they coped with the bombing raids and blockading by the Allies. The submerged aircraft are also important because they are a source of information about Japanese World War II aircraft (Jeffery, 2004a, 2006, 2012). Many Japanese records were destroyed in the bombing raids, and others were deliberately destroyed by the Japanese prior to surrender, particularly any that may be useful to the US, or those relating to prisoners of war and their treatment (Stewart, 1985).

These sites are important to the Asia-Pacific region because they are connected with an event which markedly changed the way of life for many Pacific Islanders (Jeffery, 2004b). For Americans and Japanese people, Chuuk Lagoon is a tangible reminder of World War II, and is viewed as a memorial (Hezel & Graham, 1997; Jeffery, 2004b). For Americans, Chuuk Lagoon is an important World War II historic site, instrumental in ending the war. It is a site of victory and is seen by some as retribution for the attack on Pearl Harbour in 1941 (Bailey, 2000; Jeffery, 2006, 2012).

Japanese people consider the ‘ghost fleet’ to be open war graves, and treat them as shrines. The shipwrecks are the graves of around 4,000 Japanese military personnel. Many Japanese people with affiliations to Service personnel lost at Chuuk still come to pay their respects on the anniversary of Operation Hailstone each year, while others visit throughout the year. As such, many Japanese people are not happy with divers visiting these sites, and are particularly upset that some divers touch human remains on the wrecks. The Japanese would like divers to respect these sites as war graves (Bailey, 2000; Jeffery, 2006, 2012). Other veterans and younger Japanese people consider the sites are valuable for deterring future wars because they demonstrate the futility and tragedy of war (Jeffery, 2012).

These sentiments were echoed by Kimiuo Aisek, who wanted to promote not only diving, but also an understanding of the suffering and futility of war and for divers to respect others and promote peace. He had a flag made for his first dive boat, which had ‘Dive in Peace’ at the top and ‘Truk’ at the bottom (Strong, 2013). Today this sentiment lives on with a mural near the Sunset Bar at Blue Lagoon resort depicting the slogan (Figure 28), and t-shirts sold in the Blue Lagoon Dive Shop displaying this slogan.

During the 1970s and 1980s the Chuuk government gave permission for Japanese divers to recover some human remains from certain shipwrecks (Jeffery, 2006; Stewart, 1985). The Chuuk government have not approved subsequent requests to retrieve further human remains from the shipwrecks (Bailey, 2000). Many Japanese are not happy with this decision, as it prevents them from following Buddhist funeral practices. This means that the spirits of the dead cannot find nirvana, and wander around eternally (Jeffery, 2012). Some Japanese people consider the Chuuk government is holding the human remains as ‘hostages’ to ensure visitation and the associated revenue continues (Bailey, 2000).

Figure 28 **Dive in peace mural at Blue Lagoon Dive Resort, Weno**

Image © 2018 Joanne Edney.

Although the shipwrecks are now part of the Chuukese landscape, they were largely forgotten by the Chuukese after they sank, because they had little relevance to the lives of Chuukese people. The shipwrecks and submerged aircraft are associated with the death of Japanese military personnel, and not Chuukese. Intangible heritage and traditional sites are more important to the Chuukese than World War II sites. However, or because, of the horrors, hardships and suffering associated with the terrestrial World War II sites, the Chuukese have some emotional connection with these sites. These connections are possibly due to the family connections with these sites, and may serve as reminders of the suffering and loss of Chuukese lives during the war (Jeffery, 2004a, 2006, 2012).

The terrestrial sites are numerous and many are still intact, although they are not promoted as tourist attractions. These sites are left untouched resulting in many of them being overgrown with vegetation. Western values may see this as neglect, however, to the Chuukese, abandoned landscapes can be a memorial, and may indicate that these sites are revered (Jeffery, 2004a, 2006, 2012). Another reason for the Chuukese having different values for the submerged and terrestrial sites may be due to traditional ownership of resources. Reefs and islands are owned by families of clans and are of foremost importance, whereas the lagoon where the shipwrecks lie is not owned by families or clans (Jeffery, 2004a).

Micronesian people have typically shown little interest in the tangible reminders of World War II. This is partly due to their culture placing more importance on intangible heritage, particularly oral traditions and histories, and possibly also due to tangible remains being reminders of a difficult and painful time (Jeffery, 2004a; Spennemann, 1992). The lack of emotional attachment to the submerged sites by Chuukese was highlighted by Jeffery (2012), who described the opinion of a Chuukese staff member of the Chuuk Historic Preservation Office. This staff member explained that the shipwrecks are reminders of a difficult time in Chuuk's history, while the terrestrial sites are reminders of the difficulties experienced by their families. Another explanation for the lack of interest in the World War II sites is that Micronesian people have been invisible in most accounts of World War II, by both the Allies and Japanese. However, this may change as today there are some Micronesian people who would like their role and the impact of the war acknowledged, and as such, would like to see World War II sites protected (Jeffery, 2004b).

The 'ghost fleet' has a range of values for the Chuukese. The shipwrecks are a valuable economic resource. The shipwrecks and submerged aircraft are a major tourist attraction and source of revenue for Chuuk, and for the Chuukese involved in the dive tourism industry. They are therefore considered dive tourism resources by many Chuukese people.

The shipwrecks have other livelihood values as well. Many Chuukese line and spear fish on the shipwrecks. For some Chuukese, particularly some dive guides and their families, the wrecks are also a source of artefacts for sale, and although this practice is illegal it is lucrative. They are also a source of explosives for use in dynamite fishing. The sites are also used for dynamite fishing by some individuals due to the abundance of marine life associated with them (Jeffery, 2004a, 2006, 2014; Jeffery, 2007).

The shipwrecks and submerged aircraft are an important dive tourism resource, visited by many divers from around the world. At Chuuk, divers are able to dive wrecks that are mostly intact, and contain much of the cargo they were carrying when they were attacked more than 70 years ago. Divers are able to see first-hand the damage caused by bombs and torpedoes, and the devastation associated with war (Jeffery, 2004a, 2012). They can also see how the destruction has been transformed by prolific and diverse marine life into objects of great beauty (Earle & Giddings, 1976). The majority of divers who visit Chuuk only dive the wrecks. Some of the

Japanese divers who visit Chuuk dive the shipwrecks, although most prefer to dive the reefs (Jeffery, 2007).

The shipwrecks and submerged aircraft also have scientific values related to the abundant and diverse biodiversity associated with them. The first biodiversity survey was undertaken by the renowned marine biologist Sylvia Earle in 1976, for National Geographic. Earle visited Chuuk because the shipwrecks provided her with a unique opportunity to study the growth rates and patterns of marine life. This was because the exact age of the reef was known. Earle recorded a new genus and several new species of plants, coral growth rates, and gained new insights into aspects of reef ecology and data that reinforced the implications of substrate (Earle & Giddings, 1976).

A survey conducted in 2006 recorded 266 species of reef fish from 33 families, and ten individuals of a rare scleractinian coral (*Acropora pichoni*) on the *Fujikawa Maru*, located in depths shallower than what is understood to be its usual range. This was unexpected because it is not usual for rare species to be recorded on artificial reefs. This study recommended the shipwrecks be protected for their biodiversity values, particularly for their role as a refuge for rare coral reef species (Jeffery, 2012).

6.5.4 Laws and protection of sites

The submerged World War II ships and aircraft are protected by three forms of legislation, Chuuk State law, Federated States of Micronesia law and United States law (Jeffery, 2004b). In August 1971, legislation was proclaimed by the Chuuk State government to designate the submerged World War II sites in Chuuk Lagoon the ‘Truk District Monument’. This legislation has been amended three times since its introduction, most recently in 2000, and is now incorporated into the *Draft Chuuk State Code, Title 25. Maritime and Marine Resources* and documented as *Chapter 8, Chuuk Lagoon Monument* (Browne, 2014a, 2014b; Hezel & Graham, 1997; Jeffery, 2012). This requires divers to purchase a dive permit and to be accompanied by a licensed dive guide in order to dive the submerged World War II sites (Hezel & Graham, 1997; Jeffery, 2012). The dive permits are obtained from the dive operators and cost US$50.00 per year (Blue Lagoon Dive Shop, 2016). The permits do not contain any conditions to prevent or manage diver impacts. However, these permits are a potential source of funds for management programs for the shipwrecks and submerged aircraft.

At a national level, these sites are protected by Federated States of Micronesia Public Law 18-96, *Title 26: Historical sites and antiquities* of the Code of the Federated States of Micronesia 2014 (Government of the Federated States of Micronesia, 2014a). Both the Chuukese State and FSM national laws prohibit disturbance to the sites, including removal of artefacts, and penalties for breach of these laws include fines and imprisonment (Jeffery, 2012).

The importance of the sites has also been recognised by the United States government, under the US *National Historic Preservation Act of 1966*. They were placed on the US National Register of Historic Places in 1976 and declared a National Historic Landmark, the ‘Truk Lagoon Underwater Fleet’, in 1985. Subsequently, in 2002, they were listed as a threatened national historic landmark due to looting, vandalism and deterioration of the sites (Jeffery, 2012). Listing by the US government on the National Register of Historic Places and its declaration as a National Historic Landmark make these sites eligible for federal grants for historic preservation from the US government (National Park Service, n.d.).

The Federated States of Micronesia announced in March 2018 that it would ratify the UNESCO Convention on the protection of Underwater Cultural Heritage (UNESCO, 2018), setting it ahead of other Pacific Island nations, and indeed Australia, which have not yet done so. However, the World War II sites currently do not meet the criteria to be protected under this convention because they have been submerged for less than 100 years. Nevertheless, the Convention provides a sound universal framework that can be applied to management of the shipwrecks and submerged aircraft in Chuuk Lagoon.

6.5.5 Diver and other human impacts on sites

Although storms, particularly monsoons, cause damage to the shipwrecks and submerged aircraft at Chuuk and accelerate their decay, their location in the lagoon has largely protected them. The lagoon waters are sheltered by the fringing reefs and protected from waves, currents and wind. There is also little variation in water temperature throughout the year, or with depth (Jeffery, 2004a, 2012; MacLeod & Richards, 2011). This is supported by corrosion studies, which found that these shipwrecks are corroding at a rate 26-30 percent slower than they would occur if they were located in the open ocean (MacLeod, 2003).

Although there was some limited salvage undertaken on the shipwrecks shortly after World War II, much of the contents of the shipwrecks remained in place when divers began visiting the sites (Jeffery, 2004a). Divers have now been visiting the ‘ghost fleet’ for more than 40 years and this has had an impact on the wrecks.

Diver impacts on shipwrecks were documented in section 4.3, and many of the examples given are from Chuuk. Therefore, this discussion provides a brief outline of these impacts. The main diver related impacts at Chuuk are anchor damage, impairment of site integrity, and the removal of munitions to make dynamite bombs. Other impacts, including those resulting from contact with the wrecks by divers’ bodies, equipment and air bubbles, also occur.

Anchor and mooring damage occurs on the shipwrecks. Some of the live-aboard dive boat operators installed off-site moorings on a number of the shipwrecks to prevent anchor damage. However, these moorings have not prevented damage by smaller vessels. The smaller dive boats commonly use moorings tied off on the wrecks, or anchor directly onto the wrecks, causing damage (Jeffery, 2006). In addition, Jeffery (2006) reported that dive boats drag their anchors onto wrecks, and the researcher has observed that practice as recently as 2014.

Many artefacts were removed from the shipwrecks by the Cousteau expedition, and taken back to France. It is understood that they were stored a warehouse somewhere in France, unavailable to the public (Bailey, 2000; Strong, 2013). Subsequently, many more artefacts were removed from the sites by the early divers to the wrecks, including by government staff. Some of these artefacts were kept for display, but not properly conserved, and many were taken from Chuuk. Some of the artefacts that were removed by government staff to put on display ended up at the Chuuk Visitors Bureau and Xavier High School on Weno. It is thought that some of these artefacts were confiscated from divers who had removed them illegally and attempted to export them from Chuuk (Jeffery, 2007; Strong, 2013). The dive shops also exhibit artefacts removed from the wrecks. In 2013, the Kimiuo Aisek Memorial Museum (Figure 29) was opened at the Blue Lagoon Resort, and now displays many artefacts removed from the wrecks (Figures 30 and 31).

Figure 29 **Kimiuo Aisek Memorial Museum, Weno**

Image © 2018 Joanne Edney. Shell casings and aircraft propeller blades adorn the entry to the museum.

Figure 30 **Dinnerware on display at the Kimiuo Aisek Memorial Museum, Weno**

Image © 2018 Joanne Edney.

The illegal trade in cultural property, such as artefacts from shipwrecks, is a growing multibillion-dollar global industry. It is surpassed in volume and scale only by the black market trade in illegal drugs and armaments (Browne, 2014b; Timothy, 2011). In Chuuk, dive guides are known to supply artefacts for the growing market in World War II artefacts (Browne, 2014b; Hezel & Graham, 1997).

Figure 31 **Gas mask and drink canteens on display at the Kimiuo Aisek Memorial Museum, Weno**

Image © 2018 Joanne Edney.

Guides, even if well intentioned, also contribute to the disturbance of the sites by moving artefacts around to create a perceived better experience for divers (Edney & Howard, 2013; Hezel & Graham, 1997). Most of the shipwrecks and submerged aircraft have artefact clusters on or adjacent to them. Artefacts are removed from inside the wrecks, or from different parts of the wrecks, and displayed in shallower depths, or where there is better light for viewing and photography. Sometimes artefacts are moved to other locations in preparation for removing them as souvenirs (Hezel & Graham, 1997; Jeffery, 2006).

Many divers like to see human remains on the shipwrecks. One popular example is the skull in the engine room of the *Yamagiri Maru* (Jeffery, 2006). Human remains are also clustered, and it is not known whether divers move them around, or the dive guides, or both. The researcher has seen human long bones stacked neatly on the operating table inside the *Shinkoku Maru* along with other artefacts, and has observed that the artefacts and bones are moved around. This has been apparent from personal observations and by looking at photographs of the operating table taken at different periods of time. The operating table on the *Shinkoku Maru* appeared in the Cousteau documentary the Lagoon of Lost Ships, and there are no are artefacts or human remains visible on it. Rosenberg's (1981) book has an image of the operating table, and there were no human remains or artefacts visible on it. However, a number of the artefacts seen on the table in later photographs are visible on the floor near to the operating table in the image in Rosenberg's book.

The researcher has also seen human remains arranged around the commemorative plaques on the *Aikoku Maru*, and observed two human skulls present during a visit in 2009. On her next visit in 2011, there was only one skull visible near the plaque. The dive guide pulled the other skull out from beneath a ledge where it was concealed not far from the plaque, so he could show it to the divers (Figure 6, section 4.3.2). On this same trip the researcher dived on the *Kikukawa Maru* with the same dive guide. This wreck is not often visited by divers (Bailey, 2000), possibly because it is almost completely upside down, relatively deep, and there is relatively little marine life associated with it. The dive guide allowed the divers to explore the inside of the wreck independently. At one point during the dive, the guide signalled for the divers to move over to where he was. He had found human remains, long bones and a pelvis, and was dusting the silt off them and arranging them near some other artefacts.

Dynamite fishing is another activity that is causing negative impacts on the shipwrecks. The Japanese introduced the Chuukese to dynamite fishing during the Spanish period when Japanese traders had an illegal trade in a number of items, including explosives for fishing (Jeffery, 2007). Dynamite fishing is known to be carried out on the wrecks of the *Fujikawa Maru*, *Sankisan Maru* and *Susuki* (Bailey, 2000; MacLeod & Richards, 2011). It is considered to be the biggest threat to the conservation of the shipwrecks at Chuuk (Jeffery, 2007). Dynamite fishing is destructive both to the shipwrecks and marine life, killing all animal life, and denuding shipwrecks of the concretions and other sessile marine life attached to the exposed surfaces of shipwrecks. This renews and accelerates corrosion (MacLeod, 2003). Dynamite fishing is contrary to traditional practices and is illegal, but is very profitable. The fish collected from one bomb can earn US$2,000–$3,000. However, many Chuukese have been seriously injured and lost their lives removing munitions, and when making and deploying the dynamite bombs, yet the practice still continues (Jeffery, 2007).

Corrosion studies were undertaken in 2002 and 2006-2008 on the shipwrecks and submerged aircraft to assess the level and rates of deterioration. These studies found dynamite fishing was resulting in increased rates of corrosion on the shipwrecks. For example, it was found that one of the most popular shipwrecks for divers, the

Fujikawa Maru, had a corrosion rate 46 percent higher than would be expected for a shipwreck at that depth, due largely to dynamite fishing. Disturbingly, it had a 14 percent increase in corrosion rate between 2002 and 2006, largely attributed to dynamite fishing (MacLeod & Richards, 2011). The researcher observed the effects of dynamite fishing whilst undertaking field research for this study in Chuuk in 2014. Large sections of the starboard side of bridge of the *Fujikawa Maru* was completely denuded of its protective coatings and bare metal was visible, many of the plates were buckled and sections of the bridge area had collapsed (Figures 32 and 33). This damage was not present when the researcher visited Chuuk in 2011.

Figure 32 **Dynamite fishing damage to the *Fujikawa Maru*, November 2014**

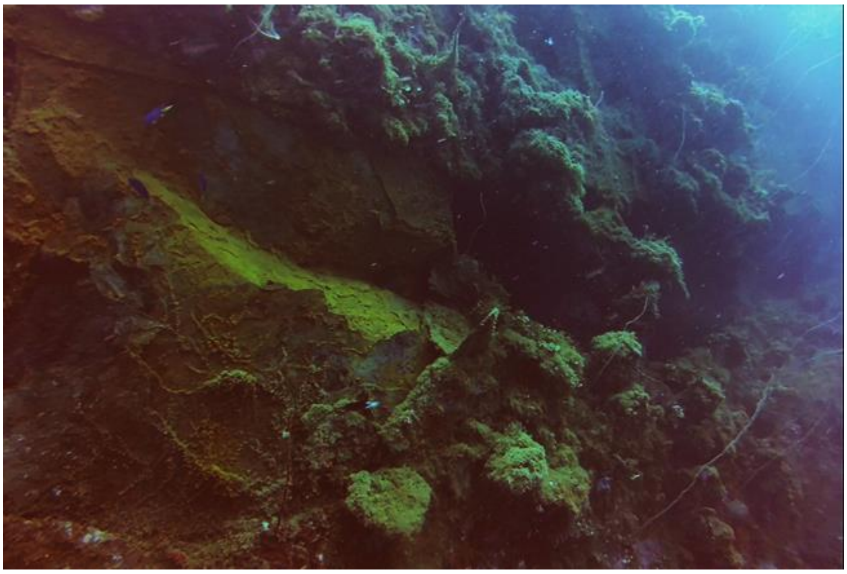


Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 33 **Dynamite fishing damage to the *Fujikawa Maru*, November 2014**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Dynamite fishing may lead to the premature collapse of some of the shipwrecks. However, the structural integrity of the shipwrecks is not the only thing that is affected by dynamite fishing. Site integrity, tourism values and Chuukese livelihoods also stand to be adversely affected. Damage from dynamite fishing has the potential to seriously reduce tourism that the Chuukese are reliant upon. All of the beach mines in the forward hold of the *Nippo Maru* have been removed, as were the six inch shells in a hold in the *Fujikawa Maru*. One of the highlights of diving the *San Francisco Maru* is seeing the beach mines in one of the forward holds (Figure 34). This hold was once full of beach mines, but now there are few remaining. These mines were taken for use in dynamite bombs. Dynamite fishing also results in the destruction of fish habitat and the fish stocks that the Chuukese are reliant upon (Bailey, 2000; Hezel & Graham, 1997; Jeffery, 2007).

Figure 34 **Beach mines in Hold 2 of the *San Francisco Maru***

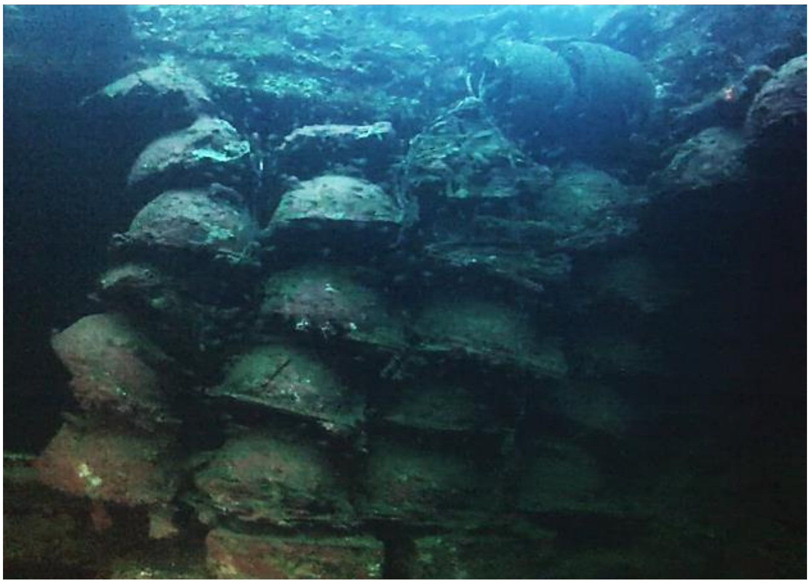


Image © 2018 Joanne Edney. Screen shot from hand-held camera.

There has been debate over the past 40 years about whether or not the munitions present on the shipwrecks pose a hazard. Some suggest they should be removed and others consider there to be little or no risk, provided they are not disturbed (Jeffery, 2014). Although divers can still see munitions on many of the shipwrecks, some were removed from certain shipwrecks and submerged aircraft during the late 1960s and early 1970s (Strong, 2013).

The shipwrecks themselves may also cause impacts on the lagoon’s marine environment. Concerns about the risk of oil leaks and possible contamination by other cargo, such as munitions, were first raised by Earle and Giddings (1976) in the

1970s. Oil and other petroleum products have been leaking from the shipwrecks and submerged aircraft since they first sank, and slicks are still visible on certain wrecks (Jeffery, 2012). More recently concerns have been raised about the threat of contamination from petroleum, following corrosion studies undertaken in 2002 and from 2006-2008. These studies estimated that many of the shipwrecks will undergo significant collapse over the next 5-10 years, and will potentially result in serious environmental damage to Chuuk Lagoon (MacLeod & Richards, 2011).

6.5.6 Management of Chuuk's submerged heritage

The Chuuk State government is responsible for managing the shipwrecks and submerged aircraft. Although the sites have had legal protection since 1971, and have had support from the US National Park Service Historic Preservation Fund, management has not been effective (Browne, 2014a; Jeffery, 2004a, 2012). The wrecks have continued to be subjected to damage (Carrell, 1991; Hezel & Graham, 1997; Jeffery, 2012). Some of the key management challenges include the large number of shipwrecks and submerged aircraft present, inconsistent enforcement of laws, insufficient funding and conflicting and competing priorities within government for available resources. Poor monitoring of sites by authorities, overlapping jurisdictions within Chuuk government between agencies, insufficient public education and interpretation and a lack of baseline data are other significant challenges. Conflicting values and use also pose a significant management challenge. The major sources of conflicts include dive tourism, artefact removal and dynamite fishing (Hezel & Graham, 1997; Jeffery, 2004a, 2006, 2012).

Specific management actions identified to more effectively manage the shipwrecks and submerged aircraft include preventing the illegal removal of artefacts and dynamite fishing, more detailed mapping and recording of the sites and their contents, surveillance of the sites and implementing a better mooring system (Hezel & Graham, 1997; Jeffery, 2004a, 2004b). During the 1980s and 1990s, the United States government provided assistance to the FSM government for managing its underwater cultural heritage. The US Submerged Resources Unit undertook site surveys, catalogued the sites and developed strategic site management plans (Jeffery, 2014). The shipwrecks and submerged aircraft have also been located and documented by Lindemann (1991), Hezel and Graham (1997), Bailey (2000) and Jeffery (2006; 2007). More recently there have been side scan sonar surveys, detailed inspections, corrosion studies, and some interpretive products were produced (Jeffery, 2004b, 2006, 2012).

Residents of Chuuk are aware that trafficking in artefacts occurs, and the scale of removal of artefacts from Chuuk indicates that it is organised, not ad hoc (Hezel & Graham, 1997; Jeffery, 2004a). Legislation is important, but also requires effective enforcement, and this has not been the case in Chuuk. Law enforcement action has been inconsistent, and in the past law enforcement officers have been involved in removing large quantities of artefacts from the wrecks (Browne, 2014a; Hezel & Graham, 1997). There are economic motivations for artefact removal. Chuuk is an impoverished nation. Dive guides are not well paid and rely on tips from divers. Turing a blind eye to divers who remove artefacts can mean the dive guide is well rewarded in tips. With a growing global market for World War II artefacts, dive guides can receive a substantial amounts of money for supplying artefacts to this market (Hezel & Graham, 1997; Timothy, 2011).

Removal of artefacts by divers themselves is another issue, and although licensed dive guides are required to accompany divers' artefact removal continues to occur. For dive guides to be effective in managing diver behaviour they must demonstrate appropriate behaviour, and intervene when they observe inappropriate diver behaviour (Barker & Roberts, 2004; Lindgren et al., 2008). However, Chuukese are known to avoid confrontations. It is contrary to Chuukese cultural norms to confront people, particularly visitors, even where there has been a major breach of a law. This is more so when there is no personal ownership claim over the artefact in question, which is one of the reasons why dive guides will avoid confrontations over artefact removal (Hezel & Graham, 1997; Stewart, 1985).

Another challenge is the lack of emotional connection the Chuukese have with the shipwrecks and submerged aircraft. This means there is a lack of community interest in their protection, particularly from human impacts. It is possible this may be a reaction to colonialism and neo-colonialism, which continues to be a contentious issue in Chuuk. Foreign efforts to protect the 'ghost fleet' may be perceived as another example of neo-colonialism. As noted earlier, Chuuk is heavily reliant on foreign aid and assistance, particularly funding via the Compact of Free Association with the US government, which has conditions attached. It has also been reported that some Chuukese would like the shipwrecks removed because they are physical reminders of the horrors of World War II, and of colonial oppression. Meaning that there is little incentive to protect them (Browne, 2014a, 2014b).

Different cultures have different ways of passing on and protecting culture for future generations. The historic preservation model applied to the shipwrecks and submerged aircraft at Chuuk is a Western model that has been imposed on the Chuukese. The values that underpin this model differ from Chuukese values, and the Chuukese way of doing things (Jeffery, 2004a; Young et al., 1997). Therefore, to improve the effectiveness of site management, management and site significance needs to better align with Chuukese values.

The importance of involving Chuukese people in the management of the underwater sites was recognised by the US government in 1989, and remains relevant today. The Truk Lagoon Historical Park Study was undertaken to determine whether the 'ghost fleet' could be best protected by inclusion of them into a reserve. The report recommended a protected area management agency at FSM national level be developed and staffed by FSM employees to resolve the looting and vandalism occurring at the sites. This recognised the importance of community support in the prevention of these impacts (Browne, 2014a; Jeffery, 2014; National Park Service, 1989).

Effective management is also challenged by the different values held by Americans, Chuukese and Japanese. The sites need to be managed in a way that addresses the values of all key stakeholders (Jeffery, 2012). In doing so, the global significance of the sites may be understood and appreciated by the Chuukese. It is important the values of the 'ghost fleet' are understood by a broader section of the Chuukese community if efforts to protect them are to be effective (Jeffery, 2004a). If this can be achieved, it would not only help ensure protection of the cultural heritage values of the 'ghost fleet', it would also benefit the Chuukese community because the revenue gained from these wrecks are linked to their economic future (MacLeod & Richards, 2011).

Adequate resources and a more collaborative approach to management is also required to achieve effective management of the shipwrecks and submerged aircraft. It would be appropriate for Japan and the US to work in collaboration with the Chuuk and FSM governments to develop a management strategy for the submerged World War II heritage in Chuuk Lagoon. Such a strategy should incorporate the views of

Chuukese (government agencies, communities and individuals), Japanese, Americans and other major stakeholders, such as divers (Jeffery, 2004a, 2012). This type of approach is supported by the UNESCO Convention on Underwater Cultural Heritage (Jeffery, 2004a, 2004b, 2012, 2014), The revenue collected for dive permits, presently around US$66,000 (Strong, 2016), could be used for managing the shipwrecks and submerged aircraft. To date it does not appear that this revenue has been used for this purpose, instead it appears to be used to create new government jobs (Jeffery, 2004a, 2012).

Chuuk is an impoverished State, deficient in basic infrastructure, such as electricity, telecommunications, roads and safe drinking water. Like many other developing nations, insufficient resources mean it is a challenge to undertake basic governance roles. Therefore, it is not surprising that the management of the World War II underwater cultural heritage of Chuuk is not given a higher priority. Effective management of the underwater sites will also be reliant upon a range of social, economic, political, and legal issues being addressed (Browne, 2014a, 2014b).

World War II was a war fought by 56 nations, and in the Pacific was fought on many Pacific Islands, largely between the US and Japan (Jeffery, 2004a, 2006). Chuuk did not choose to be part of World War II, the war was thrust upon it. Therefore, the Chuuk or FSM governments should not be expected to manage the World War II sites unaided. It is unrealistic to expect a small, impoverished nation, who did not choose to be part of the war, to manage the sites unaided. Even for prosperous developed nations, the management of more than 50 shipwrecks up to 13 submerged aircraft would be an overwhelming prospect (Browne, 2014a; Jeffery, 2012).

6.6 Justification

Chuuk was an ideal choice for a location to undertake the fieldwork component of this research. It is an internationally renowned wreck diving destination, which attracts divers who are focused on wreck diving. It is recognised that the choice of study location also limits the research to some extent, as it does not include in the sample the more casual wreck divers. However, this limitation was outweighed by the advantages of situating the research at Chuuk.

A logistical advantage, noted in the discussion above, is that the dive opportunities offered at Chuuk are almost exclusively wreck diving. Therefore, the divers who visit

Chuuk are there to dive wrecks rather than reefs. The wrecks also offer a range of diving opportunities, including wreck penetration, and the presence of artefacts.

The environmental factors at Chuuk were also conducive to the study. In particular the clear water, which is ideal for observations. Clear water makes it easier to undertake third party observations without the need to be close to the divers under observation. This leaves less potential for bias, as divers are less likely to be aware that they are being observed. Clear water also provides opportunities to record more than one diver at a time.

6.7 Chapter summary

The fieldwork component of this research was conducted at Chuuk Lagoon, FSM, arguably one of the world's best wreck diving destinations. This chapter provided an overview of the geography, economy and historical background of Chuuk, to provide context for the diving environment and associated management issues.

Chuuk was first inhabited around 2,000 years ago. Traditionally, social structure was based on matrilineal clans headed by chiefs, who were custodians of the land. However, this social structure was changed following European colonisation, first by Germany in the 19th century, then Japan and the United States in the 20th century. Chuuk gained independence in 1986, as part of the FSM. The economy of the FSM is heavily reliant on international economic assistance, and grants from the United States government, under the Compact of Free Association, are a major source of revenue. The most important industries are agriculture, hunting, fishing, forestry and tourism. Tourism is an important source of income for FSM, and the shipwrecks in Chuuk Lagoon are FSM's major tourist attraction. Chuuk receives around 4,700 visitors each year, and a large proportion of these visitors are wreck divers.

During World War II, Chuuk was a key strategic advance military base for Japan's push into the Pacific. It was effectively neutralised by Allied aerial attacks between 1944 and 1945, most notably Operation Hailstone in February 1944. As a result of these attacks, there are now between 50 and 60 shipwrecks and 13 submerged aircraft resting on the bottom of Chuuk Lagoon, a tangible reminder of World War II.

From a Western perspective, the shipwrecks and submerged aircraft have important cultural heritage values, particularly associated with their historical, archaeological and social values. For divers they are a recreational resource. As the graves of around

4,000 Japanese military personnel, many Japanese people consider the shipwrecks to be war graves. For the Chuukese, the wrecks have livelihood values. They are a source of income for those employed in the dive industry and associated tourism service industries, and many people fish at the wreck sites. Illegal activities at the sites are also a source of income. Some Chuukese people remove munitions as a source of explosives for dynamite fishing, which often takes place on the wrecks. Dive guides also remove artefacts to supply the black market trade in World War II artefacts, and are known to turn a blind eye to divers removing artefacts from the wrecks, in the expectation of receiving better tips from customers.

Dive tourism began in Chuuk in the 1970s, and remains a popular destination for divers from around the globe. The wrecks provide high quality diving experiences, and not just because of the number and diversity of the wrecks available or their easy accessibility. The wrecks are located in warm, clear and relatively calm waters, are relatively intact and contain much of the cargo they were carrying when they sank. Diving these wrecks allow divers to connect with history, and see first-hand the damage and destruction associated with war. Divers are also able to enjoy the wide diversity and abundant marine life attracted to the wrecks.

Although the wrecks are important to Chuuk's economy, their management presents a number of challenges for the Chuuk State government. There are insufficient resources to manage the sites. The sheer number of shipwrecks and submerged aircraft present a significant challenge, and would for any government even in more affluent nations. Another significant challenge, that should not be underestimated, is the conflicting values arising from the different values held by the Chuukese, Japanese and Western society in relation to the wrecks.

Chapter 7 – Survey results

7.1 Introduction

This chapter reports on the results of the descriptive and inferential statistical analyses of the survey data. Descriptive statistical analyses were completed for all survey questions. However, as some of the survey questions served another purpose and are not directly relevant to the current study (see section 5.3.3), there was no further analysis or further discussion of them in this thesis. The questions and results this applies to are clearly identified throughout the chapter.

The chapter begins with an overview of the survey results, then the results of the descriptive and inferential statistical analyses of the survey data. This includes diver profiles, frequency of participation in wreck diving, motivations for wreck diving, attitudes towards the protection of shipwrecks and preferences and opinions towards artificial reef wrecks.

7.2 Description of survey results

The vast majority of survey respondents were wreck divers (n = 724, 88.4%), and the remainder (n = 95, 11.6%) were non-wreck divers. Although this survey was open to all divers, it was targeted at wreck divers. Wreck diving is a specialised form of diving, and therefore, this finding may not necessarily suggest that there are more wreck divers than non-wreck divers globally

There were a total of 848 survey participants. Although 918 people agreed to take part in the survey, 40 participants did not complete any questions after agreeing to participate, and 30 survey responses were deleted following the analysis of IP addresses of respondents. As described in section 5.3.3 above, internet protocol addresses of participants were collected to determine whether multiple responses had been received from a single device. The results of the analysis of IP addresses are presented in Table 7.

The vast majority of responses (88%) were received from a single device, there were 38 cases (76 responses, 8%) of two responses from the same device, and there were two cases (6 responses, 0.7%) of three responses from the same device. All of these responses were retained for analysis. It was considered acceptable for up to three responses to be received from a single device, as this would be reasonable from a single household. Additionally, the low number of occurrences of three responses from a single device meant it was unlikely to affect the integrity of the data.

There was one case where four responses were received from a single device, in this case the first response was retained. The reason for keeping this response was because the respondent had made a note in a free text question of the survey that the later three responses were completed so that a copy could be made of the survey for discussion purposes. There was one case where 12 responses were received from a single IP address, and another where there were 15 responses from a single IP address. All of these responses were deleted and excluded from the analysis to prevent any possible 'poll-crashing' or 'ballot-stuffing' (section 5.3.2).

Table 7 Analysis of internet protocol addresses of participants

Number of responses for single IP address	Number of cases	Response/action
1	805	All responses retained for analysis
2	38	All responses retained for analysis
3	2	All responses retained for analysis
4	1	The first response was kept and the following three form this IP address were deleted
12	1	All of these responses were deleted and excluded from the analysis
15	1	All of these responses were deleted and excluded from the analysis

As noted in section 5.3.1, the survey was translated into Chinese, Japanese, Korean and Russian. However, the Russian version of the survey was the only translated version of the survey that received any responses. Four Russian language responses were received. Participants who live or were born in China, Japan and Korea, or are of these nationalities, all completed the English version of the survey. A copy of the full survey instrument is at Appendix 1.

7.3 Analysis of survey results

7.3.1 Diver profiles

The demographic profile of all participants is presented in Table 8 below (actual frequencies are presented in Appendix 6). Almost three quarters of the wreck divers were male (74.3%) and one quarter were female (25.7%). This is in contrast to non-wreck divers, where the predominance of males was less distinct (64.2%) and there was a higher proportion of females (35.8%).

The most prevalent age grouping of wreck divers was the 35-44 years grouping, with just over one quarter (25.8%) of these divers falling into this category, and a relatively even spread across the 25-34, 45-54 and 54-64 year age categories, at around 20 percent. This was in contrast to the non-wreck divers, where the most prevalent age grouping was 25-34 years (27.4%) and only 10.5 percent were in the 55-64 year age category. There were similar proportions of non-wreck divers in the 35-44 and 45-54 year age categories, with 22.1 and 21.1 percent respectively.

The majority of wreck and non-wreck divers had completed a Bachelor or higher degree, although a higher proportion of non-wreck divers (72.6%) had this level of education than wreck divers (66%). Similarly, more non-wreck divers (20%) had diplomas than wreck divers (15.1%). However, substantially more wreck divers (11.9%) had trade qualifications than non-wreck divers (2.1%).

Table 8 Demographic profile – all divers

Demographic variable	Frequency (%) All divers	Frequency (%) Non-wreck divers	Frequency (%) Wreck divers
Gender			
Female	26.7	35.8	25.7
Male	73.3	64.2	74.3
Age			
< 25 years	5.3	6.3	5.0
25-34 years	20.6	27.4	19.6
35-44 years	25.4	22.1	25.8
45-54 years	20.8	21.1	20.6
55-64 years	19.8	10.4	21.1
65-74 years	7.1	9.5	7.1
> 74 years	1.0	3.2	0.8
Level of education			
Primary school	0.5	2.1	0.3
Secondary school	6.1	3.2	6.7
Trade qualification	11.2	2.1	11.9
Diploma	16.0	20.0	15.1
Degree/higher degree	66.2	72.6	66.0
Country of residence			
Australia	24.8	20.0	25.8
China	0.5	1.1	0.4
Japan	6.5	18.9	4.6
Korea (South)	0.5	0	0.4
Russia	1.2	2.1	0.7
USA	40.0	34.7	41.3
Other	26.5	23.2	26.8
Country of birth / nationality			
Australia	20.0	14.7	21.3
China	6.7	21.1	4.6
Japan	0.7	1.1	0.6
Korea (South)	0.1	0	0.1
Russia	1.2	0	0.8
USA	39.5	35.8	40.3
Other	31.8	27.3	32.3

The majority of participants were residents of the United States, 41.3 percent of wreck divers and more than a third of non-wreck divers (34.7%). The next highest was Australia where around one quarter (25.8%) of wreck divers resided, and one fifth of non-wreck divers. Just over one quarter (26.5%) of the survey respondents lived in countries not specifically listed in the survey (i.e. ‘Other’). The remainder resided in Japan (6.7%), Russia (1.2%), China (0.1%) and Korea (0.1%). The largest group in the other countries category were residents of Canada (33.4%), who accounted for 8.8 percent of survey participants. The next largest group in the other countries category was Europe, and this group made up 6.4 percent of the survey participants. Full details of the composition of the other countries category for country of residence are presented at Appendix 7.

Higher proportions of divers from Australia, the United States and South Korea were wreck divers than non-wreck divers, and there were higher proportions of non-wreck divers from China, Japan and Russia. However, due to the small sample size from China (n = 4), Korea (n = 4) and Russia (n = 10) no further statistical analyses were undertaken for these countries (section 5.6.1). Chi square analysis found a statistically significant difference between divers from Australia and those from Japan. More Australian divers were wreck divers than Japanese ($\chi^2 = 33.432$, df = 6, $p < .001$).

The largest number of participants were either born in, or citizens of, the United States (39.5%), followed by Australia (20%), China (6.7%), Russia (1.2%), Japan (0.7%) and South Korea (0.1%). The largest group in the other countries category was Europe, which accounted for 13 percent of survey participants, followed by Canada (7.9%). Full details of the composition of the other countries categories for country of birth or nationality are presented at Appendix 8. Similar to country of residence, higher proportions of Australian and United States born or nationals were wreck divers (14. 7% and 35.8 % respectively) than to non-wreck divers (21.3% and 40.3% respectively). Higher proportions of Russian divers were also wreck divers compared to non-wreck divers. In contrast, there were higher proportions of non-wreck divers from China and Japan. As data on country of birth or nationality was collected to serve another purpose (see methods section 5.3.3), and is not directly relevant to this study, no further analysis was undertaken and there is no further discussion of these data.

The dive experience profiles of the participants are presented in Table 9 (see Appendix 9 for actual frequencies). Just over three quarters (75.9%) of participants had completed more than 100 dives, and 60 percent of participants had completed more than 250 dives. Almost half (42.6%) had completed more than 500 dives, and just over one quarter (25.7%) of participants had completed more than 1,000 dives.

Table 9 Dive experience profile

Experience variable	Frequency (%) All divers	Frequency (%) Non-wreck divers	Frequency (%) Wreck divers
Number of dives completed			
≤ 5	0.9	4.2	0.6
6-20	4.7	15.8	3.2
21-50	7.6	18.9	6.4
51-100	10.7	7.4	11.3
101-250	15.9	15.8	15.9
251-500	17.4	14.7	17.5
501-1,000	16.9	9.5	17.5
> 1,000	25.7	12.6	27.5
Don’t know	0.2	1.1	0.1
Highest level of certification			
Open water	7.3	29.5	4.4
Specialty course	2.4	4.2	2.2
Advanced open water	29.6	42.1	28.3
Master scuba diver	7.5	3.1	8.2
Divemaster or equivalent	15.3	7.4	16.3
Instructor	11.1	6.3	11.3
Master instructor	5.1	2.1	5.5
Technical	21.7	5.3	23.8
Years diving experience			
≤ 5	29.2	48.8	26.7
6-10	18.3	16.8	18.8
11-15	13.3	9.5	13.4
16-20	9.6	6.3	9.8
21-25	9.6	6.3	9.9
26-30	6.4	4.2	6.9
31-35	5.0	1.1	5.5
36-40	3.7	3.2	3.9
> 40	4.9	4.2	5.1

There were differences between wreck and non-wreck divers. More than three quarters of wreck divers (78.4%) had completed more than 100 dives, compared to just over half (52.6%) of non-wreck divers. Well over half (62.5%) of wreck divers had completed more than 250 dives compared to just over one third (36.8%) of non-wreck divers. The differences between the two groups of divers was greater as the number of dives increased. Forty five percent of wreck divers had completed more than 500 dives, compared to 22.1 percent of non-wreck divers, and 27.5 percent of wreck divers had completed more than 1,000 dives, compared to only 12.6 percent of non-wreck divers. Chi square analysis found some statistically significant differences. Significantly more divers who had completed 51-100 dives and more than 250 dives were wreck divers than those who had completed 20 or less dives (χ^2 = 69.189, df = 6, p < .001). There were also significant differences in number of dives completed and gender. Significantly more males had completed 251-500 dives and >1,000 dives (χ^2 = 12.710, df = 6, p = .048) than females.

Few divers (7.3%) held entry level diver certifications (open water), almost one third held advanced open water certification (29.6%) and leadership (divemaster, instructor, and master instructor) certifications (31.5%), and 21.7 percent of participants held technical diving certifications as their highest levels of certification. Appendix 10 lists the technical diving qualifications held by participants. There were clear differences between the certification levels of the wreck and non-wreck diver groups, with wreck divers holding higher levels of certification than non-wreck divers. Almost half (42.1%) of non-wreck divers were advanced open water divers, compared to 28.3 percent of wreck divers. A considerably higher proportion of wreck divers held leadership certifications (33.1%) compared to non-wreck divers (15.8%), and a more marked difference between wreck and non-wreck divers when technical diver certifications were compared (23.8% and 5.3% respectively). The reverse was the case with respect to entry level certification, with 29.5 percent of non-wreck divers holding open water diver certifications, compared to 4.4 percent of wreck divers. Significantly more divers who held master scuba diver, leadership (i.e. divemaster, instructor and master instructor) and technical certifications were wreck divers than those who held entry level certifications, and significantly more divers with technical certifications were wreck divers than advanced open water divers (χ^2 = 102.871, df = 6, p < .001). There were also gender based differences, significantly more males were advanced open water and technical divers (χ^2 = 21.419, df = 6, p = .002).

The majority of participants (60.8%) had been diving for up to 15 years, almost half (47.5%) for up to 10 years, and almost one third (29.2%) for five or less years. There were noticeable differences between the wreck and non-wreck divers, with almost half (48.4%) of non-wreck divers having dived for five or less years, compared with just over a quarter (26.7%) of wreck divers.

7.3.2 Motivations for scuba diving

This question collected data about wreck and non-wreck diver general motivations for scuba diving. It served another purpose that is not directly relevant to the current study. Therefore, the results of the responses to this question are presented in Appendix 11, and the responses to 'other' motivations are presented in Appendix 12. The focus of this study is on the motivations to *wreck dive*, which are reported in section 7.3.4.

7.3.3 Frequency of participation in wreck diving

Non-wreck divers and wreck divers were identified by the survey question 'Do you dive shipwrecks?' Over 88 percent (n = 724) of respondents identified themselves as wreck divers by answering yes to this question (question 13). The remaining (11.6%) of respondents did not identify themselves as wreck divers and did not complete any further survey questions. Almost half (44.8%) of the wreck divers participated in wreck diving occasionally, and just over one third (34.1%) frequently dived wrecks. Just over 10 percent rarely dived wrecks and less than 10 percent had wreck dived on less than five occasions (Table 10).

Table 10 Relative frequency of wreck diving

Descriptor / variable	Frequency (N)	Frequency (%)
Frequently	245	34.1
Occasionally	322	44.8
Rarely	86	11.9
<5 times	66	9.2
Total	**719**	**100**

7.3.3.1 Differences in frequency of participation

Kruskal-Wallis tests found significant differences between diver profile variables (i.e. demographics and dive experience) and frequency of wreck diving. These differences are summarised in Table 11. A detailed description of these results is at Appendix 13.

Table 11 Relative frequency of participation in wreck diving – summary of significant differences

χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	More frequent	Less frequent
$H(5) = 11.715$, $p = .039$	$p = .022$	Aged 45-54 years	Aged 25-34
$H(6) = 33.312$, $p <.001$	$p > .001$ $p > .001$ $p > .001$	Australia United States Other	Japan
$H(6) = 126.746$, $p > .001$	$p < .001$ $p < .001$ $p = .011$ $p = .011$	>1,000 dives	≤ 20 dives 51-100 dives 101-250 dives 501-1,000 dives
	$p < .001$	501-1,000 dives	51-100 dives
	$p < .001$ $p < .001$	251-500 dives	≤ 20 dives 51-100 dives
	$p < .001$ $p < .001$	101-250 dives	21-50 dives 51-100 dives
$H(6) = 156.754$, $p < .001$	$p < .001$ $p < .001$ $p < .001$ $p = .002$ $p < .001$ $p < .001$	Technical divers	Open water Specialty Advanced open water Master scuba divers Divemasters Instructor/master instructors
	$p < .001$ $p < .001$	Instructors/master instructors	Open water Advanced open water
	$p = .002$ $p = .011$ $p = .001$	Divemasters	Open water Specialty Advanced open water
	$p = .003$ $p < .001$ $p = .007$	Master scuba divers	Open water Specialty Advanced
$H(6) = 39.914$, $p < .001$	$p < .001$ $p = .013$ $p = .005$ $p < .001$ $p = .017$	>30 years diving 26-30 years diving 21-25 years diving 11-15 years diving 6-10 years diving	≤ 5 years diving

7.3.4 Motivations for wreck diving

The motivations for wreck diving were grouped into four thematic clusters: environmental, history/heritage, structure/technology and treasure hunting, and are shown in Table 12. These themes were adapted from Edney and Spennemann (2014).

When the means of all responses were compared, the top four motivations for wreck diving were seeing historically significant shipwrecks (mean 3.99), marine life (3.94), artefacts (3.82) and enjoying the peace and tranquillity of the underwater environment (3.78). The top two motivations had the lowest standard deviations, indicating less variance in the scores than the other motivations. All but two of the other motivations scored relatively highly, with means higher than three, with the lowest mean being 3.15, indicating that all of these motivation factors were important, although to differing degrees. The least important motivations for wreck diving were collecting artefacts and fittings (1.78) and searching for artefacts and fittings (2.71), Table 12. Although scoring second lowest, searching for artefacts and fittings scored above the neutral score of 2.5.

Half of the top four motivations for wreck diving were from the history/heritage cluster and the other half were from the environmental cluster. Notably, both of the motivations in the treasure hunting cluster were the least important motivations for wreck diving.

Table 12 Motivations for wreck diving

Motivation factor	Cluster	N	Mean*	Mean rank	SD
Seeing historically significant shipwrecks	History/heritage	711	3.99	1	1.09607
Seeing marine life	Environmental	712	3.94	2	1.06777
Seeing artefacts	History/heritage	713	3.82	3	1.12078
Peace & tranquillity of the underwater environment	Environmental	712	3.78	4	1.13458
The clear water	Environmental	712	3.41	5	1.24284
Researching or learning more about a wreck	History/heritage	712	3.40	6	1.20961
Complexity & size of the wreck	Structure/technology	711	3.34	7	1.23120
Observing effects of time (decay) on the wreck	Environmental	712	3.34	8	1.20831
Penetrating a wreck	Technique/challenge	710	3.28	9	1.36441
Photography	Technique/challenge	713	3.22	10	1.41756
Exploring & discovering machinery & fittings	Structure/technology	713	3.15	11	1.32766
Searching for artefacts	Treasure hunting	716	2.71	12	1.33903
Collecting artefacts &/or fittings	Treasure hunting	711	1.78	13	1.18103

* Value is the mean score on a 5 point scale ranging from 1 = not important to 5 = very important

The ‘Other’ motivations category was not included in the analysis of means because it covered a variety of themes, and was therefore not directly comparable to the statements listed for scoring. Some of the motivations participants listed in this category reiterated those listed in the survey instrument, while others were different. The most prevalent themes in this category included seeing marine life associated with wrecks, experiencing and learning about the history and human dimensions of a wreck, observing the colonisation of wrecks by marine life, the type of wreck, and the condition of the wreck. Some examples of these responses include:

> ‘I love seeing the marine life growing and living around a wreck as much as the wreck itself’

> ‘I principally look for the growth of marine life on wrecks rather than the wreck itself unless it has significant historical value’

> ‘Historical wrecks are fascinating underwater museums. Some are actual tombs that can be awing. Wrecks vary widely and research about each is an integral part of the experience of diving on a wreck’

> ‘The wrecks of Chuuk and Palau emanate emotions from the lost souls lost on the wrecks. Similarly the Australian wreck the Yongala has a magnetic feeling which is powerful’
>
> ‘I enjoy watching how wrecks & artificial reefs become part of the environment as well as discovering the history behind them’
>
> ‘…it is fascinating to see how the marine environment colonises them’
>
> ‘authentic wrecks encapsulate a moment in time – going back to that instant’
>
> ‘I prefer real wrecks to artificial reef wrecks. Not fun to dive a giant steel box completely stripped of anything worth seeing’
>
> ‘See a wreck intact and/or upright’

Although the collection of artefacts was the least important motivation for wreck diving, it was important enough to two participants to add it to the other motivations category in this section of the survey and to the other motivations category of the motivations to scuba dive section. For example:

> ‘Loot, pillage, and plunder’
>
> ‘Artifact hunting’
>
> ‘Wrecks…collecting goodies’
>
> ‘Artifact recovery…’.

In contrast, one participant’s motivation was:

> ‘Diving without touching or disturbing the wreck, artefacts or the bottom’.

Similarly, although not a motivation for wreck diving, seven participants felt strongly enough about removal of artefacts to make comments about it in this section of the survey:

> ‘Please be advised, most recreational divers are trained to “take only picture, leave only bubbles”. In other words, they should not be collecting artifacts’
>
> ‘I believe the removal of artifacts spoils the richness of the diving experience for others in the future’
>
> ‘Collecting artifacts is my least pressing motivation. Removing artifacts means it is not there for the next diver to appreciate’
>
> ‘As a club we dive the wrecks in ALL 5 of the great lakes. Artifacts are not collected as they are protected by the laws of the surrounding states’

> ‘The question ”Collecting artifacts…” should perhaps be removed as a good wreck diver does not remove anything from a wreck. The wreck divers motto is “Take pictures, leave only bubbles”. :-)’

> ‘It is important to see how disrespectful other divers are for the “no touch” policy involving wrecks, and its effect on the wreck itself’.

The final comment was more general but implied artefact removal, and broader issues:

> ‘The most important thing is to take nothing from the environment, and leave nothing behind to pollute the environment’.

Full details of the other category motivations are listed in Appendix 14.

7.3.4.1 Differences in motivations to wreck dive between groups

Statistically significant differences were found between diver demographics, level of diving experience, and frequency of wreck diving and motivations for wreck diving. These differences are reported on by cluster, and are summarised in Table 13. The detailed description of these results is at Appendix 15.

Table 13 Motivations to wreck dive – summary of significant differences

Cluster	Motivation factor	Rank	Mean	χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	More important to	Less important to
History/heritage	Seeing historically significant shipwrecks	1	3.99	χ^2 = 15.878, df = 4, p = .003	-	Males	Females
				H(6) = 18.743, *p* = .005	*p* = .019 *p* = .007	Japan	Australia United States
				H(6) = 20.487, *p* = .002	*p* = .009	Technical	Open water
				H(3) = 41.278, *p* < .001	*p* = .003 *p* < .001	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive
					p < .001	Occasionally wreck dive	Rarely wreck dive
					p = .006	Wreck dived < 5 times	rarely
	Seeing artefacts	3	3.82	χ^2 = 17.264, df = 4, *p* = .002	-	Males	Females
				H(6) = 13.644, *p* = .034	*p* = .030	Japan	United States
				H(6) = 15.968, *p* = .014	*p* = .019	Technical	Advanced open water
				H(3) = 38.341, p < .001	*p* = .001 *p* < .001	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive
					p = .003	Occasionally wreck dive	Rarely wreck dive
					p = .014	Wreck dived < 5 times	Rarely wreck dive
	Researching & learning	6	3.40	*H*(6) = 31.319, *p* < .001	*p* < .001 *p* = .040	Technical Instructor/master instructor	Advanced open water
				H(3) = 57.548, *p* < .001	*p* < .001	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived < 5 times
					p < .001	Occasionally wreck dive	Wreck dived < 5 times
Environmental	Seeing marine life	2	3.94	χ^2 = 29.143, df = 4, *p* < .001	-	Females	Males
				H(6) = 24.041, *p* = .001	*p* = .005	United States	Other countries
				H(6) = 26.064, *p* < .001	*p* = .038	≤ 20 dives	501-1,000 dives
					p = .006 *p* = .003	21-50 dives	501-1,000 dives >1,000 dives

Table 13 (continued)

Cluster	Motivation factor	Rank	Mean	χ^2 or H result	Adjusted p-value (pairwise comparison)	More important to	Less important to
Environmental (continued)	Seeing marine life (continued)	2	3.94	$H(6) = 60.256, p < .001$	$p < .001$ $p < .001$ $p < .001$ $p < .001$ $p < .001$ $p = .004$	Open water Specialty Advanced open water Master scuba diver Divemaster Instructor/master instructor	Technical
				$H(6) = 15.671, p = .016$	$p = .014$	≤ 5 years diving	11-15 years diving
				$H(3) = 36.012, p < .001$	$p < .001$	Wreck dived <5 times Rarely wreck dive Occasionally wreck dive	Frequently wreck dive
	Peace & tranquillity	4	3.78	$\chi^2 = 15.756$, df = 4, $p = .003$	-	Females	Males
				$H(6) = 29.832, p < .001$	$p < .001$ $p < .001$ $p = .001$	Japan	Australia United States Other countries
				$H(6) = 29.030, p < .001$	$p = .045$ $p = .008$	≤ 20 dives	501-1,000 dives >1,000 dives
					$p = .006$	21-50 dives	>1,000 dives
					$p = .042$	51-100 dives	>1,000 dives
				$H(6) = 32.540, p < .001$	$p = .036$ $p < .001$ $p = .048$	Open water Advanced open water Instructor/master instructors	Technical
				$H(6) = 30.237, p < .001$	$p = .027$ $p = .013$ $p = .012$ $p = .002$ $p = .001$	≤ 5 years diving	6-10 years diving 11-15 years diving 16-20 years diving 26-30 years diving >30 years diving
				$H(3) = 23.659, p < .001$	$p < .001$ $p = .020$ $p = .027$	Wreck dived <5 times Rarely wreck dive Occasionally wreck dive	Frequently wreck dive
					$p = .041$	Wreck dived <5 times	Occasionally wreck dive

Table 13 (continued)

Cluster	**Motivation factor**	**Rank**	**Mean**	**χ^2 or *H* result**	**Adjusted *p*-value (pairwise comparison)**	**More important to**	**Less important to**
Environmental (continued)	Clear water	5	3.41	$\chi^2 = 11.231$, df = 4, $p = .024$	-	Females	Males
				$H(6) = 25.534$, $p < .001$	$p = .004$ $p = .007$ $p = .001$	Japan	Australia United States Other countries
				$H(6) = 75.252$, $p < .001$	$p = .021$ $p = .003$ $p < .001$	≤ 20 dives	251-500 dives 501-1,000 dives >1,000 dives
					$p = .009$ $p < .001$	51-100 dives	500-1,000 dives >1,000 dives
				$H(6) = 95.179$, $p < .001$	$p = .037$ $p < .001$ $p = .015$ $p = .002$	Open water	Master scuba divers Technical Divemasters Instructor/master instructors
					$p = .002$	Specialty	Technical
					$p < .001$ $p = .002$	Advanced open water	Technical Instructor/master instructors
					$p = .007$ $p < .001$ $p = .003$	Master scuba divers Divemasters Instructor/master instructors	Technical
				$H(6) = 25.370$, $p < .001$	$p = .002$ $p = .017$ $p = .001$	≤ 5 years diving	6-10 years diving 11-15 years diving >30 years diving
				$H(3) = 71.275$, $p < .001$	$p = .001$ $p < .001$	Wreck dived < 5 times	Occasionally wreck dive Frequently wreck dive
					$p = .011$ $p < .001$	Rarely wreck dive	Occasionally wreck dive Frequently wreck dive
					$p < .001$	Occasionally wreck dive	Frequently wreck dive
	Observing effects of time (decay)	7	3.34	$H(6) = 20.634$, $p = .002$	$p = .026$	Divemasters	Advanced open water
				$H(3) = 33.335$, $p < .001$	$p = .011$ $p < .001$ $p = .005$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived < 5 times

Table 13 (continued)

Cluster	Motivation factor	Rank	Mean	χ^2 or H result	Adjusted p-value (pairwise comparison)	More important to	Less important to
Structure & technology	Complexity & size of a wreck	7	3.34	$\chi^2 = 32.487$, df = 4, $p < .001$	-	Males	Females
				$H(5) = 13.507$, $p = .019$	$p = .021$	Aged < 25 years	Aged 55-64 years
				$H(3) = 9.650$, $p = .022$	$p = .024$	Trade qualifications	Bachelor or higher degree
				$H(6) = 38.098$, $p < .001$	$p = .029$ $p < .001$	Technical	Specialty Advanced open water
				$H(3) = 55.305$, $p < .001$	$p = .001$ $p < .001$ $p < .001$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived < 5 times
					$p = .011$ $p = .001$	Occasionally wreck dive	Rarely wreck dive Wreck dived < 5 times
	Exploring & discovering machinery & fittings	10	3.15	$\chi^2 = 50.723$, df = 4, $p < .001$	-	Males	Females
				$H(3) = 11.727$, $p = .008$	$p = .026$	Trade qualifications	Bachelor or higher degree
				$H(6) = 51.768$, $p < .001$	$p = .002$ $p = .007$ $p < .001$ $p = .044$	Technical	Open water Specialty Advanced open water Master scuba diver
				$H(3) = 64.314$, $p < .001$	$p < .001$ $p < .001$ $p < .001$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived < 5 times
					$p = .032$	Occasionally wreck dive	Rarely wreck dive
Technique/challenge	Wreck penetration	8	3.28	$\chi^2 = 27.988$, df = 4, $p < .001$	-	Males	Females
				$H(6) = 18.094$, $p = .006$	$p = .003$	Australia	United States
				$H(6) = 15.580$, $p = .016$	$p = .032$	>1,000 dives	21-50 dives
				$H(6) = 63.527$, $p < .001$	$p < .001$ $p = .001$ $p < .001$ $p = .022$ $p < .001$	Technical	Open water Specialty Advanced open water Master scuba divers Divemasters
					$p = .027$	Instructor/master instructors	Open water
				$H(3) = 44.609$, $p < .001$	$p < .001$ $p < .001$ $p < .001$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived <5 times

Table 13 (continued)

Cluster	Motivation factor	Rank	Mean	χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	More important to	Less important to
Technique/challenge (continued)	Wreck penetration (continued)	8	3.28	$H(3) = 12.528, p = .006$	$p = .047$ $p = .014$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive
	Photography	9	3.22	-	-	-	-
Treasure hunting				$\chi^2 = 9.517$, df = 4, $p = .049$	-	Males	Females
				$H(3) = 15.652, p = .001$	$p = .011$	Trade qualifications	Degree or higher degree
					$p = .026$	Degree or higher degree	Diploma
				$H(6) = 33.574, p < .001$	$p < .001$ $p = .003$	Technical	Advanced open water Master scuba diver
				$H(3) = 53.781, p < .001$	$p < .001$ $p < .001$ $p = .001$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive Wreck dived <5 times
					$p < .001$ $p = .001$	Occasionally wreck dive	Rarely wreck dive Wreck dived <5 times
	Collecting artefacts &/or fittings	12	1.78	$H(6) = 19.372, p = .004$	$p = .008$	United States	Other countries
				$H(3) = 12.528, p = .006$	$p = .047$ $p = .014$	Frequently wreck dive	Occasionally wreck dive Rarely wreck dive

7.3.5 Attitudes to the protection of shipwrecks

Two survey questions sought to determine participants' attitudes to management controls over shipwrecks. The first question was a general question about their attitudes to management controls based on a set of statements (Table 14), and the second question asked participants to rank the same set of statements in relation to shipwrecks they dived regularly or enjoyed diving the most (survey questions 16 and 21 respectively – Appendix 1). The second question served a different purpose not directly relevant to the current study. Therefore, the results are presented in Appendix 16.

Table 14 Attitudes to management controls over shipwrecks

Statement	Cluster	N	Mean*	Mean rank	SD
Harsh penalties should be imposed on some divers who take things from wrecks	High restriction	694	4.00	1	1.33441
Divers should be required to have permits to dive some wrecks	Moderate restriction	703	3.31	2	1.49226
Only divers who have special certification should be allowed to dive on wrecks	Moderate restriction	707	2.85	3	1.45080
Some accessible wrecks should be off-limits to divers	Moderate restriction	686	2.71	4	1.48161
An underwater guide should control what divers do underwater	Moderate restriction	704	2.60	5	1.34558
A dive briefing is enough to control diver behaviour	Low restriction	704	2.31	6	1.07902
There should be no controls on what divers do on wrecks	Low restriction	704	1.69	7	1.16568
Moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site	Knowledge	699	1.60	8	1.00231
Wrecks (except wrecks deliberately sunk as artificial reefs) should be protected from all visitation	High restriction	704	1.46	9	.84900

* Value is the mean score on a 5 point scale ranging from 1 = strongly disagree to 5 = strongly agree

Attitudes to management controls were grouped into clusters based on the relative level of control or restriction: high, moderate and low (Table 14). The high restriction cluster includes management actions that are invasive and highly controlling. The moderate cluster includes management actions that are controlling but to a lesser degree than those in the high cluster. The low cluster includes management actions often referred to as indirect, such as information and education, and no restrictions. The final cluster, knowledge, is about the level of knowledge divers have about the effect their actions may have on the impairment of site integrity.

The statements that received the highest level of agreement to the general question about management controls were ‘harsh penalties should be imposed on some divers who take things from wrecks’ (mean 4.00) and ‘divers should be required to have permits to dive some wrecks’ (3.31) (Table 14). The other management controls did not receive high levels of agreement and were close to being neutral. The lowest scoring statements were that wrecks (with the exception of artificial reef wrecks) should be protected from all visitation (1.46), that ‘moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site’ (1.60) and ‘there should be no controls over what people do on wrecks’ (1.69). It is notable that the least variance in responses was to the statement about protecting wrecks from all visitation. The standard deviation score for this statement was notably lower than other statements. All the other statements had standard deviations higher than one, indicating a wider range of scores.

7.3.5.1 Differences in attitudes to management controls between groups

Statistically significant differences were found between diver demographics, level of diving experience and frequency of wreck diving, and attitudes towards management controls to protect shipwrecks. These differences are reported on by cluster, and are summarised in Table 15. The detailed description of these results is at Appendix 17.

Table 15 Attitudes to management controls – summary of significant differences

Cluster	Management control	Rank	Mean	χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	Higher level of agreement	Lower level of agreement
High restriction	Harsh penalties	1	4.00	$\chi^2 = 14.550$, df = 4, $p = .006$	-	Females	Males
				$H(6) = 65.902$, $p < .001$	$p < .001$ $p < .001$ $p < .001$	Australia Japan Other countries	United States United States United States
				$H(6) = 25.850$, $p < .001$	$p = .029$ $p = .019$	Divemaster	Open water Technical
					$p = .033$ $p = .033$ $p = .021$	Instructor/master instructor	Open water Specialty Technical
				$H(6) = 25.053$, $p < .001$	$p < .001$ $p = .026$ $p = .004$ $p = .001$	≤ 5 years diving 6-10 years diving 11-15 years diving 21-25 years diving	>30 years diving
				$H(3) = 8.011$, $p = .046$	$p = .038$	Occasionally wreck dive	Frequently wreck dive
	No visitation by divers	9	1.46	$\chi^2 = 10.069$, df = 4, $p = .039$	-	Females	Males
				$H(6) = 22.278$, $p = .001$	$p < .001$	Advanced open water	Open water
				$H(3) = 20.096$, $p < .001$	$p = .003$ $p = .001$	Occasionally wreck dive Rarely wreck dive	Frequently wreck dive
Moderate restriction	Permits to dive some wrecks	2	3.31	$\chi^2 = 20.270$, df = 4, $p < .001$	-	Females	Males
				$H(5) = 16.739$, $p = .005$	$p = .021$	Aged 25-34 years	Aged 45-54 years
				$H(6) = 19.160$, p = .004	$p = .009$	Japan	United States
				$H(6) = 19.860$, $p = .003$	$p = .006$	≤ 5 years diving	>30 years diving
				$H(3) = 12.436$, $p = .006$	$p = .017$	Dived wrecks < 5 times	Frequently wreck dive
	Special certification	3	2.85	$H(5) = 40.605$, $p < .001$	$p = .001$ $p = .006$ $p < .001$	Aged < 25 years	Aged 45-54 years Aged 55-64 years Aged ≥ 65 years
					$p = .009$ $p = .001$	Aged 25-34 years	Aged 45-54 years Aged ≥ 65 years
					$p = .008$ $p < .001$	Aged 35-44 years	45-54 years Aged ≥ 65 years

Table 15 (continued)

Cluster	Management control	Rank	Mean	χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	Higher level of agreement	Lower level of agreement
Moderate restriction (continued)	Special certification (continued)	3	2.85	*H*(6) = 39.268, p < .001	*p* = .011 *p < .001*	Japan	Australia United States
					p < .001	Other countries	United States
				H(6) = 30.438, *p* < .001	*p* = .002	51-100 dives	>1,000 dives
					p < .001	101-250 dives	>1,000 dives
				H(6) = 16.436, *p* = .012	*p* = .009	Divemasters	Open water
				H(6) = 39.682, *p* < .001	*p* = .018 *p* = .001	≤5 years diving	26-30 years diving >30 years diving
					p = .004	6-10 years diving	>30 years diving
					p = .013	11-15 years diving	>30 years diving
	Some accessible wrecks off-limits to divers			χ^2 = 13.846, df = 4, *p* = .008	-	Females	Males
				H(5) = 11.935, *p* = .036	*p* = .014	Aged 25-34 years	Aged 45-54 years
				H(3) = 19.245, *p* = .001	*p* = .001	Bachelor or higher degree	Trade qualifications
				H(6) = 18.645, *p* = .005	*p* = .013	Other countries	Australia
				H(6) = 15.068, *p* = .020	*p* = .007	51-100 dives	>1,000 dives
				H(6) = 15.104, *p* = .019	*p* = .016	Advanced open water	Technical
				H(3) = 13.794, *p* = .003	*p* = .036 *p* = .023	Occasionally wreck dive Rarely wreck dive	Frequently wreck dive
	Underwater guide	5	2.60	χ^2 = 16.350, df = 4, *p* = .003	-	Females	Males
				H(5) = 28.289, *p* < .001	*p* = .031 *p* = .043	Aged <25 years	Aged 45-54 years Aged 55-64 years
					p = .004 *p* = .007	Aged 25-34 years	Aged 45-54 years Aged 55-64 years
					p = .029	Aged 45-54 years	Aged ≥65 years
					p = .042	Aged 55-64 years	Aged ≥65 years
				H(6) = 56.072, *p* < .001	*p < .001* *p < .001* *p < .001*	Japan	Australia United States Other countries
					p = .001	Other countries	Australia
				H(6) = 38.931, *p* < .001	*p* = .002 *p* = .002	21-50 dives	501-1,000 dives >1,000 dives
					p = .003 *p* = .002	51-100 dives	501-1,000 dives >1,000 dives
					p = .015 *p* = .012	101-250 dives	501-1,000 dives >1,000 dives

Table 15 (continued)

Cluster	Management control	Rank	Mean	χ^2 or *H* result	Adjusted *p*-value (pairwise comparison)	Higher level of agreement	Lower level of agreement
Moderate restriction (continued)	Underwater guide (continued)	5	2.60	$H(6) = 67.437$, $p < .001$	$p = .014$ $p < .001$ $p < .001$ $p < .001$ $p < .001$	Open water Advanced Master scuba divers Divemasters Instructors/master instructors	Technical
				$H(6) = 32.898$, $p < .001$	$p = .027$ $p = .023$ $p = .028$ $p = .003$ $p < .001$	≤ 5 years diving	6-10 years diving 11-15 years diving 21-25 years diving 26-30 years diving >30 years diving
				$H(3) = 49.418$, $p < .001$	$p < .001$ $p < .001$ $p < .001$	Occasionally wreck dive Rarely wreck dive Dived wrecks < 5 times	Frequently wreck dive
					$p = .004$	Dived wrecks < 5 times	Occasionally wreck dive
Low restriction				$H(6) = 17.584$, $p = .007$	$p = .010$	Japan	Other countries
				$H(3) = 9.171$, $p = .018$	$p = .023$	Dived wrecks < 5 times	Frequently wreck dive
	No controls	7	1.69	$H(6) = 20.663$, $p = .002$	$p = .001$	United States	Other countries
				$H(6) = 20.034$, $p = .003$	$p = .002$ $p = .048$	>30 years diving	11-15 years diving 16-20 years diving
Knowledge	Moving artefacts around a wreck site is okay	8	1.60	$H(5) = 17.474$, $p = .004$	$p = .005$	Aged 45-54 years	Aged 34-45 years
				$H(6) = 15.700$, $p = .015$	$p = .046$	United States	Other countries
				$H(6) = 16.185$, $p = .013$	$p = .032$	>30 diving	11-15 years diving

7.3.6 Attitudes to shipwreck protection based on cultural values

Two survey questions sought to determine participant's attitudes about the importance of protecting wrecks with different cultural values, and the results are presented in Table 16. The first was a general question and the second was the same set of questions, but in relation to wrecks that have direct links to the participants' culture or country (survey questions 17 and 18 respectively – Appendix 1). These two questions received very similar responses, with the ranking of the top three being the same. The only differences were the rankings of wrecks with cultural values associated with wars or historical events. The question relating to links with participants' culture or country was designed to serve another purpose, as outlined in the methods (section 5.3.3). This question is not relevant to the current study objectives, therefore, no further analyses of these results were undertaken, and there is no further discussion of this data.

Focusing on the general response, all of the cultural variables received high levels of support. Wrecks that were war graves were ranked as most important to protect (mean 4.35), followed by those associated with a tragic event and containing human remains (4.19), tragic event where people were killed (3.77), an historic event (3.62), war (3.61) and a tragic event with no loss of human lives ranked lowest (3.02).

Table 16 Attitudes to protection of shipwrecks based on cultural values

Cultural value variable	General response			Linked to participant's culture/country		
	N	Mean*	SD	N	Mean*	SD
A war grave	697	4.35	1.07230	694	4.30	1.11610
A tragic event where human remains are present	698	4.19	1.15194	692	4.17	1.15921
A tragic event where people were killed	696	3.77	1.26818	691	3.77	1.29092
An historic event	695	3.62	1.28724	691	3.57	1.33059
A war	695	3.61	1.31093	690	3.69	1.29866
A tragic event with no loss of human lives	697	3.02	1.42314	692	3.17	1.41450

* Value is the mean score on a 5 point scale ranging from 1 = strongly disagree to 5 = strongly agree

7.3.6.1 Differences in importance of shipwreck cultural values

Statistically significant differences were found between diver demographics, level of diving experience, and frequency of wreck diving and diver attitudes to the protection of wrecks that had different cultural values associated with them (general response). Chi square analysis found differences between the genders in the importance given to the protection of wrecks with the listed cultural values. Kruskal-Wallis tests found statistically significant differences between the levels of dive experience and certification, frequency of wreck diving, age and countries of residence of wreck divers and the importance of protecting wrecks with the listed cultural values. These differences are reported by category of cultural value, and are summarised in Table 17. The detailed description of these results is at Appendix 18.

Table 17 Cultural significance – summary of significant differences

Cultural value variable	Rank	Mean	χ^2 or H result	Adjusted p-value (pairwise comparison)	More important to	Less important to
War grave	1	4.35	$H(6) = 18.486$, $p = .005$	$p = .010$	501-1,000 dives	>1,000 dives
			$H(6) = 22.490$, $p = .001$	$p < .001$	Specialty	Technical
			$H(6) = 15.587$, $p = .016$	$p = .024$ $p = .028$	≤ 5 years diving 11-15 years diving	>30 years diving
Tragic event – human remains present	2	4.19	($\chi^2 = 10.366$, df = 4, $p = .035$	-	Females	Males
			$H(6) = 18.351$, $p = .005$	$p = .022$	251-500 dives	>1,000 dives
			$H(6) = 24.059$, $p = .001$	$p = .001$ $p = .005$	Specialty Advanced open water	Technical
			$H(6) = 14.519$, $p = .024$	$p = .009$	11-15 years diving	>30 years diving
			$H(3) = 13.918$, $p = .003$	$p = .035$ $p = .005$	Occasionally wreck dive Rarely wreck dive	Frequently wreck dive
Tragic event – people killed	3	3.77	$\chi^2 = 20.035$, df = 4, $p < .001$	-	Females	Males
			$H(6) = 12.803$, $p = .046$	$p = .026$	Divemasters	Technical
			$H(3) = 13.035$, $p = .005$	$p = .013$	Rarely wreck dive	Frequently wreck dive
Historic event	4	3.62	$\chi^2 = 14.583$, df = 4, $p = .006$		Females	Males
			$H(6) = 21.893$, $p = .001$	$p = .009$ $p < .001$ $p = .004$	Japan	Australia United States Other countries
A war	5	3.61	$H(5) = 21.789$, p = .001	$p = .002$ $p = .014$	Aged 25-34 years	Aged 45-54 years Aged 55-64 years
			$H(6) = 14.706$, $p = .023$	$p = .009$	Divemasters	Technical
			$H(6) = 18.348$, $p = .005$	$p = .009$	≤ 5 years diving	>30 years diving
Tragic event – no loss of human lives	6	3.02	$\chi^2 = 23.722$, df = 4, $p < .001$	-	Females	Males
			$H(5) = 14.117$, $p = .015$	$p = .037$	25-34 years	55-64 years

7.3.7 Preferences and opinions towards artificial reef wrecks

A question identified the wreck divers who had dived artificial reef wrecks and those who had not (question 11). Those who had dived artificial reef wrecks were directed to the questions about these wrecks and the divers who had not were not did not complete any further survey questions. Almost ninety percent (89.9%) of wreck divers had dived an artificial reef wreck and around 10 percent (10.1%) had not. The results wreck diver preferences and opinions to artificial reef wrecks are presented in Table 18.

Table 18 Preferences and opinions towards diving artificial reef wrecks

Statement	N	Mean*	SD
Deliberately sunk ships offer better opportunities for developing wreck diving skills and training than other wrecks	611	3.96	1.09530
Some deliberately sunk ships should be zoned only for scuba diving so that other uses such as fishing are excluded	612	3.78	1.32286
I am interested in diving deliberately sunk ships because I can observe marine life colonising these wrecks over time	619	3.69	1.11917
Deliberately sunk ships should be used to take the pressure off historic shipwrecks	608	3.36	1.19132
There are enough opportunities for me to dive on deliberately sunk shipwrecks	609	2.98	1.31024
I would prefer to dive a deliberately sunk ex-military wreck than all other types of deliberately sunk wrecks	604	2.95	1.21099
Deliberately sunk ex-military ships have more historical interest to me than other types of deliberately sunk ships	612	2.79	1.31666
Deliberately sunk ships can offer more challenging if not better dive experiences than accidentally sunk ships	605	2.45	1.13473
I would prefer to dive deliberately sunk ships than accidentally sunk ships	607	2.41	.99363
Deliberately sunk ships offer more interesting dive experiences than accidentally sunk ships	606	2.23	1.02663
There should be no controls over what divers do on deliberately sunk ships	622	2.21	1.28447
Deliberately sunk ships have more historical interest to me than accidentally sunk ships	615	1.81	.95105

* Value is the mean score on a 5 point scale ranging from 1 = strongly disagree to 5 = strongly agree

When the means of all responses were compared, the statements that received the highest level of support were ‘deliberately sunk ships offer better opportunities for developing wreck diving skills and training than other wrecks’ (mean 3.96), ‘some deliberately sunk ships should be zoned only for scuba diving so that other uses such as fishing are excluded’(3.78), ‘I am interested in diving deliberately sunk ships because I can observe marine life colonising these wrecks over time’ (3.69), and ‘deliberately sunk ships should be used to take the pressure off historic shipwrecks’ (3.36). The statements that received the lowest levels of support were ‘deliberately sunk ships have more historical interest to me than accidentally sunk ships’(1.81), ‘there should be no controls over what divers do on deliberately sunk ships’ (2.21), and ‘deliberately sunk ships offer more interesting dive experiences than accidentally sunk ships' (2.23). This question served another purpose, as described in the methods section above (see Section 5.3.3), therefore no further analysis was undertaken and there is no further discussion.

7.4 Chapter summary

This chapter presented the results of the survey questionnaire. A total of 724 wreck divers participated in the self-completed web-based survey of the key source populations of wreck divers who visit the Asia-Pacific region. Almost three quarters of participants were male, and almost half of participants were aged between 35 and 54 years of age, with the most prevalent age grouping being the 35 to 44 year category, which represented just over one quarter of participants. Two thirds of participants held a Bachelor or higher degree and more than 80 percent had completed tertiary education. Just over 40 percent of participants were from the United States, one quarter were from Australian and just over one quarter from countries not specifically listed in the survey.

Participants were experienced divers. More than one quarter had completed in excess of 1,000 dives, almost one half had completed more than 500 dives and over three quarters had completed greater than 100 dives. More than half of participants had been diving for 15 or fewer years and one quarter had been diving for five or fewer years. The participants were highly qualified divers, with around one third holding leadership certifications (i.e. divemaster, instructor or master instructor), almost one quarter held technical diving certifications and under five percent held entry level certifications (open water). Over one third of the participants classified themselves as frequent wreck divers and almost half as occasional wreck divers.

The top four motivations for wreck diving, in order of importance, were seeing historically significant shipwrecks, marine life and artefacts, and enjoying the peace and tranquillity of the underwater environment. Importantly, participants were least motivated by searching for and collecting artefacts and fittings. Diver profile variables also moderated motivations for wreck diving.

Diver attitudes towards the protection of shipwrecks was also examined. In regard to attitudes towards specific management controls, the majority of participants had a convincing level of support for two controls. These were penalties and permits. Significantly, most divers did not support not having any controls in place to protect wrecks, indicating in-principle support for management controls to protect wrecks.

Importantly, preventing divers having access to wrecks received the least support for the majority of participants. Diver profile variables were found to moderate attitudes. Diver attitudes towards the protection of wrecks associated with particular cultural values were also tested. Participants had high levels of support, in order of importance, for the protection of wreck sites that were war graves, and those associated with a tragic event where human remains are present, tragic event where people were killed, historic events, wars and tragic events with no loss of lives.

A synthesis and comparison of these results and the results of the diver observation reported in Chapter 8 are presented in Chapter 9.

Chapter 8 – Video results

8.1 Introduction

The results of the video observations are reported in this chapter, and represent novel and data rich evidence regarding the research of wreck diver behaviour. This chapter presents a considerable amount of data, and is therefore necessarily large. The chapter begins with background information that provides contextual material for this aspect of the study. The results of the researcher observational data is presented first because it sets the scene for the analysis of the participant-generated video data. The researcher observational data section includes a qualitative analysis of dive guide behaviour, provides context and additional information about the participants' behaviour, and includes opportunistic observations of non-participant divers. The results of the participant-generated data follow, and are the main focus of the chapter. The quantitative analysis of the data is presented first, followed by the qualitative analysis.

8.2 Background to observations

The researcher visited Chuuk, and dived the wrecks, on three occasions prior to undertaking this study. The researcher's first visit to Chuuk was in 2007, and on that occasion she dived with the two land based dive operators, Blue Lagoon Dive Shop and Truk Stop Dive Center. In 2009, the researcher stayed on one of the live-aboard vessels, Odyssey, and 2011 dived again with Blue Lagoon Dive Shop. This gave the researcher a good knowledge and understanding of the wrecks, and also the manner in which the various operators and their associated dive guides conducted the diving.

On each visit to Chuuk, prior to undertaking the fieldwork for this study, the researcher had observed that the dive guides would make a point of taking divers to see the artefact clusters. In many cases, the guides would encourage divers to touch the artefacts. In the three years between the researcher's last visit as a tourist diver and undertaking the fieldwork in 2014, this practice appeared to have changed. In 2014, the dive guides touched the artefacts less frequently, and in many cases did not point out artefact clusters to divers, even when they swam over them during a dive. It was noticeable in 2014 that most artefact clusters had significant amounts of marine growth on them. This indicated that the dive guides, or divers, were not cleaning these artefacts, and the artefacts were not being handled as much as they had been in the past.

Another difference the researcher observed was that the dive guides seemed to be moving divers around the wrecks at a faster pace and covering, or attempting to cover, the whole wreck in a single dive. On previous visits by the researcher, the dives had been conducted at a more leisurely pace and there was more time to look at, and interact with, artefacts throughout the dive. This meant that only part of the wreck would be seen on any particular dive. The pace that the dives were being led during the fieldwork in 2014 meant that divers had less opportunity to touch artefacts until near the end of the dive on the wrecks that had artefact clusters located in shallower water near to the ascent/descent line. The reason for the change in the way dives are led is not known.

As noted in section 6.5.5, the Kimiuo Aisek Memorial Museum opened in 2013 on the grounds of the Blue Lagoon Dive Resort. The focus of the museum is the display of artefacts from many of the wrecks. There is also a display that includes a magazine article about Chuuk's 'ghost fleet' and Kimiuo Aisek. In this article, Kimiuo requested people respect the wrecks, and only look at and not touch the wrecks and their contents. It is possible that these sentiments are becoming more well known, and his philosophy of respecting the wrecks is being realised, following completion of the museum and the exhibition of items that commemorate Kimiuo and his role in the exploration of the wrecks. The researcher also noticed that some of the dive guides had retired since her last visit. It is possible, therefore, that practices have changed as the older dive guides have moved on, and as younger Chuukese have become dive guides.

The researcher had a conversation with Gradvin Aisek, Kimiuo's son, about this research when she first arrived to conduct the fieldwork. He told the researcher that over the past few years he had noticed a change in what divers do on the wrecks and what they want to see. He said that in the past most divers wanted to go deep inside the wrecks. Now it was the technical divers using twin tanks or rebreathers who wanted to do this type of diving, and the single tank divers seemed to prefer staying on the outside and looking at marine life. This perception may have had a role in changing the way dive guides lead the dives.

The dive briefings delivered to the researcher by different guides prior to each dive, with and without participants present, were all very similar. The dive guides conducted the briefings at the dive site, immediately prior to divers entering the water. All were very short in duration. The pre-dive briefings included the name of the wreck about to be dived, the part of the wreck the boat was moored or anchored to, and basic information about the route of the dive around the wreck. Some briefings included basic information about highlight features of the wreck that divers would see throughout the dive. None of the briefings the researcher was present at provided any information about the laws in place to protect the wrecks, or not touching or removing anything from the wrecks. To the researcher’s knowledge, the same style and content of briefing was given to all of the video data collection participants.

8.3 Researcher observational data

8.3.1 Background

The researcher completed 45 dives for this study. Observational video data was collected on 30 of these dives, on 21 different wrecks: 19 shipwrecks and two submerged aircraft. Table 19 lists these dives and details about the presence of participants or other divers on these dives. The cameras failed completely on 15 of the dives, and partially during three dives, therefore there is video data for 27 full dives, and partial video data for the other three dives (Appendix 19). Just over 16 hours of researcher-generated video data were analysed. In addition to the wrecks listed in Table 19, the researcher made observations on a further four wrecks, the *Hoki Maru*, *Hoyo Maru*, *I-169* submarine and the *Fumitzuki*.

The main purpose of the researcher video observations was to supplement the perspective of the participant-generated data. As noted in section 5.4.4, the researcher also gathered additional video data using hand held GoPro® HERO 2, and took notes following each dive. This data was used in addition to the head-mounted video data in the qualitative analyses.

The shipwrecks the researcher video observations were carried out on included: the *Aikoku Maru* (2), *Amagisan Maru* (1), *Fujikawa Maru* (2), *Fujisan Maru* (1), *Gosei Maru* (1), *Heian Maru* (1), *Kensho Maru* (2), *Kiyosumi Maru* (1), *Momokawa Maru* (1), *Nippo Maru* (2), *Reiyo Maru* (1), *Rio De Janeiro Maru* (3), *San Francisco Maru*

Table 19 Researcher video observations

Obs. No.	Dive site	Participants present	Other divers present in same group	Dive guide	Other dive groups present	Participant Obs. No.
1	*Rio De Janeiro Maru*	No	Yes, 2 UK divers	DG1	No	-
2	*Shotan Maru*	No	No	DG1 + Unknown	No	-
3	*Susuki*	No	No	DG1	No	-
4	*Momokawa Maru*	No	No	DG1	No	-
5	*Aikoku Maru*	No	No	DG4 & DG1	No	-
6	*Amagisan Maru*	No	No	DG1	No	-
7	*Shinkoku Maru*	No	No	DG1	No	-
8	*Rio De Janeiro Maru*	Yes	No	DG1	Yes, 1 DG & 1 diver	1, 2 & 3
9	*Rio De Janeiro Maru*	Yes	Yes, 2. 1 female and 1 male (AUS)	Unknown	No	20
10	*Kiyosumi Maru*	Yes	Yes, AUSM5	DG1	Yes, 1 DG & 1 diver	22 & 23
11	*San Francisco Maru*	Yes	Yes, 1 male	DG2	Yes, another boat	4 & 6
12	*Heian Maru*	No	No	DG1	No	-
13	*Sankisan Maru*	No	Yes, 2 males (UKM6) & 2 females (UKF5)	DG1	Yes, another boat (later)	-
14	*Shinkoku Maru*	No	Yes, 1 male & 1 female (US)	DG3	No	-
15	*Gosei Maru*	Yes	No	DG1	No	7, 8 & 9
16	*Kensho Maru*	No	UKF5, UKM3, UKM5	DG1	No	-
17	*Fujikawa Maru*	No	UKM3	DG1	No	-
18	*Fujisan Maru*	No	UKM3	DG1	No	-
19	*Nippo Maru*	No	No	DG1	No	-
20	*Reiyo Maru*	No	No	DG1 & Unknown	No	-
21	*Seiko Maru*	No	UKM3	DG1	No	-
22	*Aikoku Maru*	No	UKM3	DG1	No	-
23	*Kensho Maru*	Yes	No	DG1	Yes (6+) & DG unknown	21
24	*Sankisan Maru*	No	UKM3	DG1	No	-
25	*Yamagiri Maru*	No	UKM3	DG1	No	-
26	Betty Bomber	No	UKF5, UKM3, UKM5	DG1	No	-
27	Emily	No	UKF5, UKM3, UKM5	DG1	No	-
28	*Nippo Maru*	No	UKM3	DG1	No	-
29	*Fujikawa Maru*	No	UKM3	DG1	Yes, UKF5, UKM5 & 2 others	-
30	*Shinkoku Maru*	No	No	DG1	Yes, UKM2 + 7 others	-

Note: DG means dive guide

(1), *Sankisan Maru* (2), *Seiko Maru* (1), *Shinkoku Maru* (3), *Shotan Maru* (1), *Susuki* (1), and *Yamagiri Maru* (1). The submerged aircraft were the Betty Bomber (1) and the Emily (1). Appendices 4 and 5 list, and provide information about, the shipwrecks and submerged aircraft used in this study by both participants and the researcher. This includes their size, depth, orientation, location and type of vessel or aircraft.

8.3.2 Qualitative analysis of researcher observations

The data obtained from observations made by the researcher have been grouped into seven thematic clusters for discussion: dive guide contact behaviours, diver contact behaviours, artefacts and artefact clusters, human remains, cleaning features, submerged aircraft, and anchoring. It is acknowledged that there is overlap between dive guide and diver behaviour and the later three themes. However, the issues associated with these themes warranted separate discussion.

Although divers are required to be accompanied by dive guides, there were three occasions where the dive guide signalled to the researcher and her buddy to complete part of their dive independently. Once was during a dive on the *Aikoku Maru*, where the dive guide sent the divers to the stern section of the wreck while he remained around the hold behind the superstructure. Another time was during a dive on the *Sankisan Maru*, where the same dive guide joined the researcher and her buddy in hold two. The third occasion was on the *Fujikawa Maru*.

8.3.2.1 Dive guide contact behaviours

Intentional contacts were the most prevalent of the dive guide contact behaviours observed. The most frequent one was the dive guides standing or resting on their fins on the wrecks (Figure 35). This mostly occurred when the dive guides were waiting for all divers in the group to descend or to catch up to them during dives. The dive guides were also observed holding onto the wrecks (Figure 36), mostly when waiting for divers and when pointing out features of a wreck or marine life.

Figure 35 **Dive guide standing on his fins on the hull of the *Rio De Janeiro Maru***

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera. Dive guide was Waiting for divers to descend.

Figure 36 **Dive guide holding onto the grille of a truck in a hold of the *San Francisco Maru***

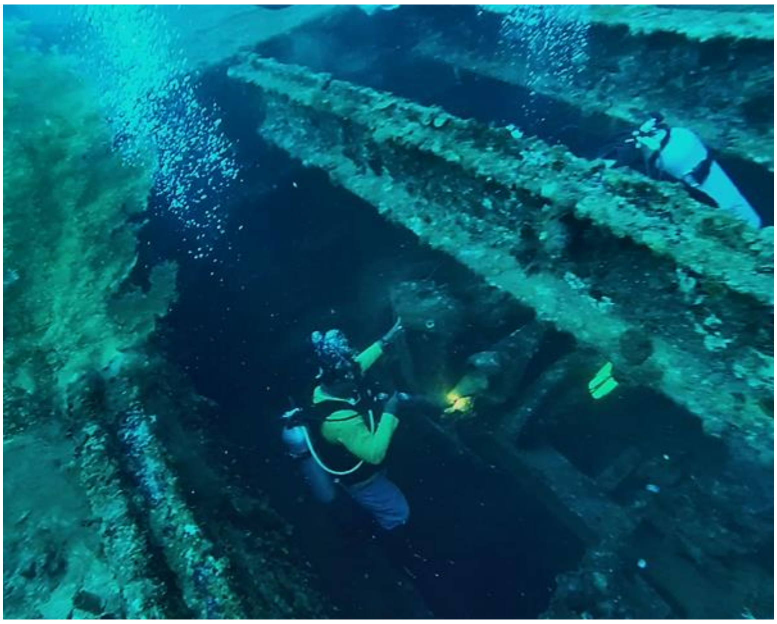


Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera. Dive guide held onto the truck while pointing it out to divers

Touching and moving telegraphs was another notable contact behaviour (Figure 37). An example of a dive guide moving the telegraph and influencing diver behaviour is discussed in more detail in section 8.4.3.10 (diver observation 14). There were other examples of dive guides moving telegraphs, on the *Fujikawa Maru* and the *Fujisan Maru*. However, the researcher observed this practice to occur more frequently in the past than during this fieldwork. Dive guides were also observed holding telegraphs on a few other occasions when pointing them out to divers.

Figure 37 **Dive guide moving the telegraph and standing on deck of the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from a participant's (UKF3) head-mounted camera.

Another example of dive guide contact behaviour influencing diver behaviour occurred inside the *Kensho Maru*. The dive guide pointed out a large radio to the researcher and her dive buddy (UKM3). He then showed them a dial on the radio that could be moved and demonstrated moving it. The researcher's buddy then also moved the dial (Figures 38 and 39).

Figure 38 **Dive guide showing diver moving dial on a radio inside the *Kensho Maru***

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera.

Figure 39 **Diver moving dial on a radio inside the *Kensho Maru*, while dive guide watches**

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera.

During a dive on the *San Francisco Maru* the dive guide stood on the bow gun platform and held the gun as though he was operating it and posed for the divers (Figure 40), in this case the researcher and her buddy on that dive (UKM3). Similarly, during a dive on the *Shotan Maru*, the same dive guide pointed the stern gun out to the researcher, then held onto it and pretended to fire it. The researcher observed this practice more frequently during previous visits to Chuuk than when undertaking this fieldwork. During the study it was more common practice for the dive guides to show divers the guns without touching them.

Figure 40 **Dive guide with the bow gun of the *San Francisco Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera. Dive guide is standing on the gun platform and holding onto the gun.

A number of unintentional contacts were observed, and these were primarily hitting wrecks with their fins while inside the wreck in confined spaces. The dive guides carry a tank of spare air slung across the front of their BCD (sling tank). There were some occurrences of the guides' sling tank getting caught when moving into or out of the wrecks, and gauges and the regulator of the sling tank dragging or getting caught on the wrecks. Few instances of hand pulling were recorded, and when this was observed, it was predominantly when moving around inside the wrecks, which is an appropriate dive technique to use in this context.

8.3.2.2 Diver contact behaviours

Some of the participant divers' contact behaviours were not visible in their video recordings, and as such were not included in the quantitative analyses of the observations (section 8.4.2). The most prevalent of these behaviours was unintentionally hitting the wrecks with fins while kicking, which occurred inside and outside the wrecks. However, only 12 instances of this behaviour were observed. There were also some instances of participants standing, kneeling and holding onto the wrecks, and one of sitting on a wreck. There were a few instances of divers' unsecured equipment dragging across the wrecks, predominantly attributable to one diver. There was also an instance of a non-participant diver's sling tank making contact with the wreck (Figure 41), captured on the video of a participant (UKF4, observation 16, section 8.4.3.12). Specific examples of behaviours not visible in the participant-generated videos but visible in the researcher's video recordings or observed by the researcher are discussed in section 8.4.3.

Figure 41 **Diver's sling tank making contact with the *Amagisan Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera. Image shows a diver's sling tank making contact with the wreck as the diver attempted to enter the wreck.

8.3.2.3 Artefacts and artefact clusters

The most unexpected and noteworthy behaviours of a dive guide occurred during a dive on the *Sankisan Maru*. Present on the dive were the dive guide, a diver (UKM3) and the researcher. The dive guide was allowing the divers to dive relatively independently. During the dive, the researcher noticed the dive guide doing something at a small artefact cluster in one of the holds. At the time the researcher approached the dive guide, her head-mounted GoPro® was recording and she was also using her hand-held GoPro®.

The artefact cluster was located in a metal container that was lying on its side in the upper level of the hold. The artefact cluster was comprised of small medicine bottles originally located in another part of the hold. The bottles were clear, green, blue and brown in colour (see Figure 42). The researcher went over to investigate what the guide was doing. The dive guide was kneeling on the floor of the hold, shaking the bottles and rubbing them, presumably to clean silt out of them and to clean their exterior surface. He then put a bullet inside one of the bottles and used it to clean inside the bottle (Figure 43).

Figure 42 **Medicine bottle artefact cluster on the *Sankisan Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The dive guide then noticed the researcher was present and passed the bottle to her. The researcher took the bottle in her hand, then the dive guide signalled to her to hold onto the bottle and keep it (Figures 44 and 45). The researcher shook her head and replaced the bottle back into the artefact cluster. The dive guide did not react to this, he continued cleaning the bottles, and did not mention it when we surfaced after the dive, or in the days following. It is not clear whether the level of familiarity the dive guide had with the researcher played a role in this. This incident occurred approximately halfway through the fieldwork, and the researcher had previously dived with this guide in 2011.

This was the only time during the fieldwork that the researcher touched an artefact. The exchange was not visible to any other divers, as her buddy was in the lower part of the hold and not visible at the time the incident occurred. No other divers were present on the wreck at the time of this incident, therefore her action would not have influenced the behaviour of other divers.

Figure 43 **Dive guide cleaning medicine bottles with a bullet on the *Sankisan Maru***

Image © 2018 Joanne Edney. Screen shot from head-mounted camera.

Figure 44 **Dive guide passes medicine bottle to researcher**

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera.

Figure 45 **Dive guide signals to researcher to keep artefact**

Image © 2018 Joanne Edney. Screen shots from researcher's head-mounted camera.

Although there was never any question of the researcher removing the artefact from the wreck and keeping it, and her refusal was immediate, there was some level of temptation. The bottle was a beautiful shade of blue with tiny air bubbles through the glass. The experience demonstrated how easily this can occur and how tempting it could be, particularly if a dive guide offered an artefact to them. They are beautiful, small and there are many inside the hold, so a diver could rationalise that taking one would not matter. They are also small enough to easily conceal in dive gear and from airport security checks.

Over the 45 dives completed by the researcher, there were only a few occasions where the dive guide pointed out artefact clusters to the divers, or touched artefacts, and one occasion when a dive guide was observed cleaning artefacts. The divers often paid no attention to the artefact clusters, even when they were pointed out by the dive guide, or when the divers swam them over the top of them.

There were two instances where the dive guide picked up artefacts from a cluster to show the divers. The first was picking up crockery and pretending to eat from it. The second was picking up and moving an artefact (see observation 23, section 8.4.4.2). There were two instances of the dive guide picking up an artefact and passing it to a diver, and one of these divers was the researcher, which was described above. There was one example of the dive guide touching artefacts at a cluster and a diver then doing the same (see observation 22, section 8.4.4.1).

During a dive on the *Susuki*, where only the researcher and dive guide were present, the researcher observed the dive guide pick something up from the deck of the wreck and place it in his BCD pocket. The dive guide was not aware that the researcher had seen him take something from the wreck.

In most cases, the divers present with the researcher did not touch artefacts, although there were some exceptions. Mostly, the divers either looked at the artefact clusters from a distance or did not go and look at them at all. Other non-participant divers present when observation 20 (section 8.4.3.16) was undertaken were observed touching and picking up artefacts throughout the dive (Figure 46). This participant's buddy was also observed by the researcher inside the *Rio De Janeiro Maru* touching and moving artefacts while videoing them. This same diver was also observed picking up an artefact and pretending to drink from it. The participant from observation 9 (UKM3, section 8.4.3.5) was present on a number of other dives with the researcher. On three different dives he was observed touching and picking up artefacts, both in situ and in clusters.

There was evidence of some artefacts being moved around on some of the wrecks, although not witnessed by the researcher. Near the commemorative plaques on the deck of the *Fujikawa Maru*, the researcher observed a number of pieces of dark blue coloured fabric (possibly clothing) strewn around (Figure 47). The fabric had been moved from another part of the wreck, presumably placed there by dive guide(s) or diver(s) unknown. The researcher has seen dark blue fabric around this artefact cluster on a previous occasion. There was also blue fabric on the top of the anti-aircraft gun on the *Nippo Maru*, and has been observed previously by the researcher in this location. Fabric deteriorates quickly when exposed, so it is likely the fabric observed on the decks of these wrecks had been removed from silt inside the wreck, where they had been preserved.

Figure 46 **Divers touching artefacts on the *Rio De Janeiro Maru***

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera. One diver is holding and shining her light onto an artefact and another is holding onto a large ceramic bowl.

Other examples of artefacts being moved occurred on the *Sankisan Maru*. The researcher dived this wreck twice during the fieldwork. On one occasion, bullets were used to spell out the name 'Miranda' (Figure 48) on a hatch cover beam, and on another occasion 'Annette' (Figure 4, section 4.3.2). Although the researcher did not observe any divers or dive guides doing this during the fieldwork, or encouraging others to do so, she has observed dive guides doing this on previous visits to Chuuk.

Figure 47 **Blue fabric on the deck of the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 48 **Bullets used to spell out the name ‘Miranda’ in hold 1 of the *Sankisan Maru***

Image © 2018 Joanne Edney. Screen shot from researcher’s head-mounted camera.

8.3.2.4 Human remains

Human remains are present and visible on a number of the wrecks. Dive guides usually lead divers to see human remains on the wrecks as a feature of those dives, and many divers specifically request to be taken to see human remains. Most of the human remains shown to divers have been moved from their original location to other parts of the wrecks.

On the *Aikoku Maru*, the artefact cluster on the deck near the commemorative plaques includes human remains (Figure 49). During fieldwork, the researcher observed bones near the plaques, in similar locations to previous visits. However, the long bones observed stacked up on the statue near the plaques during the fieldwork were not observed present on the statue on previous occasions. The bottle visible during the fieldwork also was not present on previous occasions (Figures 50 and 51). After the dive, the researcher’s buddy (UKM3) told her the last time he had dived that wreck was in 2007. During that dive he observed the dive guide pick up one of the long bones placed near the plaque and pretended to gnaw on it. On another dive on this wreck, the researcher penetrated some of the cabins with a dive guide and observed a human long bone (most likely a femur) placed on a toilet in one of the bathrooms in the wreck (Figure 52).

Figure 49 **Dive guide pointing out human remains near commemorative plaques on the *Aikoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 50 **Human bones stacked on statue near commemorative plaques on the *Aikoku Maru* 2014**

Image © 2018 Joanne Edney. Screen shot from hand-held camera. Image shows human long bones stacked on the statue along with a bottle

Figure 51 **Statue on the *Aikoku Maru* in 2011 with no human remains present**

Image © 2011 Joanne Edney. Screen shot from hand-held camera. Shows the statue on the *Aikoku Maru* with some artefacts stacked on it.

Figure 52 **Human bone placed on a toilet inside the *Aikoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The human remains in the *Yamagiri Maru* are popular with divers. There is a skull wedged in between machinery in the engine room (Figure 53), and on a shelf below are other bones (Figure 54), possibly from the same person. One of the dive guides told the researcher when they find any small bones in that part of the engine room they place them on the shelf with the other bones. The dive guides led divers to these remains on each dive the researcher did on this wreck during fieldwork, with one exception. This was because these divers had been taken to see these human remains on a previous dive and they indicated they wanted to see other human remains. The dive guide led the divers to another location in the wreck where there was a skull stuck to the inside of the wreck, near the hull.

Figure 53 **Human skull inside the engine room of the *Yamagiri Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 54 **Human remains below the skull in the engine room of the *Yamagiri Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The operating table inside the *Shinkoku Maru* has human long bones and various artefacts placed on it (Figure 55). The dive guides usually take the divers to see the operating table, and did so on all dives the researcher did on this wreck during the fieldwork. This was also the case on previous visits to Chuuk. Most divers are interested in seeing it, however one diver, USM2 (observation 12, section 8.4.3.8), did not appear interested in it. On another occasion, the researcher was photographing the operating table and a group of divers came through and merely swam past, paying no attention to the table or artefacts displayed on it.

Figure 55 **Operating table inside the *Shinkoku Maru* with human long bones and artefacts cluster**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The *Kiyosumi Maru* also has human remains visible to divers. Some long bones have been placed at the entry to one of the holds. A dive guide pointed these human remains out to a group of divers, and one diver was observed touching them (Figure 56). This action was visible in the participant-generated video data from observation 11. It was not scored, as the participant did not engage in this behaviour, and is therefore not discussed in the analysis of the participant's behaviour (section 8.4.3.7).

Figure 56 **Diver touching human remains, *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

8.3.2.5 Cleaning features on wrecks

Section 4.3.3 above discussed the practice of cleaning marine life and concretions from wrecks to reveal features, such as the ship's name. During this study, the dive guides led divers to the name of the ship on the stern of the *Rio De Janeiro Maru* (Figure 57) and the bow and stern of the *Heian Maru*, which are clearly visible. The name on the bow of the *Heian Maru* is visible in English and Kanji (Figure 58), although the name in Kanji is not as clean as the one in English, and the name on the stern is not as clean as the bow. The researcher observed the names on these wrecks on previous occasions.

Figure 57 ***Rio De Janeiro* name on stern**

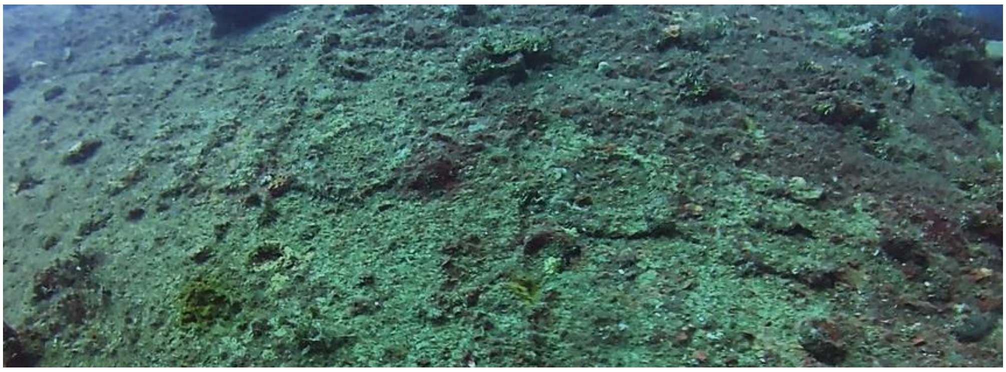


Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 58 ***Heian Maru* name on bow**

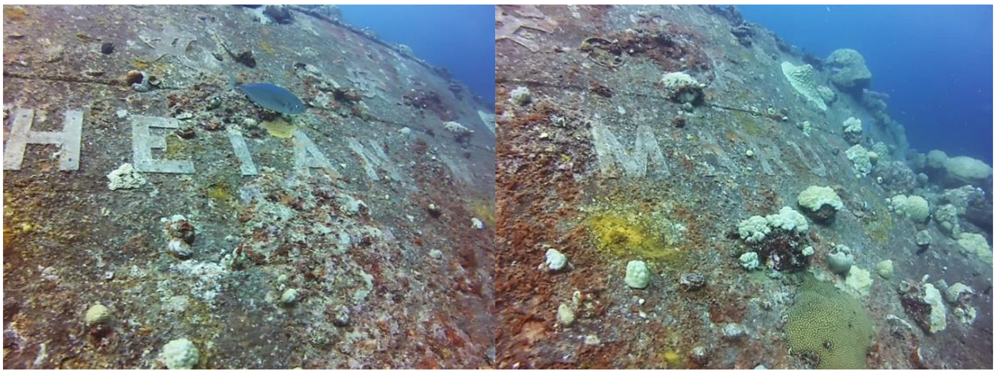


Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Inside hold two of the *Fujikawa Maru* are the fuselages of four Zero aircraft, and the dive guide showed the researcher a Hinomaru roundel on the wing of one of the Zeros (Figure 59). This part of the aircraft appeared to have been cleaned so that the Hinomaru roundel could be seen by divers. These examples indicate that certain features on and in the wrecks have been, and continue to be, cleaned so that they are more easily visible to divers.

Figure 59 **Hinomaru roundel visible on wing of Zero inside hold of the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The researcher has not witnessed any of the features described above being cleaned. However, it is likely that dive guides are responsible so they have features to show to divers, which are presumably intended to result in better diving experiences.

8.3.2.6 Submerged aircraft

The submerged aircraft have been discussed separately because of the marked difference in dive guide and diver behaviour on them in comparison to behaviours observed on the shipwrecks. The researcher dived the Emily twice and the Betty Bomber once. The Emily is in shallow water and is usually dived with air remaining from a previous dive, therefore it is a relatively brief dive. The Betty Bomber is in deeper water and more intact than the Emily and usually dived as a full dive.

The first dive on the Emily was following participant observation 20 (section 8.4.3.16) and included the same group of divers present during observation 20. It was an impromptu decision to do this dive. Therefore, the battery in the researcher's camera had insufficient power remaining to video the dive, and she did not have a spare battery at hand. One of the divers descended rapidly and immediately entered the cockpit. Later in the dive, her buddy also went into the cockpit, while another diver videoed her sitting in the cockpit (Figure 60). Both divers who entered the cockpit were wearing large twin tanks.

Figure 60 **Diver sitting in the cockpit of the Emily and posing for photographs**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

The second dive on the Emily was with UKF5, while UKM6 snorkelled it. The researcher's camera failed early in this dive. However, no attempt was made by the diver to enter the cockpit or to touch anything. The dive guide was only present for the start of the dive, and was observed to sit on one of the propellers, and hold onto a propeller and one of the floats.

The dive on the Betty Bomber was a full dive, and there were two other divers present (UKF5 and UKM6). The dive guide led the divers to the artefact cluster on the seabed adjacent to the fuselage (Figure 61). He picked up an aircraft seat and showed it to the divers. The dive guide then demonstrated how the ejection seat worked by moving the lever (Figure 62) and signalled the effect it would have.

Figure 61 **Part of the artefact cluster adjacent to Betty Bomber, Chuuk**

Image © 2018 Joanne Edney. Screen shot from hand-held camera. In the foreground are some containers and a piece of the aircraft, in the middle ground a propeller blade and behind that the toilet to the right and a radio (black box to the left). In the background behind the radio are some oxygen cylinders.

Figure 62 **Dive guide moving Betty Bomber ejection seat lever**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Next, the dive guide sat on a toilet that had been removed from the fuselage, and demonstrated its use (Figure 63). He then signalled to a diver (UKM6) to sit on the toilet, however, the diver declined. The dive guide then sat back on the toilet when the other diver (UKF5) approached. The second diver also did not sit on the toilet. Another item in the artefact cluster was a gun, which the dive guide picked up and pretended to shoot it. He then posed for a photo holding the gun (Figure 64). The dive guide then left the divers to explore the wreck independently for the remainder of the dive. The divers were not observed touching the artefacts.

Figure 63 **Dive guide demonstrating use of the toilet removed from the Betty Bomber**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 64 **Dive guide holding gun and posing for photographs at the Betty Bomber artefact cluster**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

After showing the divers the artefact cluster, the dive guide moved back to the fuselage and opened the hatch. He then sat inside the aircraft with his head and shoulders protruding from the hatch, and saluted the divers (Figure 65). The nose section of the Betty Bomber has detached from the fuselage and is damaged. The hatch area is the forward most intact section of the fuselage and resembles a cockpit, and many divers and dive guides refer to it as the cockpit.

When the dive guide got out of the hatch he signalled to the researcher to do the same, she declined. The guide then went back into the hatch and saluted and waved to the other divers. The researcher did not observe other divers enter the hatch.

Another example of diver behaviour and aircraft occurred on one of the aircraft inside the *Fujikawa Maru*. The researcher's buddy (UKM3) was observed reaching into the cockpit and moving the joystick (Figure 66) of one of the Zeros in the hold. Figure 67 shows the interior of the cockpit of one of the Zero fuselages in the *Fujikawa Maru*. On previous visits to Chuuk the researcher has observed other divers and dive guides doing the same.

Figure 65 **Diver observing dive guide sitting in the Betty Bomber hatch**

Image © 2018 Joanne Edney. Screen shot from hand-held camera.

Figure 66 **Diver moving joystick in the cockpit of a Zero inside the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera. The behaviour depicted was not visible in the participant-generated video.

Figure 67 **Cockpit of Zero fuselage in the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from hand-held camera. Moveable joystick visible.

8.3.2.7 Anchoring

Many of the wrecks at Chuuk have moorings. These moorings are often secured to parts of the wrecks, particularly the superstructure. Some of the more popular wrecks have moorings secured to the seabed adjacent to the wreck. On previous visits to Chuuk the researcher noted that the small dive boats used by the land based dive operators primarily anchored on the wrecks, rather than tying up to the mooring lines. During fieldwork, the researcher observed that this practice had changed and dive boats were primarily using the moorings.

However, there were some exceptions. Two occurrences were observed on the *Sankisan Maru*. On one occasion, the researcher observed the dive guide standing on the deck near the bow while he picked the dive boat anchor into the wreck, only one to two metres from the bow mooring line tied off on the bow. While picking the anchor in the dive guide broke a large piece of coral, which fell to the deck. On another occasion the researcher observed the anchor of the dive boat picked into the bow of this same wreck, immediately adjacent to the mooring line. Figure 68 shows the positioning of the two lines. It is not known why this was done. A dive guide was also observed picking an anchor on to the bridge of the *Shinkoku Maru,* only metres from the mooring line.

Figure 68 **Bow of the *Sankisan Maru* with mooring and anchor lines**

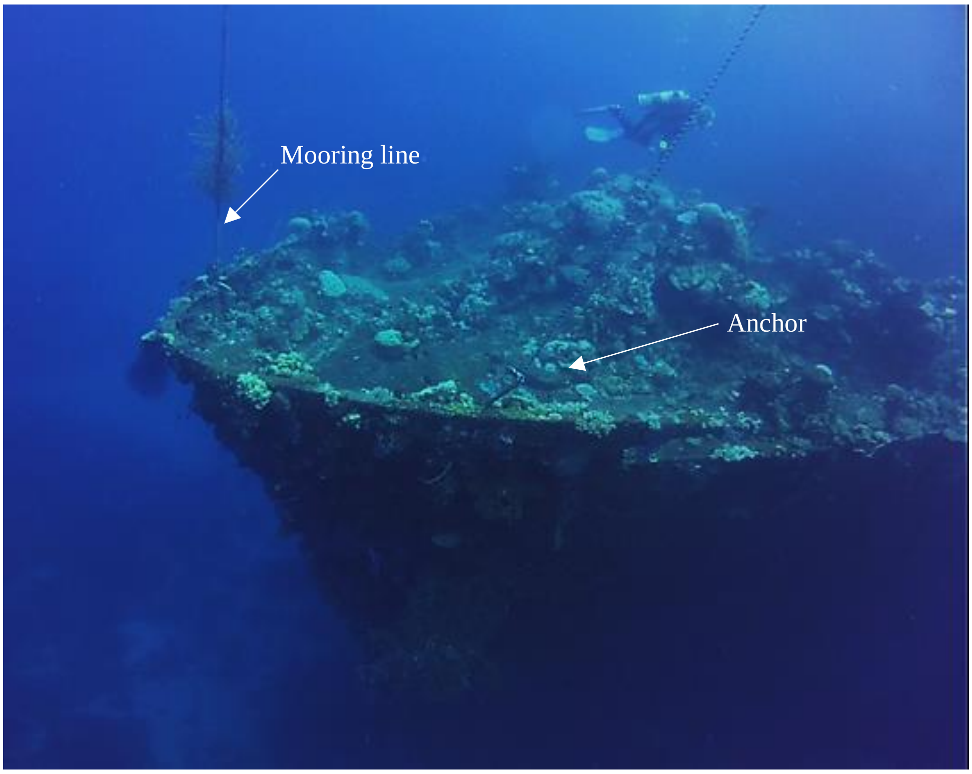


Image © 2018 Joanne Edney. Screen shot from hand-held camera.

8.4 Participant-generated data

8.4.1 Background and participant profiles

Participant-generated data was collected for 23 dives by 20 divers, 22 of these were complete dives and one was partial (approximately three quarters of the dive). The purpose of the participant-generated data was to observe, from a first-person perspective, the behaviour of participants while diving shipwrecks. Some observations occurred on the same dive. These were observations 1, 2 and 3; 4 and 6; 7, 8 and 9; and, 22 and 23.

Technical issues resulted in the loss of data for four of the dives where participants had agreed to wear cameras. Cameras failed at the start or near the start of three of these dives, and data was lost for one dive when the files were being transferred from the camera to the researcher's computer. One diver, who appeared to be having difficulty with buoyancy and/or dive equipment, removed the camera about three quarters of the way through the dive. His dive buddy, who had been a participant on a different dive, put the camera on her head. Analysis ended when this participant removed his camera, and was recorded in the event log as 'started ascent', to mark the end of the observation. Fourteen hours of participant-generated video data were analysed.

Information about the participant-generated data collection, including observation number, dive site, participant data, dive guides, and the presence or absence of the researcher, is presented in Table 20. Data was collected on 12 different shipwrecks: *Amagisan Maru* (1), *Fujikawa Maru* (1), *Gosei Maru* (4), *I-169* submarine (1), *Kensho Maru* (1), *Kiyosumi Maru* (3), *Nippo Maru* (1), *Rio De Janeiro Maru* (4), *San Francisco Maru* (2), *Sankisan Maru* (1), *Shinkoku Maru* (2), and the *Yamagiri Maru* (2). The researcher was present on 14 (61%) of the dives on which participants collected data (Observations 1-9, 13). Appendix 4 provides details about each of these wrecks, including the type of vessel, depth and orientation.

Three participants, two males and one female (AUSF2, AUSM1, and AUSM2), wore the camera on two occasions, and the repeat dives were at a different dive site to the first observation. These repeat observations provide interesting comparison data, and may contribute to improving the trustworthiness of the data. They provided the opportunity to check for consistency in the behaviour of these divers, and to contrast any differences in behaviour between different dives and diving conditions. This data is reported in Section 8.4.4 below.

Table 20 Participant-generated video data

Observation No.	Diver ID	Dive site	Researcher present	Gender	Dive experience level	Country of residence	Dive guide
1#	AUSM5	*Rio De Janeiro Maru*	Yes	Male	Less experienced	Australia	DG1
2#	AUSM1	*Rio De Janeiro Maru*	Yes	Male	Less experienced	Australia	DG1
3#	AUSF2	*Rio De Janeiro Maru*	Yes	Female	Moderate	Australia	DG1
4#	AUSM4	*San Francisco Maru*	Yes	Male	Moderate	Australia	DG2
5	AUSM2	*Yamagiri Maru*	Yes	Male	Moderate	Australia	DG2
6#	AUSM2	*San Francisco Maru*	Yes	Male	Moderate	Australia	DG2
7#	UKF5	*Gosei Maru*	Yes	Female	Moderate	UK	DG1
8#	UKM6	*Gosei Maru*	Yes	Male	Less experienced	UK	DG1
9#	UKM3	*Gosei Maru*	Yes	Male	Experienced	UK	DG1
10	UKM1	*I-169*	No	Male	Experienced*	UK	Not known
11	USF1	*Kiyosumi Maru*	No	Female	Less experienced	US	Not known
12	USM2	*Shinkoku Maru*	No	Male	Less experienced	US	Not known
13	USM1	*Shinkoku Maru*	Yes	Male	Experienced*	US	DG3
14	UKF3	*Fujikawa Maru*	No	Female	Experienced	UK	Not known
15	UKF2	*Gosei Maru*	No	Female	Experienced*	UK	Not known
16	UKF4	*Amagisan Maru*	No	Female	Experienced*	UK	Not known
17	UKF1	*Sankisan Maru*	No	Female	Experienced*	UK	Not known
18	UKM4	*Yamagiri Maru*	No	Male	Experienced^	UK	Not known
19	AUSM6	*Nippo Maru*	No	Male	Experienced*	Australia	Not known
20	AUSM3	*Rio De Janeiro Maru*	Yes	Male	Experienced*	Australia	Not known
21	UKM2	*Kensho Maru*	Yes	Male	Experienced	UK	DG1 + 1 Not known
22#	AUSM1	*Kiyosumi Maru*	Yes	Male	Less experienced	Australia	DG1
23#	AUSF2	*Kiyosumi Maru*	Yes	Female	Moderate	Australia	DG1

^ Diver using a rebreather
* Diver using twin tanks
# Note: Observations 1, 2 and 3; 4 and 6; 7-9; and, 22 and 23 occurred on the same dive.

The researcher grouped participants into categories based on her observations, and discussion with the participants. The categories included gender, country of residence and relative levels of dive experience. This data is presented in Table 21. The first two columns contain data based on the total observations, and the second two columns present the data based only on individual participants (i.e. the repeat observations have been removed).

Almost two thirds of the participants were male. The vast majority of participants were residents of the United Kingdom and Australia, accounting for 43.5 percent, while the remaining 13 percent were from the United States. Around half of the participants were experienced divers. Eight of the participants were either using a rebreather or twin tanks and were technical divers. The less experienced category did not include any novice divers. The less experienced divers were, however, had lower levels of dive experience relative to other participants. Most divers visiting Chuuk have high levels of dive experience, which is likely due to the depths the wrecks are located at (Appendix 4).

Table 21 Participant demographic and dive experience data

Variable	Number of observations	Percent of observations	Number of participants	Percent of participants
Gender				
Male	15	65.2	13	65
Female	8	34.8	7	35
Country of residence				
Australia	10	43.5	7	35
United Kingdom	10	43.5	10	50
United States	3	13.0	3	15
Level of dive experience				
Less experienced	6	26.1	5	25
Moderate	6	26.1	4	20
Experienced	11	47.8	11	55

8.4.2 Quantitative analysis of participant-generated data

This section presents the results of the quantitative analysis of the participant-generated video data. There are six components to this section. The first provides an overview of behaviour frequencies and durations. This is followed by an analysis of behaviour frequencies, an analysis of behaviour durations, an analysis of contact behaviours, an analysis of non-contact behaviours, and the sixth component is a subsection that presents visualisations of the diver behaviours.

8.4.2.1 Overview of behaviour frequencies and durations

The behaviours of participants were coded from when the diver completed their descent until the diver commenced their ascent, using The Observer® XT 12.5. This meant that the duration of dives analysed were primarily influenced by the depth of the dives, which determines dive time limits and the diver's air consumption rates.

The behaviours were subdivided into non-contact and contact behaviours. Non-contact behaviours include looking at features of wrecks and marine life, being inside a wreck and using a camera. Contact behaviours include hand pulling on a wreck and marine life, sitting and standing on a wreck, holding onto a wreck, touching artefacts, unintentional contacts with wrecks, and touching marine life. The unintentional contacts with wrecks had modifiers to differentiate the type of contact (i.e. diver's body, or various pieces of equipment). However, the only unintentional contacts recorded were from the divers 'other equipment', which included lights, buoyancy control device, camera or other accessories, therefore the modifiers are not identified in the analysis.

Quantitative analysis of participant divers' behaviours included the frequencies of each behaviour, and duration of all behaviours, with the exception of hand pulling on a wreck and hand pulling on marine life. These two behaviours were scored as point event data and therefore did not have durations. A summary of the results of these analyses are presented in Table 22.

Non-contact behaviours scored the highest frequencies. They accounted for just over 85 percent of behaviour frequencies. The most frequent of non-contact behaviour was looking at marine life, followed by looking at features of wrecks and using a camera. Being inside wrecks was the least frequent of the non-contact behaviours. The most frequent contact behaviour was hand pulling on wrecks, followed by touching artefacts and holding onto wrecks. Touching marine life and hand pulling on marine life ranked fourth and fifth highest in frequency. The frequencies of sitting and standing on wrecks and unintentional contacts were low.

The behaviour durations show how much time was spent on the various behaviours. The non-contact behaviours represented just over 98 percent of behaviour durations. Participants spent the highest proportion of their time looking at features of wrecks. This behaviour was almost three times higher than looking at marine life, which had the second highest duration. Being inside wrecks was another popular activity. Only two participants did not go inside the wrecks, and one of the wrecks not penetrated by the participant was the *I-169* submarine. It is not possible to penetrate this wreck. The other participant was diving a wreck that divers often go inside, however, the dive guide did not lead the group into the wreck on that occasion. Collectively, contact behaviours accounted for just under two percent of the scored behaviours.

Table 22 Summary of scored behaviours

Behaviour	Frequency (n)	Mean frequency (n)	Proportion of observed behaviour frequency (%)	Duration (seconds)	Mean duration (seconds)	Proportion of observed behaviour duration (%)
Non-contact behaviours						
Look at feature of wreck	438	19.04	28.13	34,197.77	1,486.86	57.68
Inside a wreck	64	3.05	4.11	9,231.18	439.58	15.57
Look at marine life	535	24.32	34.36	12,038.31	547.20	20.31
Use camera	287	28.70	18.43	2,762.85	276.29	4.66
Total non-contact	**1324**	**-**	**85.03**	**58,230.11**	**-**	**98.22**
Contact behaviours						
Hand pulling - wreck	82	6.31	5.27	-	-	-
Sit on wreck	1	1.00	0.07	34.50	34.50	0.06
Stand on wreck	3	1.50	0.19	16.91	8.46	0.03
Hold wreck	46	2.88	2.96	310.59	19.41	0.52
Touch artefact	48	9.60	3.08	587.62	117.52	0.99
Unintentional contact - wreck	2	2.00	0.13	3.64	3.64	0.01
Hand pulling – marine life	24	12.00	1.54	-	-	-
Touch marine life	27	4.50	1.73	100.17	20.03	0.17
Total contact	**233**	**-**	**14.97**	**1,053.43**	**-**	**1.78**
Total - All behaviours	**1557**	**-**	**100**	**59,283.54**	**-**	**100**

8.4.2.2 Analysis of behaviour frequencies

The frequencies of behaviours for each of the 23 observations are presented in Table 23. The non-contact behaviour looking at marine life was the most frequent behaviour. Frequencies of this behaviour ranged from 1-28, with a mean of 24.32. However, one participant was not observed looking at marine life. Looking at features of the wrecks had the next highest frequency, and all participants were engaged in this behaviour. Frequencies ranged from 5-36, and the mean was 19.04.

Using a camera was another frequent behaviour, and almost half of the participants used cameras during their data collection. Ten participants were observed using cameras, with frequencies ranging from 1-74 and a mean of 28.7. The behaviour 'use camera' was further defined using modifiers (Table 24). Marine life and the wrecks were the most frequent subject of photography, followed by people and wrecks then artefacts. People with artefacts was the least frequent subject of the photography. Features of the wrecks commonly the subject of the photos were the bows, masts and kingposts, windlasses, vehicles on or inside the wrecks and the contents of holds.

Contact behaviours were notably less frequent than the non-contact behaviours. The most frequent contact behaviour was hand pulling on wrecks. There were 13 occurrences of hand pulling on wrecks (Figure 69), by 12 participants. Frequencies ranged from 1-24, with a mean of 6.31. The next most frequent contact behaviour was touching artefacts (Figure 70). This behaviour was recorded for five of the observations, by four participants. The frequencies ranged from 5-22, and the mean was 9.6. Touching artefacts was further refined using modifiers (Table 25). Picking up and inspecting artefacts was the most frequent, and markedly more frequent than the other types of touching artefact behaviour. Cleaning, picking up and cleaning, and picking up and passing artefacts to other divers were the next most frequent ways divers touched artefacts. Holding onto the wrecks (Figure 71) was the next most frequent contact behaviour and occurred in 16 of the observations, by 15 participants.

Figure 69 **Diver hand pulling through a wreck**

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera.

Table 23 Frequency of participant behaviours

Behaviour	Frequency (n)																							Total	Mean
	Observation Number																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Look at feature of wreck	12	19	25	9	17	5	28	36	23	16	16	10	35	20	32	12	22	11	8	32	20	14	16	**438**	**19.04**
Inside a wreck	3	3	4	1	3	1	3	2	7	-	4	1	4	3	3	2	2	6	2	4	-	3	3	**64**	**3.05**
Look at marine life	1	16	14	-	19	2	44	22	58	43	33	10	38	19	62	11	37	20	1	11	29	18	27	**535**	**24.32**
Use camera	-	-	20	25	-	11	-	49	-	-	13	-	-	33	-	74	-	1	1	-	60	-	-	**287**	**28.70**
Non-contact behaviour totals	**16**	**38**	**63**	**35**	**39**	**19**	**75**	**109**	**88**	**59**	**66**	**21**	**77**	**75**	**97**	**99**	**61**	**38**	**12**	**47**	**109**	**35**	**46**	**1324**	**-**
Hand pulling - wreck	3	21	-	3	5	-	1	1	3	-	-	-	-	1	-	-	-	4	24	1	-	14	1	**82**	**6.31**
Sit on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	**1**	**1.00**
Stand on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	**3**	**1.50**
Hold onto wreck	-	8	-	3	1	-	2	1	1	1	-	-	2	3	-	-	1	2	3	1	1	11	5	**46**	**2.88**
Touch artefact	-	5	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	6	-	-	22	6	**48**	**9.60**
Unintentional contact with wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	**2**	**2.00**
Hand pulling – marine life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	3	**24**	**12.00**
Touch marine life	-	4	-	-	1	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	15	4	**27**	**4.50**
Contact behaviour totals	**3**	**38**	**0**	**6**	**7**	**0**	**3**	**2**	**15**	**2**	**0**	**0**	**2**	**4**	**0**	**0**	**1**	**6**	**35**	**2**	**1**	**87**	**19**	**233**	**-**
Total – all behaviours	**19**	**76**	**63**	**41**	**46**	**19**	**78**	**111**	**103**	**61**	**66**	**21**	**79**	**79**	**97**	**99**	**62**	**44**	**47**	**49**	**110**	**122**	**65**	**1557**	**-**

Note: Observations 2 and 22, 3 and 23, and 5 and 6 were recorded by the same divers – refer to Table 20 above for more details.

Figure 70 **Diver picking up a bottle from an artefact cluster on the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from the participant's head-mounted camera.

Figure 71 **Diver holding onto a wreck**

Image © 2018 Joanne Edney. Screen shot from a participant's head-mounted camera. Diver is holding onto part of the wreck to stay steady while looking into a small opening.

Contact with marine life included hand pulling on marine life and touching marine life, which had frequencies of 24 and 27 and means of 4.5 and 12 respectively. Unintentional contact with wrecks, sitting and standing on wrecks had very low frequencies, and two participants were responsible for all instances of these behaviours. With the exception of observation 19, the participants using cameras had very few contact behaviours, and four (40%) had no contact behaviours.

Table 24 Use camera modifier frequencies

Use camera modifiers	Frequencies – Observation number										Total n	Total %
	3	4	6	8	11	14	16	18	19	21		
Artefacts	3	11	2	7	6	10	4	-	-	1	**44**	**15.3**
People & artefacts	-	1	1	3	-	1	-	-	-	-	**6**	**2.1**
Wreck fabric	8	6	4	11	2	12	31	-	-	11	**85**	**29.6**
People & wreck	3	7	4	10	3	1	34	-	1	-	**63**	**22.0**
Marine life	4	-	-	18	2	9	5	1	-	48	**87**	**30.3**
Undetermined	2	-	-	-	-	-	-	-	-	-	**2**	**0.7**
Total - Use camera	**20**	**25**	**11**	**49**	**13**	**33**	**74**	**1**	**1**	**60**	**287**	**100**

Table 25 Touch artefact modifier frequencies

Touch artefact	Frequency (n) – Observation number					Total n	Total %	
	2	9	19	22	23			
Clean	1	4	-	2	-	**7**	**14.6**	**27.1**
Pick up & clean	1	2	1	2	-	**6**	**12.5**	
Pick up & hold up	-		1	-	-	**1**		**2.1**
Pick up & inspect	2	3	3	13	6	**27**		**56.2**
Pick up & move	1	-	-	5	-	**6**		**12.5**
Pick up & pass to other diver	-	-	1	-	-	**1**		**2.1**
Total	**5**	**9**	**6**	**22**	**6**	**48**		**100**

Note: Observations 2 and 22 were recorded by the same diver – refer to Table 20 above for more details.

8.4.2.3 Analysis of behaviour durations

The durations of behaviours were also analysed. Durations were analysed in two ways: duration as a percentage of observation time and actual duration in seconds. When making comparisons across the whole data set (Table 22) actual durations were used because they are a more useful comparison at this scale. However, when making direct comparisons between participants, the duration of the behaviours as a percentage of observation time was more appropriate. Duration as a percentage of observation time accounts for the differences in dive durations. In doing so, this allows direct comparisons to be made of the proportion of dive time spent on the various behaviours between different participants.

The results of the duration as a percentage of observation time are presented in Table 26. The means for these durations are presented in Table 27. Data for the actual durations (in seconds) can be found at Appendices 20-22. The duration of behaviours as a percentage of observation time can be more than 100 percent. This is because the various diver behaviours can overlap (Grieco et al., 2015).

The durations of the non-contact behaviours were considerably higher than the contact behaviours. Participants spent the most time looking at features of wrecks (Figure 72), and the percent duration of observation time ranged from 37.81-82.32, with a mean of 59.73 percent. This was followed by looking at marine life (Figure 73), which ranged from 0.0-59.2 percent and had a mean of 20.57. Being inside a wreck was next, and ranged 7.15-30.51 percent, with a mean of 17.5. The percent duration of observation time for using a camera ranged from 0.08-32.02, and the mean was 13.37. Using a camera was further refined using modifiers, and this data is presented in Table 28. Participants spent the greatest proportion of their time photographing marine life, which ranged from 0.08-24.82 percent duration of observation time and had a mean of 5.56 percent. This was followed by taking photos of the wrecks, and this ranged from 0.32-7.24 percent, with a mean of 4.38. The next was taking photographs of artefacts with a range of 0.07-15.06 percent and a mean of 3.85, then taking photos of people and the wrecks (range 0.37-8.57, mean 3.0), and people and artefacts (range 0.09 -1.3, mean 1.07).

Figure 72 **Fireplace in the officer's mess, *Seiko Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

Figure 73 **Trevally circling, *Fujisan Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

The highest percent duration of observation time for contact behaviours was touching artefacts, which ranged from 2.22-13.49 percent and had a mean of 5.13 percent. Touching artefacts was further refined using modifiers and this data is presented in Table 29. Participants spent the most amount of time picking up artefacts to inspect them, and this ranged from 1.13-9.78 percent duration of observation time and had a mean of 3.25 percent. Cleaning and picking up artefacts and cleaning them followed, with ranges of 0.20-1.61 and 0.51-1.56 percent and means of 1.12 and 1.06 percent respectively. Next was picking up and holding artefacts up, which only one participant did (1.0%), picking up and moving (range 0.03-0.59, mean 0.31%), and passing to another diver (0.18%) which was only done by one participant, the same participant who was responsible for picking up and holding up an artefact.

Table 26 Duration of participant behaviour (percentage of observation time)

Behaviour	Duration (percentage of observation time)																						
	Observation number																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Look at feature of wreck	54.23	65.88	57.21	40.81	58.39	59.18	37.49	45.36	65.14	82.32	57.49	37.81	63.02	64.00	62.20	79.51	76.96	70.46	73.86	61.61	51.86	57.72	51.25
Inside a wreck	9.70	13.74	17.81	14.76	30.51	15.28	12.11	11.54	27.18	-	20.53	7.15	18.94	22.28	18.58	18.77	13.49	18.14	28.40	22.53	-	13.29	12.83
Look at marine life	0.09	11.19	14.58	-	12.14	1.73	29.16	18.48	32.21	30.53	32.20	4.76	16.60	15.66	32.14	4.03	36.80	20.17	0.18	3.65	59.20	33.24	43.70
Use camera	-	-	10.97	32.02	-	2.67	-	21.61	-	-	3.65	-	-	17.10	-	17.53	-	0.08	0.74	-	27.28	-	-
Non-contact behaviour total	**64.02**	**90.81**	**100.57**	**87.59**	**101.04**	**78.86**	**78.76**	**96.99**	**124.53**	**112.85**	**113.87**	**49.72**	**98.56**	**119.04**	**112.92**	**119.84**	**127.25**	**108.85**	**103.18**	**87.79**	**138.34**	**104.25**	**107.78**
Sit on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.79	-	-	-	-
Stand on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19	-	-	0.62	-
Hold onto wreck	-	3.43	-	4.07	0.52	-	0.60	0.11	0.11	0.07	-	-	0.63	1.40	-	-	0.02	0.32	0.54	0.05	0.21	2.53	1.55
Unintentional contact	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	-
Touch artefact	-	2.80	-	-	-	-	-	-	3.50	-	-	-	-	-	-	-	-	-	3.64	-	-	13.49	2.22
Touch marine life	-	0.75	-	-	0.26	-	-	-	0.31	0.63	-	-	-	-	-	-	-	-	-	-	-	2.27	0.50
Total of contact behaviours	**0**	**6.98**	**0**	**4.07**	**0.78**	**0**	**0.60**	**0.11**	**3.92**	**0.7**	**0**	**0**	**0.63**	**1.40**	**0**	**0**	**0.02**	**0.32**	**6.16**	**0.05**	**0.21**	**19.08**	**4.27**
Total – all behaviours	**64.02**	**97.79**	**100.57**	**91.66**	**101.82**	**78.86**	**79.36**	**97.1**	**128.45**	**113.55**	**113.87**	**49.72**	**99.19**	**120.44**	**112.92**	**119.84**	**127.27**	**109.17**	**109.34**	**87.84**	**138.55**	**123.33**	**112.05**

Notes: The percentages for each observation may be higher than 100 percent because behaviours can overlap.
Observations 2 and 22, 3 and 23, and 5 and 6 were recorded by the same divers – refer to Table 20 above for more details.
There is no duration data for hand pulling – wreck and marine life because these behaviours are point event data.

Table 27 Mean duration of participant behaviour (percentage of observed time)

Behaviour	Mean (% of observed time)
Look at feature of wreck	59.73
Inside a wreck	17.50
Look at marine life	20.57
Use camera	13.37
Sit on wreck	1.79
Stand on wreck	0.41
Hold onto wreck	1.01
Unintentional contact	0.17
Touch artefact	5.13
Touch marine life	0.79

Table 28 Use camera modifiers – duration as a percentage of observation time

Use camera	Duration (percentage of observation time)										Mean
	Observation number										
	3	4	6	8	11	14	16	18	19	21	
Artefact	2.64	15.06	0.59	4.44	1.99	5.12	0.74			0.07	**3.83**
People & artefacts		1.30	0.09	2.50		0.37					**1.07**
Wreck fabric	5.93	7.09	1.48	4.34	0.32	6.27	7.24			2.39	**4.38**
People & wreck	0.44	8.57	0.51	4.27	0.83	0.37	8.27		0.74		**3.00**
Marine life	1.23			6.06	0.51	4.97	1.28	0.08		24.82	**5.56**
Undetermined	0.73										**0.73**
Total	**10.97**	**32.02**	**2.67**	**21.61**	**3.65**	**17.10**	**17.53**	**0.08**	**0.74**	**27.28**	

Table 29 Touch artefact modifiers – duration percentage of observation time

Touch artefact	Duration (% of observation time)					Total	Mean
	Observation number						
	2	9	19	22	23		
Clean	0.20	1.61	-	1.56	-	**3.37**	**1.12**
Pick up & clean	1.44	0.51	0.72	1.56	-	**4.23**	**1.06**
Pick up & hold up	-	-	1.00	-	-	**1.00**	**1.00**
Pick up & inspect	1.13	1.38	1.74	9.78	2.22	**16.25**	**16.25**
Pick up & move	0.03	-	-	0.59	-	**0.62**	**0.62**
Pick up & pass to other	-	-	0.18	-	-	**0.18**	**0.18**
Total	**2.80**	**3.50**	**3.64**	**13.49**	**2.22**	**25.65**	

Holding onto wrecks was the next highest of the contact behaviours, with a range of 0.02-4.07 percent and a mean of 1.01. The duration of the other contact behaviours was low: touching marine life ranged from 0.26-2.27 percent and had a mean of 0.79, sitting on wrecks had once occurrence of 1.79 percent, standing on wrecks had two occurrences and ranged from 0.19-0.62 percent and a mean of 0.41, and unintentional contact also had one occurrence of 0.17 percent.

8.4.2.4 Analysis of contact behaviours

Contact behaviours, such as touching artefacts, are the behaviours that can result in negative impacts on underwater cultural heritage. The frequency of these behaviours is more relevant to the level of impact than their durations. Therefore, the focus of the analysis of contact behaviours is on their frequencies.

The sources of contact behaviours are presented in Table 30. The table compares frequencies of contact behaviour by participant profile variables. The participants responsible for the most contact behaviours were males, Australians and less experienced divers. These same groups were also responsible for the majority of occurrences of touching artefacts.

Males recorded higher frequencies of all the contact behaviours than females. Males were responsible for 88 percent of the contact behaviours, yet represented 65 percent of the observations. The most marked differences between genders were standing and sitting on wrecks and unintentional contacts, which males were solely responsible for. This was followed by hand pulling, where males were responsible for 96 percent of the occurrences, touching artefacts (88%) and touching marine life (85%).

Australian participants had the highest frequencies of all the contact behaviours of the three nations represented in the observations. They were responsible for 84 percent of the contact behaviours, and only represented 44 percent of the observations. Divers from the United Kingdom also represented 44 percent of the observations, yet were responsible for only 15 percent of the contact behaviours. Participants from the United States were responsible for 1 percent of the contact behaviours, and represented 12 percent of participants. It is recognised, however, that the small sample size of this group makes it difficult to generalise that these three divers were representative of American wreck divers. For each of the contact behaviours, Australian divers recorded notably higher contacts. They were responsible for all recorded occurrences of standing and sitting on wrecks, hand pulling on marine life and unintentional contacts. Following these, the next most notable differences were touching marine life, where they were responsible for 89 percent of these contacts, hand pulling on the wrecks (88%) and touching artefacts.

Less experienced participants were responsible for 56 percent of contact behaviours and 26 percent of the observations. Moderately experienced participants also represented 26 percent of the observations, but these divers were only responsible for 15 percent of the contact behaviours. The remainder, comprising 48 percent of observations, were the experienced participants who were responsible for 29 percent of the contact behaviours. The less experienced divers were responsible for all of the unintentional contacts with wrecks, and markedly higher frequencies of hand pulling on marine life (88%), touching marine life (70%), standing on wrecks (67%), touching artefacts (56%) and hand pulling on wrecks (48%). Experienced divers were responsible for all of the occurrences of sitting on wrecks.

Table 31 presents contact behaviour frequency proportions for each participant profile variable. Although this table does not allow direct comparisons of total frequencies between variables, it shows the relative proportions of each contact behaviour by variable. For male divers, hand pulling on wrecks was proportionally the most frequent contact behaviour, followed by touching artefacts and holding onto wrecks. For females, holding onto wrecks was proportionally the most frequent contact behaviour, followed by touching artefacts and touching marine life.

Hand pulling on wrecks was proportionally the most frequent contact behaviour of Australians, followed by touching artefacts and holding onto wrecks. The most frequent contact behaviours of the participants from the United Kingdom, in order of priority, were holding onto wrecks, hand pulling on wrecks and touching artefacts. Whereas participants from the United States only held onto wrecks.

When comparing experience levels, proportionally the most prevalent contact behaviours of less experienced divers, in order of priority, were hand pulling on wrecks, touching artefacts and holding onto wrecks. For less experienced divers holding onto wrecks, hand pulling on wrecks and touching artefacts were the most prevalent. The most prevalent contact behaviour for the experienced participants was hand pulling on wrecks, and the second highest was touching artefacts and holding onto wrecks.

Table 30 Contact behaviour frequencies by diver profile variables

Diver profile variable	Frequencies																			
	Observations		Hand pull – wreck		Touch artefacts		Hold onto wreck		Stand on wreck		Sit on wreck		Unintentional contact with wreck		Touch marine life		Hand pull – marine life		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gender																				
Male	15	65	79	96	42	88	35	76	3	100	1	100	2	100	23	85	21	88	206	88
Female	8	35	3	4	6	12	11	24	0	0	0	0	0	0	4	15	3	12	27	12
Total	**23**	**100**	**82**	**100**	**48**	**100**	**46**	**100**	**3**	**100**	**1**	**100**	**2**	**100**	**27**	**100**	**24**	**100**	**233**	**100**
Country of residence																				
Australia	10	44	72	88	39	81	32	70	3	100	1	100	2	100	24	89	24	100	197	84
United Kingdom	10	44	10	12	9	19	12	26	0	0	0	0	0	0	3	11	0	0	34	15
United States	3	12	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	2	1
Total	**23**	**100**	**82**	**100**	**48**	**100**	**46**	**100**	**3**	**100**	**1**	**100**	**2**	**100**	**27**	**100**	**24**	**100**	**233**	**100**
Dive experience level																				
Less experienced	6	26	39	48	27	56	20	43	2	67	0	0	2	100	19	70	21	88	130	56
Moderate	6	26	10	12	6	13	11	24	0	0	0	0	0	0	5	19	3	12	35	15
Experienced	11	48	33	40	15	31	15	33	1	33	1	100	0	0	3	11	0	0	68	29
Total	**23**	**100**	**82**	**100**	**48**	**100**	**46**	**100**	**3**	**100**	**1**	**100**	**2**	**100**	**27**	**100**	**24**	**100**	**233**	**100**

Table 31 Contact behaviour frequency proportions by diver profile variables

Behaviour	Frequency precent							
	Gender		Country of residence			Dive experience level		
	Male	Female	Australia	United Kingdom	United States	Less	Moderate	Experienced
Hand pull - wreck	38.3	11.1	36.6	29.4	0	30	28.6	48.4
Touch artefacts	20.4	22.2	19.8	26.5	0	20.8	17.1	22.1
Hold onto wreck	17	40.8	16.2	35.3	100	15.4	31.4	22.1
Stand on wreck	1.5	0	1.5	0	0	1.5	0	1.5
Sit on wreck	0.5	0	0.5	0	0	0	0	1.5
Unintentional contact – wreck	1	0	1	0	0	1.5	0	0
Touch marine life	11.1	14.8	12.2	8.8	0	14.6	14.3	4.4
Hand pull – marine life	10.2	11.1	12.2	0	0	16.2	8.6	0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

8.4.2.5 Analysis of non-contact behaviours

Although frequencies were used for the contact behaviours, durations were more appropriate to the analysis of non-contact behaviours. The amount of time spent engaging in non-contact behaviours is more relevant than frequency because the duration of these behaviours gives an indication of the relative importance of these activities to the diver. Therefore, the focus of the analysis of non-contact behaviours is on their durations. A comparison of the durations of non-contact behaviours by diver profile variable are shown in Table 32.

Males were responsible for most of the non-contact behaviours, although this was relatively consistent with their level of representation in the observations. The duration of time spent looking at features of the wrecks and being inside wrecks was very close to the level of representation. However, there were differences between the genders in the other two behaviours. Females spent slightly more time looking at marine life (48%) and using cameras (44%) considering their level of representation (35%).

Participants residing in the United Kingdom were responsible for the more of the non-contact behaviours (55%), and represented 44 percent of the observations. The two behaviours that were notably higher were using a camera (75%) and looking at marine life (65%). Participants from the United States spent considerably less time using cameras (3%) than may be expected from their level of representation in the observations (12%).

Non-contact behaviour durations as a proportion of each variable are presented in Table 33. Although this table does not allow direct comparisons of total durations between variables, it shows the relative amounts of time, and therefore importance, of each non-contact behaviour by variable. For all variables the vast majority of their time was spent looking at features of the wrecks. When comparing genders, after looking at features of wrecks, looking at marine life and being inside wrecks were the next most important non-contact behaviours, although females spent a greater proportion of their time looking at marine life than being inside the wrecks. For males, the activities ranked the same as they did for females, although there was a less distinct difference in the proportions of time spent on each of the latter behaviours.

Looking at marine life and being inside wrecks also ranked second and third, respectively, for divers from the United States and the United Kingdom. However, looking at marine life was considerably more important to participants from the United Kingdom than being inside a wreck, while there was a less distinct difference in the amount of time participants from the United States spent on each of these activities. Australians on the other hand, spent more time inside the wrecks than looking at marine life. There were no differences in the rankings of looking at marine life and being inside wrecks when dive experience groups are compared.

The use of cameras was the lowest ranked non-contact behaviour across all variables. Both genders spent similar proportions of time on this activity, as was the case across the three levels of dive experience. However, there were differences in its relative importance between divers living in different countries. Divers from the United Kingdom spent a considerably higher proportion of time using cameras than those from the United States, and to a lesser extent, Australia.

Table 32 Non-contact behaviour durations by profile variables

Diver profile variable	Observations		Duration								Total	
			Look at feature of wreck		Inside a wreck		Look at marine life		Use camera			
	n	%	Seconds	%	Seconds	%	Seconds	%	Seconds	%	n	%
Gender												
Male	15	65	21,009.16	61.4	5,569.59	60.3	6,308.88	52.4	1,546.97	56.0	**34,434.60**	**59.1**
Female	8	35	13,188.61	38.6	3,661.59	39.6	5,729.43	47.6	1,215.88	44.0	**23,795.51**	**40.9**
Total	**23**	**100**	**34,197.77**	**100**	**9,231.18**	**100**	**12,038.31**	**100**	**2,762.85**	**100**	**58,230.11**	**100**
Country of residence												
Australia	10	44	11,591.87	33.9	3,568.80	38.7	2,619.83	21.8	610.26	22.1	**18,390.76**	**31.6**
United Kingdom	10	44	17,776.47	52.0	4,223.80	45.8	7,853.11	65.2	2,066.1	74.8	**31,919.48**	**54.8**
United States	3	12	4,829.43	14.1	1,438.58	15.5	1,565.37	13.0	86.49	3.1	**7,919.87**	**13.6**
Total	**23**	**100**	**34,197.77**	**100**	**9,231.18**	**100**	**12,038.31**	**100**	**2,762.85**	**100**	**58,230.11**	**100**
Dive experience level												
Less experienced	6	26	7,167.65	21.0	1,718.45	18.6	2,247.76	18.7	588.47	21.3	**11,722.33**	**20.1**
Moderate	6	26	5,636.34	16.5	1,955.05	21.2	2,300.02	19.1	596.05	21.6	**10,487.46**	**18.0**
Experienced	11	48	21,393.78	62.5	5,557.68	60.2	7,490.53	62.2	1,578.33	57.1	**36,020.32**	**61.9**
Total	**23**	**100**	**34,197.77**	**100**	**9,231.18**	**100**	**12,038.31**	**100**	**2,762.85**	**100**	**58,230.11**	**100**

Table 33 Non-contact behaviour duration proportions by diver profile variables

Behaviour	Duration percent							
	Gender		Country of residence			Dive experience level		
	Male	Female	Australia	United Kingdom	United States	Less	Moderate	Experienced
Look at feature of wreck	61.0	55.4	63.0	55.7	61.0	61.1	53.8	59.4
Inside wreck	16.2	15.4	19.4	13.2	18.2	14.7	18.6	15.4
Look at marine life	18.3	24.1	14.3	24.6	19.7	19.2	21.9	20.8
Use camera	4.5	5.1	3.3	6.5	1.1	5.0	5.7	4.4
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

8.4.2.6 Visualisations of diver behaviour

The Observer® XT 12.5 software has the capacity to generate charts, referred to as visualisations, which display the duration and sequence of scored behaviours for each observation. Elapsed time is shown on the x-axis and scored behaviours on the y-axis, shown as horizontal bars. The length of each bar is proportional to the duration of the behaviour, with the exception of point event behaviours (complete descent, start ascent and hand pulling), which do not have a duration. Point event behaviours are represented as a vertical line (Grieco et al., 2015).

Visualisations of each of the observations from the participant-generated data are presented in Figures 74-93 below. Due to software limitations it was not possible to standardise the scale of each observation, therefore the scale of each visualisation varied depending on dive duration. Deeper and repetitive dives were shorter in duration than the shallower dives and the first dive of the day. The visualisations also include a red vertical hairline, which is system generated and not able to be removed or altered.

When viewed on the screen using The Observer® XT 12.5 software it is possible to clearly view all behaviours, because it is possible to scroll across the whole dive beyond the limit of a single screen shot. However, in order to export the visualisations it was necessary to change the scale to fit the whole visualisation onto the screen, and in doing so, some of the behaviour details were lost. For example, the visualisation of diver observation 8 (Figure 80) included the behaviour 'hold onto wreck'. The diver had held onto the wreck to steady themselves while using a camera early in the dive. However, this is not visible in the chart due to its short duration and the scale the visualisation was required to be reduced to for exporting to other software. Nevertheless, the visualisations provide a good overview of the behaviours and the sequence in which they occurred, which is not apparent in the other quantitative analyses of the diver behaviours.

Not all of the visualisations are presented in the sequence of the observation number. This was done to allow the visualisations of the two dives completed by three of the participants to be presented together to facilitate comparison of the data (i.e. observations 2 and 22, 3 and 23, 5 and 6 – Figures 76, 77 and 78 respectively).

The visualisations show some patterns in the behaviour of the participants. Most divers were looking at features of the wrecks throughout the whole dive. Some participants did this most of the dive but were distracted by and more focused on marine life, for example, observations 7 (Figure 79) and 15 (Figure 87). Touching artefacts was opportunistic, and dependent upon the location of the artefacts on the wrecks. The artefacts handled by divers were predominantly those found in artefact clusters. These clusters are in various locations around the wrecks, therefore the pattern of touching artefacts would appear to align more with the location of the artefact and the route taken around the wreck, rather than a preference for participating in this type of behaviour at a particular phase of a dive.

Although the majority of the participants looked at marine life throughout their dive, for a number there was a stronger focus on viewing marine life near the end of the dive. This may be because near the end of the dive the divers have ascended to shallower parts of the wrecks to off-gas and there is often prolific marine life in these locations. On some wrecks lying on their side this is on the hull, on others that are upright it is on the masts or king posts. There is a lot for divers to see in these areas. Viewing marine life was opportunistic depending on where and when it occurred.

The majority of divers who participated in hand pulling on the wrecks only did it in certain areas. However, some hand pulled throughout the dive. For example, observations 19 (Figure 91) and 22 (Figure 76).

The visualisations indicate that there were no patterns of contact behaviour associated with any particular phases of the dives. Instead, the timing of the behaviours were mostly associated with opportunities and context. For example, divers mostly touched artefacts located in artefact clusters, so the touching behaviours coincided with the segments of the dives where the divers encountered the clusters. Hand pulling on the wrecks largely occurred throughout the dive, and most occurred when divers were inside the wrecks. Holding onto the wrecks also occurred throughout the dives. Looking at marine life depended on the presence of marine life and the location of the dive or the location of the diver at particular segments of the dives.

In summary, the visualisations provide a visual representation of the timing, duration and sequencing of the various behaviours. The visualisations add another dimension to the analysis of wreck diver behaviour because they allow any behavioural patterns to be more easily identified.

Figure 74 **Diver observation 1 visualisations**

Figure 75 **Diver observation 4**

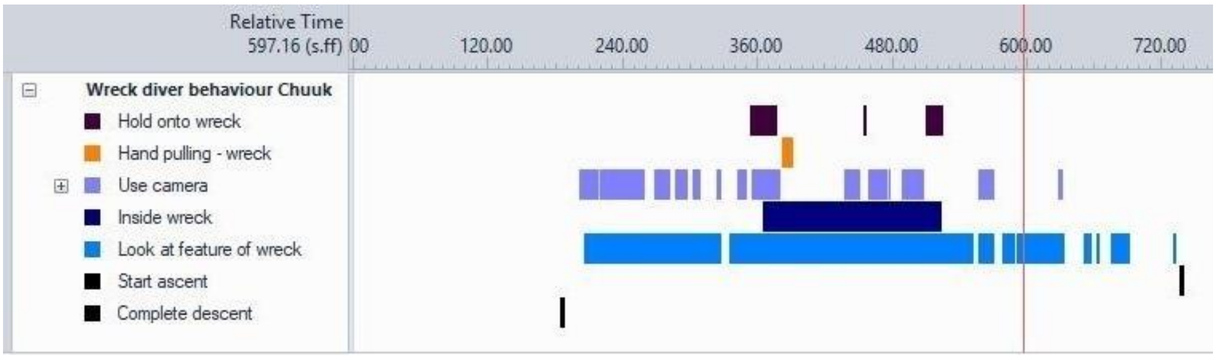
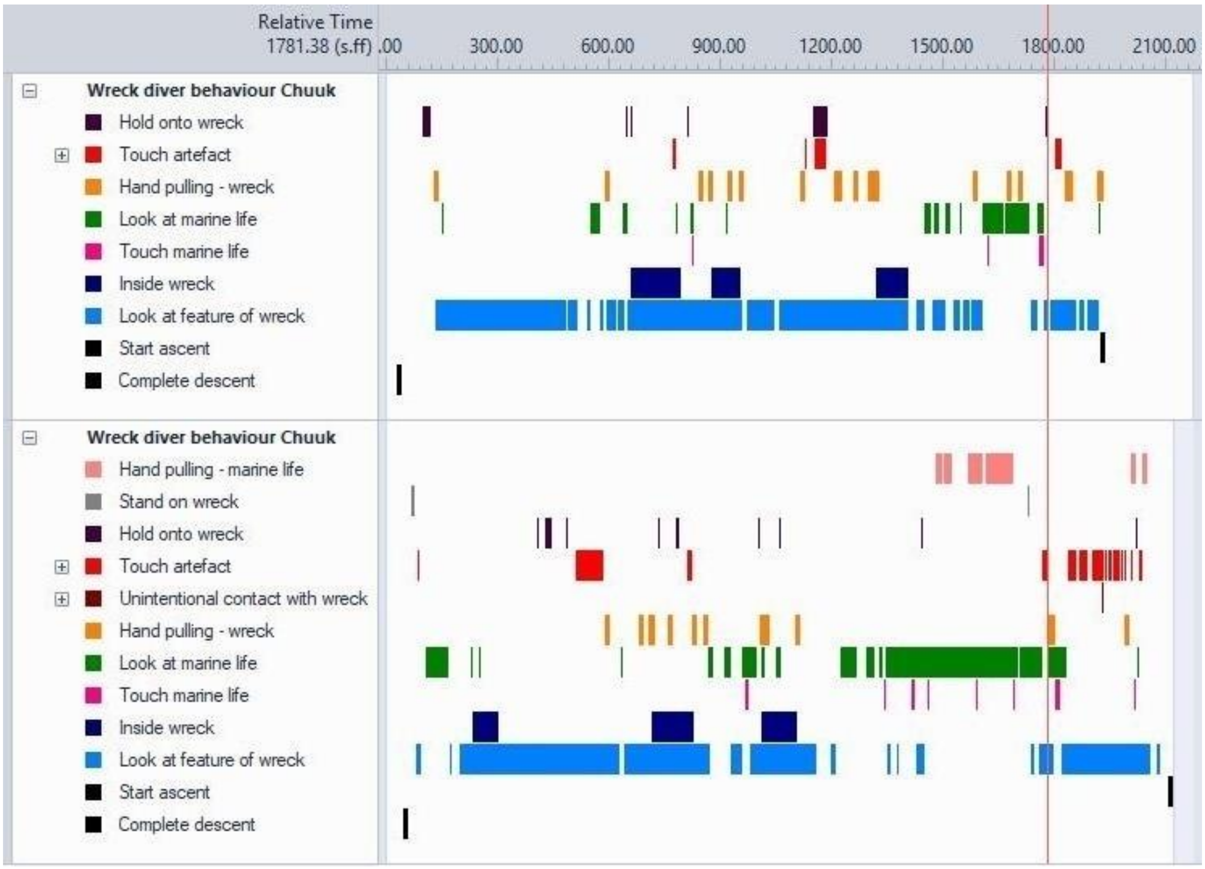


Figure 76 **Diver observations 2 & 22 visualisations**



Note: The upper visualisation is diver observation 2 and lower is diver observation 22.

Figure 77 **Diver observations 3 & 23 visualisations**

Note: The upper visualisation is diver observation 3 and lower is diver observation 23.

Figure 78 **Diver observation 5 & 6 visualisations**

Note: The upper visualisation is diver observation 5 and lower is diver observation 6.

Figure 79 **Diver observation 7 visualisation**

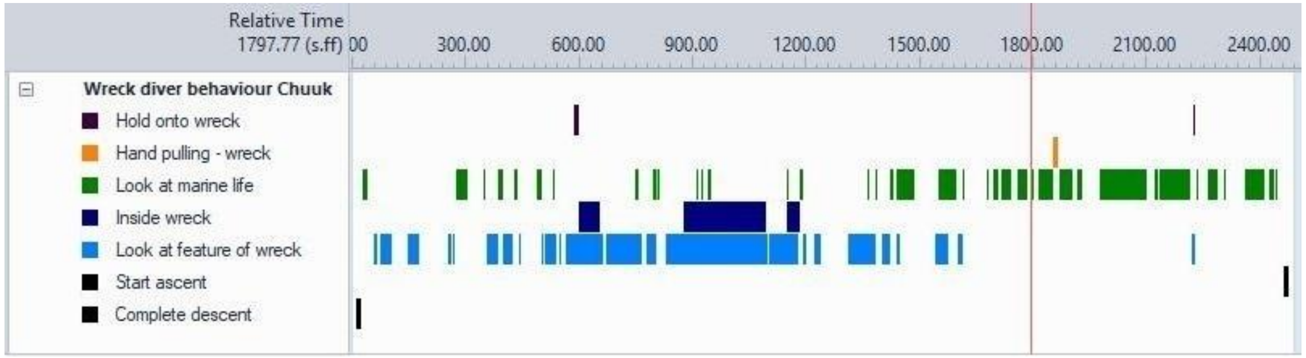


Figure 80 **Diver observation 8 visualisation**

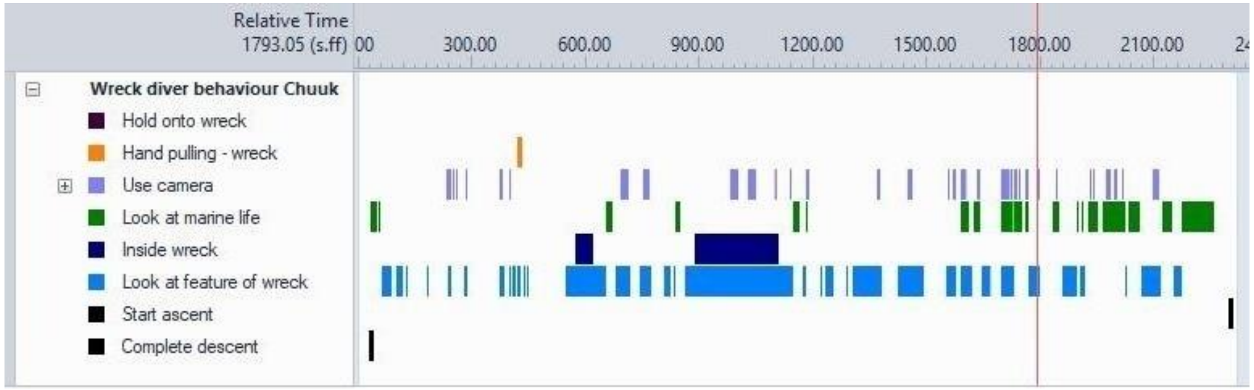


Figure 81 **Diver observation 9 visualisation**

Figure 82 **Diver observation 10 visualisation**

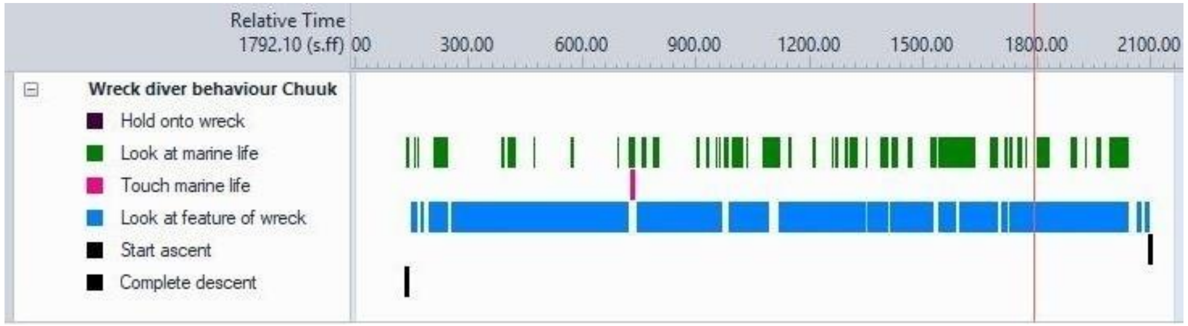


Figure 83 **Diver observation 11 visualisation**

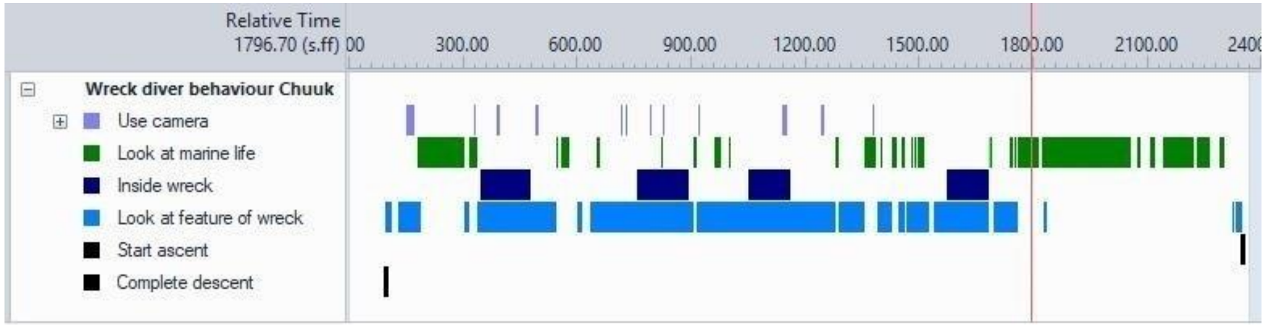


Figure 84 **Diver observation 12 visualisation**

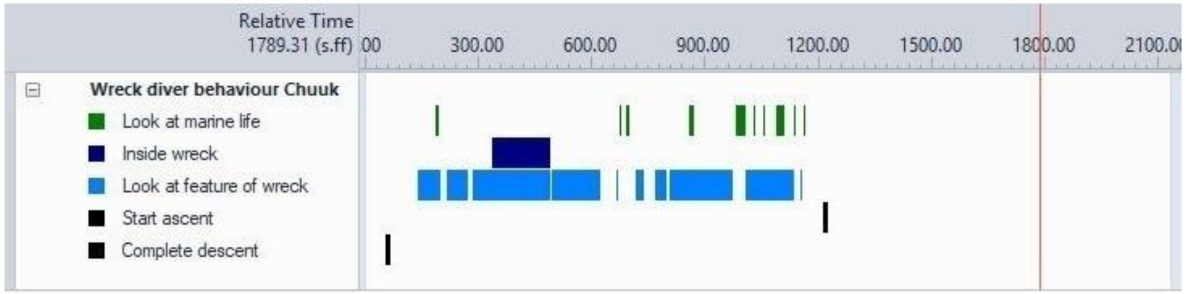


Figure 85 **Diver observation 13 visualisation**

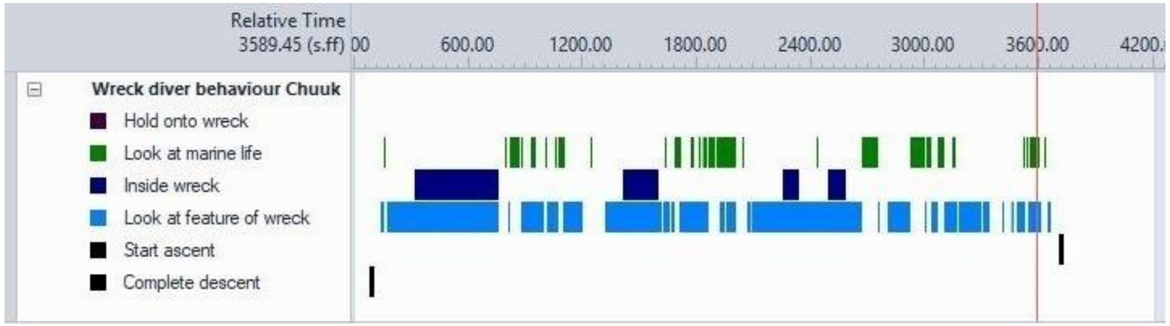


Figure 86 **Diver observation 14 visualisation**

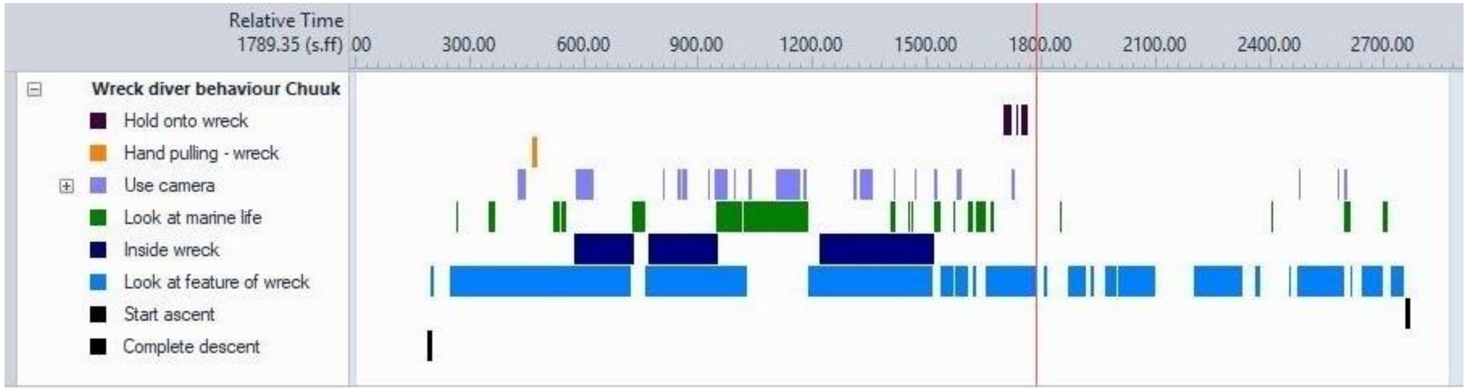


Figure 87 **Diver observation 15 visualisation**

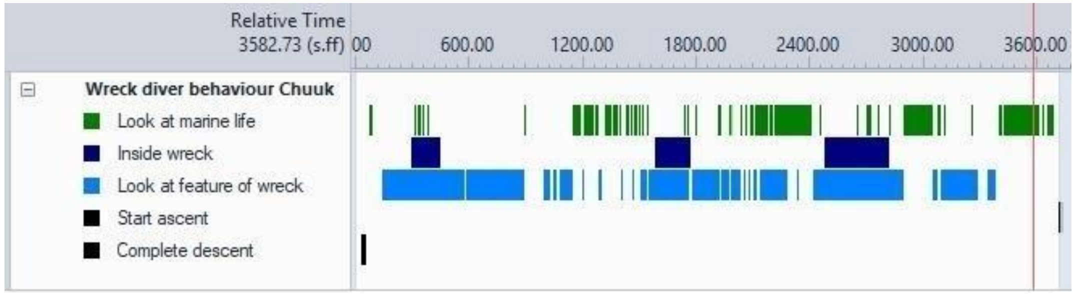


Figure 88 **Diver observation 16 visualisation**

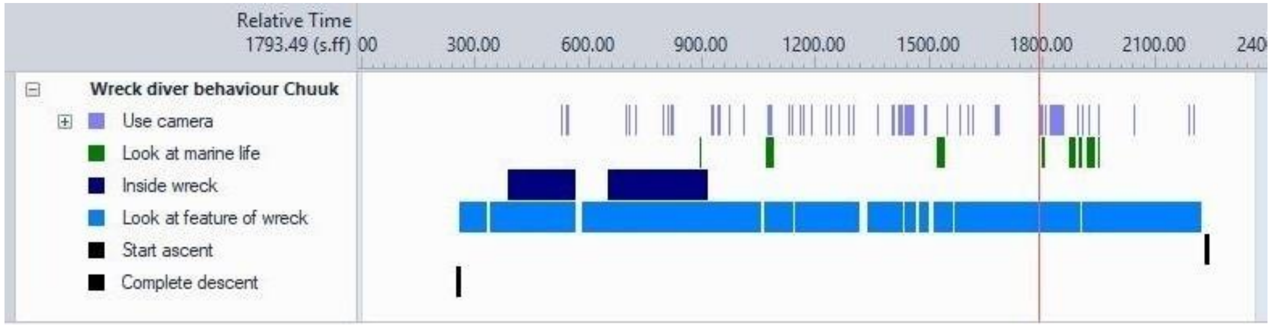


Figure 89 **Diver observation 17 visualisation**

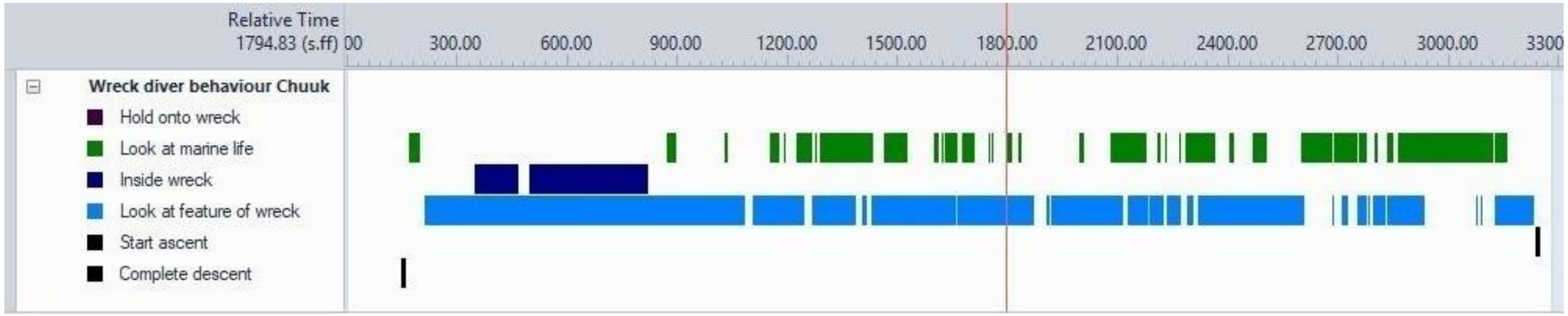


Figure 90 **Diver observation 18 visualisation**

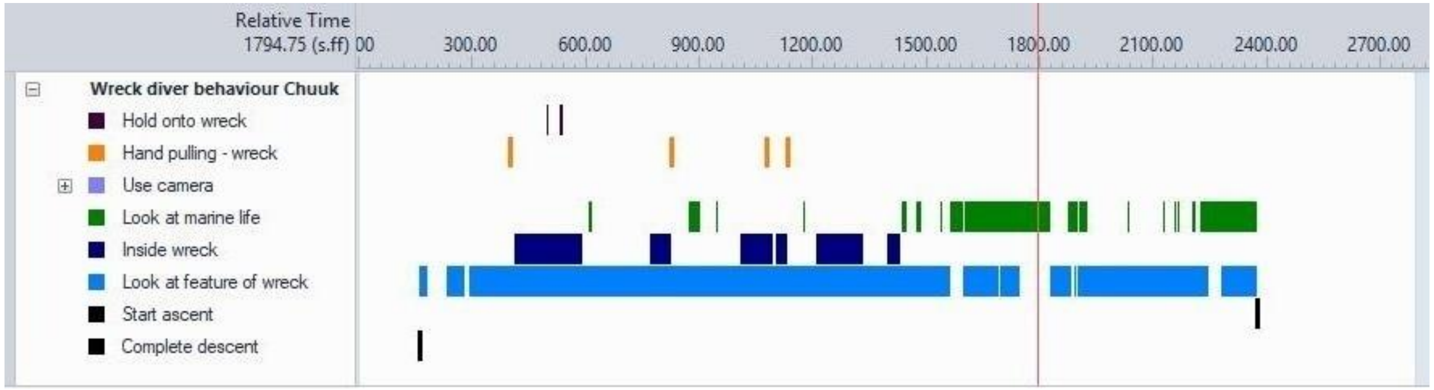


Figure 91 **Diver observation 19 visualisation**

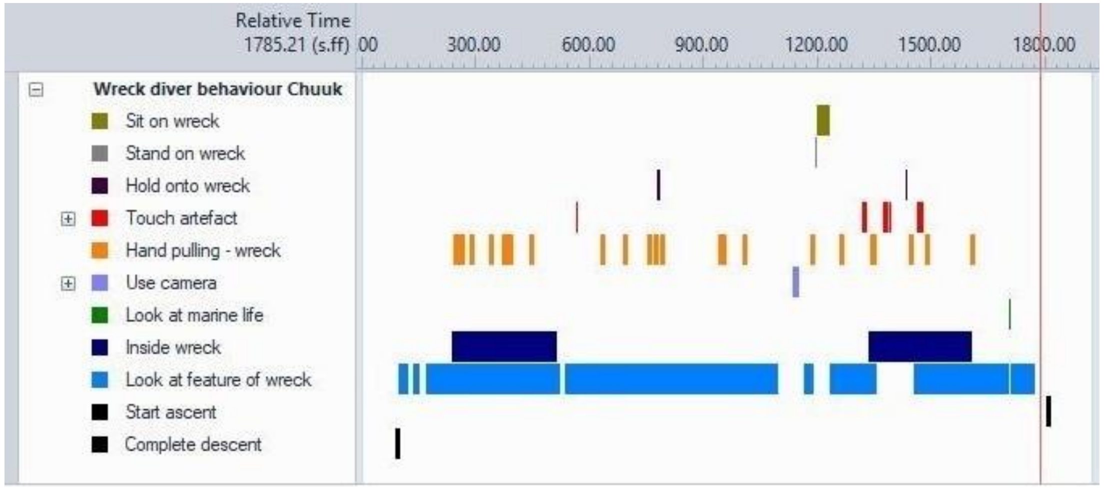


Figure 92 **Diver observation 20 visualisation**

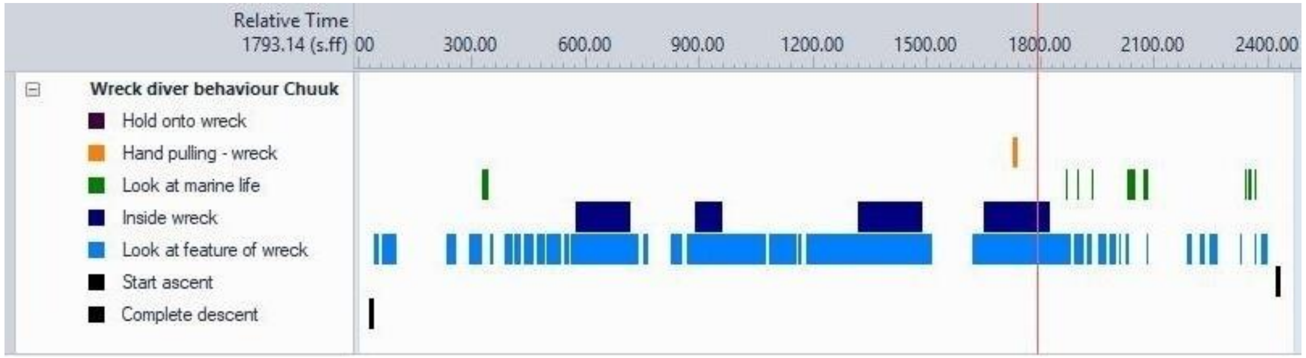


Figure 93 **Diver observation 21 visualisation**

8.4.3 Qualitative analysis of participant-generated data

This section presents the qualitative analyses of the diver observations, with the exception of six observations (2 and 22, 3 and 23, 5 and 6). The repeat observations are contained in a separate section, section 8.4.4 to facilitate comparison of the data. The qualitative analyses primarily draw on the participant video recordings, and are supplemented by the researcher's video observations and notes made by the researcher following each dive. The qualitative analyses enable a deeper understanding of diver behaviour by providing context for the quantitative analyses of the observations, described in section 8.4.2, and a description of behaviours.

8.4.3.1 Diver observation 1

Three contact behaviours were recorded from this diver's video, and all were hand pulling. The three instances of hand pulling occurred moving back along the hull from the bow to midships. As there was no current on the dive, the hand pulling was not an appropriate dive technique to use in those circumstances.

The diver did appear to be comfortable in the water, and it is not clear whether he had not dived for some time and/or was unfamiliar with the equipment he was using. He looked at features of the wreck throughout the dive, but less so than the other two participants present on the same dive, and paid less attention to marine life than to the features of the wreck. The participant watched another diver in this group touching artefacts in a cluster but did not touch anything. The participant spent quite a bit of time throughout the dive adjusting various pieces of his equipment, and it is likely the participant's attention was more focused on equipment, diving skills and techniques than enjoying the dive.

The dive guide pointed out the artefact cluster near the ascent/descent line, which the participant briefly looked at, then the dive guide signalled for him to start his ascent. The participant then had a look at another small artefact cluster on the hull and the dive guide again signalled for him to ascend. It appears the diver became more comfortable as the dive progressed, and more engaged in looking at the wreck.

The diver engaged in other contact behaviours that were not visible on the video he recorded, and therefore not included in the quantitative analysis. Most notably, he stood (Figure 94) and knelt on the wreck (Figure 95) at the start of the dive for some time. This behaviour occurred when he appeared to be having difficulty with his dive computer and was focused on trying to sort the problem out. These behaviours were visible in the researcher's video recordings and the recordings made by other participants present on the dive (AUSM1 and AUSF2). The dive guide was also observed standing on the wreck while trying to assist the participant at the start of the dive (Figure 95). Later, the dive guide was observed with one knee and one fin resting on the wreck while he assisted the diver and checked his air supply. Other contacts made by this diver that were not visible in the video he recorded included kicking the wreck on a number of occasions when entering and exiting the wreck and while moving along the hull, and standing on his fin tips in a hold while looking at its contents.

Figure 94 **AUSM5 standing on hull of the *Rio De Janeiro Maru* while adjusting dive computer**

Image © 2018 Joanne Edney. Screen shot from head-mounted camera.

Figure 95 **Dive guide standing and participant (AUSM5) kneeling on the hull of the *Rio De Janeiro Maru***

Image © 2018 Joanne Edney. Screen shot from head-mounted camera.

8.4.3.2 Diver observation 4

The participant was the buddy of the participant who collected data for observations 5 and 6. The participant had a hand held camera on the dive, which he used frequently. This diver was visibly excited and nervous about undertaking this dive, as it was the deepest dive he had ever completed. The researcher recorded a maximum depth of 55 metres on this dive, and the diver probably also dived to this depth, as he had a similar dive profile to the researcher.

This participant made a total of six contacts with the wreck throughout the dive. Half of these contacts were hand pulling, and the other half were holding onto the wreck. The hand pulling occurred while moving around inside the hold of the wreck, and is an appropriate technique in this context. The participant held onto the wreck to steady himself to look at his computer/gauges, to steady himself for photography and while looking at features of the wreck (Figure 96).

Figure 96 **Participant holding onto wreck while looking into the hold of the *San Francisco Maru***

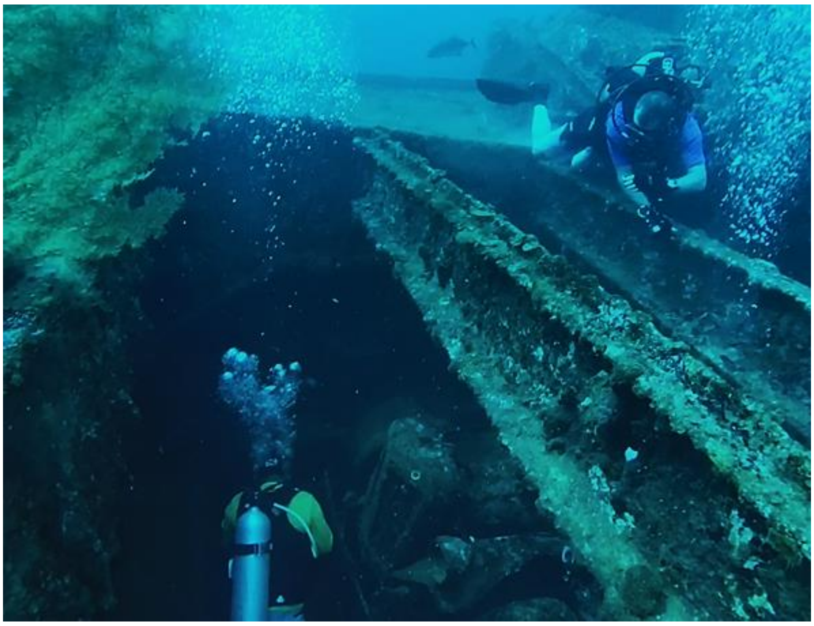


Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera.

The participant appeared a little reluctant at first to enter a hold, then to penetrate the wreck moving from the second to the first hold. It was the deepest part of the dive, and it is not clear whether the diver was uncomfortable penetrating the wreck, or going beyond 50 metres (deck level), or was perhaps feeling uncomfortable due to the effects of nitrogen narcosis at this depth (see section 8.4.4.3 for more detail about narcosis at this depth). Another possibility is that the participant may have been concerned about the contents of one of the holds, largely beach mines and artillery shells. Whatever the reason, after initial hesitation, the participant readily followed the dive guide through the wreck from the second to the first hold, and was observed looking at and photographing the beach mines and artillery shells in this hold.

After exiting the hold, the participant ascended so that he was a few metres higher than the deck, and stayed up high when the dive guide led the divers to the bow gun and showed it to them. However, none of the divers in the group attempted to touch the bow gun. The dive guide did not touch the gun.

The participant continued to move up high above the wreck for the remainder of the dive. It is possible the diver did this to reduce any possible effects of narcosis, to reduce his off gassing time on ascent, or he may not have been comfortable staying at 50 metres for the duration of the dive. From the bow gun back to the ascent/descent line on the bridge, the participant continued to gradually ascend, and continued to look down onto the wreck, indicating his interest in the wreck. Whereas other divers in his group remained at deck level until reaching the ascent line.

8.4.3.3 Diver observation 7

This diver had three contacts with the wreck, two instances of holding onto the wreck and one of hand pulling. The diver first entered the wreck through the torpedo hole, and spent some time looking at the hole and the damage caused to the hull and the hold before she moved fully into it. Before moving into this hold the diver held onto the wreck to steady herself and looked inside. The other instance of holding was later in the dive when she held onto the wreck while looking at something inside the wreck. The hand pulling occurred on the hull of the wreck while moving around the outside of the wreck towards the end of the dive. There was no current and the hand pulling was not done to prevent silting. The diver appeared equally interested in marine life and the wreck throughout the dive, but the later parts of the dive she was more focused on marine life than the wreck.

This dive was conducted at a leisurely pace and the dive guide stayed in the water but allowed the divers to dive independently for approximately the last third of the dive. Therefore, there were opportunities for the divers to touch the artefacts in and on the wreck. However, the participant did not touch any artefacts, even though early in the dive the dive guide was seen picking up an artefact from the seabed, presumably a plate or a bowl, and pretended to eat from it.

8.4.3.4 Diver observation 8

This diver had only two contact behaviours, he hand pulled once and held onto the wreck on another occasion. He hand pulled on the wreck while outside and held onto the wreck to steady himself while looking down at something on the deck. This participant had a camera and used it frequently throughout the dive. The subject of his photos appeared to be predominantly people, particularly his buddy, and the wreck, and also the wreck itself, artefacts and marine life.

This diver only entered the wreck on two occasions, both following the dive guide, although his buddy entered an additional time without him. The diver spent most of his time on the outside of the wreck and appeared more interested in marine life than the wreck itself, particularly during the latter part of the dive.

8.4.3.5 Diver observation 9

This participant had 15 occurrences of contact behaviour, and the majority of them were touching artefacts. The next most frequent behaviour was hand pulling, followed by touching marine life, and one instance of holding onto the wreck. The diver’s contact with marine life were brushing and touching coralline algae and tapping a coral with his dive light. The reason for these actions are not known.

The diver began the dive primarily looking at marine life while waiting for all divers to descend. Once all the divers had descended, the dive guide led the divers to the propeller and pointed it out to them. When the other divers had moved on, he rubbed the propeller blade with his finger (Figure 97), then got his dive knife out and was observed scraping it with his knife (Figure 98). It is possible the diver was trying to remove the marine growth and other protective coatings so he could see what type of metal the propeller was made from.

Later in the dive, the diver scraped a porthole with his dive knife. Shortly after this, he was observed rubbing the metal rim of an open porthole with his hand (covered by a glove). At one stage during the dive, the participant also held onto the wreck while he looked down into a hold. Throughout the dive the participant was observed touching and picking up artefacts in the hold and also at artefact clusters, including cordite (Figure 99). None of the other divers on this dive, or the dive guide, were observed touching artefacts. He was also observed to bend a gauge hanging down in the engine room and pull it towards himself (Figure 100).

The participant showed equal interest throughout the dive in both the wreck and marine life (inside and outside the wreck), including the last part of the dive while off gassing on the hull.

Figure 97 **Diver rubbing the blade of the propeller, *Gosei Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

Figure 98 **Diver scraping the blade of the propeller with knife, *Gosei Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

Figure 99 **Diver picking up cordite inside the *Gosei Maru***

Image © 2018 Joanne Edney. Screen shot from participant’s head-mounted camera.

Figure 100 **Diver pulling on gauge in the *Gosei Maru* engine room**

Image © 2018 Joanne Edney. Screen shot from participant’s head-mounted camera.

8.4.3.6 Diver observation 10

This participant was one of two participants who did not go inside the wreck. However, the wreck is a submarine and it is not possible to go inside. This diver was observed going into another wreck when he was the buddy of another participant, therefore the absence of the opportunity to do so is the likely the reason for this.

Two contact behaviours were observed during this dive, one case of holding onto the wreck and one of touching marine life. The participant held onto the wreck when closely inspecting the heavily damaged section. He also poked and tried to open a cockscomb oyster that was growing on the wreck.

The participant appeared very interested in the marine life associated with the wreck (Figure 101), and viewing marine life was a focus of his dive. This may be due to the marine life being prolific, and also because there are not many features to look at on the hull of a submarine (Figure 102) in comparison to a shipwreck. Although the diver also looked at features of the wreck, for example, he showed interest in the pressure hull and looked at it through holes in the outer hull when making his way along the hull to and from the propellers. He also spent time looking at the propellers (Figure 103) and stern torpedo tubes. However, he appeared most interested in the damaged section of the wreck and spent a significant proportion of is dive looking at this section of the wreck and the marine life on and around it, both at the start of the dive and after returning from seeing the propellers.

Figure 101 **Marine life on the *I-169* submarine**

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

Figure 102 **Looking along the hull of the *I-169* submarine**

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

Figure 103 ***I-169* submarine starboard propeller**

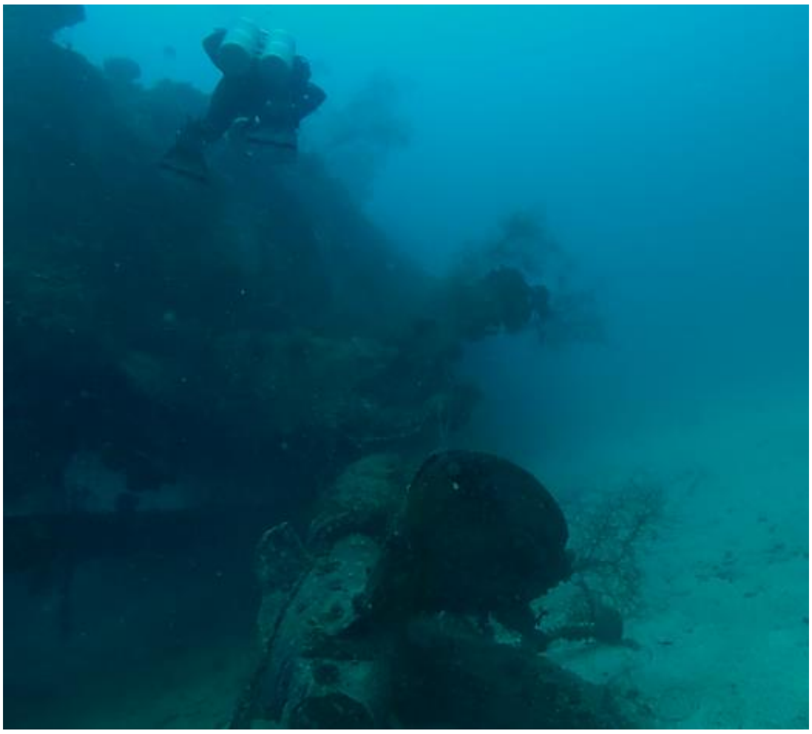


Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

A dive guide led the dive but allowed the divers to dive relatively independently, particularly after returning to the conning tower section from seeing the propellers.

8.4.3.7 Diver observation 11

No contact behaviours were recorded for this participant. She appeared equally interested in features of the wreck and marine life throughout the dive, both inside and outside the wreck. At the start of the dive, the participant looked at the artefact cluster and marine life around the artefact cluster near where she descended, while waiting for her buddy and the other divers to descend. Towards the end of the dive while swimming along the hull, her attention was more focused on marine life than the wreck.

The main subject of the participant's photography was the wreck and people. At one point in the dive, while inside the wreck the diver appeared to be looking at human long bones. She photographed the bones (Figure 104) then passed the camera to her buddy so he could take photographs, and she appeared to be in the photos with the human remains.

Towards the end of the dive one of the other divers in the participant's group could be seen holding onto the wreck. Another participant and a dive guide were observed holding onto a coral head growing on the wreck.

Figure 104 **Participant photographing human remains, *Kiyosumi Maru***

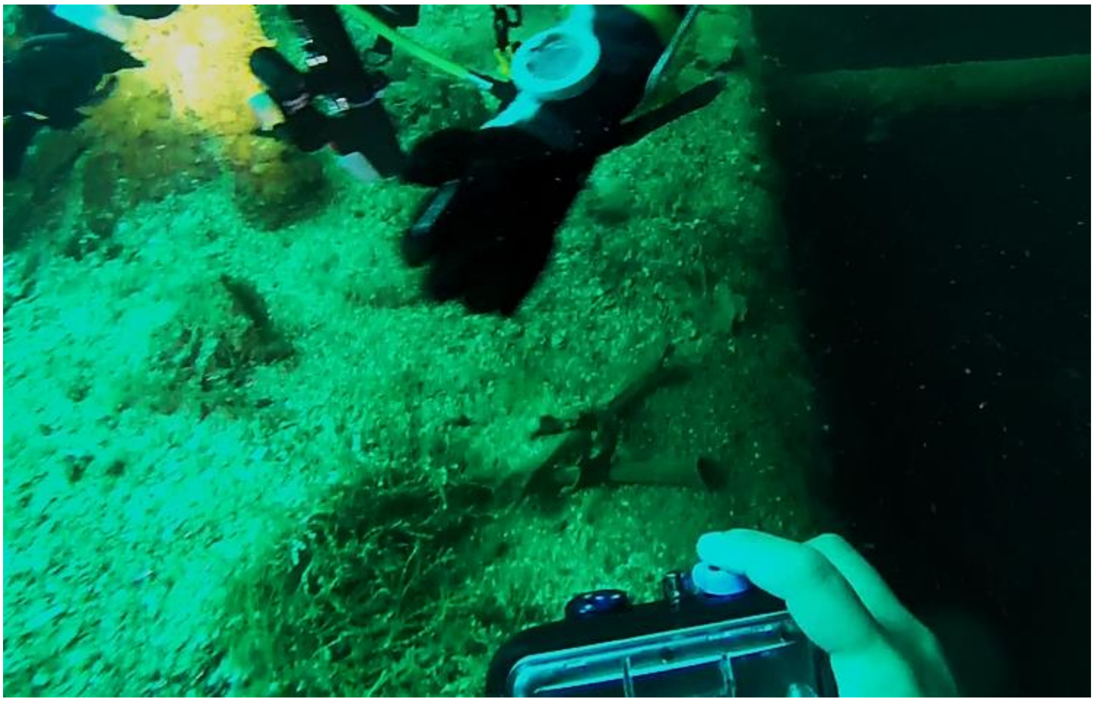


Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera. Human long bones can be seen between the participant's camera and another diver's hand. The other diver, whose hand is visible in the image touched the human remains shortly after this image was taken.

8.4.3.8 Diver observation 12

This participant was not observed to engage in any contact behaviours, despite having some kind of difficulty during the dive. Had this observation continued for the full dive, it is possible that the outcome may have been different, as it is common practice to end this dive at the artefact cluster on the bridge. The participant looked at, but did not touch, two artefact clusters on the wreck, which the dive guide pointed out. However, the dive guide moved the divers around the wreck at a fast pace, therefore it is possible that this may have played a role in the diver not touching artefacts.

The dive guide led the divers into the superstructure and into the space with the operating table, which he pointed out to the participant. The participant looked at operating table from a distance but did not approach it to look more closely, or shine his light onto it so he could see it properly in the dark. The participant also made a few glances back at it as he moved away. The dive guide also pointed out the bathrooms near the operating table and the diver looked at the doorway and swam past it, but did not have a look inside the bathrooms. His buddy also signalled to him to look inside. However, he did look at other features of the wreck and artefacts inside this same part of the superstructure.

Near the end of this observation the participant could be heard saying ‘let’s go’ through his regulator to his buddy. Shortly following this he appeared to be have some kind of difficulty with his equipment and his camera dislodged. His buddy helped adjust his equipment and replaced his camera. He then must have continued to have a problem because his buddy signalled that she would wear the camera and took it off him and placed it on her head. The observation finished when she removed his camera. The participant appeared equally interested in features of the wreck and marine life.

8.4.3.9 Diver observation 13

This participant had two instances of contact behaviour, and both were holding onto the wreck to steady himself while looking into the wreck from the outside. The participant appeared equally interested in the wreck and marine life, and this wreck is arguably the wreck with the most prolific marine life on it. Approximately halfway through this dive, while in the superstructure, the camera appears to be bumped and the angle makes it easier to see the participant’s hands than it was earlier in the dive.

During the dive, the dive guide led the divers into the superstructure and showed them the bathrooms and operating table. The participant looked at the bathrooms and the operating table and spent time looking at it and the artefact cluster on it. When the dive guide led the divers to the bow the diver had a look at the bow but did not touch the telegraph. Towards the end of the dive the dive guide left the divers to dive independently. There was no appreciable change in the participant's behaviour after the dive guide left them. The participant spent the remainder of the dive looking at the artefact cluster on the top of the bridge and looking around the bridge and deck but did not touch anything.

8.4.3.10 Diver observation 14

This participant had few contact behaviours, one hand pull and three instances of holding onto the wreck. The hand pulling occurred on the exterior of the wreck, in the absence of any current, and was therefore unnecessary. Holding onto the wreck is discussed below. The participant appeared equally interested in the wreck and marine life. The camera position was a little high so it was not always possible to see her hands. The participant did not appear interested in artefacts, for example, she dropped down to the deck with the commemorative plaques and took some photos of the plaques, but did not appear to pay any attention to the artefacts cluster around the plaques.

The participant appeared reluctant to enter the wreck, although her buddy went inside on several occasions. At the start of the dive the dive guide and the participant's buddy entered a covered deck and swam through it. She looked into the passageway but did not enter and met up with them when they came out of the wreck.

The participant's buddy and the dive guide entered a hold forward of the superstructure. However, the participant stayed outside the wreck and looked at the marine life on the hatch beams. After a while, she entered the upper level of the hold and looked down at the lower section. The participant did not remain in the upper hold for very long. After having a brief look, she went back out of the hold and looked at marine life while her buddy and the dive guide remained inside. After several minutes, the participant descended back into the upper hold and looked around at the contents. She then dropped briefly into the lower hold to look at and take photos of the Zeros and other items in that hold. However, the participant stayed up high, descending only about halfway into the hold. She then ascended and looked at the upper level of the hold, then exited and spent time looking at and taking photos of marine life.

After a few minutes, the dive guide signalled to the participant to follow him, and she descended to the upper hold and followed the dive guide from that hold to hold one inside the wreck. The dive guide signalled for her to follow him to the lower hold. However, she shook her head, and stayed in the upper level while her buddy and the dive guide explored the hold. The participant looked down at the lower hold and its contents, and eventually dropped part way down into it to have a closer look. It was not clear whether the diver was not comfortable penetrating the wreck, or was trying to limit her depth. However, based on her not entering the covered deck of the superstructure that was much shallower, it would appear likely that she was not comfortable penetrating wrecks, but was comfortable diving on her own outside of the wreck while the other divers were inside.

After visiting the holds, the dive guide led the divers to the bow area. The dive guide pointed out the bow gun, which the participant looked at and photographed. Following this, the dive guide was observed standing on the deck near the telegraph. He then got the participant’s attention and demonstrated to her that the telegraph moved, and appeared to signal to the participant to do the same (Figure 105). The dive guide was observed cleaning the face of the telegraph while he waited for the participant to move over to the telegraph. The participant then held and moved the handle of the telegraph on three occasions (Figure 106) and posed for a photo there. The dive guide could was also observed standing on the wreck while waiting for the divers.

Figure 105 **Dive guide holding and moving *Fujikawa Maru* bow telegraph and signalling to participant**

Image © 2018 Joanne Edney. Screen shot from a participant's (UKF3) head-mounted camera.

Figure 106 **Participant holding onto and moving *Fujikawa Maru* bow telegraph**

Image © 2018 Joanne Edney. Screen shot from a participant's (UKF3) head-mounted camera.

8.4.3.11 Diver observation 15

The participant did not have any contact behaviours during the dive. However, the dive guide was observed holding onto the wreck and her buddy used his arms, elbows and hands to move through the wreck. The dive guide was observed picking up artefacts inside the wreck to show them to the divers, and touching marine life on the hull towards the end of the dive.

At the start of the dive the participant paid more attention to marine life than the wreck, and ended the dive predominantly looking at marine life. Throughout the dive, she looked at the wreck and artefacts. However, when on the outside of the wreck paid more attention to marine life on the wreck and on the seabed than the wreck. The dive guide pointed out artefact clusters on the wreck, and when shown, the participant looked at them.

Initially the participant appeared reluctant to enter the wreck, and waited for all the other divers in her group to enter first, while she stayed near the entry point. However, when the dive guide led the dives between holds inside the wreck she followed. The participant looked at the torpedo hole in the hull and the damage done to the wreck by the torpedo.

8.4.3.12 Diver observation 16

The participant had no contact behaviours throughout the dive. At the start of this dive the diver appeared frustrated about something, and was heard groaning through her regulator. She seemed to have sorted out the problems and began to look at the wreck and marine life. She then appeared to have another problem, and could be heard yelling into her regulator, then was clearly be heard shout ‘fucken’ hell’. Her buddy then came over and signalled something to her, but it was not clear what was signalled due to the angle of the camera. After that interaction her dive seemed to run smoothly.

She looked at marine life after inspecting the holds and periodically, but spent more time looking at the wreck than marine life. She took many photographs throughout the dive. The diver spent quite a bit of her time looking at and photographing the bow area, including the bow gun and windlass. She also swam away from the bow to take a number of photos looking back to the bow and the wreck (Figure 107). She finished her dive looking around the outside of the superstructure near the ascent/descent mooring line (Figure 108). During this time, she watched her buddy trying to enter a doorway into the wreck (Figure 41).

Figure 107 **Participant photographing divers at the bow of the *Amagisan Maru***

Image © 2018 Joanne Edney. Screen shot from the participant's (UKF4) head-mounted camera.

Figure 108 **Divers and the *Amagisan Maru* superstructure**

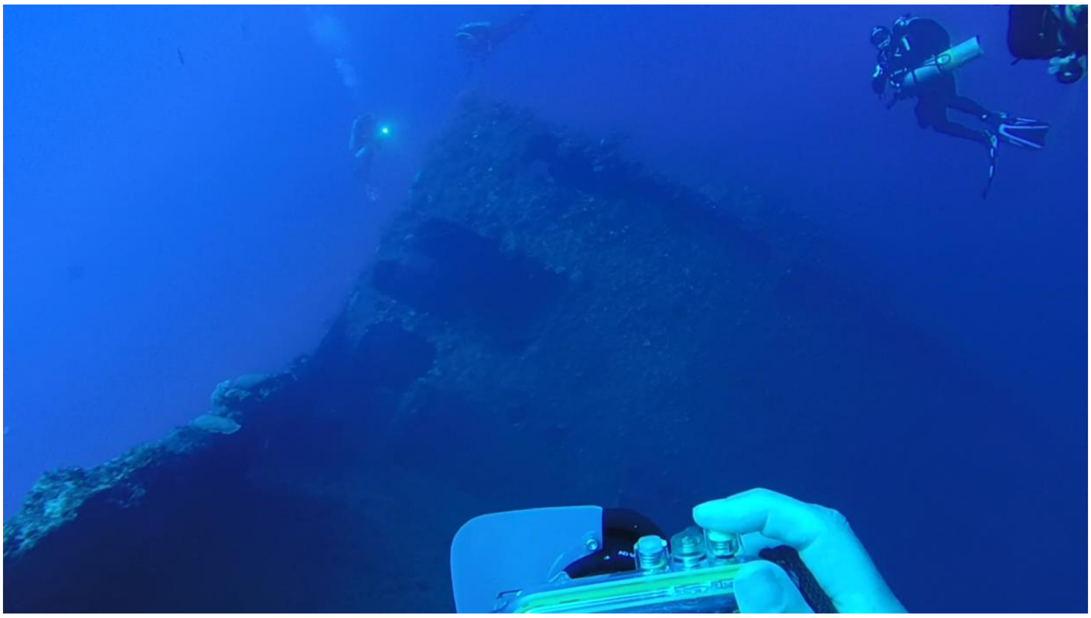


Image © 2018 Joanne Edney. Screen shot from participant's (UKF4) head-mounted camera.

8.4.3.13 Diver observation 17

This participant was the only participant who told me that the camera was not comfortable, and that she was glad to take it off at the end of the dive. The participant had only one contact behaviour, holding onto the wreck on one occasion to steady herself while she looked into the forecastle.

The participant began the dive looking at marine life around the bow area while waiting for the other divers to descend. However, once all the divers had descended she became more focused on looking at features of the wreck. This was the case for approximately the first quarter of the dive, which coincided with her exiting the holds, and after exiting the wreck the participant was equally focused on both the wreck and marine life. However, she did not appear particularly interested in seeing artefacts.

Near the start of the dive the participant swam towards the artefact cluster on the forecastle but swam over it without stopping to look at it. The dive guide then led the divers into the holds. The participant did not descend to the lower level of the first hold where the dive guide was. Instead, she stayed in the upper level and looked at the loose bullets and structure of the wreck. Again, in hold two, the dive guide was in the lower level of the hold but the participant stayed in the upper level and looked at the aircraft engine and cowling and other smaller items. The dive guide indicated to go down to the lower level but she chose not to. The participant then moved between holds two and three inside the wreck and looked at a cluster of medicine bottles. She watched the dive guide touch the medicine bottles but did not touch them. Throughout the dive, the participant observed the dive guide touching marine life, including corals.

After exiting the hold, the participant looked at the damaged section of the wreck and marine life. She then observed the dive guide standing on the wreck and corals, holding an artefact and hammering it with something (Figure 109). The hammering could be heard even after she swam away to look at other features of the wreck. Throughout the dive, the participant also observed the dive guide touching artefacts and marine life, including coral, but did not appear influenced by this behaviour.

Approximately halfway through the dive the dive guide ascended and left the divers to continue to dive independently. The participant did not enter the wreck again and spent the remainder of the dive exploring the forward section of the wreck and the marine life on and around it. During this time, she did go and have a brief look at the artefact cluster on the forecastle that the dive guide had pointed out earlier.

Figure 109 **Dive guide holding artefact and standing on coral and the deck of the *Sankisan Maru***

Image © 2018 Joanne Edney. Screen shot from participant's (UKF1) head-mounted camera.

8.4.3.14 Diver observation 18

For the majority of this dive, the participant and his buddy dived independently and interacted with the dive guide for a part of the dive, around the middle of it. His behaviour did not appear to differ based on the presence or absence of the dive guide. This participant had few contact behaviours, hand pulling and holding the wreck. The instances of hand pulling occurred inside the wreck and was an appropriate technique to use. The participant held onto the wreck on two occasions, both times to steady himself while looking at features of the wreck.

The participant and his buddy started their dive with a penetration of the superstructure. He spent time moving through the wreck and looked at artefacts in situ, such as crockery, as well as the fabric of the wreck. His penetration of the wreck included a deckhouse, where he was also observed to view crockery as well as the fabric of the wreck. When the participant exited the deckhouse, he encountered the dive guide who led the divers into an adjacent hold and showed them the 14 inch shells stowed in the hold.

Although the diver did look at marine life from time to time throughout the dive, he focused more on marine life after viewing the propellers. Unlike most divers who return to the midships ascent/descent line via the hull, where the marine life is prolific, he swam along the deck.

8.4.3.15 Diver observation 19

This participant was responsible for the third highest number of contact behaviours. Thirty five contact behaviours were recorded, including 24 instances of hand pulling, six of touching artefacts, three of holding onto the wreck and one each of sitting and standing on the wreck. The majority of this diver's hand pulling was done moving up through the engine room (Figure 110), and some inside a hold. This is an appropriate technique to use to move around in a confined space and to minimise silting inside a wreck.

Figure 110 **Diver hand pulling inside the engine room of the *Nippo Maru***

Screen shot from participant's (AUSM6) head-mounted camera.

Approximately two thirds of the way through the dive, the dive guide signalled to the diver and his buddy that he was ascending, and left the divers to continue their dive independently. After the dive guide departed, the participant closely inspected the tank on the forward deck of the wreck. He then stood on the tank and sat on the front of it, then signalled his buddy to take a photograph of him in that position (Figure 111).

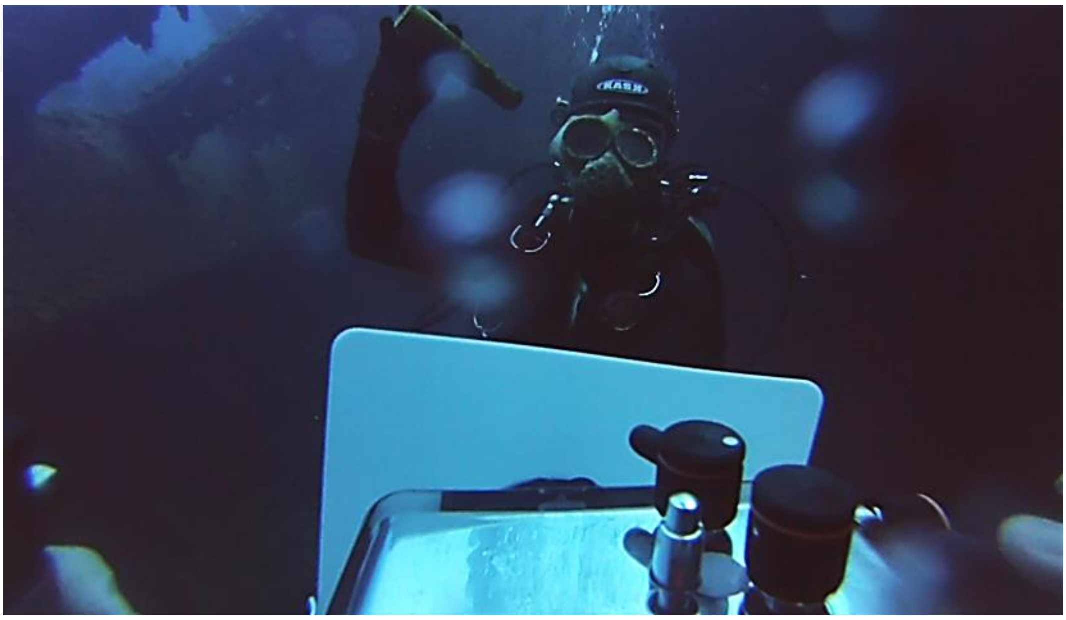
Figure 111 **Diver sitting on the tank on the deck of the *Nippo Maru***

Screen shot from participant's (AUSM6) head-mounted camera.

After being photographed sitting on the tank, the participant moved to the two forward holds. In first hold, he looked at bullets that had been placed on a beam and appeared to have been arranged to spell out a word or name. The participant picked one of the bullets up and held onto the beam to steady himself while he inspected it. He then hand pulled his way around the hold. In the same hold, the participant picked up a gas mask he found, and held it up for his buddy to take a photo. The buddy then signalled the participant to hold the mask to his face, and took more photos of the participant holding the gas mask to his face. The participant then passed the gas mask to his buddy and took the buddy's camera. His buddy then held the gas mask to his face, picked up a bottle, and posed for the photo with the gas mask on his face and pretending to drink from the bottle (Figure 112). The participant held onto the beam to steady himself while taking these photos.

After taking the photos, the participant looked at other items in the hold and picked up some of the artillery shells in this hold. It is not clear whether the participant felt less constrained in his behaviour after the dive guide left, or whether this behaviour was a response to the opportunities that were available, which happened to coincide with the dive guide's absence.

Figure 112 **Participant photographing of buddy wearing a gas mask and holding a bottle, *Nippo Maru***



Screen shot from participant's (AUSM6) head-mounted camera.

Many of the features of the wreck this diver focused his attention on were military equipment located on the upper deck and inside the holds, such as the armoured battle tank, Howitzer guns, dual purpose guns, gun barrels, detonators, artillery shells. This is likely due to his occupation as a military diver, and may also explain his lack of interest in marine life.

8.4.3.16 Diver observation 20

This participant approached the researcher and requested to participate after seeing the participants for observations 1, 2 and 3 participate in the study earlier in the day. When asked to sign the consent to participate he became defensive told the researcher he was not going to look after her or accept liability for her on the dive. The researcher had given him an information sheet to read prior to this. She outlined the study (again), ran him through the contents of the information sheet, and explained the need for, and content of, the consent form which he then signed. The researcher also assured the participant that she did not require looking after while diving. Another person in his group had agreed to wear the camera, but the camera had a problem early in the dive and there is no data for it. His buddy initially also requested to participate then declined just prior to the dive.

The participant became agitated when the researcher showed him how the camera would be mounted and operated. She explained the reasons and rationale for having the camera head-mounted, primarily to ensure diver safety was not compromised, and also consistency of the data collection. He refused to wear the camera on his head, and was patronising towards the researcher. He told her he was an instructor certifier and knew better than she did about diver safety, and that wearing the camera head-mounted was not as safe as hand-held. The researcher gently enquired about this but he was unable to provide any explanation or justification. She then explained that she only had head-mounts for the cameras and did not have a spare lanyard with her. He told her he would rig it up so that he could wear it on his arm or dive equipment.

The participant started the dive with the camera on his arm, and placed the camera on his head early in the dive. However, the camera angle was not ideal and it was not always possible to see his hands. It is not known whether the poor placement of the camera was intentional or unintentional. However, the researcher observed more contact behaviours than those recorded. These included one case each of hand pulling and on the wreck and holding onto the wreck (while adjusting buoyancy), as well as touching artefacts, kneeling (Figure 113) on the wreck, kicking the wreck with his fins and resting on his fins (Figure 114) on a few occasions. The diver showed the most interest in the structure of the wreck, its contents, damaged sections of the wreck and artefacts, particularly those in clusters.

Figure 113 **Participant kneeling on the hull of the *Rio De Janeiro Maru* and touching an artefact**

Image © 2018 Joanne Edney. Screen shot from the researcher's head-mounted camera. The behaviour depicted was not visible in the participant-generated video.

Figure 114 **Participant resting on his fins on the hull of the *Rio De Janeiro Maru***

Image © 2018 Joanne Edney. Screen shot from researcher's head-mounted camera. The behaviour depicted was not visible in the participant-generated video.

The participant watched other divers in his group pick up artefacts, and also participated in this activity. One of the artefacts the participant picked up appeared to be the cover from a light (Figure 113). He was observed to drop this artefact on the hull of the wreck, then repeatedly tapped it against the hull. The reason for this behaviour is not known. The participant was also observed touching coral and hand pulling on coral on one occasion as he moved along the hull. There was no current present, therefore there was no need to use this technique.

Early in the dive, the participant was observing the researcher, therefore the researcher was not able to observe this diver closely in the early stages of the dive. The researcher followed the dive guide and had to appear to be behaving in a similar manner to a diver, to minimise the potential for altering his behaviour. It is likely more contacts would have been observed if the researcher was able to observe him more closely. The participant also appeared to be having difficulties with his buoyancy throughout the dive, and was negatively buoyant and had poor trim for much of the dive. He spent a considerable amount of time during the dive dealing with his buoyancy difficulties and adjusting his equipment. With the exception of touching artefacts and corals, this is the probable cause of the majority of the contacts.

At one stage during the dive, he covered the camera with his hand and moved it. It was not clear whether he was just adjusting the position or concealing behaviour he did not want recorded. The researcher did not observe this occur during the dive.

On the boat ride to the dive site the participant and his buddy tried provoking the researcher by talking about how much they liked wrecks because they loved treasure. The researcher did not express an opinion one way or the other. The divers continued this all the way to the dive site, and what became apparent was that they were not only attempting to get a reaction form the researcher, but were being honest about their wreck diving intentions. While together on the boat after the dive, more information emerged. First, that he is not a current instructor certifier, and has not been for some time. He then lamented about the amount of artefacts removed from the wrecks in Chuuk since he visited there in the 1980s. He talked about how the cockpits of the Zero's in the *Fujikawa Maru* were still intact and now are bare. He also noted that he had taken great photos of his group sitting in the cockpit of one of them.

The participant then went on to tell everyone on the boat about how he removed the 'E' from the underside of the bow of the *SS President Coolidge* in Vanuatu. After removing it he gave it to the then dive operator on Bokissa Island on the condition that it stayed there, but understood it is not even in Vanuatu anymore. He also talked about how he had tried to remove a safe from the wreck of the *USS Aaron Ward* in the Solomon Islands.

The day this group were departing Chuuk, the researcher was sitting in the reception area of Blue Lagoon Dive Resort. The participant was sitting near her and talking to another diver from the group he was travelling with. They had just been to the Kimiuo Aisek Memorial Museum and were discussing how much they liked the artefacts. The participant was talking about how much he liked telegraphs and wanted one. They discussed a telegraph they had seen on the sand beside one of the wrecks they had dived (unfortunately the researcher was not able to catch the name of the wreck), and how easy it would have been to bring it to the surface. The participant thought the dive shop (i.e. Blue Lagoon) would not mind, but he did not know how he would be able to get it out of the country. Throughout the discussion, the participant kept talking about how much he wanted a telegraph, but already had a lot of artefacts from wrecks in his home. Then he said after a while you would get sick of having to polish and dust it and would probably just want to get rid of it.

8.4.3.17 Diver observation 21

This participant carried a camera, and photography appeared to the focus of his dive. He mostly took photos of marine life (Figure 115) and most of the photos he took of the wreck were of structures on the wreck, such as king posts and guns (Figure 116). Artefacts were of little interest to this diver, and this is also reflected in the subjects of his photography.

Figure 115 **Participant photographing marine life on the *Kensho Maru***

Image © 2018 Joanne Edney. Screen shot from participant's (UKM2) head-mounted camera.

This diver was responsible for one contact behaviour, holding onto the wreck. He swam over the bow and away from the wreck to take photos of the wreck, then focused on photographing marine life on the bow. It was when doing this he held onto the bow to steady himself while taking photos of marine life.

He was one of the participants who did not go inside the wreck. Yet this is a popular wreck for penetration diving, it has a picturesque engine room that is very popular with photographers, and an easily accessible galley. Entering the bridge of this wreck is also popular with most divers. The dive guide did not lead the divers inside the wreck, and this may be one reason why the participant did not enter the wreck. The reason for the dive guide not leading these divers into the wreck this is not known.

Figure 116 **Participant photographing the *Kensho Maru* bow gun**

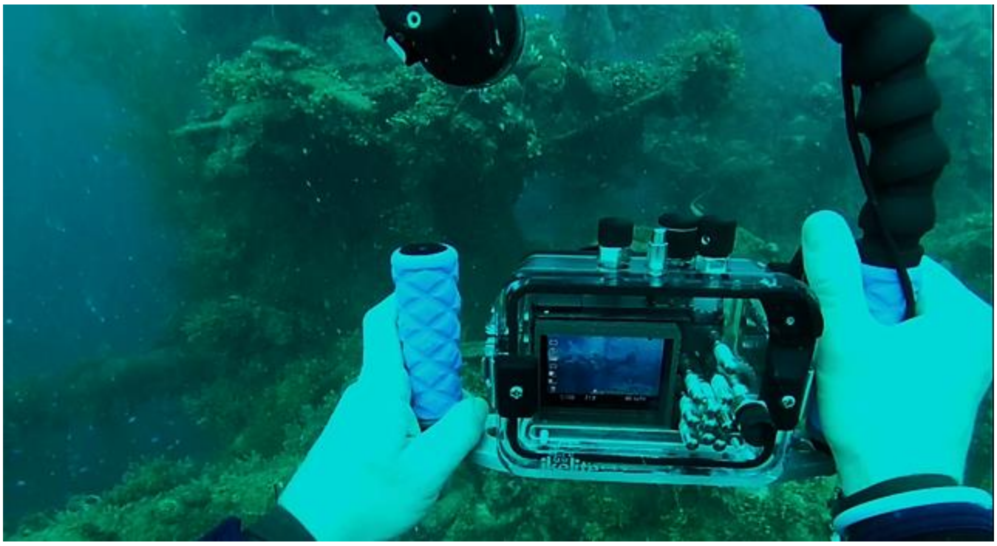


Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

8.4.4 Repeat observation comparisons of participant-generated data

As noted in section 8.4.1, three participants (two males and one female), wore a camera on two occasions, at their request. This section compares the behaviour of three divers who wore the cameras on two occasions.

These repeat dives provided the opportunity to compare participant behaviour on different dives. The observations this applies to are 2 and 22, 3 and 23, and 5 and 6 (Table 20 above). The comparisons were based on quantitative analysis of the participant-generated data (Tables 22-26, 28 and 29), including the visualisations of these dives (Figures 76-78) and qualitative observations. Tables 34 and 35 condense the non-contact and contact behaviours, to facilitate comparisons of the repeat dives.

Observations 2 and 3 were carried out on the *Rio De Janeiro Maru* and observations 22 and 23 on the *Kiyosumi Maru*, and were of similar durations. These two divers were diving in the same group on both dives. These two wrecks are similar in size, type, depth to seabed and hull, and orientation (Appendix 4). Therefore, it was expected the behaviour of the divers would be relatively consistent. The dives for observations 2 and 3 were done the day prior to observations 22 and 23. Likewise, the dive for observation 5 was carried out the day prior to observation 6.

Table 34 Participant non-contact behaviour durations (percent of observation time) – repeat observations

Behaviour	Observation number					
	2	**22**	**3**	**23**	**5**	**6**
Look at feature of wreck	65.88	57.72	57.21	51.25	58.39	59.18
Inside a wreck	13.74	13.29	17.81	12.83	30.51	15.28
Look at marine life	11.19	33.24	14.58	43.70	12.14	1.73
Use camera	-	-	10.97	-	-	2.67
Total	**90.81**	**104.25**	**100.57**	**107.78**	**101.04**	**78.86**

Notes: The percentages for each observation may be higher than 100 percent because behaviours can overlap.

There is no duration for hand pulling – wreck and marine life because these behaviours are point event data.

Table 35 Contact behaviour frequencies – repeat observations

Behaviour	Observation Number					
	2	**22**	**3**	**23**	**5**	**6**
Hand pulling - wreck	21	14	-	1	5	-
Sit on wreck	-	-	-	-	-	-
Stand on wreck	-	2	-	-	-	-
Hold onto wreck	8	11	-	5	1	-
Touch artefact	5	22	-	6	-	-
Unintentional contact with wreck	-	2	-	-	-	-
Hand pulling – marine life	-	21	-	3	-	-
Touch marine life	4	15	-	4	1	-
Total	**38**	**87**	**0**	**19**	**7**	**0**

8.4.4.1 Observations 2 and 22

There were similar non-contact behaviour durations on both of these dives (Table 34). The participant spent most of his time looking at features of wrecks, although more time was spent on this behaviour during observation 2. The time spent inside wrecks was almost identical on each of the dives. The most notable difference in non-contact behaviours was looking at marine life, which was around three times higher in observation 22. However, this wreck has considerably more marine life growing on it than the wreck dived for observation 2. Therefore, it may be because there were more opportunities to view marine life on the second wreck, particularly between the propeller and the midships area where the ascent/descent mooring line is located. Both dives ended swimming along the hull back to the ascent/descent line. During observation 2 this was from the bow to midships, and observation 22 from the propeller to midships. The hull of the wreck dived for observation 22 is covered in coral heads, sponges and anemones, whereas the hull of the wreck dived for observation 2 has considerably less marine life growing on it compared to the wreck in observation 22.

Overall, contact behaviours were more than two times higher on the observation 22 dive (Table 35). Notably, observation 22 had the highest of all contacts, with a total of 87 contacts throughout this dive. The frequency of touching artefacts was more than four times higher on observation 22 than observation 2. One of the instances of touching artefacts (Figures 117, 118 and 119) occurred during observation 22 after the dive guide pointed out an artefact cluster at the entrance to a hold. The dive guide was observed picking up artefacts, and it is possible that this influenced the participant to pick up artefacts on this occasion.

Figure 117 **Participant picking up a drink canteen at an artefact cluster on the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from the participant's head-mounted camera.

Figure 118 **Participant pretending to drink from canteen, *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera. Dive guide is looking on in the background and holding onto the wreck.

However, it is unlikely his interaction with the artefacts was heavily influenced by the dive guide, because the participant was observed touching artefacts on both dives prior to seeing the dive guide touch this particular artefact cluster. For example, on observation 2, early in the dive, the diver noticed an artillery shell that had been placed on top of something that appeared to be a section of pipe on the seabed near the propellers. The pipe was stuck into the sand and standing vertically and the shell had been placed across it horizontally. The diver saw another diver looking at it, and when this diver moved away he swam down to them and pushed the shell off the pipe onto the sand (Figure 120). The reason for this action is not known.

Figure 119 **Participant picking up a gas mask at an artefact cluster on the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera.

The diver was not gentle with artefacts when he touched them, many of which were crockery and glass, or fragile metals. Artefacts were carelessly dropped, or in some cases, thrown when he had finished looking at them, and this behaviour was consistent between the two observations.

Figure 120 **Shell placed on pipe on the seabed adjacent to the stern of the *Rio De Janeiro Maru***

Images © 2018 Joanne Edney. Screen shot from participant's head-mounted camera. The image on the right shows another diver looking at the shell balanced on a pipe. The image on the left shows the shell just after the participant pushed it off the pipe.

The touching artefacts behaviour was further defined using modifiers. When touching artefacts, the participant engaged in the modifier behaviours on both dives (Table 36). However, there were differences in the number of times he engaged different activities when touching artefacts. There were markedly more instances of picking up artefacts to inspect them during observation 22. There were also proportionally higher frequencies of moving artefacts on observation 22, and twice as many occurrences of cleaning artefacts during observation 22.

Table 36 **Comparison of touch artefact modifiers - Observations 2 and 22**

Touch artefact	Observation No.		Total
	2	22	
Clean	1	2	**3**
Pick up & clean	1	2	**3**
Pick up & hold up	-	-	**-**
Pick up & inspect	2	13	**15**
Pick up & move	1	5	**6**
Pick up & pass to other diver	-	-	
Total	**5**	**22**	**27**

This participant recorded the second highest frequency of hand pulling on a wreck, and the highest frequency of hand pulling on marine life (Table 23). The amount and type of hand pulling varied between the dives. On observation 2, the diver had considerably more occurrences of hand pulling on the wreck than on observation 22. Although there were fewer instances of hand pulling on wrecks during observation 22, there was a high number of hand pulling on marine life, predominantly coral heads (Figure 121) on this dive. This primarily occurred as the diver moved along the hull from the stern to the midships area. The dive guide was not observed to have hand pulled on the wrecks or marine life on either dive, therefore, it is unlikely the dive guide would have influenced this behaviour. It is not clear why the diver was using hand pulling as there was no current present on either of the dives, and the hand pulling was done on the exterior of the wrecks so it was not done to prevent silting.

The diver also held onto the wrecks on numerous occasions, mostly to steady himself while looking at things, and on one occasion (observation 22) to pretend to operate an anti-aircraft gun on the deck of wreck (Figure 122). The participant also stood on the wreck during observation 22 (Figure 123), and was not observed to participate in this behaviour during observation 2. However, during observation 2 another diver (AUSM5) was observed standing on the wreck. It is possible that the participant's behaviour was influenced in some way by seeing another diver and the dive guide standing on the wreck during observation 2.

Figure 121 **Participant hand pulling on coral on the hull of the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from the participant's head-mounted camera.

Figure 122 **Diver holding onto anti-aircraft gun on the *Kiyosumi Maru***

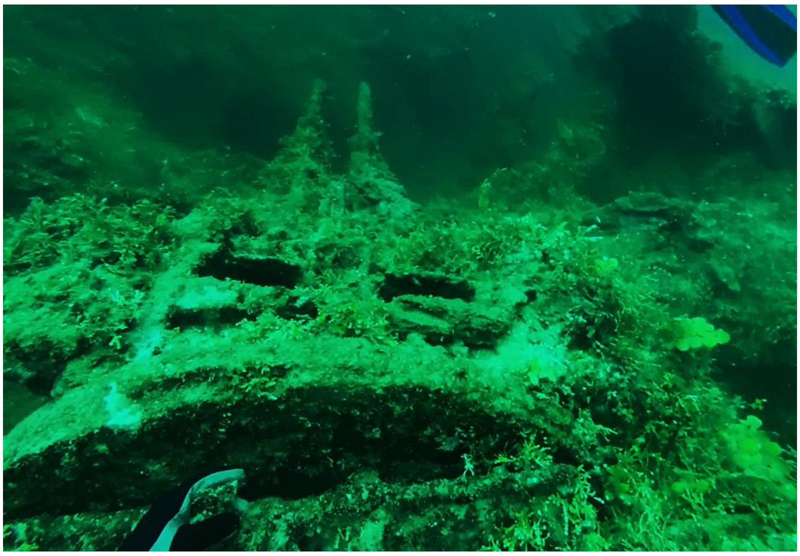


Image © 2018 Joanne Edney. Screen shot from participant's (AUSM1) head-mounted camera.

The diver also touched considerably more marine life than any other participant (Table 23). Additionally, when he touched marine life he was not gentle, and was observed poking sessile marine life, such as anemones, fan worms and sponges. This participant also fanned the top and moved the base of anemones attempting to move the anemone fish out of them. On one occasion he was observed to pick up a sea cucumber and throw it up into the water column. On observation 22, the participant was also observed swimming directly into a black coral, which could be heard scraping against his dive gear as he swam through it. The participant's behaviour towards marine life was consistent between the two observations, although a higher frequency of occurrences on observation 22.

Figure 123 **Participant standing on the hull of the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from the participant's (AUSM1) head-mounted camera.

In addition to this participant's numerous contacts during observation 22, on several occasions his equipment was dragged across the wreck and corals. He was also observed standing on his fins tips while looking at artefacts, hit the hull with his fins while kicking, and laid down on his stomach on the hull while looking at an artefact cluster, and propped himself up on his elbows while looking through the ship's binocular casing, which was part of the artefact cluster he was looking at (Figure 124). These contact behaviours were not visible in the participant's video and are additional to those recorded.

Figure 124 **Participant looking through binocular casing on the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from the hand-held camera. The participant is lying on the hull of the wreck and resting on his elbows, while looking through the casing of a set of binoculars. His dive light can also be seen resting on the hull of the wreck. The binocular casing was part of the artefact cluster on hull of the *Kiyosumi Maru*. The artefact cluster can be seen to the right of the diver. The participant's contact with the binoculars was visible in his video, but the contacts with the wreck were not visible and were therefore not recorded.

In conclusion, there was a heavier focus on checking gauges and computer on observation 2 possibly due to the perception held by another participant in his dive group that the study was actually collecting data about this behaviour. The contact behaviours were considerably higher on observation 22, however, the behaviour of this diver towards artefacts and marine life is consistent between the two dives. The differences discussed appear likely to be the result of different opportunities on the different wrecks, particularly with respect to the contact and non-contact behaviours regarding marine life. The markedly higher incidence of touching artefacts on observation 22 may have been influenced, at least in part by the dive guide stopping at an artefact cluster and picking up the artefacts. These differences may also be a result of increased confidence as the participant completed more dives at Chuuk, along with being more familiar and comfortable with the dive guide during observation 22.

8.4.4.2 Observations 3 and 23

Following the completion of the first dive (observation 3), this participant advised the researcher that she thought the researcher was not disclosing the true nature of the research, and requested to wear the camera a second time. The reason for this request was because the participant had assumed that the researcher was collecting data about how often divers check their gauges and dive computers, on behalf of the dive industry. As a result, the participant had been more closely monitoring gauges and computers than was normal. It is not clear how or why this diver made this assumption. This participant was in the same group of divers as the diver who collected the data for observations 2 and 22, and it is possible that both divers had this perception. Although this behaviour was not specifically analysed, both divers did appear to check their gauges and computers more frequently on their first dives (2 and 3) than the second two dives (22 and 23). The first observations were also carried out closer to the divers arriving at Chuuk, and it is normal behaviour to check gauges and computers more frequently when getting comfortable with diving, particularly in a different environment.

The patterns in this participant’s non-contact behaviours differed to some extent between the two observations. Similar to observations 2 and 22, the diver spent more time observing features of the wreck on the first dive (observation 3), more time inside the wreck on observation 3, and considerably more time looking at marine life on observation 23 (Table 34). The diver used her camera on observation 3, mostly taking photos of the wreck and artefacts, but did not use the camera on observation 23. This may have had a bearing on the differences in contact behaviours between the two dives, as her hands were not being used to hold and operate a camera during observation 23.

No contact behaviours were recorded during observation 3 (Table 35). However, the researcher observed the participant hit the hull of the wreck with her fins, resulting from poor buoyancy control. During observation 23 there were 19 instances of contact behaviours (Table 35). The most frequent contact behaviours were holding onto the wreck and touching artefacts. The diver appeared to be having difficulty with her buoyancy control during observation 23, and held onto the wreck twice due to buoyancy control issues. Once to slow and stop her descent, and the other to stabilise herself while adjusting her buoyancy. The other three instances of holding onto the wreck occurred when the diver steadied herself while looking at features of the wreck.

The participant was observed touching artefacts at the start of the dive while waiting for other divers to descend. An artefact cluster is located adjacent to the ascent/descent line. She did not touch artefacts again until near the end of the dive when back at this artefact cluster. At one point during the dive, the dive guide was observed showing the divers an artefact cluster, and picking up artefacts at the entrance to a hold. In these cases, the participant looked but did not touch. This was also the case during observation 3, where the dive guide picked up some crockery in an artefact cluster and pretended to eat from it, but the participant did not touch anything. This participant was not gentle when handling artefacts, for example, she was observed dropping artefacts on hull and trying to force the lid of a tin open (Figure 125). However, the participant was considerably gentler than the participant from observations 2 and 22

Figure 125 **Diver attempting to open the lid of a tin container, *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from participant's (AUSF2) head-mounted camera.

Two other contact behaviours that were not visible in the participant-generated video, and therefore not recorded, included one instance each of sitting on the deck and hitting it with her tank (Figure 126). In the video recorded by the participant, she was observed falling backwards and the dive guide pulled her back up. These contacts were the result of poor buoyancy control.

Figure 126 **Participant sitting on the *Kiyosumi Maru***

Image © 2018 Joanne Edney. Screen shot from researcher's Head-mounted camera. Participant sitting on the wreck (right), this contact was not visible in the participant's video and was therefore not recorded. Another participant (AUSM1) touching artefacts on the left of the image.

The diver also touched marine life during observation 22. Some of the occurrences were to steady herself while looking at artefacts on the hull, and others were hand pulling on coral heads when moving along the hull. Just prior to arriving back at the artefact cluster, the dive guide was observed picking up and moving an artefact on the hull, which appeared to be a fire brick. The dive guide held onto a coral head while initially inspecting the artefacts, and was also observed to carelessly drop the artefact when he had finished looking at it. The participant was observed hand pulling on coral shortly after this occurred. Therefore, it is possible her interaction with marine life may have been influenced by the dive guide. The participant was also observed holding coral heads to steady herself while looking at artefacts.

The diver's contact behaviour with the wreck and marine life was to some degree unexpected in view of her behaviour towards another diver during observation 3. The participant who undertook observation 1 (AUSM5, section 8.4.3.1) stood and knelt on the hull of the wreck at the start of the dive while he tried to sort out some of his equipment. In observation 3 the participant can be seen and heard trying to prevent the other diver (AUSM5) continuing to stand and kneel on the wreck.

In summary, although there were some differences there was also some level of consistency of the behaviour of this participant between the two dives. Consistent with the comparison of observations 2 and 22 (section 8.4.4.1), the differences in contact and non-contact behaviours may be linked to the different opportunities available on the different wrecks (particularly marine life). The presence of a hand held camera may also have played a role as it may have hampered, to some degree, the participant's ability to touch artefacts or to hand pull. The differences may also be a result of increased confidence as the diver performed more dives at Chuuk, and increasing familiarity with the dive guide during observation 23.

8.4.4.3 Observations 5 and 6

Observation 5 was carried out on the *Yamagiri Maru* and observation 6 was on the *San Francisco Maru*. These wrecks are of a similar size and type, but their orientation is different and there is a substantial difference in their depths. The *San Francisco Maru* is one of the deepest wrecks dived frequently at Chuuk. Due to its depth, divers are usually taken to this wreck once they have completed a number of dives, and the dive operator is aware of their diving capabilities and considers them able to safely dive to these depths. Typically, the minimum depth divers reach when diving this wreck is 50 metres, making it a more challenging dive. Therefore, it was expected that the behaviour of the diver on this dive may be different to that carried out on the shallower wreck, the *Yamagiri Maru*, (observation 5). The durations of the dives were also different, due to the differences in depths. Observation 5 was around twice the duration of observation 6.

On the observation 6 dive, the researcher recorded a maximum depth of 55 metres (compared to 29 metres on observation 5). It is reasonable to assume the participant also reached this depth because his participant's dive profile was much the same as the researcher's. This was the deepest dive the participant had completed, and he was visibly excited and nervous prior to the dive. The other difference between these two dives was that the participant used a hand held camera on the deeper dive.

The most noticeable difference in the diver's behaviour between the two dives was the total absence of any contact behaviours on the deeper dive (Table 35). The participant hand pulled on the wreck, held onto the wreck and touched marine life on the shallower dive (Observation 5). Hand pulling was his most frequent contact behaviour. Most of it occurred inside the wreck, which is an appropriate technique to use. However, the hand pulling that occurred outside the wreck was not necessary, as there was no current and it was not done to avoid kicking up silt. It was interesting that he did not hand pull on the deeper dive, as during this dive he was required to move through a more constricted space during observation 5. Additionally, the restricted space he moved through was moving between holds 2 and 1 of the wreck. This was the deepest point of the dive, and his motor skills and cognitive abilities would have been affected by gas (or nitrogen) narcosis, therefore it would be expected that he would be more likely to make contact with the wreck when moving through this space. Gas narcosis affects all divers and typically becomes noticeable at a depth of 30 metres and the effects increase with depth (Shreeves & Lewis, 2008).

The dive guide was observed holding onto the front grille of one of the trucks in hold 2 during observation 6, while he pointed them out to the divers. However, the participant did not copy this behaviour (Figure 36 – section 8.3.2.1), although he did hold onto the wreck during the dive while looking at something in the wreck. The participant did not touch any artefacts on either dive. The dive guide also was not observed touching any artefacts on either dive. The dive guide did show the divers various items of interest on both dives, such as items in the holds. These included munitions, such as beach mines (Figure 127) in the *San Francisco Maru* and human remains in the *Yamagiri Maru* (Figures 53 and 54, section 8.3.2.4). However, the dive guide was not observed to point out any of the artefact clusters to the divers on either of the dives. The diver touched marine life during observation 5, but this was to gently brush a sea whip out of the way before he entered a hold.

The participant spent a similar proportion of both dives looking at features of wrecks (Table 34), however, there were marked differences in the proportion of time spent looking at marine life and being inside the wrecks. There was a more than six-fold difference in time spent looking at marine life, with more time spent engaging in this activity during observation 5. This was most likely due to the opportunities available, as marine life was more prolific on the wreck dived for observation 5. There was a two-fold difference in the amount of time spent inside the wrecks, with half as much time spent inside the deeper wreck (observation 6).

Figure 127 **Participant photographing beach mines in the *San Francisco Maru***

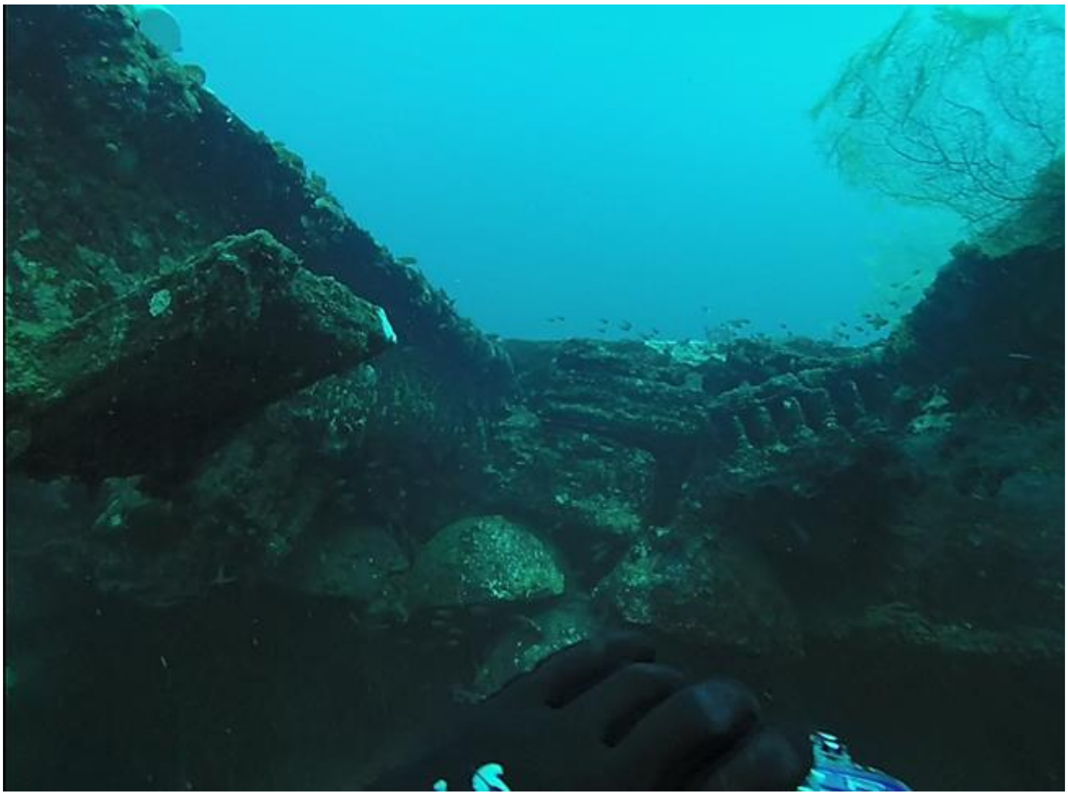


Image © 2018 Joanne Edney. Screen shot from participant's head-mounted camera. The beach mines are the semi-hemispherical objects in the middle ground of the image.

There was a distinct observable difference in this participant's willingness to penetrate the wrecks, and the distance the participant stayed from the wrecks between the two observations. On observation 5, the diver readily entered the interior of the wreck, but appeared hesitant to enter the hold on observation 6. This wreck (*San Francisco Maru*) is upright and most of the hold has direct access to the surface. The time spent in an overhead environment was limited, and only occurred when he moved between the second and first holds. The wreck from observation 5 is lying on its side, therefore all penetrations of the holds are in an overhead environment. On this dive, the participant also readily penetrated into the engine room to see human remains, and at this location there is no ambient light. The participant appeared less comfortable entering the deeper wreck. The diver also kept a noticeably greater distance from the wreck in observation 6, than during observation 5. This may have been an attempt to limit his depth on the deeper dive, possibly to reduce his ascent time and/or to limit the effects of gas narcosis. It is also possible that due to nervousness, the participant was focusing more on his diving skills and time and air supply on the deeper dive, and was more immersed in the actual dive experience during the shallower dive.

In conclusion, there were some notable differences in this participant's behaviour between the two dives: contact behaviours, looking at marine life and being inside the wrecks. These differences may be attributable to the participant's level of comfort, being observably nervous on the deeper dive. The presence of a hand held camera on the deeper dive may also have played a role, making it less convenient for the diver to touch artefacts and hand pull. Consistent with the other two comparisons, opportunities available on the different wrecks may also have been a factor, with marine life being more prevalent on the shallower wreck.

8.4.4.4 Synthesis of repeat observations

The repeat dive comparisons presented the opportunity to compare the behaviour of participants on different dives to examine the consistency of their behaviour between the two dives. Although the overall behaviour patterns of the participants were relatively consistent between the two comparison dives, there were some distinct differences.

Comparisons of observations 2 and 22 found a much greater frequency of contact behaviours on observation 22. The frequency of touching artefacts was more than four times higher on observation 22, although the activities were the same between the two observations. There was a higher frequency of hand pulling on observation 22, and a large number of the instances of hand pulling during this observation were marine life. This participant also stood on the wreck and made some unintentional contacts with the wreck during observation 22, neither of these behaviours were observed during observation 2. More time was spent looking at the wreck during observation 2, and considerably more time was spent looking at marine life during observation 22. The participant spent the same proportion of his dives inside the wrecks during both observations.

When observations 3 and 23 were compared, the most notable difference was the absence of contact behaviours during observation 3, coinciding with the use of a camera. The contact behaviours observed during observation 23 included touching artefacts, holding the wreck, touching and hand pulling on marine life, and one instance of hand pulling on the wreck. The participant spent considerably more time looking at marine life during observation 23 (more than three times more time) slightly more time inside the wreck during observation 3, and much the same amount of time inside the wrecks during both observations.

The most marked differences between observations 5 and 6 were the absence of contact behaviours and the use of a camera during observation 6. During observation 5, the participant was observed hand pulling on the wreck, holding onto the wreck and touching marine life. The participant spent similar proportions of the dives looking at features of the wrecks. However, he spent twice the amount of time inside the wreck during observation 5, compared to observation 6, and appeared more reluctant to go inside the wreck during observation 6. During observation 5, the participant spent around six times more time looking at marine life than during observation 6.

Opportunities available on the different dives, in particular the abundance of marine life, appears to have influenced both non-contact and contact behaviours related to marine life, with marine life being more abundant on the wreck in observations 22, 23 and 5. There are other factors that may have influenced diver behaviour. Observation 6 was the deepest dive this participant had ever completed, and the diver appeared nervous, excited and more cautious, yet no contact behaviours were recorded. Camera use may also have been a factor. There were no contact behaviours recorded during observations 3 and 6, and this coincided with both participants using cameras on those dives. In contrast, both participants engaged in contact behaviours on the dives that they did not use a camera.

The level of comfort of the divers may also have played a role in influencing contact behaviours. The divers' level of comfort is likely to have increased as more dives were completed at this location, and as the divers became more familiar with their dive guides. Further, the participant's level of comfort on a deep dive (observation 6) appeared to be lower. It is possible that some of the differences in behaviour between observations 5 and 6 may be attributed to the diver being more focused on the mechanics of diving, especially monitoring depth, time and air supply on the deeper dive, than enjoying the experience of the dive. Dive guide behaviour (touching artefacts) may also have played some role in the differences noted between observations 2 and 22 and 3 and 23. It is also possible these participants were less conscious of the head-mounted camera on the second observation.

8.4.5 General comments

Seeing artefacts was popular with the participants, both those in situ and clusters. There were many types of artefacts seen by the divers, such as ammunition (see below), gas masks, crockery, glassware, cooking utensils and tableware, port holes and port hole glass, bottles, light fittings, fire extinguishers, telephones, binoculars, medical supplies, containers, shoes, clothing, and guns.

Particular features of the exterior of wrecks popular with divers included looking at masts and kingposts, funnels, davits, anchors, propellers and rudders, guns, telegraphs (Figure 128), the bow, ships' names on the hull, and degaussing lines on the hull. Machinery on the decks, such as windlasses, also interested the divers. Trucks and light tanks on the decks of some of the wrecks were another drawcard (Figure 129). Most divers showed an interest in looking at damage caused to the wrecks, such as bomb damage to decks and superstructure, torpedo holes in the hull and buckling of the hull from various impacts. The large rice cooker on the deck of the *Fujikawa Maru* (Figure 130) was another point of interest to divers. Damage associated with the decay of the wrecks was also of interest, in particular the collapsing bow section of the *Rio De Janeiro Maru*. The debris field beside some of the wrecks, mostly those on their side, also interested the divers. Many of these features also make interesting and beautiful subjects for photography.

Figure 128 **Stern telegraph and speaking tube, *Shinkoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

Figure 129 **Tanks and a truck on the *San Francisco Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

Figure 130 **Rice cooker on the *Fujikawa Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera. Other artefacts have been placed on the rice cooker.

When the participants were inside the wrecks, the most commonly visited parts of the wrecks were the holds. Many of the holds in these wrecks contain cargo, including aircraft (Zeros in the *Fujikawa Maru*) and aircraft parts; various types of munitions including artillery shells, beach mines, bullets, cordite, depth charges, torpedoes (Figure 131), cannons and guns; gas masks; fuel drums; bicycles; saki, beer and medicine bottles; trucks and other machinery; clothing and shoes. Other places inside the wrecks that were popular with divers were the bridge, bathrooms (Figure 132), galleys and engine rooms. The divers looked at the contents of these spaces, which could include crockery, glassware, cooking utensils, light fittings and other small artefacts. They also looked at the structure and dimensions of the inside of the wrecks. In the engine rooms, catwalks, ladders and skylights have interesting aesthetics and beauty. Machinery associated with engine rooms were also popular. Other features of interest in the engine rooms are dials and gauges and tools still in place on the walls. The *Shinkoku Maru* has an operating table that is very popular with divers and also has an artefacts cluster on it. In the *Yamagiri Maru* many divers request to see the human remains, a skull wedged between machinery and other bones on a ledge below, which are deep inside the engine room (Figures 53 and 54, section 8.3.2.4).

Figure 131 **Torpedoes in a hold on the *San Francisco Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

Figure 132 **Japanese bath in the *Shinkoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

The marine life attached to and around the majority of the wrecks dived by the participants' was prolific, with the exception of the *San Francisco Maru* and *Amagisan Maru*. Although there is marine life associated with these two wrecks, it is noticeably less than the other wrecks dived by participants, and is likely to have affected the frequency and duration of behaviours associated with marine life. Divers most commonly looked at fish swimming inside and outside the wrecks and the marine growth attached to the outside of the wrecks, most commonly anemones (Figure 133), soft and hard corals, sea whips and fans. Turtles are also a feature (Figure 134).

It is recognised that much of what the divers look at may be influenced by where the dive guides lead them, and the features that the dive guides point out. For example, most of the divers looked at the propellers. However, the dive guides led them to the propellers and pointed them out. It is not known whether the divers would have sought these features out if they had dived the wrecks independently.

Figure 133 **Fluorescent anemone on the *Shinkoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera. Image also includes sea whips, corals, sponges and algae.

Figure 134 **Turtle inside the bridge of the *Shinkoku Maru***

Image © 2018 Joanne Edney. Screen shot from hand held camera.

The dive guides have a vested interest in giving the divers an enjoyable diving experience, as their livelihood is dependent on receiving tips from the divers.

Therefore, the guides take divers to see features of the wrecks they think the divers want to see to increase the likelihood of receiving generous tips from the divers.

It is possible for divers to request the dive guides take them wherever they want to go on the wrecks, and in the researcher's experience the dive guides willingly oblige. However, not all divers are aware that this is possible and do not ask. Additionally, many of the participants were on organised and guided tours of Chuuk, and the trip leader had decided which wrecks would be dived on which days and allocated the divers to groups. To the researcher's knowledge, these divers were not proactive about which wrecks they would like to dive each day, or what they wanted to see on any particular wrecks. This information was obtained through informal discussion with the divers.

Although not the focus of the diver observations, some comment is warranted on any differences noted between technical and non-technical wreck divers. The survey results indicated that technical divers are a more homogenous group within the wreck diving community, differing from other wreck divers in their wreck diving frequency, motivations for wreck diving and attitudes to management controls. Eight of the 20 participants in the participant-generated video were technical divers (observations 10, 13, 15, 16, 17, 18, 19 and 20). The differences that emerged between technical and non-technical divers in the survey data were not evident from the video data. The behaviour frequencies, durations and patterns of the technical divers were generally similar to and consistent with the non-technical divers (Tables 23 and 26, sections 8.4.2.2 and 8.4.2.3). Technical divers are identified in Table 20, and are those divers who used a rebreather or twin tanks. Most of the technical diver participants had few or no contact behaviours, although there was one exception. The participant from observation 19 (section 8.4.3.15) had the second highest number of contact behaviours. This participant also spent the second lowest amount of time looking at marine life. Although only two contacts were recorded in observation 20 (section 8.4.3.16) due to sub-optimal camera angle, the researcher observed other contacts. However, these were within a similar range to non-technical divers.

8.5 Chapter summary

This chapter reported on the results of the observations of diver and dive guide behaviour. These results are based on data collected by the researcher and 20 participant wreck divers, who wore head-mounted cameras while wreck diving at

Chuuk Lagoon. The researcher also made other observations that were not videoed, and these were included in the analysis. There were three significant findings. The first was that most divers behave responsibly, and only a small minority of divers are responsible for the behaviours that result in negative impacts on shipwrecks. Secondly, the source of the majority of the contacts were males, Australians, and to a lesser extent, the less experienced divers. The third was that the behaviour of dive guides had little direct influence on diver behaviour.

Observations of participants by the researcher recorded additional contact behaviours that were not visible in the participant-generated data, such as hitting the wrecks with their fins and kneeling on the wrecks. However, these contacts were few in number and consistent with the overall behaviour patterns of those participants. Observations of the dive guides revealed some unnecessary contact behaviours, such as standing on wrecks and holding onto wrecks, as well as some inappropriate behaviours. There were a few examples of dive guides touching artefacts and encouraging divers to touch artefacts. Three examples of dive guides unnecessarily anchoring on wrecks, when moorings were available and in close proximity, were observed. The most concerning and inappropriate behaviour observed was when one of the dive guides offered the researcher an artefact to keep. There were also examples given of the cleaning of features of wrecks, such as ships' names, and it is likely that dive guides are responsible.

Human remains are present on many of the wrecks at Chuuk. Seeing these human remains is popular with many divers, and is possible on some of the wrecks. However, many of the human remains viewed by divers have been moved from their original location. Examples were given of the clustering of human remains around memorial plaques on one wreck, the operating table of another, with an artefact cluster on one wreck, and near a skull that is wedged between machinery in another wreck. There was also an example of a human long bone placed on a toilet inside one of the wrecks. One diver who was not a participant in this study was observed touching the human remains that were placed in an artefact cluster.

The researcher also had the opportunity to make two observations on submerged aircraft. The behaviour of dive guides and divers was markedly different on submerged aircraft in comparison to their behaviour on shipwrecks. Divers were observed in the cockpit of the Emily, and a dive guide in the hatch of the Betty

Bomber, which resembles a cockpit. This behaviour demonstrated a lack of concern or awareness of the impact their actions may have on these fragile items. The dive guide also made more contact with artefacts and encouraged the divers to also interact more with the artefacts, than was the case on the shipwrecks.

In relation to the results of the participant-generated data, a major finding was that divers predominantly engaged in non-contact behaviours, which represented over 98 percent of behaviour durations. The divers spent the majority of their time looking at features of the wrecks, followed by looking at marine life and being inside wrecks. Almost half of the participants used cameras, however camera use represented under five percent of non-contact behaviours.

The focus of the analysis of diver behaviour was on their contact behaviours because these behaviours have the potential to result in negative impacts on shipwrecks and submerged aircraft. Hand pulling was the most prevalent of the contact behaviours, followed by touching artefacts and holding onto wrecks. Most cases of hand pulling were an appropriate technique to use in the situation that they were used, that is, moving around inside the wrecks. Touching artefacts is the contact behaviour of most concern to heritage managers. Encouragingly touching artefacts only accounted for just over one fifth of the contact behaviours, and only four of the 20 participants engaged in this behaviour. When divers touched artefacts, they primarily picked them up to inspect them more closely. Around two thirds of the participants held onto the wrecks, however, two participants were responsible for the majority of these contacts. In most cases, the divers held onto wrecks to steady themselves while looking at something. Another important finding was that no clear relationship was found between camera use and contact behaviour.

The following chapter presents a synthesis and comparison of the survey and video results.

Chapter 9 – Synthesis of results

9.1 Introduction

This chapter presents a synthesis of the key findings from the survey and diver observations presented in Chapters 7 and 8. The survey findings are presented first, followed by the observations. The two sets of findings are then compared to identify any consistencies or inconsistencies between the two data sets. This chapter sets the scene for Chapter 10, which links the outcomes of this research with existing scuba literature, and Chapter 11, which presents conceptual models that synthesise and interpret wreck diver motivations and attitudes.

9.2 Key findings

9.2.1 Survey

A total of 724 wreck divers participated in the survey, which targeted the significant source populations of wreck divers who visit the Asia-Pacific region. Almost three quarters of wreck divers were male. More than two thirds of wreck divers were aged between 35 and 64 years and almost half were aged between 35 and 54 years. Two thirds of wreck divers held a bachelor or higher degree. Around 40 percent of the participants were from the United States and over one quarter from Australia. Just over one quarter were from countries not specifically listed in the survey. One third of the divers in the 'other' countries category were from Canada, representing just over 8 percent of wreck divers, and almost one quarter were from Europe, representing around 6 percent of wreck divers (Table 8, section 7.3.1).

Survey participants were experienced divers with high levels of dive certification (Table 9, section 7.3.1). Almost half had completed more than 500 dives and more than one quarter had completed over 1,000 dives. Only around 10 percent of wreck divers had completed 50 or less dives. Around one third held leadership certifications (i.e. divemaster, instructor or master instructor) and almost one quarter had technical diving certifications. Just under five percent held entry level certification. Slightly more than one quarter of the divers had been diving for 5 years or less, almost half had been diving for 10 years or less, and more than half for 15 years or less.

9.2.1.1 Frequency of wreck diving

Just over one third of wreck divers classified themselves as frequent wreck divers and almost half classified themselves as occasional wreck divers (Table 10, section

7.3.3). The remainder, representing less than one fifth of the wreck divers, dived wrecks rarely or had dived wrecks fewer than five times.

Significant differences were found between certain diver profile variables and frequency of wreck diving. The variables that had the most influence were dive experience and certification level. Country of residence also moderated wreck diving frequency, although to a lesser degree (Table 11, section 7.3.3.1).

Divers who had completed a greater number of dives were more frequent wreck divers than those with fewer dives. The most notable difference were divers who had completed more than 1,000 dives. These divers dived wrecks more frequently than those with less experience. There was also a difference related to the number of years diving. Divers with more than five years diving experience were more frequent wreck divers than those with less than five years-experience.

Technical divers dived wrecks more frequently than divers holding all other listed certifications. Divers with leadership and master scuba diver certifications dived more frequently than those with advanced open water or lower levels of certification. Wreck divers residing in Japan were less frequent wreck divers than those from Australia, the United States and countries in the other countries category.

9.2.1.2 Motivations to wreck dive

Wreck divers were primarily motivated to wreck dive by history/heritage and environmental factors. Four motivations stood out in the level of importance given for diving above all others. In order of priority, these were: seeing historically significant shipwrecks (history/heritage), marine life (environmental) and artefacts (history/heritage), and enjoying the peace and tranquillity of the underwater environment (environmental). Another five motivations were important, albeit to a lesser extent. These were: clear water (environmental), researching and learning more about a wreck (history/heritage), the complexity and size of a wreck (structure and technology), observing the effects of time (decay) and wreck penetration (environmental). Notably, the majority of wreck divers were not motivated by treasure hunting. Both motivations in this cluster, searching for and collecting artefacts, were ranked as the least important motivations for wreck divers. Collecting artefacts scored markedly lower than any of the other motivations (Table 12, section 7.3.4).

Statistically significant differences were found in motivations for wreck diving, and were related to certain diver profile variables (Table 13, section 7.3.4.1). The key differences are summarised in Table 37. Frequency of wreck diving was the most important factor, followed by level of dive certification and gender. The level of dive experience (i.e. the number of dives completed and years diving experience) and country of residence also moderated motivations although to a lesser degree.

The motivations which were more important to the more frequent wreck divers included:

- All three motivations in the history/heritage cluster: seeing historically significant shipwrecks, seeing artefacts, and researching or learning more about a wrecks;
- Both of the structure and technology cluster motivations: complexity and size of a wreck and exploring and discovering machinery and fittings;
- Wreck penetration (technique/challenge);
- Both of the treasure hunting cluster motivations: searching for artefacts and collecting artefacts; and,
- Observing the effects of time (decay) on wrecks (environmental).

The preferences of technical divers mirrored those of the more frequent wreck divers, with two exceptions. Technical divers did not place higher importance on observing the effects of time (decay) on wrecks (environmental) or collecting artefacts (treasure hunting). The preferences of male divers were also similar to more frequent wreck divers. Males placed more importance on seeing historically significant shipwrecks and artefacts (history/heritage), both of the structure and technology cluster motivations, wreck penetration (technique/challenge) and searching for artefacts (treasure hunting). Wreck penetration was also more important to the more experienced divers and wreck divers who resided in Australia.

Table 37 Motivations – summary of key differences

Diver profile variable	Cluster											
	History/heritage			Environmental				Structure / technology		Technique / challenge	Treasure hunting	
	Seeing historically significant shipwrecks	Seeing artefacts	Researching & learning	Seeing marine life	Clear water	Peace & tranquillity	Observing effects time (decay)	Complexity & size	Explore & discover machinery & fittings	Wreck penetration	Searching for artefacts	Collecting artefacts
More frequent wreck divers	✓	✓	✓				✓	✓	✓	✓	✓	✓
Less frequent wreck divers				✓	✓	✓						
Technical divers	✓	✓	✓					✓	✓	✓	✓	
Leadership certifications			✓		✓		✓			✓		
More experienced wreck divers										✓		
Less experienced wreck divers				✓	✓	✓						
Males	✓	✓						✓	✓	✓	✓	
Females				✓	✓	✓						
Australia (resident)										✓		
Japan (resident)	✓	✓			✓	✓						
United States (resident)				✓								✓

✓ more important

Note: This table summarises statistically significant differences from Table 13 in Chapter 7

Less frequent and less experienced wreck divers and females placed more importance on three of the environmental cluster motivations: seeing marine life, clear water and peace and tranquillity. Divers living in Japan placed more importance on two of the history/heritage cluster motivations: seeing historically significant shipwrecks and artefacts. This finding may appear paradoxical because Japanese divers were found to be less frequent wreck divers than divers from Australia (Table 11, section 7.3.3.1). This may indicate, however, that there are fewer opportunities for Japanese people to dive shipwrecks than divers from Australia. It may also mean that while Japanese divers were less likely to dive shipwrecks generally, they were more motivated to dive historic shipwrecks than divers from Australia and the United States. Two of the environmental cluster motivations: clear water and peace and tranquillity. Seeing marine life (environmental) and collecting artefacts were more important to divers residing in the United States. Clear water was important to wreck divers holding leadership certifications.

The technique/challenge thematic cluster also included photography, which was not moderated by any of the diver profile variables. In hindsight, the two motivation factors in this cluster (wreck penetration and photography) may have been better placed in separate categories because the type of techniques and challenges posed by each of these activities are quite different. Photography may also be viewed as another form of observation, and therefore the subject of the photography (e.g. marine life or wreck features) may have been more relevant.

In summary, the differences found between the level of importance placed on motivations by divers with different demographic and dive experience characteristics indicates that the wreck diving community is not homogenous. Motivations were influenced by certain diver profile variables. These were (in order of importance): frequency of wreck diving, level of dive certification, gender, country of residence and level of dive experience. These relationships are illustrated in Figure 135, with the strength of influence of the variable indicated by the thickness of the line. The thicker the line the stronger the influence of that variable. The variables relating to diver specialisation are highlighted. These findings have implications for heritage managers and dive and tourism operators, which are outlined in Chapter 11 (section 11.8).

Figure 135 **Factors moderating motivations for wreck diving**

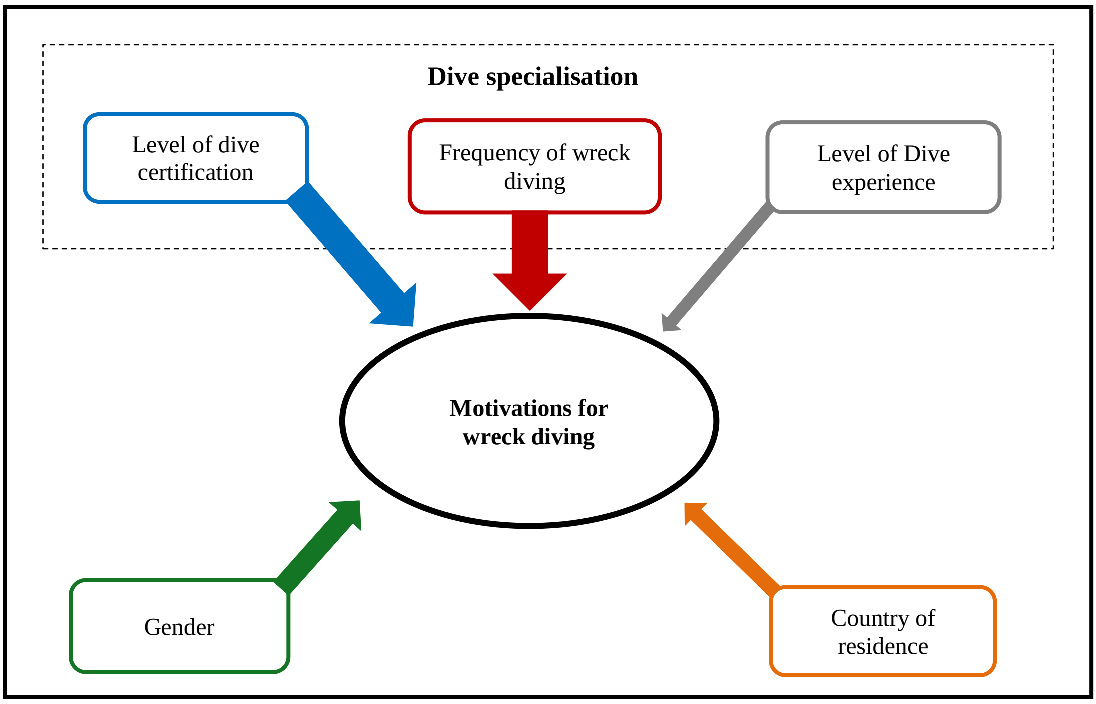


Image © 2018 Joanne Edney

9.2.1.3 Attitudes to management controls

The use of management controls to protect wrecks was supported in-principle. This was demonstrated by the high level of disagreement to the statement 'there should be no controls on what divers do on wrecks' (Table 14, section 7.3.5). However, only two specific controls were supported by the majority of wreck divers. The use of penalties (high restriction cluster) received a distinctly high level of support. Permits were also supported (moderate restriction). The strongest level of disagreement was to the exclusion of divers from all wrecks, except artificial reef wrecks (high restriction), suggesting that divers want access to wrecks. These results indicate that while most wreck divers agree in-principle to the use of management controls to protect wrecks, there were only two specific controls that received convincing support: the use of penalties and permits.

Another important finding was that most wreck divers did not consider it appropriate to move artefacts around on wreck sites. This finding indicates most divers are aware these actions, which can compromise the archaeological values of sites, were not appropriate. Two other findings warrant further comment. The first was the low level of agreement that a dive briefing is enough to control diver behaviour (ranked 6 out of 9 and mean of 2.31), a widely used strategy to avoid or minimise diver impacts on the marine environment. The other was the relatively low level of agreement to the use of dive guide to control diver behaviour (Table 14, section 7.3.5). Dive guides are commonplace at many dive destinations, and in some cases mandatory, such as at Chuuk (section 4.4.1.6). These findings have implications for heritage managers, which are outlined in Chapter 11 (section 11.8).

Statistically significant differences were found in wreck divers' attitudes to management controls, and were influenced by certain diver profile variables (Table 15, section 7.3.5.1). The key differences are summarised in Table 38. The variables that had the most influence over differences in levels of agreement to management controls were level of dive experience, country of residence and gender. Frequency of wreck diving also influenced attitudes.

More frequent wreck divers were more opposed to:

- Both of the high level restrictions management controls: the use of penalties, and some wrecks being off-limits to divers;
- Three of the moderate level restrictions: the use of permits, some wrecks off-limits to divers and the use of dive guides to control diver behaviour; and,
- Briefings (low).

Male divers showed similar preferences to the frequent wreck divers, with the exception of special certifications. The more experienced divers had lower levels of agreement to all moderate level restrictions (i.e. the use of permits and special certifications, some wrecks off-limits to divers and the use of dive guides to control diver behaviour). Technical divers had less agreement to penalties (high), and two of the moderate restrictions: the use of special certifications and dive guides. Less experienced divers had lower levels of support for no controls over what divers do on wrecks (low).

Wreck divers residing in the United States were more opposed to the use of penalties (high), three of the moderate level restrictions: permits, special certifications and dive guides. These divers had a higher level of agreement to there being no controls over what divers do on wrecks. Wreck divers living in Australia were more opposed to three of the moderate level restrictions: permits, special certifications and dive guides. However, these divers had higher levels of agreement to the use of penalties (high). Wreck divers residing in countries in the other countries group were more opposed to both low restriction controls (briefings and no controls). These divers supported penalties (high), along with special certifications and some wrecks being off-limits.

Table 38 Attitudes to management controls – summary of key differences

Diver profile variable	Level of restriction cluster							
	High		Moderate				Low	
	Penalties	No visitation	Permits	Special certification	Some wrecks off-limits	Dive guide	Briefing	No controls
More frequent wreck divers	x	x	x		x	x	x	
Less frequent wreck divers	✓	✓	✓		✓	✓	✓	
Technical divers	x				x	x		
Leadership certifications	✓			✓		✓		
More experienced divers			x	x	x	x		✓
Less experienced divers			✓	✓	✓	✓		x
Males	x	x	x		x	x		
Females	✓	✓	✓		✓	✓		
Japan (resident)	✓		✓	✓		✓	✓	
Australia (resident)	✓			x	x	x		
United States (resident)	x		x	x		x		✓
Other countries (resident)	✓			✓	✓		x	x

✓ more agreement
x less agreement

Note: this table summarises statistically significant differences from Table 15 in Chapter 7.

Less frequent wreck divers had higher levels of agreement to the management controls that the more frequent wreck divers showed less support for. These included:

- Both of the high level restriction management controls: the use of penalties, and some wrecks being off-limits to divers;

- Three of the moderate level restrictions: the use of permits, some wrecks off-limits to divers and the use of dive guides to control diver behaviour; and,

- Briefings (low).

Female wreck divers had the same preferences as the less frequent wreck divers, with the exception of briefings. The less experienced divers had higher levels of support for all four moderate level restrictions (permits, special certifications, dive guides and some wrecks being off limits to divers) and no controls (low). Divers with leadership certifications had higher levels of support for penalties and two moderate restrictions (special certifications and dive guides). More experienced divers supported no controls over divers on wrecks (low). Wreck divers living in Japan showed more support for penalties (high), three of the moderate level restrictions (permits, special certification and dive guides), and briefings (low).

The other difference was in relation to the knowledge cluster (Table 15, section 7.3.5.1). Wreck divers living in the United States and more experienced divers agreed more strongly that moving artefacts around on a wreck site is acceptable. However, those from countries in the other countries category and more experienced divers had stronger opposition to this practice.

In summary, the moderating effect of demographic and dive experience characteristics on levels of support for management controls indicates that the wreck diving community is not homogenous. Attitudes were influenced by certain diver profile variables. In order of influence, these were: country of residence, frequency of wreck diving, gender, level of dive experience and certification level. The relationship of these variables to wreck diver attitudes is illustrated in Figure 136, with the strength of influence of the variable indicated by the thickness of the line. The thicker the line the stronger the influence of that variable. The variables relating to diver specialisation are highlighted. These findings have implications for heritage managers and dive and tourism operators, which are outlined in Chapter 11 (section 11.8).

Figure 136 **Factors moderating wreck diver attitudes**

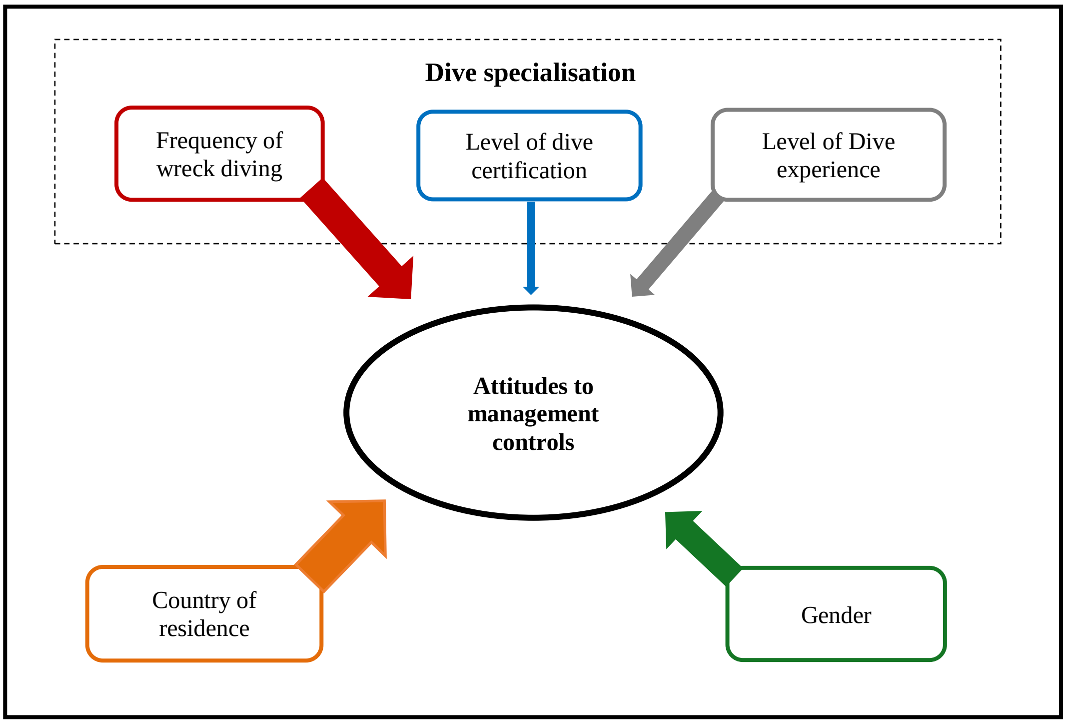


Image © 2018 Joanne Edney

9.2.1.4 Attitudes towards the protection of shipwrecks based on cultural values

Wreck divers attached high levels of importance to protecting wrecks associated with all six listed cultural values: war graves, tragic event where human remains are present, tragic event where people were killed, historic events, wars and tragic events where there was no loss of human life (Table 16, section 7.3.6). All mean scores were well above the neutral score of 2.5. War graves gained the highest level of importance, and scored considerably higher than all other values. The next highest in importance were wrecks associated with a tragic event with human remains present, followed by a tragic event where people were killed.

There were some statistically significant differences in the levels of importance placed on protecting wrecks with different cultural values based on certain diver profile variables. These differences were primarily related to level of dive experience and certification, and gender. Although the across the board high level of importance placed on protecting shipwrecks with all of the listed cultural values is encouraging, there is no further discussion of the differences because they would not serve any practical purpose in informing underwater cultural heritage management.

9.2.2 Video observations

The researcher completed 45 dives during the fieldwork. Video data was collected on 30 of these dives due to camera failures on 15 dives. Video data was collected on 19 shipwrecks and two submerged aircraft (Table 19, section 8.3.1). In addition to video data, the researcher also made notes about observations from each dive. The main purpose of the researcher observations were to supplement the participant-generated data. They also provided context for diver and dive guide behaviour, and gave a different perspective to the first-person observational data collected by participants.

Participant-generated video data was collected for 23 dives by 20 participants. The data were collected on 12 shipwrecks, and one was a submarine (Table 20, section 8.4.1). The researcher was present on 14 of these observations. The purpose of these observations was to gain a first-person perspective of the participants' visual environment and behaviour while diving shipwrecks.

The majority of participants in the video observations, and other divers observed throughout the study, behaved responsibly and did not engage in behaviours that result in negative impacts on shipwrecks. A small number of divers were responsible for the majority of these behaviours. However, there were notable differences in both diver and dive guide behaviour on the submerged aircraft, which is discussed in section 9.2.2.4.

9.2.2.1 Dive guide behaviour

Dive guides were observed to engage in some contact behaviours. The behaviours of most concern were anchoring on wrecks, and an incident where a dive guide offered an artefact to the researcher to keep. The most common dive guide contact behaviours were holding onto and standing on wrecks. It is also possible that the dive guides are responsible for cleaning some of the features on wrecks, such as ships' names.

Two examples of dive guides picking dive boat anchors into wrecks were observed during the study. One occurred at the *Sankisan Maru* and the other at the *Shinkoku Maru*. In both of these cases, the dive guide picked the dive boat anchor into the wreck only metres away from available mooring lines. In addition, in the case of the *Sankisan Maru*, the dive guide was observed standing on the wreck while picking the anchor in, and broke off a large piece coral in the process.

One of the most astonishing dive guide behaviours was offering the researcher an artefact to keep. The researcher had observed the dive guide cleaning artefacts in a cluster in one of the holds of the *Sankisan Maru* and approached to see more clearly what type of artefacts the dive guide was cleaning. When the researcher approached the dive guide she was videoing his actions using the head-mounted and a hand held GoPro® cameras. The guide was cleaning small medicine bottles. When he noticed the presence of the researcher, he offered her one of the bottles, and signalled to her to keep it. The researcher did not indicate that she wanted to touch the artefact, and had not in any way prior to or during the dive indicated to the guide that she wanted to obtain any artefacts. However, the incident demonstrates the ease of obtaining and removing artefacts from the wrecks.

Dive guides holding onto and standing on wrecks mostly occurred while they were waiting for divers to descend or catch up. The dive guides were highly competent and proficient divers with excellent buoyancy control skills. Therefore, these behaviours were not due to poor diving skills, and the reasons for them are not clear. There were limited examples of other contact behaviours, including moving a telegraph, moving a dial on a radio and touching artefacts in a cluster.

There were three examples of dive guide behaviour directly influencing the behaviour of participants. In one case, on the *Kiyosumi Maru*, a participant touched artefacts after the dive guide showed an artefact cluster to the divers and picked up some of the artefacts (observation 22, section 8.4.4.1). Another was when the dive guide showed a participant the telegraph of the *Fujikawa Maru* and moved it, prompting the diver to do the same (observation 14, section 8.4.3.10). The third example occurred during a dive on the *Kensho Maru*. The dive guide showed a diver a radio inside the wreck and moved a part on it. After the diver observed the dive guide do this, he also moved it (section 8.3.2.1, Figures 38 and 39).

Although there were few examples of dive guide behaviour directly affecting the behaviour of divers during the study, it is acknowledged that the behaviour of dive guides may have a more indirect or subtle effect on future diver behaviour. Divers witnessing these types of behaviours may feel less inhibited or constrained about touching and moving things, as well as standing, holding or kneeling on the wrecks on future dives.

Dive guides were present on all of the dives observed during this study. However, in many cases there were periods during the dives where the dive guide left the divers to dive independently. There was no appreciable change in diver behaviour when a dive guide was not present, with one exception (observation 19, section 8.4.3.15). It is possible, however, that in this case the behaviour was the result of available opportunities that arose following the departure of the dive guide, rather than the absence of the dive guide.

Another possible contact behaviour attributable to dive guides is the cleaning of features on the wrecks. These include ships' names on the bows and sterns of some of the wrecks (Figures 57 and 58), manufacturer's plates on machinery and guns (Figure 11), and even a Hinomaru roundel under the wing of a Zero in the hold of one of the wrecks (Figure 59). It is likely the dive guides are responsible for cleaning these features because these are features of the wrecks the guides show to divers.

9.2.2.2 Human remains

The wrecks at Chuuk are the graves of many Japanese military personnel, and human remains are visible in many of the wrecks. Many divers have an interest in seeing these human remains. The dive guides are aware of this interest and usually lead divers to locations where human remains are visible, and point them out to the divers. It is also not uncommon for divers to request to see human remains. In a few of the wrecks human remains have been moved to locations where they are visible to divers, and in some cases have clustered. Diver interest in seeing human remains may encourage dive guides, or perhaps other divers, to move human remains to more visible locations and to cluster them. However, the reasons for clustering human remains on the wrecks is not clear.

It is possible that some clusters may have been formed as acts of memorialisation. This is a likely explanation for the cluster of human remains found around the commemorative plaques and statue on the deck of the *Aikoku Maru* (Figures 49 and 50, section 8.3.2.4). Memorialisation may also be one reason for the cluster of human remains on the operating table inside the *Shinkoku Maru* (Figure 55, section 8.3.2.4). Other reasons for this cluster of human remains maybe for photographic opportunities, and as a feature to show divers.

The cluster of human remains inside the engine room of the *Yamagiri Maru* beneath the skull wedged between machinery (Figure 54, section 8.3.2.4) is another possible example of memorialisation. However, it is equally plausible that this cluster was formed as an attraction for divers. There are other examples of clusters of human remains that are not consistent with memorialisation. These clusters appear to have been created as attractions for divers, or for reasons unknown. An example of a diver attraction was the human long bone placed at the entrance to one of the holds in the *Kiyosumi Maru* amongst other artefacts (Figure 56, section 8.3.2.4). Whereas, the reason for placing the human long bone on a toilet bowl in the *Aikoku Maru* (Figure 52) is not known. However, it is unlikely it was placed there to display to divers, as this location is not frequently visited by divers. Whatever the reason, it is one of the more disrespectful and insensitive examples of treatment of human remains in Chuuk Lagoon.

9.2.2.3 Participant diver behaviour

The majority (65%) of the participant observations were of male divers, just over a third (35%) were females. The majority of the observations were of divers from Australia (44%) and the United Kingdom (44%), and the remaining 12 percent were Americans. Almost half of the observations (48%) were of highly experienced divers, and the remainder were more equally divided between moderate (26%) or lower (26%) levels of experience. These classifications of experience are relative, and the less experienced category does not include any novice divers (Table 21, section 8.4.1). Due to the nature of the diving at Chuuk, most divers who visit are experienced divers.

Behaviours were categorised into non-contact and contact behaviours. Non-contact behaviours included looking at features of the wrecks and marine life, being inside the wrecks and using a camera. Contact behaviours included hand pulling on a wreck and marine life, sitting and standing on a wreck, holding onto a wreck, touching artefacts, unintentional contacts with wrecks, and touching marine life (Table 6, section 5.6.2).

The durations and frequencies of these behaviours were analysed. However, for non-contact behaviours the focus was on durations because the amount of time spent engaging in these activities is more relevant than their frequency, in that it indicates their relative importance to participants. However, frequencies were the focus for contact behaviours because the frequencies of these behaviours are more relevant to their level of impact on wrecks.

Non-contact behaviours accounted for just over 98 percent of behaviour durations (Table 22, section 8.4.2.1). Participants spent the majority of their time (58%) looking at features of wrecks (Table 39), including artefacts, masts and kingposts, propellers, bows, anchors and windlasses. Looking at marine life was the next most prevalent non-contact behaviour (21%). The wrecks at Chuuk have prolific marine life in, on and around them, providing divers with ample opportunities to enjoy viewing marine life. This includes hard and soft corals, sponges and anemones with anemone fish. Sharks were a highlight, although seldom seen during the fieldwork, and large pelagic fish such as barracuda and schools of trevally swirling above the wrecks. The huge variety of small colourful fish associated with the corals were also popular. Penetrating wrecks was also popular (16%), and all except two divers went inside the wrecks. Holds containing cargo were the most commonly visited parts of the wrecks, and divers were interested in seeing the contents of these holds, for example, various types of munitions, gas masks, fuel drums, bicycles, vehicles and other machinery. Superstructures were also entered to see the bridge, bathrooms and galleys. Various types of artefacts were also popular, from munitions to objects of everyday life, such as crockery, containers, glassware, cooking utensils, tableware, shoes and clothing, and beer and saki bottles. Also items used on the ships including fire extinguishers, brass lanterns, light fittings and fans. Human remains on the wrecks were also of interest to the divers.

Table 39 Summary of non-contact behaviour durations

Behaviour	**Duration (seconds)**	**Mean duration (seconds)**	**Behaviour duration (%)**
Look at feature of wreck	34197.77	1486.86	58
Look at marine life	12038.31	547.20	21
Inside a wreck	9231.18	439.58	16
Use camera	2762.85	276.29	5
Total	**58230.11**	**-**	**100**

When the proportion of durations of non-contact behaviours were compared by diver profile, all profile groups spent the majority of their time looking at features of the wrecks (Table 33, section 8.4.2.5). The rankings of the next most prevalent non-contact behaviours were the same for all groups, with the exception of participants from Australia. Looking at marine life ranked second and being inside wrecks third. Whereas, participants from Australia spent more time inside wrecks than looking at marine life. This information can assist dive and tourism operators in tailoring the experiences offered to visiting divers. It can also indicate to heritage managers and dive operators the experiences sought by different segments of the wreck diving community.

Although contact behaviours represented just under two percent of the behaviour durations and just under 15 percent of frequencies (Table 22, section 8.4.2.1), understanding these behaviours is critical because they can cause negative impacts on underwater cultural heritage. Information about the frequency of these behaviours is more relevant to their impact, and therefore their management. The frequencies of contact behaviours are summarised in Table 40.

Hand pulling on wrecks was the most frequent contact behaviour, making up more than one third (35%) of these behaviours. Almost half of the participants did not engage in this behaviour (Table 23, section 8.4.2.2). Two participants were responsible for the majority of occurrences of hand pulling. However, in most cases this behaviour was appropriate to the situation, as it was used to move through the inside of the wrecks. This is a technique used to minimise silting. It is also appropriate to use when moving around the exterior of a wreck when moving against a current. There were some cases of unnecessary hand pulling on the wrecks. For example during observation 22 (section 8.4.4.1) the diver hand pulled his way along the hull of the wreck, in the absence of current.

Table 40 Summary of contact behaviour frequencies

Behaviour	Frequency (n)	Mean frequency (n)	Frequency (%)
Hand pulling - wreck	82	6.31	35.2
Sit on wreck	1	1.00	0.4
Stand on wreck	3	1.50	1.3
Hold onto wreck	46	2.88	19.7
Touch artefact	48	9.60	20.6
Unintentional contact	2	2.00	0.9
Hand pulling – marine life	24	12.00	10.3
Touch marine life	27	4.50	11.6
Total	**233**	**-**	**100**

Although touching artefacts was the next most frequent behaviour (21%), it is arguably the most important because it has the potential for more consequential impacts on underwater cultural heritage. Only four participants engaged in this behaviour. One participant recorded the majority of these contacts (Table 23, section 8.4.2.2). Touching artefacts was further defined using modifiers (Table 25), and when the participants touched artefacts it was primarily picking them up to inspect them more closely. Cleaning the artefacts was the next most prevalent activity when participants touched artefacts. The artefacts touched by the divers were almost exclusively those in artefacts clusters.

Holding onto wrecks ranked third highest, accounting for almost 20 percent of the contact behaviour frequencies. Less than two thirds of the participants engaged in this behaviour. Two participants recorded the majority of cases of this behaviour (Table 23, section 8.4.2.2) and in most cases the divers held onto the wreck to steady themselves while looking at something. Touching marine life and hand pulling on marine life combined made up another 22 percent of the contact behaviours. Only two participants hand pulled on marine life, and one diver was responsible for the vast majority of both of these contacts (Table 23). Five divers touched marine life, and one diver was responsible for the majority of these contacts. This was the same diver who did the majority of the hand pulling on marine life. The remaining contact behaviours (i.e. sitting, standing and unintentional contacts) represented less than two percent of these behaviours, and were primarily due to a lack of proficiency in, or attention to, buoyancy control.

Almost half of the participants used cameras, and it was expected these divers would have a higher frequency of contact behaviours than those not using cameras. For example, holding onto wrecks or kneeling to steady themselves while taking photos. However, with one exception (observation 19, section 8.4.3.15) camera users had either low frequencies of, or no, contact behaviours (Table 23). In addition, two of the participants who completed more than one observation used a camera on one of their dives. No contact behaviours were observed for either of these divers on the dive they used a camera, whereas both engaged in contact behaviours on the dive where they did not use a camera.

When the contact behaviours were compared by diver profiles (Table 30, section 8.4.2.4), males, Australians and the less experienced participants were responsible for the majority of contact behaviours. Males and Australian participants in were the groups that were responsible for the vast majority of contacts, while the less experienced divers were responsible for just over half. Information regarding the primary sources of contact behaviours can assist heritage managers in determining appropriate management strategies and targeting education.

The relative proportions of the behaviours were compared by diver profile variable (Table 31, section 8.4.2.4). Hand pulling on wrecks, touching artefacts and holding onto wrecks were the most prevalent contact behaviours, in order of priority, for males, Australians, the less experienced and experienced participants. For females, touching artefacts was highest, followed by holding onto wrecks and touching marine life. Holding onto wrecks, hand pulling on wrecks and touching artefacts were the most prevalent contact behaviours, in order of priority for participants from the United Kingdom and those with moderate dive experience. Participants from the United States only contact behaviour was holding onto wrecks. However, this was a small sample size and may not be indicative of all American wreck divers. These findings can assist heritage managers in determining the appropriate site management strategies and where to target management actions, including education.

It is acknowledged that not all contact behaviours made by participants were recorded. This is because only behaviours visible in the participants' video data were recorded. The cameras were head-mounted, therefore it was not always possible to observe contacts made by the divers' equipment or lower body. In some cases, the participants' hands were not always visible due to sub-optimal camera angle. However, many of the contact behaviours not visible in the participant-generated data were visible in the video recordings made by the researcher and other participants. When this was analysed, the frequency of these contacts were not substantially higher than those recorded. Further, these unrecorded contacts were consistent with the overall behaviour patterns of those individuals (described in sections 8.4.3 and 8.4.4).

The repeat observations of three participants presented the opportunity to compare the behaviour of participants on different dives, and to examine the consistency of their behaviour (section 8.4.4). Some differences were found, but the overall behaviour patterns were generally consistent across both dives. The exception was the difference in the frequency of contact behaviours. For two of the participants (observations 3 and 23, 5 and 6, sections 8.4.4.2 and 8.4.4.3 respectively), this may have been related to camera use, because no contact behaviours were observed on the dives where they used a camera.

The comparisons indicated that the divers' level of comfort may influence their behaviour. Level of comfort is likely to have increased as more dives were completed at the study location, and as the divers became more familiar with their dive guides. It is possible that a higher level of comfort may be the reason for the higher frequency of contact behaviours during observations 22 and 23. It may also explain the absence of contact behaviours on observation 6. This was a deep dive and the participant's level of comfort appeared to be considerably lower than it was during observation 5. On the deeper dive the participant may have been more focused on the mechanics of diving, especially monitoring depth, time and air supply, than enjoying the experience of the dive. This may have contributed to the absence of contact behaviours. The higher contact frequencies of observations 22 and 23 compared to 2 and 3 may be due to these participants being less conscious of the head-mounted camera on the second observation. Camera use may also have played a role in the different contact behaviours between observations 3 and 23 and 5 and 6, as camera use also coincided with no contact behaviours (observations 3 and 6).

9.2.2.4 Submerged aircraft

The above discussions refer to dive guide and diver behaviour on shipwrecks. There was a marked difference between these behaviours and those observed on submerged aircraft. The reasons for these differences are not known.

Divers wearing twin tanks were observed inside the cockpit of the Emily. Twin tanks have the potential to cause more damage than a single tank, due to their size and weight. A dive guide was observed sitting in the hatch of the Betty Bomber, which resembles a cockpit, and encouraging the divers present to do the same. In the past, the researcher has observed similar behaviours on submerged aircraft in Palau, Papua New Guinea, the Solomon Islands and Vanuatu. This behaviour is concerning because submerged aircraft are more fragile than shipwrecks (Neyland, 2011).

The dive guide who was observed sitting in the Betty Bomber hatch was also seen touching various artefacts that had been removed from the aircraft. This included sitting on the toilet and holding a gun to demonstrate their use and pose for photographs. In addition, during one dive, the researcher observed a diver moving the joystick in the cockpit of one of the Zeros located in one of the holds of the *Fujikawa Maru* (section 8.3.2.6). The researcher has also observed this behaviour by a dive guide and other divers on previous visits to Chuuk.

9.3 Comparison of survey and video results

The survey and video observations served different purposes. Although their results are not directly comparable, it was possible to compare some aspects of the two data sets. This included certain aspects of diver profiles, motivations for wreck diving and attitudes to management controls. Comparing the two data sets was important to identify consistencies or possible inconsistencies in the results between the two data sets. Understanding how the two different data sets compare can assist in gaining a better understanding of wreck divers.

9.3.1 Diver profiles

Participants of both the survey and participant-generated video observations were predominantly male. There was a slightly less distinct gender difference in the participants of the video observations, with around a 10 percent higher representation of females in this data set compared to the survey. There was a higher representation of people from Australia and the United Kingdom (Appendix 7 and Table 21, section 8.4.1) in the observations, than in the survey. Residents of the United Kingdom represented just under four percent of survey participants and around 44 percent of video observation participants. The difference was less distinct for Australians who represented one quarter of survey participants and around 44 percent of survey participants. The largest group of survey participants (40%) were from the United States, and represented only 12 percent of video observation participants (Tables 8 and 21).

Dive experience of survey participants was gauged in three ways, the number of dives completed, number of years diving and highest level of dive certification. The level of dive experience of the participants in the video observation were estimated by the researcher based on conversations with the participants, along with the researcher’s observations of their diving skills and pre-dive behaviour. The video participants were divided into three levels of experience, ranging from less experienced to experienced. When the survey participants were grouped into similar categories, there were differences in the levels of representation between the two data sets. The survey participants had a higher proportion of less experienced divers, slightly lower proportion of moderately experienced and a noticeably lower proportion of experienced divers than participants in the video observations. Technical divers represented just under one quarter of survey participants, and were a distinct and more homogenous group in the survey. Technical divers in the survey differed from video participants with other levels of certification in their frequency of wreck diving, motivations and attitudes. More than half of the participants in the video observations were technical divers. Although determining differences between technical and non-technical divers was beyond the scope of the video observations, there was no indication of differences in behaviour between technical and non-technical divers in the video observations. The behaviour frequencies, durations and patterns of the technical divers were generally similar to and consistent with the non-technical divers (section 8.4.5).

9.3.2 Motivations for wreck diving

It is not possible to observe diver motivations, however, it is possible to compare some of the motivations with video observations of diver behaviour. The top motivation for wreck diving was to see historically significant shipwrecks (Table 12, section 7.3.4). The wrecks at Chuuk have historical significance (section 6.5.3), therefore it is reasonable to assume this was at least part of the attraction of diving at Chuuk for the participants in the video observations. It is possible to make some comparisons between the results of the video observations and six of the other motivations: seeing marine life, seeing artefacts, penetrating a wreck, photography, searching for artefacts and collecting artefacts.

Video participants spent the highest proportion of their time looking at features of the wrecks (Table 22, section 8.4.2.1), and this included looking at artefacts. As noted above, looking at historically significant shipwrecks ranked one and three respectively in the survey. Participants spent the second highest proportion of their time looking at marine life, which also ranked second highest in importance in the survey (Table 12).

Being inside a wreck (penetrating a wreck) was the next highest non-contact behaviour, and using a camera was ranked fourth. Although these ranked ninth and tenth respectively in the survey results, it was not possible to directly compare the five intervening motivations with the behaviour observations. The last two motivations that can be compared are searching for and collecting artefacts. These ranked lowest in the survey, and there was no evidence of either of these behaviours in any of the video observational data. This is consistent with the low importance placed on these motivations by the majority of survey participants. Touching artefacts was an observed behaviour, and represented less than one percent of the observed behaviour durations, and just over three percent of observed behaviour frequencies (Table 22, section 8.4.2.1). The artefacts that were touched by participants were mostly in artefact clusters.

Differences based on diver profile variables were found in motivations for wreck diving (Tables 12 and 37), and those comparable to the video observations are discussed. Male survey participants placed a higher level of importance on seeing artefacts and penetrating wrecks than females, and seeing marine life was more important to females. The observations of divers found that males spent a higher proportion of their time looking at features of the wrecks than females, and females spent a higher proportion of their time looking at marine life. Males spent a slightly higher proportion of their time inside wrecks. No divers were observed searching for artefacts (Table 33, section 8.4.2.5). The divers were following dive guides and this to a certain extent would determine what the divers saw or had the opportunity to see and do. Therefore, it is possible that these differences may have been more distinct if the divers were diving independently.

Less experienced survey participants placed more importance on seeing marine life than more experienced divers. However, there were only slight differences between the proportions of time spent in the video observations spent on looking at marine life by divers of different levels of experience. The less experienced divers spent the lowest proportion of time looking at marine life (Table 33).

The ubiquity of GoPro® and other cameras, including head-mounted cameras, on dives meant that divers were accustomed to their presence. Participants and other divers present during this study did not appear to pay attention to the cameras. However, it is acknowledged that divers may have been on their best behaviour during the study.

9.3.3 Attitudes to management controls

Diver attitudes cannot be observed. However, it is possible to compare some of the results of the video observations with one aspect of the survey attitudinal data. The majority of survey participants did not consider it acceptable to move artefacts around on wreck sites (Table 14, section 7.3.5). The findings of the video observations indicate support for these findings because touching artefacts represented a very minor component of participant behaviour, at just over three percent of behaviour frequencies (Table 23, section 8.4.2.2). Touching artefacts represented around one fifth of the contact behaviours. Further, moving artefacts made up around 13 percent of the frequency of this behaviour (Table 25, section 8.4.2.2) and only 2.6 percent of all contact behaviours (Table 40). One participant was responsible for all occurrences of this behaviour. Further, the objects were part of an artefact cluster and were moved within a small area (less than 2 metre radius).

However, it is acknowledged that artefacts in clusters have previously been moved from different parts of the wrecks to the location of the cluster. Almost all of the artefacts touched by participants were in artefact clusters. This may indicate that divers assume it is acceptable to touch these artefacts because they have already been moved. Or it may indicate to divers that the artefacts have been placed in clusters so divers can interact with them, and therefore it is acceptable to touch these artefacts. The easy access of these artefacts may be another factor influencing divers' decision to touch them.

Differences were found in the level of agreement to certain management controls (Table 38). Survey participants from the United States showed more support for the statement 'moving artefacts around on a wreck site is okay so long as the artefacts remain at the site. The results from the video participants from the United States did not support this. None of these participants touched any artefacts, the only contact behaviour observed from them was holding onto a wreck. However, it was a small sample size and may not reflect the behaviour of the broader United States wreck diving community.

9.4 Chapter summary

A synthesis and comparison of the key findings of the survey and diver observations were presented in this chapter. The majority of the 724 survey participants were male, aged between 35 and 64 years and held a Bachelor or higher degree. The countries with the highest representation in the survey were the United States and Australia. Survey participants were experienced divers with high certification levels. Most participants were occasional or frequent wreck divers. The majority of survey respondents were primarily motivated to see historically significant shipwrecks, marine life and artefacts, and to enjoy the peace and tranquillity of the underwater environment. Motivations were influenced by diver profile variables. The most influential were frequency of wreck diving, certification level and gender. Dive experience level (i.e. number of dives completed and number of years diving) and country of residence also influenced motivations, although to a lesser extent. The majority of participants gave in-principle support for the use of management controls to protect shipwrecks, however, only two specific controls were distinctly supported: penalties and permits. Participants' attitudes to management controls were influenced by diver profile variables. Country of residence, frequency of wreck diving and gender had the strongest influence over attitudes, while dive experience and certification levels also played a role in influencing wreck diver attitudes.

The researcher undertook observations of divers and diver guides at Chuuk Lagoon during 45 dives on 19 different shipwrecks and two submerged aircraft, and collected video data on 30 of these dives. These observations provided context for the participant-generated video observations and additional data. Twenty participants collected video data over 23 dives on 12 different shipwrecks, providing a first-person perspective of their behaviour. More than two thirds of the video participants were male and almost half were highly experienced divers. The majority of these participants were from Australia and the United Kingdom, which were equally represented, and a minority were from the United States. The participants spent the overwhelming majority of their time engaged in non-contact behaviours. Most of their time was spent looking at features of the wrecks, followed by viewing marine life and being inside the wrecks. The majority of participants behaved responsibly and did not engage in behaviours that can result in negative impacts on shipwrecks, and only a small minority of divers were responsible for these behaviours. Of all the diver contact behaviours, touching artefacts is the one of most concern to heritage managers because it has the potential for the greatest impact on the cultural heritage values of shipwrecks. Encouragingly, touching artefacts only represented a small portion of contact behaviour. Males and Australians were the main source of contact behaviours, and for most of the instances of touching artefacts. Less experienced divers also recorded higher incidences of contact behaviours than other divers, although to a lesser extent than males and Australians.

Some aspects of the behaviour of dive guides was concerning. This included offering the researcher an artefact to keep, the unnecessary picking of anchors into wrecks and touching artefacts and fittings and encouraging divers to do the same. However, the behaviour of the dive guides had little direct effect on diver behaviour.

The behaviour of divers and dive guides with respect to the human remains present on the shipwrecks suggests the need to more ethical and respectful treatment of human remains at Chuuk.

The behaviour of dive guides and divers when diving submerged aircraft was vastly different to their behaviour on shipwrecks. There were substantially more contacts with submerged aircraft, and these contacts had the potential to cause significant damage, for example sitting in cockpits. These observations indicate that different management approaches may be required for shipwrecks and submerged aircraft.

The comparison of the results of the survey and behaviour observations found similarities in the gender ratios of participants. There were also some differences. The participants in the video observations were more experienced divers and had a higher representation of technical divers than the survey participants. There was also a considerably higher representation of participants from the United Kingdom and Australia, and a lower representation of divers from the United States in the observations in comparison to the survey.

Although it is not possible to observe motivations listed in the survey, it was possible to link some of the survey motivations to observable behaviours. The video observations supported the top three motivations for wreck diving and the low importance placed on the treasure hunting motivations. Linking attitudes to observable behaviour was more difficult. However, the low level of support for the attitudinal statement relating to the acceptability of moving artefacts around on a wreck site was supported by the video data.

In conclusion, although not directly comparable, there was congruence in the findings of the survey and video data. The video data lent support for the survey findings. The differences were primarily in the composition of the diver profiles. These differences may be a product of the sample sizes of the data sets, and differences between the broader wreck diving community and those who travel for wreck diving. The survey had more than 30 times the number of participants than the video observations, and is more likely to be representative of the broader wreck diving community than those who participated in the video observations. The congruence of the survey and video observation results suggests that social desirability bias in the survey responses has been minimised (section 5.3.2). Large inconsistencies between observed behaviour and survey responses would expected if the survey responses had been greatly affected by social desirability bias.

The survey and behavioural observation findings are evaluated against relevant literature in Chapter 10, and discussed in more detail in Chapter 11.

Chapter 10 – Linkages between study outcomes and existing literature

10.1 Introduction

This chapter links the outcomes of this research with the existing scuba diving literature to acknowledge any similarities and contrasts. Survey findings are primarily compared with other studies of wreck divers, including wreck diver profiles, motivations for wreck diving, attitudes to management controls and recreation specialisation. The scope for linking the findings of the behaviour observations is more limited because this study appears to be the first example of *actual* wreck diver behaviour in the literature. It also appears to be the first study to examine diver *non*-contact behaviour. However, comparisons are possible with certain aspects of other published studies of general scuba diver behaviour on reefs, and these are discussed.

10.2 Wreck diver survey

This section compares the survey findings primarily with other studies of wreck divers, and where relevant comparisons are made with studies of scuba divers. A total of 724 wreck divers participated in the survey, and survey findings were reported in Chapter 7 and summarised in Chapter 9. This section links key survey findings to the literature. Wreck diver profiles are discussed first, followed by motivations, attitudes and recreation specialisation.

10.2.1 Wreck diver profiles

10.2.1.1 Wreck diver demographics

The majority of wreck divers in this study were male, aged between 35 and 64 years and held a bachelor degree or higher degree. The largest segment of participants were from the United States, followed by Australia. There were similarities and some differences in the demographic characteristics of the participants of this study, compared with the 2010 survey of Australian wreck divers (Edney, 2012b) and the 2009 survey of wreck divers at Chuuk (Edney, 2012a). Detailed comparisons of these results are presented in Table 54 (Appendix 23).

The three recent wreck diver studies referred to in the above paragraph had similar gender ratios, with males representing almost three quarters of participants. There were similarities in the age of the participants of the current study and the Australian survey. Just over two thirds (67.5%) of the participants in the current study were aged between 35 and 64 years, compared to almost two thirds of participants in the Australian survey (65.8%). In comparison, participants in the Chuuk survey tended to be older with 85 percent aged between 35 and 64 years. The age category with the highest frequency of participants for this study was 35 to 44 years (25.8%). It was also the largest category in the Australian survey (28.7%), while 65 percent of participants of the Chuuk survey fell into this age category. The highest frequency age category in the Chuuk survey was 45 to 54 years (43%).

When levels of tertiary education (i.e. diploma and degree or higher degree) were compared, there were more similarities between the current study and the Chuuk survey. Around 80 percent of the participants in the current study and the Chuuk surveys had completed tertiary education, and slightly less in the Australian survey (72%). Although tertiary education levels were similar across the three studies, there were differences in the frequency of participants holding bachelor or higher degrees. The Chuuk survey had the highest frequency of participants holding degrees or higher degrees, at 75 percent, followed by the current study with 66 percent. However, only 56 percent of participants in the Australian survey held a degree or higher degree.

Similar to these three recent studies of wreck divers, Holecek and Lothrop's (1980b) study of wreck divers in the Great Lakes Region of the United States found a predominance of males, with male representation at 86 percent (Holecek & Lothrop, 1980b). Participants in Holecek and Lothrop's study were younger than those from the recent wreck diver studies, with 63 percent aged 21 to 30 years. Education levels were considerably lower in Holecek and Lothrop's study, with less than one quarter of these participants holding a degree or higher degree.

The current study also found some differences between the demographic profiles of wreck divers and non-wreck divers. Wreck divers tended to be older. While there was a predominance of males in both groups of divers, the gender ratio was less distinct amongst non-wreck divers.

There were some broad similarities between the demographic characteristics of the participants in the current study, and those of recent studies of general scuba divers. These include the predominance of males and high levels of education (Bentz et al., 2016; Chung et al., 2013; Musa et al., 2010; Roche et al., 2016; Tschapka & Kern, 2013). Moreover, wreck divers were older than general scuba divers (Bentz et al., 2016; Chung et al., 2013; Lucrezi, Saayman, & Van Der Merwe, 2013b; Musa et al., 2010; Toyoshima & Nadaoka, 2015).

10.2.1.2 Wreck diver dive experience

Wreck divers in the current study were experienced divers with high levels of dive certification. Almost half of the participants had completed more than 500 dives and had been diving for 10 or fewer years. One third held leadership certifications and almost one quarter were technical divers. More than two thirds of participants held certifications above advanced open water diver level.

There were similarities in the number of dives completed and years diving experience between the current study, the Australian wreck diver survey (Edney, 2012b) and the Chuuk survey (Edney, 2012a). However, certification levels differed between the three studies. Detailed comparisons of these results are presented in Table 55 (Appendix 24).

This study and the Australian wreck diver study had similar results across most categories of number of dives completed, although the participants in the current study had completed slightly more dives. For example, 28 percent of participants in the current study had completed more than 1,000 dives, compared to 24 percent in the Australian survey. There were also similarities between the results of this survey and the Chuuk survey. Both had similar proportions of divers who had completed more than 250 dives and more than 500 dives, which was the highest category in the Chuuk survey. The results from this study and the Chuuk survey differed most in the lower categories. Ten percent of participants in this study had completed 50 or fewer dives, compared to three percent of the Chuuk participants. Just over 20 percent of participants in the current study had completed 100 or fewer dives, in comparison to ten percent in the Chuuk survey.

The number of years participants in each of the surveys had been diving was generally similar across all categories. The majority of divers in all surveys had been diving for 15 or fewer years, and just over one quarter had been diving for five or fewer years. The results for the Australian survey were slightly higher than the current study and the Chuuk survey across these categories, although, the Australian survey was slightly lower in the categories for more than 20 years diving experience.

The Chuuk survey had the highest frequency of leadership certifications. Half of the Chuuk survey participants held leadership certifications (i.e. divemaster, instructor and master instructor), compared to 40 percent in the Australian survey and 33 percent in the current study. The Chuuk survey also recorded the highest frequency of instructors and master instructors. Thirty one percent of the Chuuk survey participants held this certification level, compared to 20 percent in the Australian survey and 17 percent in the current study. Entry level certifications (open water) were similar for the current study and the Chuuk survey, at around four percent, while 10 percent of participants in the Australian survey held open water diver certifications. There were similarities between the current study and the Australian survey in the frequency of participants with advanced open water diver certifications. Twenty eight percent of participants in the current study and 30 percent in the Australian survey held advanced open water certifications, compared to only 13 percent of Chuuk survey participants. Technical diver certifications were not quantified in the Australian or Chuuk surveys.

Holecek and Lothrop’s (1980b) study included certification levels and years diving experience. The participants in the recent wreck diver studies held higher levels of certification, had been diving longer and had more years diving experience than those from Holecek and Lothrop’s study. Over 59 percent of participants in Holecek and Lothrop’s study held entry level certifications, compared to four percent in the current study, and 12 percent held advanced and specialty certifications, compared to 31 percent of participants in the current study. However, at instructor level the differences were less distinct. Fourteen percent of participants in Holecek and Lothrop’s study held instructor level certifications, compared to 17 percent in the current study.

The categories used for years diving were not directly comparable between the current study and Holecek and Lothrop’s (1980b) study. Nevertheless, some broad comparisons were possible. Participants in the current study had more years diving experience than those from Holecek and Lothrop’s study. Forty five percent of participants in Holecek and Lothrop’s study had been diving for four or fewer years, compared to 27 percent in the current study having five or fewer years diving experience. Thirty one percent of participants in Holecek and Lothrop’s study had between 5 and 8 years diving experience, compared to 19 percent of participants in the current study who had 6 to 10 years diving experience. Just over 85 percent of

Holecek and Lothrop's participants had 16 or fewer years diving experience. In comparison, 59 percent of participants in the current study had 15 or fewer years diving experience. This may indicate that diver drop-out rates were higher in the past, or the maturation of the dive industry over time.

The current study also found some differences between wreck divers and non-wreck divers. Wreck divers tended to be more experienced divers. They tended to have completed more dives, had been diving for more years and had higher levels of certification than non-wreck divers. These differences are consistent with comparisons between wreck divers and general scuba divers. Wreck divers were more experienced divers than general scuba divers. They had completed more dives and been diving for longer than general scuba divers (see Hammerton, 2017a; Kirkbride-Smith et al., 2013; Lucrezi et al., 2013a; Musa et al., 2010; Roche et al., 2016; Toyoshima & Nadaoka, 2015), and overall held higher levels of certification (see Chung et al., 2013; Hammerton, 2017a; Kirkbride-Smith et al., 2013; Roche et al., 2016; Toyoshima & Nadaoka, 2015).

The higher levels of experience held by wreck divers recognised in the previous Australian and Chuuk surveys is also consistent with the findings of the current study. This research found wreck divers had completed more dives, and had been diving longer than non-wreck divers (section 7.3.1). This is also consistent with Holecek and Lothrop's (1980b) study, which found wreck divers held higher levels of certification than non-wreck divers. These findings were not unexpected. Wreck diving requires higher levels of skill, training and experience to safely participate, because it is more demanding and challenging than general scuba diving.

10.2.2 Wreck diver representation

The vast majority (88.4%) of the current survey participants were wreck divers, and 11.6 percent were non-wreck divers. The Australian survey had similar results, with 80 percent of the participants being wreck divers and 20 percent non-wreck divers (Edney, 2017). This contrasts with Ekberg's (2009) study of 308 Swedish recreational divers, which comprised of 97.6 percent wreck divers and 1.2 percent non-wreck divers.

10.2.3 Frequency of wreck diving participation

There were contrasts between the current research and Ekberg's (2009) study of Swedish divers regarding frequency of wreck diving. Just over one third (34.1%) of wreck divers in the current study dived wreck frequently, compared to over two thirds (69.1%) of Swedish divers. Almost half (44.8%) of wreck divers in the current research were occasional wreck divers, in contrast to one quarter (25.6%) of Swedish divers, who sometimes dived wrecks. Just over one fifth (21.1%) of the participants in the current study rarely dived wrecks, or had completed fewer than five wreck dives, compared to three percent of Swedish divers who seldom dived wrecks.

10.2.4 Motivations for wreck diving

Seeing historically significant shipwrecks, marine life and artefacts, and enjoying the peace and tranquillity of the underwater environment were the highest motivations for wreck diving in this study. A comparison of wreck diver motivation findings from this research, the 2010 survey of Australian wreck divers and the 2009 survey of wreck divers at Chuuk, is presented in Table 41. There were notable similarities in the findings of the three studies.

History/heritage and environmental cluster motivations featured in the top three motivations of all studies. The current study and the survey of Australian wreck divers shared the same top five motivations for wreck diving, although the rankings of the top four differ. Notably, seeing marine life was the top motivation in the Australian wreck diver survey. The current study and the Chuuk survey shared the same top three motivation factors, although ranked differently. Both studies shared the same top motivation, seeing historically significant shipwrecks, however, the ranking of the second and third highest motivations differed.

Importantly, common to all three studies were the rankings of the bottom two motivations, both in the treasure hunting cluster. Collecting artefacts was ranked lowest and searching for artefacts second lowest. This consistency indicates that treasure hunting activities are not the focus for the majority of wreck divers, and are only important to a minority of wreck divers.

Although the motivation factors in Holecek and Lothrop’s (1980b) study did not include information about their content, and were therefore not directly comparable to the current study, some general comparisons were possible. The top motivation of the current study, seeing historically significant shipwrecks, could be considered to have some similarities with the broader primary motivation of what Holecek and Lothrop call ‘just to look at wrecks’. The next most important motivations in Holecek and Lothrop’s study were ‘treasure and trophy’ (comparable to collecting artefacts) and photography. These high rankings bear no similarity to the findings of the current study, and indeed the former provides notable contrast to the current and other recent studies. The difference in the importance given to collecting artefacts between the current and recent studies, and Holecek and Lothrop's study may be a reflection of the changes in diver attitudes towards underwater cultural heritage over time. In the past, the collection of artefacts was an acceptable activity within the diving community, and in some cases was a significant focus of their diving activities (Todd et al., 2001). More recently, however, in many cases laws do not permit removal of artefacts from historic shipwrecks, and there has been a significant shift in diver behaviour, attitudes and ethics away from such activities (Edney, 2012a, 2016).

Table 41 Wreck diver motivations comparison table

Motivation factor	Cluster	This study		Australian wreck divers~		Wreck divers at Chuuk#	
		Mean rank	Mean*	Mean rank	Mean*	Mean rank	Mean*
Seeing historically significant shipwrecks	History/heritage	1	3.99	2	4.01	1	4.31
Seeing marine life	Environmental	2	3.94	1	4.21	3	4.01
Seeing artefacts	History/heritage	3	3.82	4	3.88	2	4.08
Peace & tranquillity of the underwater environment	Environmental	4	3.78	3	4.00	5	3.66
The clear water	Environmental	5	3.41	5	3.85	6	3.56
Researching or learning more about a wreck	History/ heritage	6	3.40	7	3.58	7	3.52
Complexity & size of the wreck	Structure/ technology	7	3.34	9	3.46	8	3.43
Observing the effects of time (decay) on the wreck	Environmental	8	3.34	8	3.53	11	3.04
Penetrating a wreck	Technique/ challenge	9	3.28	7	3.58	4	3.76
Photography	Technique/ challenge	10	3.22	6	3.59	10	3.15
Exploring & discovering machinery & fittings	Structure/ technology	11	3.15	10	3.29	9	3.33
Searching for artefacts	Treasure hunting	12	2.71	11	2.57	12	2.79
Collecting artefacts &/or fittings	Treasure hunting	13	1.78	12	2.07	13	1.92

Key:
* Value is the mean score on a 5 point scale ranging from 1 = not important to 5 = very important
~ Edney (2012b)
# Edney (2011b)

10.2.4.1 Moderation of motivations

Certain wreck diver profile variables moderated motivations. The most influential variables were frequency of wreck diving, level of certification and gender. Country of residence and level of dive experience (i.e. number of dives and years diving) also influenced motivations, although to a lesser degree. There were some similarities between the findings of the current study and the Australian and Chuuk wreck diver studies (Edney, 2011b, 2012a). Wreck diver motivations were moderated by gender across all three studies. Male wreck divers in the Australian and Chuuk surveys placed higher importance on the structure and technology, treasure hunting (searching for artefacts) and technique/challenge (wreck penetration) clusters. Common to all three studies was the higher importance of the environmental thematic cluster, specifically, seeing marine life, to females.

10.2.5 Wreck diver attitudes to management controls

Although this study found in-principle support for the use of management controls, only two management controls received support from the majority of wreck divers. The use of penalties (high restriction) received the highest level of support, while permits (moderate restriction) also received a convincing level of support. Notably, there was a high level of disagreement regarding the prevention of divers visiting shipwrecks. This suggests that while there is in-principle support for management controls to protect shipwrecks, divers still want access to them.

A comparison of wreck diver attitudes from the current study, the 2010 survey of Australian wreck divers and the 2009 survey of wreck divers at Chuuk is presented in Table 42. There were a number of similarities. Importantly, common to all three studies was the in-principle support for having management controls in place. This is evidenced by the low score and ranking of not having any management controls in place to control diver behaviour on wrecks. Additionally, penalties and permits were ranked first and second, and were the only management controls to receive convincing levels of support across all three wreck diver studies. Another consistency was the lowest ranking management control: that wrecks (with the exception of artificial reef wrecks) be protected from visitation by divers.

Other notable findings were that two controls commonly used to manage diver behaviour: the use of dive guides and pre-dive briefings, received low levels of support. The use of dive guides scored just above neutral, while dive briefings scored below the neutral score in all three wreck diver studies. Both of these actions are used at a number of different locations throughout the world. Dive guides have been found effective in reducing diver impacts on reefs (Barker & Roberts, 2004; Hammerton &

Bucher, 2015; Roche et al., 2016). Edney's (2012a) study of wreck divers at Chuuk adds weight to this finding. In addition to the survey, a number of divers completed in-depth interviews, and these divers generally supported the use of dive guides in certain circumstances. However, they did not agree that dive guides accompanying divers should be a mandatory requirement, particularly on wrecks in their local area, that is, wrecks that they were familiar with, or when they wanted independence and the experience of self-reliance. These divers supported the use of dive guides when they were diving unfamiliar wrecks, particularly if the wreck was large, or the diver wanted to penetrate an unfamiliar wreck. Therefore, the low level of support for dive guides to manage diver behaviour, as articulated in the survey, may be due to perceived constraints guides may place on the recreational freedom of divers.

Table 42 Wreck diver attitudes comparison table

Statement	Cluster	This study		Australian wreck divers~		Wreck divers at Chuuk#	
		Mean rank	Mean*	Mean rank	Mean*	Mean rank	Mean*
Harsh penalties should be imposed on some divers who take things from wrecks	High restriction	1	4.00	1	4.17	1	3.85
Divers should be required to have permits to dive on some wrecks	Moderate restriction	2	3.31	2	3.39	2	2.81
Only divers who have special certification should be allowed to dive on wrecks	Moderate restriction	3	2.85	3	2.83	5	2.52
Some accessible wrecks should be off-limits to divers	Moderate restriction	4	2.71	5	2.63	7	2.30
An underwater guide should control what divers do underwater	Moderate restriction	5	2.60	4	2.65	3	2.69
A dive briefing is enough to control diver behaviour	Low restriction	6	2.31	6	2.48	6	2.40
There should be no controls on what divers do on wrecks	Low restriction	7	1.69	7	1.77	8	1.90
Moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site	Knowledge	8	1.60	8	1.76	4	2.68
Wrecks (except wrecks deliberately sunk as artificial reefs) should be protected from all visitation	High restriction	9	1.46	9	1.47	9	1.20

Key:
* Value is the mean score on a 5 point scale ranging from 1 = strongly disagree to 5 = strongly agree
~ Edney (2012b)
\# Edney (2011b)

Wreck divers did not consider dive briefings effective in managing diver behaviour. This is in contrast to study findings on the effectiveness of pre-dive briefings in reducing diver impacts on the marine environment (Barker & Roberts, 2004; Camp & Fraser, 2012; Hammerton & Bucher, 2015; Krieger & Chadwick, 2013; Medio et al., 1997; Toyoshima & Nadaoka, 2015). This finding does not necessarily indicate opposition to dive briefings per-se, rather it indicates scepticism about their effectiveness in managing diver behaviour. It also demonstrates that divers perceptions about the effectiveness of dive guides differ from research findings in the literature on the effectiveness of pre-dive briefings in reducing diver impacts.

Although Holecek and Lothrop’s (1980b) study of divers in the Great Lakes region of the United States is dated, there were also some consistencies between the findings of their study and the current study. Holecek and Lothrop’s study found high in-principle support for management controls to protect wrecks, and support for the use of permits.

10.2.5.1 Moderation comparisons

Attitudes were moderated by certain wreck diver profile variables. The variables that had the most influence were country of residence, frequency of wreck diving and gender. Level of dive experience and certification also influenced attitudes, although to a lesser extent. There were some similarities in the influence of the diver profile variables on attitudes with other studies of wreck divers. Consistent with the Australian and Chuuk surveys, female wreck divers had stronger agreement to the use of dive guides than males. However, there were mixed results regarding the influence of country of residence. The current study found that Australian wreck divers had stronger disagreement to the use of permits and special certifications. This is in contrast to the findings of the Australian wreck diver study, which found Australian wreck divers had higher levels of agreement. The finding from the current study that residents of the United States had less support for permits and special certifications bears some similarity to the Chuuk survey, which found that those from North America had low support for these controls (Edney, 2011b).

10.2.6 Recreation specialisation

In this study, the variables used to determine level of specialisation were, frequency of wreck diving, level of certification, number of dives completed and number of years diving (section 5.6.1).

10.2.6.1 Motivations and recreation specialisation

Recreation specialisation theory predicts that the level of dependency that recreationists have on specific resources increases with increasing levels of specialisation (Bryan, 1977; Ditton et al., 1992; Oh & Ditton, 2006; Salz & Loomis, 2005). The findings from this study were consistent with this aspect of recreation specialisation theory. They were also consistent with the findings of Bentz et al.'s (2016) study of general scuba divers in the Azores, Portugal, and Dearden et al.'s (2006) study of divers at Phuket in Thailand. Both of these studies found more specialised divers had specific resource requirements.

The more specialised wreck divers in the current study placed higher levels of importance on the motivations that had more specific resource dependency. These included seeing historically significant shipwrecks and artefacts, the complexity and size of a wreck, wreck penetration, and searching for and collecting artefacts. Seeing marine life, clear water and enjoying the peace and tranquillity of the underwater environment were, on the other hand, more important to the less specialised wreck divers (Table 37, section 9.2.1.2). These latter preferences are less dependent on specific resources and can be accommodated at a wide range of dive sites, including reefs.

10.2.6.2 Recreation specialisation and attitudes to management controls

Support for more restrictive management rules is predicted to increase with increasing levels of specialisation, in line with recreation specialisation theory. This is partly based on the premise that recreationists who are more specialised have a better understanding of the potential impacts of their activity. This means that they place more importance on the protection of the settings of their activity to enable them to continue to have high quality experiences in these settings (Bryan, 1977; Ditton et al., 1992; Oh & Ditton, 2006; Salz & Loomis, 2005; Scott et al., 2005; Thapa et al., 2005, 2006).

The findings of the current study, however, were not consistent with this aspect of recreation specialisation theory. Notably, the more specialised wreck divers were more strongly opposed to management controls in the high and moderate restriction clusters, while these more restrictive management controls gained higher levels of support from less specialised wreck divers.

Similarly, Edney and Spennemann's (2014) study of Australian wreck divers found more specialised wreck divers had significantly less support for management controls than the less specialised divers. Other studies of general scuba divers have had similar findings. Sorice et al.'s (2009) study of diver preferences for management regimes in marine protected areas in the United States found highly specialised divers had less support for management restrictions than less specialised divers. Likewise, Todd et al.'s (2001) study of divers in the Great Lakes region of the United States found more specialised divers were less supportive of restrictive management controls than the less specialised divers.

There are several possible explanations for the inconsistency of such findings in the current study and studies of scuba divers against the implications of recreation specialisation theory (section 2.4.2). First, is the loss, or perceived loss, of behavioural freedom in their recreational activity: restrictive management controls have been shown to reduce behavioural freedom (Lucas, 1982, 1983). This may indicate that the divers placed higher importance on self-interest and short term gains in their use of a common pool resource (section 2.5), i.e. diving a wreck, to maintain or maximise behavioural freedom in their activity (Sorice et al., 2009). Secondly, scuba diving is a self-regulated activity and as such, behavioural ethics are primarily communicated during diver training courses (Ditton et al., 1992; Sorice et al., 2009). In contrast, other activities, such as fishing, which have a long history of regulation are found to be more consistent with this aspect of recreation specialisation theory. Participants in these activities tend to be more accustomed to regulation, and therefore more accepting of management rules aimed at conservation of the resource the activity depends on. Importantly, successful and acceptable management restrictions associated with such activities tend to be focused on managing consumptive behaviours (e.g. bag limits), rather than granting or limiting freedom of access (Sorice et al., 2009).

Furthermore, it is possible that more specialised divers may have experienced the implications of management restrictions, while management restrictions may represent a more hypothetical situation for less specialised divers (Todd et al., 2001). Less specialised divers may be more amenable to controls having most likely dived under controlled management conditions, such as with and under the direct control of commercial operators. A further possible reason related to behavioural freedom is that more specialised wreck divers may wish to be given higher levels of personal responsibility for their actions because they understand the potential impacts of their activities, and have the knowledge and skills to minimise or avoid them (Edney, 2012b; Sorice et al., 2009; Todd et al., 2001). However, Todd et al.'s (2001) study did not support this notion. Todd et al.'s study found that the less specialised divers were aware that it is not acceptable to touch or remove items from shipwrecks, while the more specialised were not.

The analysis of wreck diver attitudes in this research also included assessing divers' level of knowledge about moving artefacts around on wreck sites, an activity which can diminish the cultural heritage values of sites. Consistent with recreation specialisation theory, it was expected that the more specialised wreck divers would have greater levels of awareness about the potential impacts moving artefacts around on a wreck site. This research found, however, that the more specialised divers considered it was acceptable to move artefacts around on a wreck site, whereas the less specialised divers did not (Table 38, section 9.2.1.3). These findings were consistent with Todd et al.'s (2001) study. Although only one aspect of awareness was assessed in the survey, the results indicated a low level of knowledge of the impacts of moving artefacts around, a finding of some concern.

These findings stand in contrast to those of some studies of general scuba divers. Thapa et al.'s (2005, 2006) study of general scuba divers in Florida demonstrated that more specialised divers had higher levels of marine based environmental knowledge, while both Anderson and Loomis (2011) and Thapa et al. (2005, 2006) found a positive relationship between environmentally responsible behaviours and recreation specialisation. Although these studies were consistent with recreation specialisation theory, they examined consistency in relation to environmentally responsible behaviours. The current study, and those by Sorice et al. (2009) and Todd et al. (2001), which examined divers support for management rules, demonstrated an inverse relationship between support for management rules and specialisation by scuba divers.

10.3 Wreck diver behaviour

This study appears to be the first to examine *actual* wreck diver behaviour, and the first example of a study that has examined actual *non*-contact behaviours of scuba divers. This research also appears to be the first to examine diver behaviour from a *first-person* perspective. Opportunities to contextualise the findings of this study were therefore limited. A number of studies have examined scuba diver behaviour at reefs, especially with a focus on diver contacts with reefs, from a third-person perspective. Aspects of their findings may be comparable with the current study of wreck diver contact behaviours. It was, however, harder to contextualise the findings relating to non-contact behaviours. This section, therefore, contextualises wreck diver contact behaviour against those of scuba diver contact with reefs. The discussion includes a comparison of the types of contact behaviours: buoyancy control and contact behaviours; the timing of contact behaviours; and the association of contact behaviours with dive experience, gender, country of residence and photography. A number of similarities were found between the contact behaviours of wreck divers and scuba divers visiting reefs, while it should be noted there were also some differences.

10.3.1 Comparison with studies of diver contacts with reefs

One of the most important findings of this study was that a small number of divers were responsible for the majority of contact behaviours. The finding is not, however, unique to wreck divers. It is consistent with the findings of a number of studies of diver contacts with reefs (Chung et al., 2013; Harriott, Davis, & Banks, 1997; Rouphael & Inglis, 2001; Toyoshima & Nadaoka, 2015).

10.3.1.1 Types of contacts

The overwhelming majority of wreck divers contact behaviours were intentional. Unintentional contacts were negligible, and caused by one less experienced diver. It is acknowledged that not all unintentional contact behaviours were recorded, particularly those caused by divers' fins. However, additional intentional and unintentional contact behaviours were visible in the video recordings made by the researcher and other participants, and were included in the qualitative analysis of diver behaviour (sections 8.4.3 and 8.4.4). These additional unrecorded contacts were few in number.

These findings are in contrast to a number of studies of diver contacts with reefs. The majority of contacts in these studies were unintentional, and largely the result of poor buoyancy control (Camp & Fraser, 2012; Chung et al., 2013; Hammerton, 2017a; Hammerton & Bucher, 2015; Harriott et al., 1997; Walters & Samways, 2001; Worachananant et al., 2008). The primary source of unintentional contacts with reefs were divers' fins (Camp & Fraser, 2012; Chung et al., 2013; Hammerton & Bucher, 2015; Harriott et al., 1997; Krieger & Chadwick, 2013; Poonian et al., 2010; Roche et al., 2016; Rouphael & Inglis, 2001; Walters & Samways, 2001).

Importantly, Hammerton and Bucher (2015) found a relationship between contact rates and the finning technique used by divers. More contacts resulted when divers used the scissor kick, and less when they used the frog kick. Many of the divers observed in Chuuk used the frog kick, which may in part explain the differences between this study and studies of diver contacts with reefs. The differences may also be due to the level of experience of the divers observed at Chuuk. There were no novice divers present during the data collection, and the more experienced and highly trained divers tend to use the frog kick technique.

The most prevalent intentional contact behaviours of wreck divers were hand pulling, touching artefacts and holding onto wrecks. Hand pulling on wrecks was the most frequent, and accounted for over two thirds of contact behaviours. In the majority of cases, hand pulling was used to move around inside wrecks and was an appropriate technique to use in this context. Touching artefacts was the next most frequent contact behaviour, and represented just over one fifth of contacts. The majority of artefacts touched were in artefact clusters. Holding onto wrecks accounted for just under one fifth of contacts. Holding onto wrecks was mostly done to help the diver remain steady while looking at various features of wrecks, such as looking down into holds. The finding relating to the reason for holding onto wrecks is consistent with Camp and Fraser (2012), who found that most intentional contacts with reefs occurred when the divers held onto the reef for support while looking at something.

10.3.1.2 Buoyancy control and contacts

Few contacts in this study were the result of poor buoyancy control. This is in contrast to studies of diver contact with reefs. These studies have found poor buoyancy control (Camp & Fraser, 2012; Chung et al., 2013; Hammerton & Bucher, 2015; Toyoshima & Nadaoka, 2015) and incorrect trim, resulting from being overweighted (Hammerton & Bucher, 2015), to be the cause of the majority of diver contacts with reefs. Poor buoyancy control is generally related to inexperience (Edney, 2006; Toyoshima & Nadaoka, 2015). In this study, there were no novice divers, and even the less experienced divers would not be considered inexperienced divers. This may explain the negligible amount of unintentional contact behaviour recorded in the current study.

In addition, Hammerton's (2017a) study of diver contacts with reefs found that fewer contacts were made as the depth of the dive increased. More contacts occurred in shallow water, possibly due to the effects of surge and the rapid changes that can occur in buoyancy in shallower water, and require more careful management. In the current study, the majority of divers were in relatively deep water, and were deeper than those recorded at Hammerton's (2017a) study sites. It is possible, therefore, that water depth may also have played a role in the lower number of contacts recorded in the current study in comparison to studies of diver contacts with reefs.

10.3.1.3 Timing of contacts

Consistent with studies of diver contacts with reefs, it was expected that there would be higher rates of contact behaviours in the initial phases of dives when divers are adjusting their buoyancy and equipment (Barker & Roberts, 2004; Camp & Fraser, 2012; Roche et al., 2016). This was not, however, the case, as the contact behaviours of wreck divers were recorded to have occurred throughout dives.

There were no patterns of contact behaviour associated with any particular segments of dives. Instead, the timing of the contact behaviours were mostly associated with opportunity and context. Divers, for example, mostly touched artefacts located in artefact clusters, therefore the touching of artefacts coincided with the segments of the dives where the divers encountered the artefacts. Hand pulling on the wrecks largely occurred throughout the dive, and mostly when divers were inside the wrecks. Holding onto the wrecks also occurred throughout the dives. If contacts associated with holding were related to poor buoyancy control, a higher frequency of this behaviour would have been expected near the start of dives when divers were adjusting their buoyancy. This, however, was not the case, and most participants were observed to have proficient buoyancy control skills. Indeed, wreck diver contact behaviours overall were not related to poor buoyancy control, which may largely explain the differences found in the timing of the contacts between the current study and studies of diver contact with reefs.

10.3.1.4 Dive experience and contacts

The less experienced divers were responsible for a higher number of contacts with wrecks than those with moderate or higher levels of experience (Table 30, section 8.4.2.4). This finding is consistent with a number of studies of diver contacts with reefs, which have found less experienced divers made more contacts than those with higher levels of experience (Luna et al., 2009; Roberts & Harriott, 1995; Toyoshima & Nadaoka, 2015; Worachananant et al., 2008). Other studies, however, have found no correlation between level of experience or certification and the number of contacts (Barker & Roberts, 2004; Camp & Fraser, 2012; Harriott et al., 1997; Roche et al., 2016; Rouphael & Inglis, 2001). One study found more experienced divers made more contacts with reefs than less experienced divers (Hammerton, 2017a).

Level of dive experience may also be relevant to the types of contact behaviour in this study. Walters and Samways (2001) study of diver contacts with reefs found that more experienced divers made more deliberate or intentional contacts with reefs than did less experienced divers. The predominance of intentional contacts in the current study, therefore, may be due to the low numbers of less experienced divers represented in the study.

10.3.1.5 Gender and contact behaviours

Male wreck divers were responsible for the vast majority of contacts with wrecks. This is consistent with the findings of some studies of diver contacts with reefs (Hammerton & Bucher, 2015; Luna et al., 2009; Rouphael & Inglis, 2001; Shackleton, 2010). It is inconsistent with two studies that found no difference in contact behaviours between the genders (Camp & Fraser, 2012; Chung et al., 2013), and another two studies that found female divers were responsible for more contact behaviours than males (Uyarra & Côté, 2007; Worachananant et al., 2008).

10.3.1.6 Country of residence and contact behaviours

Wreck divers from Australia recorded the second highest number of contact behaviours (Table 30). The reason for this is not clear, although it resonates to some extent with the findings of Hammerton's (2017a) study of diver contacts with reefs in marine protected areas in eastern Australia. Hammerton's study found that divers who were initially certified in Australia had higher contact rates than those certified overseas.

10.3.1.7 Photography and contacts

Most divers using cameras made few or no contacts with the wrecks. Although the sample size was not sufficient to undertake a statistical analysis of the differences between those using a camera and those who were not, the number of contacts made by divers using cameras were generally comparable to the number of contacts made by most other participants who did not use cameras. In other words, in most cases there was not a noticeable difference between the rates of contacts of divers with or without cameras. This is consistent with the findings of Camp and Fraser's (2012) study of divers in Florida and Roche et al.'s (2016) study of divers in the Philippines, both of which found the use of a camera had no effect on the number of diver contacts with reefs.

There were some exceptions, however, especially revealed by comparisons of the contact behaviours of two participants who completed repeat dives, and used a camera on one of the dives. There was a notable absence of contact behaviours from both participants during the dive that they used a camera, while both recorded contact behaviours during their dive without a camera. This finding was unexpected, and it is possible that the presence of a hand held camera may have reduced their capacity or desire to touch the wrecks, artefacts or marine life. On the other hand, a notable exception was the participant who recorded the third highest number of contacts. This diver was using a camera. This observation bears some similarity with the findings of a number of studies of diver contacts with reefs, which found significantly higher rates of contacts from divers using cameras than those not using cameras (Barker & Roberts, 2004; Hammerton & Bucher, 2015; Krieger & Chadwick, 2013; Medio et al., 1997; Rouphael & Inglis, 2001; Uyarra & Côté, 2007; Walters & Samways, 2001).

10.3.1.8 Influence of dive leaders on diver behaviour

Studies of general scuba divers have found divers copy the behaviour of dive leaders (Howard, 1999; Lindgren et al., 2008). It was expected, therefore, that wreck diver behaviour would be similarly influenced by the behaviour of the dive guides. Observations made during this research found, however, that in most cases the behaviour of the dive guides had little direct influence on wreck diver behaviour.

10.4 Chapter summary

This chapter linked findings of this study with the existing scuba literature. Similarities and contrasts were identified. Survey findings were primarily compared with other studies of wreck divers. The scope for linking the findings of the behaviour observations is limited because this appears to be the first example of empirical research of *actual* wreck diver behaviour. Certain aspects of studies of scuba diver contact behaviours at reefs were relevant and comparable. However, this research also appears to be the first example of an empirical research study that has observed scuba diver *non*-contact behaviours, therefore comparisons were not possible.

Survey findings were consistent with other recent studies of wreck divers. The demographic and dive experience profiles of the participants of this study were similar to those from other recent wreck diver studies. The top motivations for wreck diving, along with the least important, were also consistent with other recent studies of wreck divers. Likewise, there was congruence in the attitudes of wreck divers between this research and other recent wreck diver studies. The consistency between the findings of the current study and other recent studies of wreck divers indicates that the survey findings accurately reflect wreck diver profiles, motivations and attitudes more broadly.

Motivations were also found to be consistent with recreation specialisation theory. The more specialised divers had higher resource dependency than less specialised divers, which is consistent with the findings of another study of scuba divers that examined motivations and recreation specialisation. Diver attitudes to management controls, however, were not consistent with recreation specialisation theory, with the more specialised divers being more strongly opposed to management controls and the less specialised being more supportive. These findings are similar to two studies of scuba divers that examined diver support for management rules.

There were both similarities and contrasts in the findings of the behavioural observations when compared to studies of scuba diver contacts. The most significant similarity was that a small number of divers are responsible for the majority of contacts. Other similarities were that males and less experienced divers were responsible for more contacts than other divers, and that there was no noticeable difference in contact rates between divers using cameras and those who did not. The most significant difference was that wreck divers contacts were almost exclusively intentional. This is in notable contrast to scuba diving on reefs, in which unintentional contacts were more prevalent than intentional contacts, and was related to poor buoyancy control.

The vast majority of wreck diver behaviours were non-contact behaviours. As this appears to be the first empirical study to examine non-contact behaviours of divers, no comparisons with other studies were possible. Although comparisons with general scuba diver contact behaviours were possible, the behaviours examined in this study are also specific to wreck diving. As such, this study provides a benchmark for actual wreck diver behaviour, especially non-contact behaviours.

Chapter 11 – Discussion

11.1 Introduction

The focus of this study was to gain a better understanding of wreck divers, which could be used to inform the management of underwater cultural heritage sites visited by divers in the Asia-Pacific region. This was achieved through a survey of the key source populations of wreck divers who visit the Asia-Pacific region, and observations of diver behaviour at Chuuk Lagoon, a major Asia-Pacific wreck diving destination. This chapter draws together and discusses the findings of the study presented in Chapters 7, 8 and 9, and evaluated against the relevant literature in Chapter 10.

Research was undertaken into wreck diver motivations because it enables managers to understand the types of experiences sought and preferred by divers. This can provide managers with insights into the effect management decisions may have on diver experiences and preferences. It also gives managers the opportunity to accommodate diver aspirations in management strategies. Understanding diver attitudes was also important because it enables managers to understand which controls divers are likely to support or oppose. Controls that receive greater levels of support by divers are likely to gain higher levels of voluntary compliance, whereas those not supported are less likely to be complied with. Management strategies that achieve high levels of voluntary compliance by divers are more likely to be effective in achieving their goals, and require fewer resources to implement. The effectiveness of management strategies may also be enhanced when they target actual diver behaviour. However, there has been an absence of empirical data about *actual* wreck diver behaviour in the literature, and so, research was undertaken here into wreck diver behaviour to fill this gap in the literature and to deepen understanding of wreck divers.

This chapter presents conceptual models that synthesise and interpret wreck diver motivations and attitudes. These models highlight the complexities inherent in wreck diver motivations and attitudes, and identify patterns that enhance our understanding of wreck diver motivations and attitudes. This chapter is rounded off with a discussion of key study findings and key management implications of the findings.

11.2 Wreck diver profiles

Wreck diver demographic, dive experience and training data were collected as part of the primary data for this research. The results were presented in Chapters 7 and 9, and were contextualised against relevant literature in Chapter 10. The majority of wreck divers were male, aged between 35 and 64 years and held a Bachelor or higher degree. They were also experienced divers holding high levels of dive certification. Chapter 10 contains detailed comparisons with other studies of wreck divers and general scuba divers. In summary, the findings of this study are similar to those other recent studies of wreck divers in Australia and Chuuk (Edney, 2011b, 2012a, 2012b). The consistency between the results of the current research and those of other recent wreck diver studies indicate that the findings of this study are a good reflection of wreck diver profiles more broadly.

Wreck divers are a special interest group of scuba divers, therefore differences were expected between wreck divers and scuba divers. This study found wreck divers to be older and to have a higher representation of males than general scuba divers. Wreck divers were also more experienced and, overall, had higher levels of dive certification than general scuba divers.

Wreck diving is more challenging and demanding than general scuba diving. As such, it requires higher levels of skill, training and experience to safely participate. The additional training and experience required for wreck diving may be a reason for wreck divers being older than general scuba divers. The difference in gender ratios between wreck diving and scuba diving may be due to the different preferences of male and female divers, which are discussed in section 11.3 below. Briefly, females preferred the environmental aspects of wreck diving, such as seeing marine life. On the other hand, male wreck divers had a preference for experiences specific to wreck diving, such as seeing historically significant wrecks, artefacts, exploration of machinery and fittings and wreck penetration. It would be expected, therefore, that wreck diving would attract more males than females in comparison to general scuba diving.

11.3 Motivations for wreck diving

Understanding the complexity of wreck diver motivations has particular relevance to heritage managers and dive and tourism operators because it identifies the types of experiences more popular with different segments of the wreck diving community.

Heritage managers can readily determine the types of experiences sought by key segments of the wreck diving community, can better assess the effects of management strategies on different segments of the wreck diving community, and can take this into account when developing management strategies. They are also better placed to understand the impacts of management actions on wreck divers. Dive and tourism operators can use this data to identify the preferences of different segments of the wreck diving community and use the information in deciding on the choice of dive experiences offered to clients, and in their marketing.

Diver motivations were collected as part of the primary data for this research. The results were reported in Chapters 7 and 9, and evaluated against the relevant literature in Chapter 10. Motivations for wreck diving were grouped into five thematic clusters: history/heritage, environmental, structure/technology, technique/challenge and treasure hunting, and are illustrated in Figure 137.

Figure 137 **Wreck diver motivations by thematic cluster**

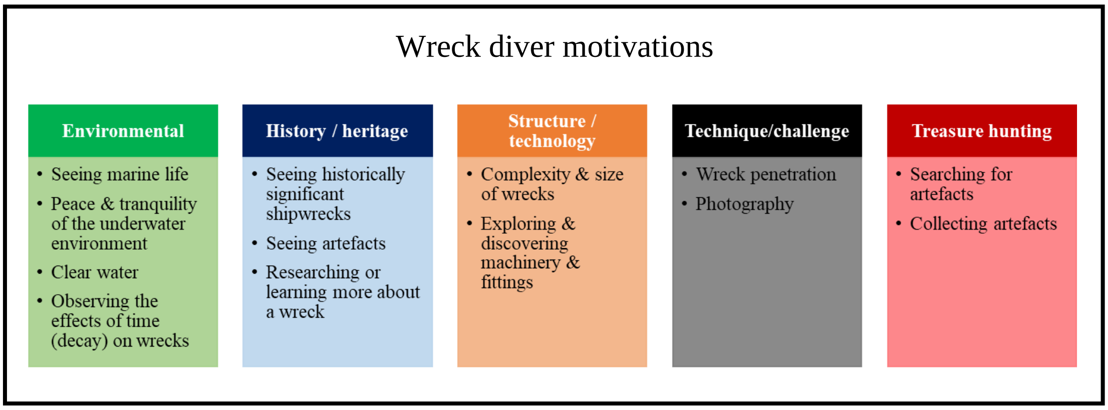


Image © 2018 Joanne Edney

Data analysis showed that the majority of wreck divers were primarily motivated to see historically significant shipwrecks, marine life and artefacts, and to enjoy the peace and tranquillity of the underwater environment. All of these motivations were in the history/heritage and environmental thematic clusters. Treasure hunting motivations (searching for and collecting artefacts) were least important to the majority of wreck divers. This type of aggregated diver motivation data is useful for gaining a broad understanding of the preferences of the majority of wreck divers, or the average wreck diver.

However, aggregated data does not take into account complexities in wreck diver motivations, which result from diversity within the wreck diving community. This study found wreck diver motivations were influenced by a number of the diver profile variables. Examination of this diversity can assist in gaining a more accurate understanding of wreck diver motivations.

The Wreck Diver Motivations Model (Figure 138) illustrates the influence wreck diver profile variables had on wreck diver motivations. The model was derived from the statistically significant differences found in the analyses of wreck diver motivations. Frequency of wreck diving, dive certification level and gender had the strongest influence on motivations. Figure 138 shows these variables with a thicker line connecting them with motivations to indicate their higher level of influence. Dive experience level (i.e. number of dives completed and years diving) and country of residence also influenced motivations, although to a lesser extent. A thinner line, therefore, connects these variables to motivations.

The Wreck Diver Motivations Model highlights the intricacy of wreck diver motivations, as well as some patterns. The similarities in motivations between more frequent wreck divers, technical divers and males are illustrated by the model. Both structure and technology cluster motivations (complexity and size of a wreck and exploring and discovering machinery and fittings) were of greater importance to these groups of wreck divers, as was wreck penetration (technique/challenge). They also placed higher level of importance on searching for artefacts (treasure hunting).

More frequent wreck divers and technical divers placed greater importance on all three of the history/heritage cluster motivations (seeing historically significant shipwrecks and artefacts, and researching or learning about shipwrecks). Two of these motivations (seeing historically significant shipwrecks and artefacts) were more important for male wreck divers.

There were also similarities between less frequent wreck divers, less experienced divers and females. Three of the four environmental cluster motivations were more important this group of wreck divers. These included seeing marine life, clear water and enjoying the peace and tranquillity of the underwater environment.

Figure 138 **Wreck Diver Motivations Model**

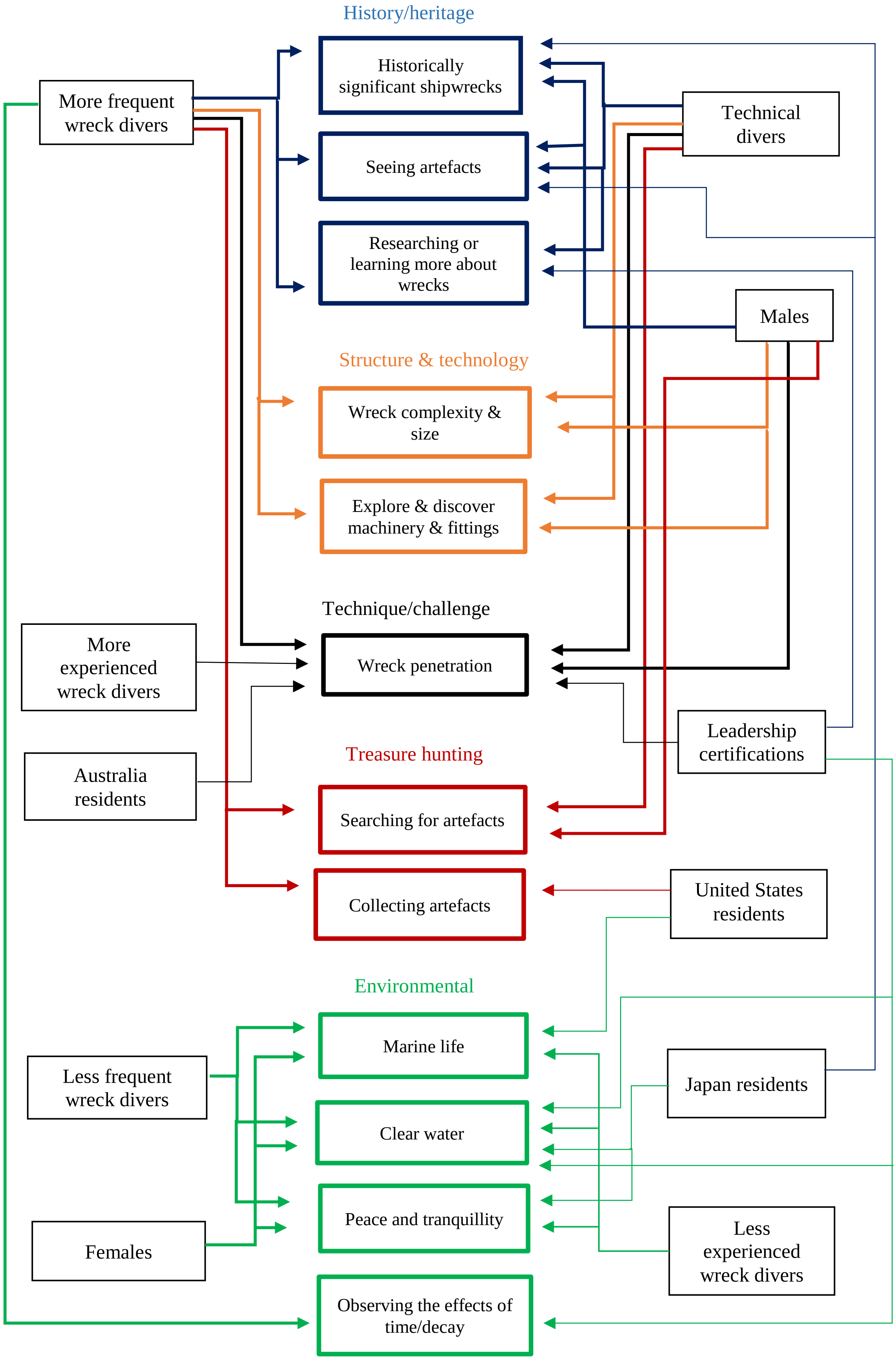
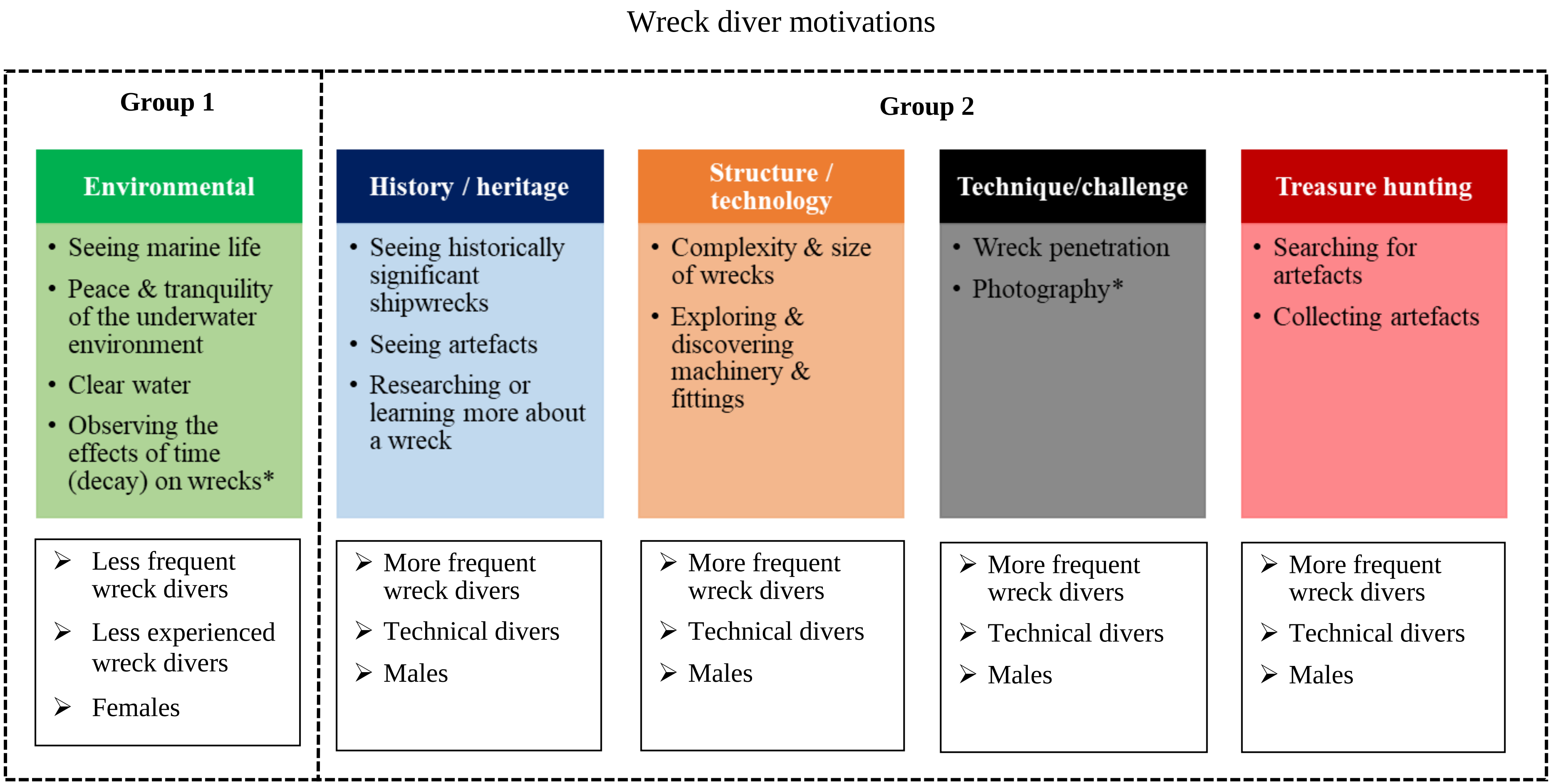


Image © 2018 Joanne Edney

However, not all motivations fitted neatly into groups. Wreck penetration was also important to more experienced divers, those holding leadership certifications and wreck divers from Australia. Collecting artefacts (treasure hunting) was more important to frequent wreck divers. Researching and learning more about wreck, and observing the effects of time (decay) on wrecks was important to more frequent wreck divers and those with leadership certifications. Clear water was also important to participants holding leadership certifications.

Two distinct groups within the wreck diving community emerged from the Wreck Diver Motivation Model. Less frequent and less experienced wreck divers, and females formed one group, and the environmental thematic cluster motivations were of greater importance to this group. The other group comprised more frequent and more experienced wreck divers, technical divers and males. The history/heritage, structure and technology, and treasure hunting thematic cluster motivations, along with wreck penetration from the technique challenge cluster were more important to this latter group. These relationships are represented in Figure 139, which synthesises the Wreck Diver Motivations Model.

Figure 139 **Key findings of significant patterns in wreck diver motivations**



* indicates that this motivation factor is excluded from the groupings

11.4 Wreck diver attitudes to management controls

Wreck diver attitudes to management controls were collected as part of the primary data for this research. The results were reported in Chapters 7 and 9, and evaluated against relevant literature in Chapter 10. Management controls were grouped into three clusters based on their relative levels of restriction, high moderate and low. The controls included in each cluster are shown in Figure 140.

The data analysis revealed that the majority of wreck divers had in-principle support for the use of management controls, although only two specific management controls were supported. These were the use of penalties (high restriction cluster) and permits (moderate). This aggregated data is useful for gaining a broad understanding of the preferences of the majority of wreck divers, or the average wreck diver.

Figure 140 **Management restrictions by cluster**

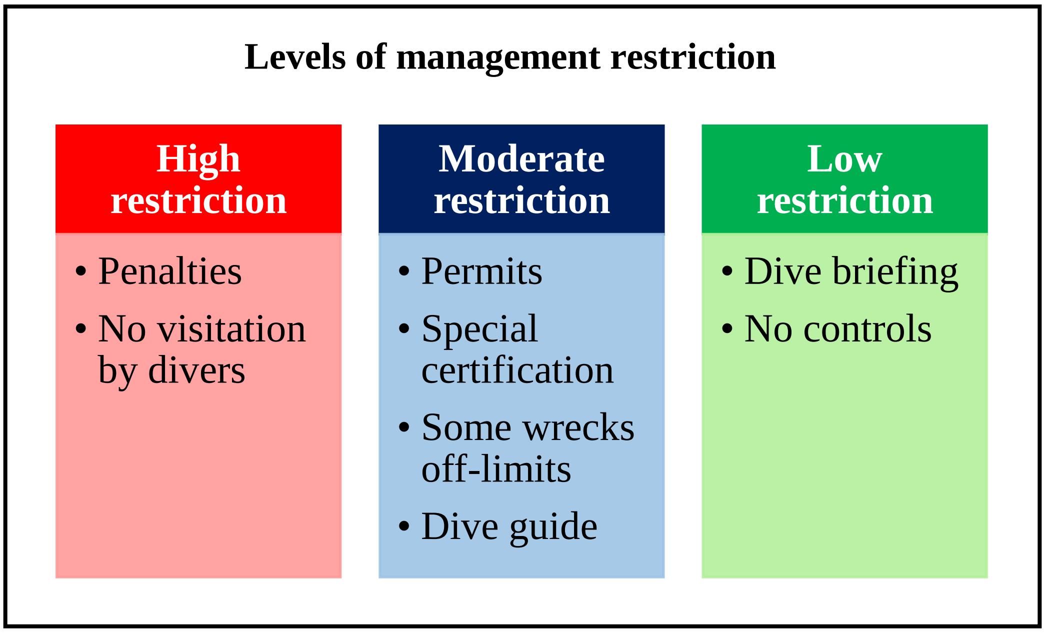


Image © 2018 Joanne Edney

However, while useful, aggregated data does not take into account the intricacies of wreck diver attitudes, resulting from diversity within the wreck diving community. This study found a number of diver profile variables influenced wreck diver attitudes. The most influential were country of residence, frequency of wreck diving and gender. Level of dive experience and certification also influenced attitudes, although to a slightly lesser extent.

Importantly, these variables are shown to influence attitudes both positively and negatively. Two models are presented in Figures 141 and 143, which illustrate the influence of wreck diver profile variables on attitudes. The Wreck Diver Opposition to Management Controls Model (Figure 141) illustrates the relationship between diver profile variables and specific management controls, where there was stronger opposition to management controls. The Wreck Diver Support for Management Controls Model (Figure 143) illustrates the relationship between diver profile variables and specific management controls, where there was stronger support for management controls. The thickness of the lines in the figures signifies the relative level or strength of influence of each variable. These models were derived from the statistically significant differences found in the analyses of wreck diver motivations.

These models are important because they can assist heritage managers in developing more robust management strategies. Although the aggregated data on wreck diver attitudes to management controls can indicate overall support for or opposition to specific management controls, it does not recognise the diversity in attitudes within the wreck diving community. If managers only cater to the average wreck diver and do not take into account these differences and address them, the likely outcome is that certain segments of the wreck diving community will be, or feel, disenfranchised. Disenfranchised divers are less likely to voluntarily comply with management rules (Oh & Ditton, 2006; Salz & Loomis, 2005), resulting in less effective management of the sites in question. It follows that divers disenfranchised by management rules will be less likely to have political support for the protection of underwater cultural heritage, and low levels of political support mean less resources are allocated for management of these sites (Timothy, 2011).

11.4.1 Stronger opposition to management controls

The variables that had the most influence over wreck diver opposition to management controls were, in order of influence, country of residence, frequency of wreck diving and gender, and are indicated by the thicker lines (Figure 141). Level of dive experience and certification had a lesser influence, indicated by the thinner lines.

The Wreck Diver Opposition to Management Controls Model shows that more frequent wreck divers and males were more opposed to both high restriction controls: penalties and no visitation to wrecks by divers. Technical divers and wreck divers living in the United States also express stronger opposition to penalties.

More experienced and more frequent wreck divers, males and residents of the United States were more opposed to the use of permits (moderate restriction), while more experienced divers and residents of Australia and the United States expressed less support for special certifications (moderate restriction). There was stronger opposition to the other two moderate restrictions – the use of dive guides and some wrecks being off-limits to divers – by more experienced and more frequent wreck divers, males and residents of Australia. Residents of the United States also expressed less support for some wrecks being off-limits. Allowing divers access to wrecks enables divers to form a connection with underwater cultural heritage, and limiting access may lead to less political support for the protection of underwater cultural heritage.

More frequent wreck divers and residents of Australia and the United States expressed lower levels of agreement with the use of dive guides to control diver behaviour (low restriction). Wreck divers from countries in the other countries category were more opposed to both low level restrictions. Less experienced divers were more strongly opposed to there being no controls over divers on wrecks.

The Wreck Diver Opposition to Management Controls Model enriches our understanding of wreck diver attitudes. It demonstrates the complexities of wreck diver attitudes resulting from the diversity in the wreck diver community. The model shifts understanding of wreck diver attitudes beyond the realm of the average wreck diver to a more comprehensive understanding, which incorporates and represents the diversity of attitudes. This diversity is important for heritage managers to understand, as it identifies particular segments of the wreck diving community that are more strongly opposed to specific management controls. Divers strongly opposed to specific management controls are less likely to voluntarily comply with management rules, and less likely to support the protection of underwater cultural heritage.

The relationships between wreck diver profile variables and their opposition to management controls, illustrated in the Wreck Diver Opposition to Management Controls Model, have been synthesised in Figure 142. Figure 142 aligns the three clusters of management controls with the diver profile variables that predicate stronger opposition to the controls listed. Strength of influence of the variable on opposition is indicated by the position of the variable in the list: those at the top have the strongest influence, with the remainder listed in descending order of influence.

Figure 141 **Wreck Diver Opposition to Management Controls Model**

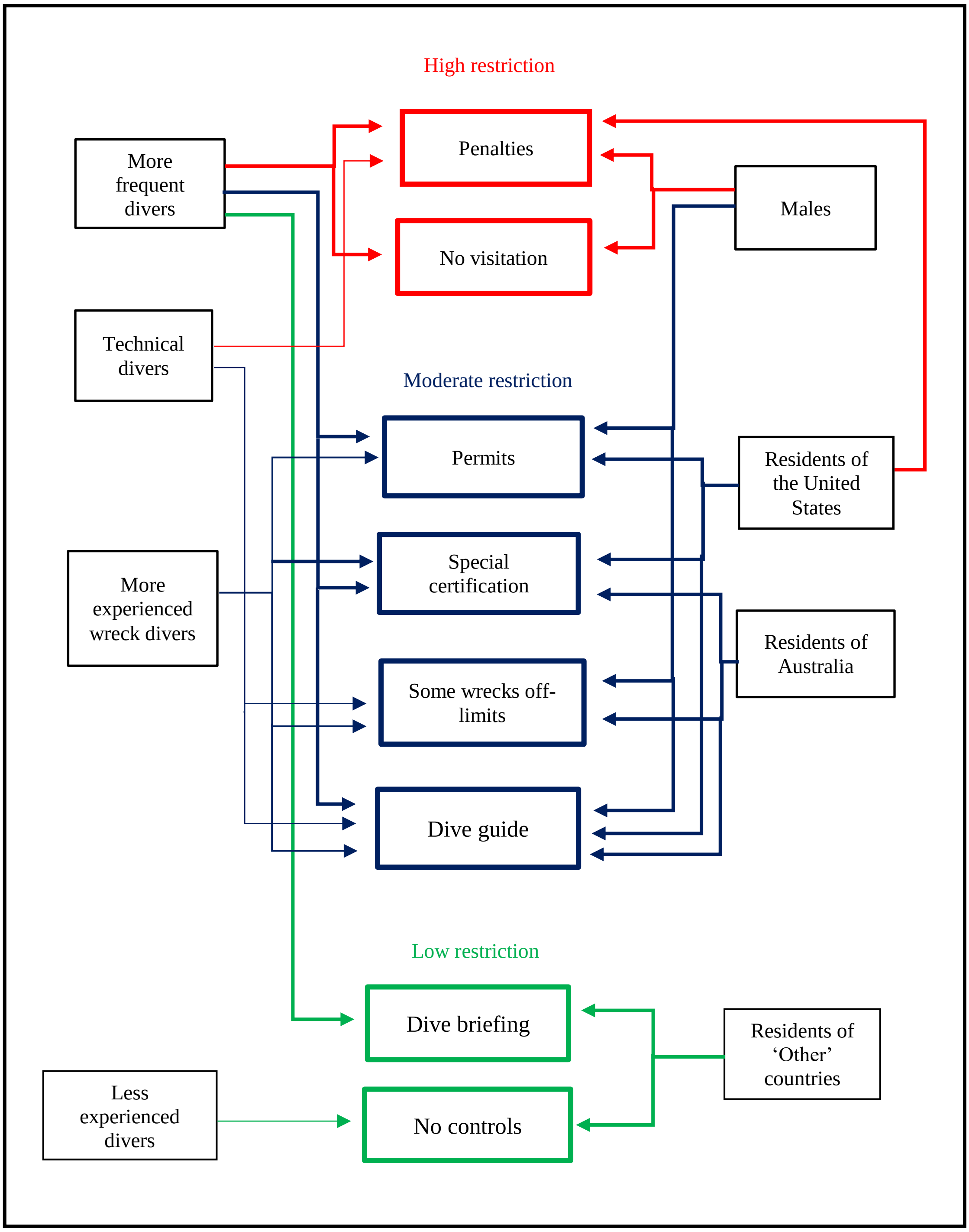


Image © 2018 Joanne Edney

Note: the arrows connect the groups within wreck divers to the management controls that they are opposed to.

Figure 142 **Synthesis of wreck diver opposition to management controls**

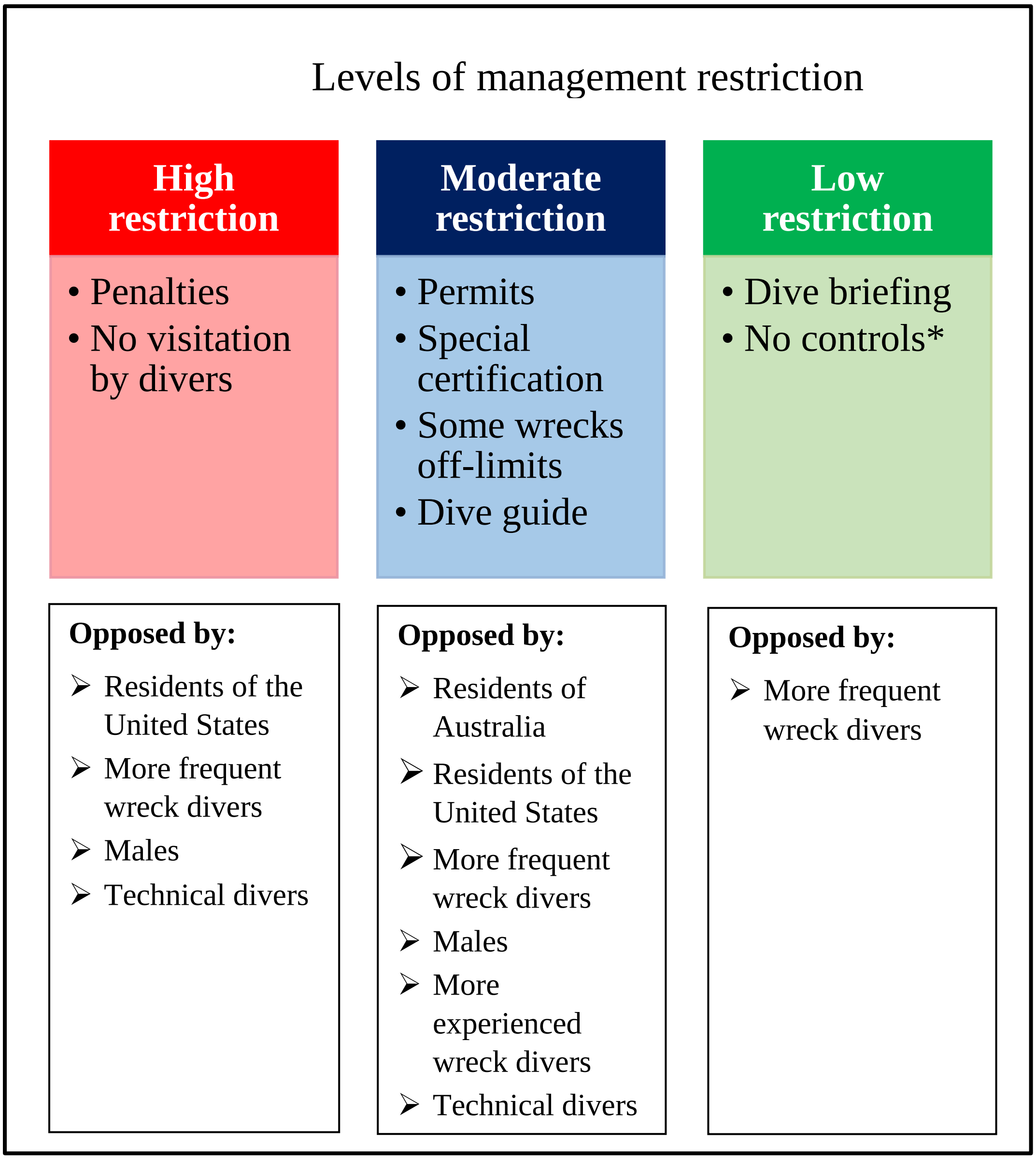


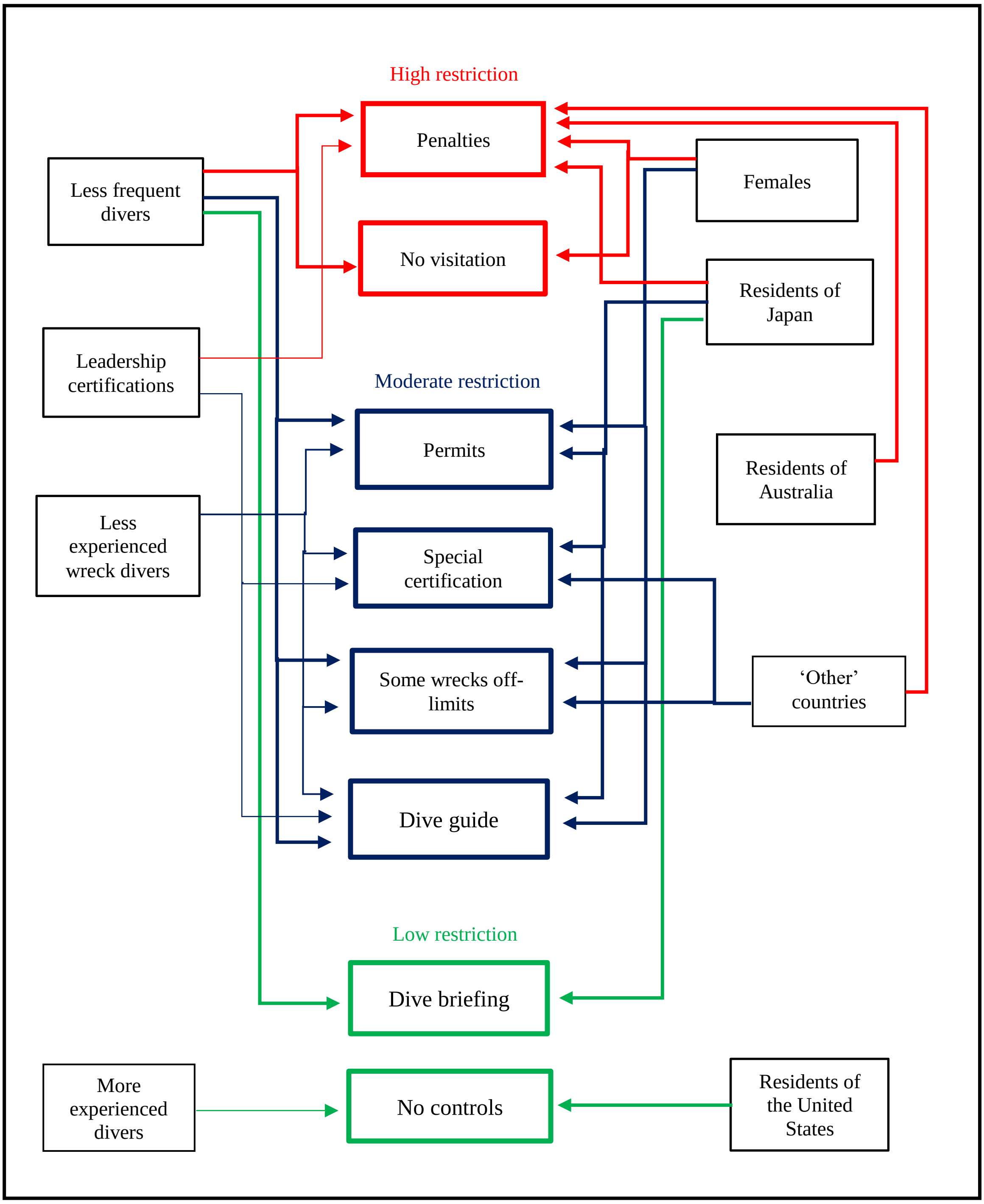
Image © 2018 Joanne Edney
* Indicates the management controls excluded

11.4.2 Stronger support for management controls

The variables that had the most influence over wreck diver support for management controls were, in order of priority, country of residence, frequency of wreck diving and gender. This relationship is indicated by the thicker lines in Figure 143. Level of dive experience and certification has a lower level of influence on specific management controls.

Support for the use of penalties (high restriction) is evident from less frequent wreck divers, those holding leadership certifications, females, and wreck divers from Australia, Japan and countries in the other countries category.

Figure 143 **Wreck Diver Support for Management Controls Model**



The less experienced wreck divers supported all four moderate level restrictions. Less frequent wreck divers and females supported three of the moderate level restrictions:

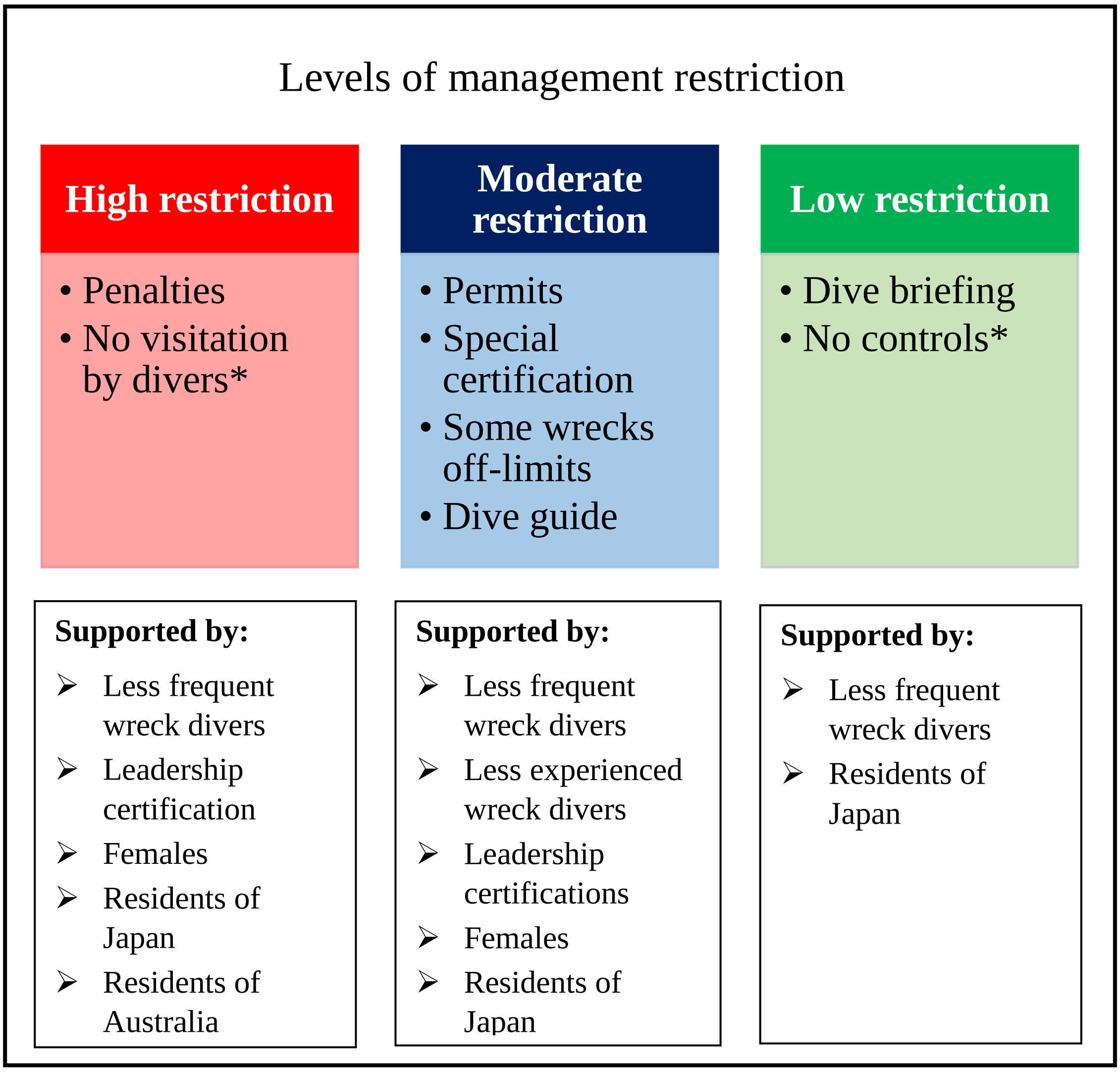
the use of permits, dive guides, and some wrecks being off-limits to divers. Wreck divers from Japan also supported three of the moderate restrictions: the use of permits, special certifications and dive guides. Residents in countries in the other countries category supported the use of special certifications, dive guides, and some wrecks being off-limits to divers. Wreck divers with leadership certifications supported the use of special certifications and dive guides.

The use of briefings to control dive behaviour (low restriction) gained stronger support from less frequent wreck divers and residents of Japan. The other low level restriction was not having any controls over what divers can do on wrecks, and this was supported by more experienced divers and residents of the United States. Although the majority of divers did not support no controls over what divers can do on wrecks (low restriction), more experienced divers and residents of the United States expressed higher levels of agreement with this approach.

The Wreck Diver Support for Management Controls Model enhances our understanding of wreck diver attitudes. It demonstrates the complexities of wreck diver attitudes resulting from the diversity in the wreck diver community. The model shifts understanding of wreck diver attitudes beyond the average wreck diver to a more comprehensive understanding, which incorporates and represents the diversity of attitudes. This diversity is important for heritage managers to understand, as it identifies particular segments of the wreck diving community that more strongly support specific management controls. This allows managers to gauge the management controls that are more likely to gain higher levels of voluntary compliance.

The relationships between wreck diver profile variables and their support for management controls, illustrated in the Wreck Diver Support for Management Controls Model, are synthesised in Figure 144, illustrating the links between the three clusters of management controls and diver profile variables that predicate stronger support. The strength of influence of the variable is indicated by the position of the variable in the list, with those at the top having the strongest influence, and the others listed in descending order of influence.

Figure 144 **Wreck diver support for management controls by level of restriction**



* Indicates the management controls excluded

11.5 Recreation specialisation and wreck divers

A central tenant of recreation specialisation theory is recognition of the heterogeneity in the characteristics, motivations, and preferences of participants within a given recreational activity (Bryan, 1977; Scott, 2012). This diversity can present challenges for managers aiming to balance site protection with the provision of high quality recreational experiences (Oh & Ditton, 2006). Recreation specialisation theory can overcome this challenge because it can be used to gain a better understanding of recreationists. This is achieved by placing recreationists, in this case wreck divers, into groups based on their level of specialisation. The characteristics, motivations and preferences of each of the groups are then examined (Hawkins et al., 2009; Salz et al., 2001).

This information can then be used by managers when developing management strategies. Management strategies that are able to cater to the heterogeneity of divers are more likely to be successful, because they are better able to address the needs and preferences of a greater proportion of the group, than would an approach based on the average wreck diver (Bentz et al., 2016; Salz & Loomis, 2005).

Analysis of the primary data in this research shows that recreation specialisation influenced wreck diver motivations and attitudes. Motivations were consistent with recreation specialisation theory in that the more specialised divers had higher resource dependency than the less specialised divers. Seeing historic shipwrecks and artefacts were, for example, of greater importance to more specialised divers, and such preferences can only be accommodated at a limited number of sites. Therefore, any restrictions placed on access will have a greater impact on these divers. This is an important consideration for managers because access to sites is key to ensuring heritage continues to have relevance to society, and therefore political support (Garrod & Fyall, 2000; Hall & McArthur, 1998). In comparison, the less specialised divers placed greater importance on seeing marine life and enjoying the peace and tranquillity of the underwater environment. These motivations are more generalist and can be accommodated at a wide range of dive sites, including reefs. The influence of recreation specialisation is highlighted in the Wreck Diver Motivations Model (Figure 138).

Attitudes were inconsistent with recreation specialisation theory. There was an inverse relationship between support for management controls and level of specialisation. The more highly specialised divers were more strongly opposed to the high and moderately restrictive management controls, while the less specialised divers expressed more support for the more restrictive management controls. These relationships are highlighted in the Wreck Diver Opposition to Management Controls Model and Wreck Diver Support for Management Controls Model (Figures 141 and 143).

Although the findings of this study relating to attitudes are inconsistent with recreation specialisation theory, there is congruence with a study of Australian wreck divers and two studies of scuba divers in the United States. The Australian wreck diver study found more specialised divers had lower levels of support for management controls than the less specialised divers (Edney & Spennemann, 2014, 2015). Two studies of scuba divers in the United States examined diver support for management rules. Both of these studies found the more highly specialised divers were less supportive of management rules (Sorice et al., 2009; Todd et al., 2001). This may suggest that for scuba divers, the relationship between recreation specialisation and support for management rules differs to other outdoor recreation activities, and the inverse relationship between specialisation and support for management rules is a characteristic of this activity.

Even though attitudes were inconsistent with recreation specialisation theory, the high resource dependency of the more specialised wreck divers may at least in part explain this inconsistency. More specialised divers will be more affected by management rules which limit access to sites than less specialised divers, whose needs can be met at many different sites. More specialised divers are also more likely to want more freedom in their activity than less specialised divers, and are therefore affected to a greater extent by more invasive management controls. Indeed, Sorice et al. (2009) have suggested this as a possible reason for the inconsistency. They also suggested it may be because scuba diving is a self-regulated activity and divers are not accustomed to government regulation. Todd et al. (2001) suggested that more specialised divers may have experienced the implications of management restrictions, whereas less specialised diver may not have and are therefore more supportive of more restrictive management controls.

While recreation specialisation theory provides a useful framework for understanding heterogeneity amongst wreck divers, the heterogeneity of wreck divers is not fully attributable to recreation specialisation. Other diver profile variables also played a key role in influencing diver motivations and attitudes, most notably gender and country of residence. The importance of gender and country of residence is evident in the Wreck Diver Motivation Model, Wreck Diver Opposition to Management Controls Model and Wreck Diver Support for Management Controls Model. Therefore, examining recreation specialisation can make an important contribution to understanding wreck divers, but cannot be relied upon alone. When specialisation is combined with other variables, in particular gender and country of residence, a more comprehensive understanding of wreck diver heterogeneity can be achieved.

11.6 Wreck diver behaviour

This section discusses the key findings from the primary data analysis of diver behaviour observations. The results were reported in Chapters 8 and 9 and were evaluated against relevant literature in Chapter 10. These findings were the outcomes of a systematic study of the behaviour of divers on shipwrecks. Other opportunistic observations were made of dive guide behaviour on shipwrecks, diver and dive guide behaviour on submerged aircraft and diver and dive guide behaviour associated with human remains. A discussion of these findings follows the discussion of diver behaviour.

11.6.1 Wreck diver behaviour

11.6.1.1 Non-contact behaviours

Non-contact behaviours accounted for the vast majority of wreck diver behaviours. Looking at features of wrecks, such as masts, propellers, machinery and artefacts was the most prominent non-contact behaviour. Looking at marine life was the second most popular non-contact behaviour, and there was a huge abundance and variety of marine life attracted to the wrecks at Chuuk for divers to see. The wrecks at Chuuk also offer divers ample and diverse wreck penetration opportunities, and this was the next most prevalent non-contact behaviour. These non-contact behaviours are an indication of the experiences the divers enjoy, and has relevance to both heritage managers and dive operators seeking an understanding of experiences sought by wreck divers.

11.6.1.2 Contact behaviours

Contact behaviours represented a minor component of total wreck diver behaviour. However, there was a focus on the analysis of these behaviours because they can result in negative impacts on underwater cultural heritage. The focus of the analysis was on the frequencies of these behaviours because the frequency of contact has more relevance to level of impact than durations of the behaviours.

Contact behaviours by wreck divers were almost exclusively intentional. This indicates that the contacts are not attributable to deficient diving skills, such as poor buoyancy control. Significantly, only a small number of divers were responsible for the majority of contacts. Further, men and Australians were responsible for the vast majority of contacts. Less experienced divers also contributed to more contact behaviours than more experienced divers. Management approaches should therefore target the management of these primary sources of diver impacts on wrecks, and not place heavy restrictions on all divers. Placing heavy restrictions on the majority of divers whose behaviour is not causing negative impacts on wrecks is likely to unnecessarily impinge of the quality of their diving experience, and disenfranchise these divers. This in turn is likely to result in less support for management objectives, and in the larger scheme of things, less political support for the protection of underwater cultural heritage. Another way diver impacts may be better managed is by educating divers. More education can inform divers, and the dive industry, about the causes and consequences of diver impacts on wrecks, and what divers can do to prevent and minimise their impacts. More education is also required on the benefits of minimising diver impacts, not only to protect underwater cultural heritage, but also the benefit to diver experiences. Benefits to divers include continued access to high quality diving experiences now and into the future. This also has benefits for dive guides livelihoods and revenue for segments of the dive industry reliant on wrecks.

The most frequent contact behaviour identified in this study was hand pulling on wrecks. Hand pulling is a propulsion technique used by divers to minimise silting while moving around inside wrecks, or to conserve energy when moving against a current (Edney, 2006, 2011a; PADI, 2008b). In most cases, the divers hand pulled when moving around inside the wrecks, and this was therefore an appropriate technique to use.

Touching artefacts was the second most frequent contact behaviour, and represented around one fifth of contact behaviours, and around three percent of total behaviour frequencies. A minority of divers touched artefacts and the artefacts touched were primarily those included in artefacts clusters. In most cases, the divers picked up the artefacts to inspect them more closely. It was encouraging that touching artefacts accounted for such a small portion of contact behaviours, due to the negative impacts associated with the activity. These include the impairment of site integrity when artefacts are moved from their original location, and accelerated decay of the artefact (Delgado, 1988b; Edney, 2016; MacLeod & Richards, 2011; Nutley, 1996).

Although touching artefacts that are part of artefact clusters may appear more benign than touching artefacts in situ, clustering artefacts does cause negative impacts on the cultural heritage values of the wrecks. The artefacts that form part of artefact clusters have been moved from their original location to the cluster, which alters the site context, and diminishes archaeological values. In addition, when artefacts are moved to more exposed locations and touched by divers, corrosion and decay of these items is accelerated. Moving artefacts around on a wreck site can also diminish recreation values, as divers enjoy seeing artefacts in situ (Delgado, 1988b; Edney, 2006, 2012, 2016; Hosty, 1987; MacLeod & Richards, 2011; Nutley, 1996). The management implications of artefact clusters are discussed further below.

11.6.2 Influences on wreck diver behaviour

Although the systematic study of dive guide behaviour was beyond the scope of this study, opportunistic third-person observations made of dive guides, participants and other divers were reported and analysed. These opportunistic observations were important because they had the potential to reveal more about diver behaviour than the systematic observations alone. The behaviour of dive guides can be important, as it has the potential to influence diver behaviour (section 10.3.1.8). Key outcomes of these opportunistic observations are discussed in this section.

The opportunistic observations of divers included participants and non-participants. It provided context and additional data for the participant observations and additional data on the behaviour of non-participants. The findings from these opportunistic observations of divers and dive guides suggest that diver behaviour is not set, and may be different in different circumstances. It also suggests that dive environment may have a strong influence on diver behaviour. Dive guide behaviour is discussed first, followed by a discussion of the influence of different dive environments on diver and dive guide behaviour, with respect to submerged aircraft and human remains.

11.6.2.1 Dive guide behaviour

In most cases, the behaviour of the dive guides had little influence on diver behaviour. It is acknowledged, however, that the behaviour of dive guides may have had a more subtle or delayed effect on diver behaviour because divers are known to copy the behaviour of dive leaders (Howard, 1999; Lindgren et al., 2008). When divers observe dive guides touching artefacts and moving telegraphs they may feel less constrained or inhibited about engaging in similar behaviours on future occasions. Therefore, it is important dive guides lead by example and display appropriate behaviour.

The most significant dive guide behaviours observed were picking anchors onto the wrecks, offering the researcher an artefact to keep and touching artefacts and fittings. Anchoring causes more damage to wrecks than other impacts associated with recreational diving (NSW Heritage Office, 2000), and is the most easily avoided impact. This behaviour was most concerning because all instances were unnecessary and avoidable, due to the proximity and availability of moorings. There was also no logical justification evident for this practice. Anchoring on wrecks results in damage to the wrecks themselves and marine life. This can diminish the cultural heritage and aesthetic values of the wrecks. Ultimately, this will degrade the diving experience, which has implications for the dive industry. Dive guides should be encouraged to use available moorings, and heritage managers and the dive industry should consider the installation of moorings at heavily visited sites and more fragile sites.

Another behaviour of major concern occurred when a dive guide offered the researcher an artefact to keep. The most astonishing aspect of this incident was that the dive guide did this with full knowledge that he was being videoed. Equally astonishing was that it was totally unsolicited. This suggests although removal of artefacts from the wrecks is illegal, this practice is not unusual and dive guides are willing to assist divers in removing artefacts from the wrecks. The legal protection of these sites does not appear to deter this behaviour. This behaviour should be discouraged, and ideally dive guides should be provided with better incentives to comply with the laws in place to protect the wrecks. Other concerning dive guide behaviours included touching artefacts and fittings, in particular telegraphs, and encouraging divers to do the same.

Dive guides could be used more effectively to protect the shipwrecks and submerged aircraft. For example, dive guides should be encouraged to demonstrate appropriate behaviour, and intervene to correct inappropriate diver behaviour at the time it occurs. This has been found an effective method of reducing diver impacts on reefs (Barker & Roberts, 2004; Hammerton & Bucher, 2015). In order for this to occur, education of dive guides is needed so they understand the impact of inappropriate behaviours on underwater cultural heritage, and the message should connect with their values. For example, dive guides need to understand how damage to these sites can diminish their longer-term livelihood. In terms of artefact disturbance and removal, divers like to see artefacts in situ on wrecks, and leaving them in situ means a better diving experience for divers, and better tips may therefore be expected.

11.6.2.2 Different dive environment

Submerged aircraft

In addition to the abundance and variety of shipwrecks available for divers to explore at Chuuk, there are also a number of submerged aircraft visited by divers. The behaviours discussed in section 11.6 above relate to diver and dive guide behaviours on shipwrecks. There was, however, a marked difference between their behaviour on shipwrecks and submerged aircraft. There was more contact behaviour on the submerged aircraft. Of particular concern were the divers who sat in a cockpit for photos while wearing twin tanks, and the dive guide who sat and posed in a hatch that resembled a cockpit, then encouraged others to do the same.

Submerged aircraft are more fragile than shipwrecks (Neyland, 2011), and therefore the potential for diver damage is higher than for shipwrecks. When divers enter cockpits, and other similar small spaces, their tanks are likely to come into contact with various parts of the aircraft, particularly the seat and other delicate items. Divers' tanks are of significant concern because they have the potential to cause considerable damage, being metal and heavy. Most divers have their tanks mounted on their back and are not always aware of how far the tank protrudes from their body. This results in the tank being hit against the aircraft. Twin tanks have the potential for even more damage than a single tank, as they are much wider and heavier, and therefore significantly more difficult to fit into the confined spaces inside aircraft, including cockpits.

Although this study did not examine the behaviour of divers on submerged aircraft in detail, the findings suggest that different management approaches may be required for submerged aircraft visited by divers to those used for shipwrecks. The findings also suggest that the behaviour of divers and dive guides in relation to submerged aircraft should be looked at in more detail.

Human remains

The presence of human remains are a part of the experience of diving at Chuuk, as the shipwrecks and submerged aircraft are the result of World War II. Many divers at Chuuk have an interest in seeing human remains, and seek opportunities to view them. The dive guides are aware of this interest and usually lead divers to locations where human remains are visible and show them to divers. It is also not uncommon for divers to specifically request to see human remains. However, the way in which divers and dive guides treat these human remains is a sensitive issue.

Some of the human remains viewed by divers are in situ, but most have been moved from their original location. On some of the wrecks, human remains have been moved and displayed, often in clusters. Possible reasons for the clustering of human remains on the wrecks are as acts of memorialisation, as attractions for divers, and in some cases as both memorials and attractions. The placement of human remains around commemorative plaques, for example, may be acts of memorialisation. The placement of human remains on an operating table may also represent memorialisation, or they may have been placed there as an attraction for divers, or for both reasons. The human remains placed near other artefacts are most likely as an attraction for divers. There was also one example of the placement of human remains on a toilet, which defied explanation, and does not appear to fit into any of these categories. The reason for the placement is not known, however, it may be considered disrespectful and insensitive. The movement and touching of human remains may be a special class of touching artefacts, however, due to the sensitive nature of this issue, requires special consideration. Further work is needed to understand diver behaviour in relation to human remains.

In any other setting, the type of disturbance to human remains observed at Chuuk would be unacceptable. Many Japanese people consider the ‘ghost fleet’ of Chuuk Lagoon to be open war graves, and treat them as shrines. As such, they do not approve of divers visiting the wrecks. They are aware that divers touch human remains and are particularly disturbed by this. Many Japanese people would like the divers to respect the sites and treat them as war graves (Bailey, 2000; Jeffery, 2006, 2012). Visible human remains are a strong reminder of the destruction, futility and tragedy that created the exceptional diving experience that divers enjoy today. In this light, some Japanese war veterans, and younger Japanese people recognise this and see value in divers visiting the sites, as a deterrent for future wars (Jeffery, 2012).

The observations made in this study suggest there is a need for the human remains to be dealt with in a more respectful and ethical manner than is currently the case. Educating divers and dive guides about how current practice affects Japanese people would be a move in the right direction.

11.6.3 Artefact clusters and management considerations

The whole issue of artefact clusters presents a management conundrum. On the one hand, artefact clusters could play a beneficial role in site management. The clusters could be considered ‘sacrificial’, in much the same way sacrificial areas are used in protected area management (see section 4.4.2.10). This provides divers with the opportunity to more easily see and photograph artefacts, and to touch artefacts without disturbing the site. By allowing this to occur, other artefacts at the site may remain undisturbed by divers and be protected. However, there are also disadvantages to this approach. The clustering of artefacts may indicate to divers that moving and handling artefacts is acceptable. It may also encourage divers to contribute to the cluster, as they may consider it appropriate if they find other artefacts at the site. The presence of artefact clusters may even encourage divers to search for more artefacts to add to the cluster. The ease of access to artefacts located in clusters may also provide easy opportunities for some divers to remove the artefacts from the wrecks.

It is notable the vast majority of artefacts that were touched in this study were artefacts that were in clusters. This may indicate that most divers were aware it is not appropriate to touch artefacts in situ, and therefore did not touch those. It may also indicate the clusters encourage divers to touch artefacts because divers assume they have been clustered for that purpose.

Management has an opportunity to target these primary sources of diver impacts identified in this study and not place heavy restrictions on all divers. Placing heavy restrictions on all divers is unnecessary and risks disenfranchising divers who may otherwise support management aims. More education is required to inform divers about the causes and consequences of diver impacts on wrecks, both to the cultural heritage values and to the divers themselves.

Two dive guide behaviours were of particular concern. The first was the unnecessary and unjustifiable picking of anchors into the wrecks. The second was the unsolicited offer of an artefact to keep made to the researcher. This indicates the need to encourage dive guides to use available mooring in preference to anchoring. The dive guides may need education regarding the impacts of anchoring on the shipwrecks, and the consequences of this for the wrecks, and ultimately their livelihoods. There is a need to curb the removal of artefacts from the wrecks, and the dive guides play an important role in this regard. Education is required so they understand how removal of artefacts affects not only the cultural heritage values of the wrecks, and more consequential to the diver guides, the recreation values of the wreck. Any decline in the recreation values of the wrecks will ultimately detrimentally affect the short and long-term livelihood values of the wrecks for the dive guides and the broader community. Dive guides can play a positive role in protecting the recreation values of wrecks by modelling appropriate behaviour.

11.7 Key study findings

With regard to the wreck diver survey there are eight key findings:

- The majority of wreck divers were motivated to see historically significant shipwrecks, artefacts and marine life, and to enjoy the peace and tranquillity of the underwater environment, and least motivated by treasure hunting.
- Wreck divers' motivations are complex, due to the diversity within the wreck diving community. Motivations are heavily influenced by frequency of wreck diving, level of dive certification and gender.
- There were two key groups of wreck divers with distinct motivation preferences: female divers and the less frequent and less experienced wreck divers; and, male divers, more frequent wreck divers and technical divers.
- There was overall in-principle support amongst the majority of wreck divers for the use of management controls to protect shipwrecks.
- Two specific management controls were supported convincingly by the majority of wreck divers: penalties and permits.
- There was strong opposition to preventing diver access to wrecks.
- Wreck diver motivations were consistent with recreation specialisation theory: more experienced divers had higher resource dependency than the less specialised divers.
- Wreck diver attitudes to management controls were inconsistent with recreation specialisation theory: there was an inverse relationship between support for management controls and level of specialisation.

In regard to wreck diver behaviour, there are six key findings:

- The vast majority of wreck diver behaviours were non-contact behaviours. The divers spent most of their time looking at features of the wrecks, followed by viewing marine life and penetrating wrecks.

- Contact behaviours represented a minority of wreck diver behaviours, and were almost exclusively intentional.

- Only a small number of divers were responsible for the majority of contacts. Contacts were primarily made by men, Australians, and to a lesser extent, less experienced divers.

- Touching artefacts represented one fifth of contact behaviours, and most of the artefacts touched were in artefact clusters. This raises questions of whether divers only touched these artefacts because they were in clusters, or whether the availability of artefacts in the artefact clusters discouraged divers from searching for and touching artefacts in situ.

- Dive guide behaviour, in most cases, does not directly influence diver behaviour, but may have subtle or delayed effects on diver behaviour.

- There is a notable difference in the behaviour of divers and dive guides between shipwrecks and submerged aircraft. Behaviour on submerged aircraft was more depreciative than on shipwrecks, with aircraft being treated more as dispensable theme park type attractions. The divers and dive guides appeared to have little or no regard for the actual or potential damage of their behaviours on the aircraft.

11.8 Implications of study findings

A number of important management implications have emerged from the findings of this research, and have been identified throughout this chapter. The key implications to the management of sites visited by divers, and areas that require further investigation are summarised and highlighted in this section.

Key implications for the management of sites and divers:

- The major sources of contact behaviours should be targeted in management strategies, rather than placing heavy restrictions on all divers.

- Management should target the contact behaviours that have the potential for the highest impacts on cultural heritage values of sites, i.e. anchoring and touching artefacts.

- Submerged aircraft sites may require different management approaches to those used at shipwreck sites.

- Specific management actions that deal with the ethical and respectful treatment of human remains should be considered at sites where human remains are present.

- Education for divers and dive guides about the causes and consequences of diver impacts on cultural heritage and recreation and tourism values of shipwrecks and submerged aircraft, and how to avoid or minimise them, is recommended to assist in reducing diver impacts.

- Education for dive guides about the benefits to their livelihood of preventing and managing negative diver impacts on shipwrecks and submerged aircraft may assist in improving dive guide behaviour.

- Encourage dive guides to demonstrate appropriate behaviour and correct inappropriate diver behaviour when they observe it occurring.

- The impacts of management decisions on wreck divers can be better determined when diver motivations are taken into account.

- More specialised wreck divers have the highest resource dependency and are affected more than less specialised divers by management actions that limit or restrict access to sites.

- The use of management controls that are accepted by divers may contribute to more effective site management by increasing voluntary compliance with controls.

- Management strategies can be more effective when the heterogeneity of diver motivations and attitudes are taken into account. The Wreck Diver Motivations Model, Wreck Diver Opposition to Management Controls Model and Wreck Diver Support for Management Controls Model can assist managers in understanding diversity amongst the wreck diving community and can be used to inform the development of management strategies.

11.9 Chapter summary

This chapter focused on a discussion of the results presented in Chapters 7, 8 and 9, and drew on key links with the literature that were discussed in detail in Chapter 10. A number of the findings have important implications for heritage managers and the dive industry.

The study established that the majority of wreck divers are male, middle-aged, well educated, and highly experienced divers with high levels of dive certification. The top motivations for wreck diving were seeing historically significant shipwrecks, artefacts and marine life, and enjoying the peace and tranquillity of the underwater environment. Most wreck divers were in support of management controls being in place to protect wrecks. However, only two specific controls were supported, the use of penalties and permits. Wreck divers were also strongly opposed to controls preventing diver access to wrecks. These findings provide a broad understanding of wreck divers.

However, the wreck diving community is not homogenous, and general statements do not take into account the diversity inherent in the wreck diving community, and the complexities involved in wreck diver motivations and attitudes. Wreck diver profile variables were found to influence motivations and attitudes. Motivations were most influenced by frequency of wreck diving, certification level and gender. In comparison, country of residence, frequency of wreck diving and gender had the strongest influence on wreck diver attitudes.

Three conceptual models were developed as a result of analyses of the heterogeneity of wreck divers. The Wreck Diver Motivations Model, the Wreck Diver Opposition to Management Controls Model and the Wreck Diver Support for Management Controls Model. These models enrich our understanding of wreck diver motivations and attitudes by moving understanding of wreck divers beyond the realm of the average wreck diver. The models highlight the complexities inherent in wreck diver motivations and attitudes resulting from diversity within the wreck diving community. The models also identify and highlight the diver profile variables which have the most influence over motivations and attitudes.

The models provide heritage managers and the dive industry with a more comprehensive understanding of wreck divers. When heritage managers understand the diversity in motivations within the wreck diving community they will be better able to accommodate wreck diver aspirations in developing management strategies. Managers will also be better positioned to understand the impacts management actions can have on wreck divers, and which segments of the wreck diving community may be most affected. The dive industry can use the Wreck Diver Motivations Model to identify the types of experiences more popular with different segments of the wreck diving community, which can assist when deciding on the choice of dive experiences offered to clients, including in destination marketing.

A more comprehensive understanding of diver attitudes is pertinent to heritage managers. Understanding the complexity and diversity in diver attitudes to management controls enables managers to gain a better appreciation of the way in which specific management controls may be received by different elements of the wreck diving community. This understanding is important because support for management rules can result in higher levels of voluntary compliance. Therefore, it is beneficial to recognise which segments of the wreck diving community support certain rules and those who oppose them. Management strategies can then be designed to address these considerations. Further, if managers rely upon aggregated data alone, it may result in segments of the wreck diving community being disenfranchised. This in turn, is likely to result in lower levels of compliance with management rules by these divers, and ultimately less effective site management.

Recreation specialisation theory provides a useful framework for understanding heterogeneity amongst wreck divers. However, the models developed in this thesis have demonstrated that the heterogeneity of wreck divers is not fully attributable to recreation specialisation. Other important variables must also be considered, including gender and country of residence. Motivations were found consistent with recreation specialisation theory, as the more specialised divers were more highly resource dependent. However, diver attitudes were inconsistent with theory because there was less support for management controls by the more highly specialised divers. Significantly, two studies which examined scuba diver support for management rules had similar findings. This outcome suggests scuba divers have a different relationship between recreation specialisation and support for management rules than other outdoor recreation activities, and the inverse relationship between specialisation and support for management rules is a characteristic of this activity.

The research conducted for this study is the first example of an empirical study of actual wreck diver behaviour, and represents the first example of a study of diver non-contact behaviours. Therefore, the findings of the behaviour observations reported are significant. The vast majority of wreck diver behaviours were non-contact behaviours. The most popular activity was looking at the various features of wrecks, followed by viewing marine life and penetrating wrecks. Contact behaviours represented a minority of wreck diver behaviours, and were almost exclusively intentional. Importantly, only a small number of divers were responsible for the majority of contacts. Men, Australians and to a lesser extent less experienced divers were responsible for the majority of contact behaviours. The contact behaviour of most concern regarding impacts on cultural heritage values of the wrecks was touching artefacts. However, this represented a minor portion of contact behaviours. Another important aspect of the behaviour observations was that they broadly supported survey findings.

Although the behaviour findings are encouraging, they apply to diver behaviour on shipwrecks. Diver behaviour on submerged aircraft was markedly different, as divers engaged in more potentially damaging behaviours. This finding is concerning because submerged aircraft are more fragile and therefore more susceptible to damage than shipwrecks. It suggests that different management regimes may be required for shipwrecks and submerged aircraft.

The treatment of human remains in wrecks also requires special attention. Many of the wrecks at Chuuk contain human remains. The treatment of human remains, and even divers visiting these wrecks, causes distress for many Japanese people. Examples were given of the clustering of human remains. In some cases, this may represent acts of memorialisation, while in other cases human remains appear to have been moved from their original locations as attractions for divers. Whatever the justification, the findings suggest that more respectful and ethical treatment of the human remains on these wrecks is needed.

Chapter 12 – Conclusion

12.1 Introduction

The aim of this research was to gain a comprehensive understanding of wreck diver attitudes, behaviour and motivations, to assist heritage managers balance underwater cultural heritage protection and diver access to high quality diving experiences. The study focus was the behaviour of divers in Asia-Pacific region, and the attitudes and motivations of wreck divers from the major source populations of wreck divers who visit the Asia-Pacific region. The research objectives used to achieve the aim were:

1. Examine and critique wreck diver behaviour, motivations and attitudes.

2. Explore the possibilities for an enhanced integration of divers and the management of underwater cultural heritage.

The research used pragmatism and mixed methods methodology. Diver observations were undertaken to collect diver behavioural data. Wreck diver attitudes and motivations data were collected using a quantitative survey. This chapter presents the conclusions that have emerged from this research, highlights how the thesis has addressed the research objectives, and outlines the contributions this study makes to diving, outdoor leisure and heritage management. The chapter concludes with an outline of suggested future research directions that have emerged from this research.

12.2 Wreck diver behaviour, motivations and attitudes

The first research objective focused on wreck diver behaviour, motivations and attitudes. This section discusses study conclusions and how this thesis has met research objective one.

12.2.1 Wreck diver behaviour

Wreck diver behaviour was studied at Chuuk Lagoon, a major Asia-Pacific wreck diving destination. Two methods were used to examine diver behaviour. The primary method was to place head-mounted cameras on divers to gain a first-person perspective of the diver’s behaviour and visual environment. The second method involved third-person perspective observations by the researcher, including the use of a head-mounted camera to record the behaviour of participants, other divers and dive guides. This provided context for, and supplemented, the observational data collected by participants. It also and provided additional data on diver behaviour.

A sample of 20 divers wore head-mounted cameras over 23 dives. The key findings of this research were:

- The vast majority of wreck diver behaviours are non-contact behaviours.
- Most divers behave responsibly.

Other important findings were:

- Descriptions of the nature of contact behaviours.
- Marked differences in diver behaviour at submerged aircraft sites and shipwrecks.
- The minor influence of dive guide behaviour on wreck divers.

Non-contact behaviours represented the overwhelming majority of wreck diver behaviours. The durations of these behaviours were analysed to give an indication of the relative importance of each activity to the divers. Wreck divers spent the majority of their time looking at features of wrecks, including artefacts, masts, propellers, holds and machinery. The next most prominent non-contact behaviour was looking at the prolific marine life attracted to the wrecks. The divers also spent a considerable proportion of their time inside the wrecks, looking at the contents of holds, exploring engine rooms, bathrooms and other parts of the wrecks. The relative proportion of time spent on these behaviours are an indication of the activities most enjoyed or preferred by the divers.

Although *contact behaviours* represented a small component of wreck diver behaviours there was a focus on the analysis of these behaviours as they can result in negative impacts on underwater cultural heritage. The frequencies of these behaviours were examined because frequency is more relevant to the level of impact of these behaviours than their durations. *Importantly, a small number of divers were responsible for the majority of contacts*. Men and Australians were the source of the vast majority of contacts, while less experienced divers were responsible for more contacts than were the more experienced divers.

The contact behaviours were almost exclusively intentional. Hand pulling was the most frequent of the contact behaviours. In most cases hand pulling was an appropriate dive technique to use in the situation (i.e. moving around inside the wrecks). Touching artefacts was the second most frequent contact behaviour. Touching artefacts is the most concerning of the diver contact behaviours recorded because it has the most potential for negative impacts on the cultural heritage values of the wrecks. Encouragingly, touching artefacts was minor in the scheme of diver behaviours, representing only one fifth of contact behaviours.

The majority of artefacts touched by divers were components of artefact clusters. It is not known whether the clusters encourage divers to touch these artefacts, or whether they may play a role in reducing divers touching artefacts in situ. It is possible that touching artefacts in clusters is an opportunistic behaviour, and divers may not touch artefacts when clusters are not present. Nevertheless, whether or not artefact clusters play a beneficial or detrimental role in site management remains a vexed question that requires further investigation.

The outcomes of this research suggest that diver behaviour is not fixed and may be influenced by the dive environment. Three possible influences were identified and discussed: dive guides, the presence of human remains, and submerged aircraft. Divers are known to copy the behaviour of dive guides (Howard, 1999; Lindgren et al., 2008). In contrast, this study found that dive guide behaviour had a minimal direct influence on the behaviour of the divers. However, it is recognised that dive guide behaviour may have a more subtle, indirect or delayed influence on diver behaviour. The divers who observe dive guides behaving inappropriately may feel less constrained or inhibited about participating in these, or similar behaviours, in the future. Three concerning dive guide behaviours were observed. The first was the unnecessary picking of anchors into wrecks. The second was offering an artefact to the researcher to keep. The third was encouraging divers to touch artefacts and fittings.

Human remains are visible to divers on some of the wrecks at Chuuk, and dive guides lead divers to see human remains at Chuuk. Some of the human remains viewed by divers are in situ, but most are located in clusters. Clustering involves handling and moving human remains. The clusters at Chuuk may be attributed to memorialising those lost, while others appear to have been clustered as attractions for divers and photographic opportunities.

The behaviour of divers and dive guides in relation to the human remains on the wrecks at Chuuk is a sensitive issue. This study has indicated the need for more ethical and sensitive treatment of human remains by divers and dive guides at Chuuk, and other wreck diving destinations where human remains are present.

The behaviour of divers and diver guides at submerged aircraft sites was markedly different to, and more depreciative than, the behaviour described on shipwrecks. Contact behaviours were more common. The dive guides and certain divers appeared to treat submerged aircraft as dispensable attractions. This is concerning because submerged aircraft are more fragile, and therefore more easily damaged than shipwrecks. This suggests different management requirements for submerged aircraft and shipwrecks.

12.2.2 Wreck diver motivations and attitudes

Wreck diver motivations and attitudes were examined through a self-completed web-based survey of the significant source populations of wreck divers to the Asia-Pacific region. A sample of 724 wreck divers reported on their demographic characteristics and dive experience (diver profile), motivations for wreck diving and attitudes to management controls. The majority of wreck divers were male, aged between 35 and 64 years of age, held a Bachelor or higher degree, and were experienced divers with high levels of certification. Although wreck divers are a special interest group of divers, there was considerable diversity within this group of divers, with different diver profile variables found to influence motivations and behaviour.

Thirteen motivations for wreck diving were examined, and were grouped into five thematic clusters. The top motivations for the majority of wreck divers were in the *history/heritage* and *environmental clusters*. Divers were primarily interested in seeing historically significant shipwrecks, artefacts and marine life, and enjoying the peace and tranquillity of the underwater environment. Encouragingly, *treasure hunting motivations were the least important to the majority of wreck divers*.

Wreck diver motivations were, however, more complex than this view, which assumes homogeneity in motivations amongst wreck divers. A more comprehensive understanding of wreck divers was gained by examining the heterogeneity of wreck diver motivations. Motivations were moderated by certain diver profile variables. The most influential of these were *frequency of wreck diving, certification level and gender*. *Country of residence* and *dive experience* (number of dives completed and number of years diving) also played a role in moderating motivations.

This research has generated a model of wreck diver motivations, the Wreck Diver Motivations Model. This model illustrates the diversity and complexities of wreck diver motivations, providing a more nuanced representation of wreck diver motivations that recognises the complexities of influences and enables the diversity within the wreck diving community to be better understood.

The Wreck Diver Motivations Model also highlights two distinct groups of wreck divers:

- *Less frequent divers, less experienced divers and females*. This group places greater importance on motivations in the environmental thematic cluster, such as seeing marine life and enjoying the peace and tranquillity of the underwater environment.

- *More frequent wreck divers, technical divers and males*. The other four motivation thematic clusters are more important to this group i.e. history/heritage, structure/technology, technique/challenge and treasure hunting.

Understanding diver motivations is important because it enables managers to understand the types of experiences sought and preferred by divers, and what is important to the different segments of the wreck diving community. This allows heritage managers to better assess how different segments of the wreck diving community may be affected by management decisions.

Eight management controls were examined and grouped into three clusters based on their relative levels of restriction. One of the most significant findings was that *majority of divers had in-principle support for the use of management controls to protect wrecks*. However, only *two specific management controls, penalties (high restriction) and permits (moderate restriction) were supported*.

Another key outcome of the study was the *low level of support from majority of participants for divers being prevented from visiting wrecks*. This indicates that although wreck divers support having controls in place to protect wrecks, they want to be able to visit wrecks.

Similar to motivations, attitudes were shown to be more complex than these averaged results. A more complete understanding of wreck diver attitudes was gained by examining the diversity of wreck diver attitudes. Attitudes were influenced by certain diver profile variables. The most influential of these were *country of residence, frequency of wreck diving and gender*. *Level of dive experience and certification* also played a role in moderating attitudes.

Two conceptual models were developed that provided a more holistic representation of wreck diver attitudes, the Wreck Diver Opposition to Management Controls Model and the Wreck Diver Support for Management Controls Model. These conceptual models recognise and illustrate the complexities and diversity inherent in wreck diver attitudes. The models enrich the understanding of wreck diver attitudes, by moving understanding beyond the more simplistic average wreck diver, to a deeper understanding that recognises the complexities of, and diversity within the wreck diving community.

Understanding diversity within the wreck diving community regarding motivations and attitudes is important because it better positions managers to develop more effective and robust management strategies. Wreck diver motivations and attitudes were, therefore, also examined with reference to recreation specialisation. Recreation specialisation theory provides a recognised framework for understanding the diversity of participants in a given recreational activity (Bryan, 1977; Scott, 2012).

Wreck diver motivations are found consistent with recreation specialisation theory, in that more specialised wreck divers had higher resource dependency than less specialised divers. This has major implications for site management. Management actions that limit diver access to sites impinge on the needs and preferences of more specialised divers to a greater extent than less specialised divers. In contrast, the needs and preferences of less specialised divers are able to be met at a large range of sites, including reefs.

However, regardless of the above alignment with recreation specialisation theory, *wreck diver attitudes to management controls are found to be inconsistent with recreation specialisation theory*. There was an inverse relationship between level of specialisation and support for management controls. The more specialised divers were more strongly opposed to management controls, whereas the less specialised divers were more supportive of management controls. This finding may be linked to both the high resource dependency of more specialised divers, and a greater need for recreational freedom by these divers.

Although these findings are inconsistent with recreation specialisation theory, they are congruent with other studies of wreck (Edney & Spennemann, 2014) and scuba divers (Sorice et al., 2009; Todd et al., 2001) with regard to diver support for management rules. This suggests that the inverse relationship found between wreck diver recreation specialisation and support for management rules may be typical of scuba diving, setting it apart, importantly, from other outdoor recreation activities.

Recreation specialisation provides a useful framework for gaining a more comprehensive understanding of wreck divers and their interaction with heritage management. However, while recreation specialisation makes a valuable contribution to understanding wreck divers, the aforementioned findings indicate that other diver profile variables also play a key role in influencing diver motivations and attitudes. The most notable variables identified in this study are *gender* and *country of residence*. A more comprehensive understanding of wreck divers can be gained by combining recreation specialisation with such diver demographic variables. In the case of wreck divers, the three conceptual models presented in this thesis can be used by managers to assist in understanding the diversity and complexity of wreck diver motivations and attitudes, and therefore anticipate likely responses amongst divers to management actions.

12.3 Divers and the management of underwater cultural heritage

The second objective of the research conducted for this thesis explored possibilities and opportunities to enhance the integration of divers and the management of underwater heritage. The review of the global literature on approaches to managing diver impacts on underwater cultural heritage revealed there are three main opportunities to include divers in the management of underwater cultural heritage:

- Engagement and partnership programs.
- Maritime archaeology training for divers.
- Collaboration and consultation with divers regarding management of sites.

Engagement and partnership programs between divers and heritage managers provide opportunities for divers to be involved in and contribute to the management of underwater cultural heritage, and for heritage managers to gain from divers' contributions. The literature records several aspects of this positive mutual relationship. Divers can make a valuable contribution to the management of underwater cultural heritage by locating, recording, researching and monitoring sites (i.e. citizen science). Involving divers in this way is beneficial because it can result in divers developing a sense of ownership over sites, and potentially playing a stewardship role at these sites. This is advantageous for heritage managers because the work done by divers can increase the number of sites that can be identified, recorded and monitored. Additionally, when divers develop a sense of ownership and stewardship towards sites, higher levels of compliance with management rules, and even a degree of self-regulation may occur. This also benefits heritage management. Another positive aspect is the increased presence at sites when divers are recording and monitoring sites.

The literature also demonstrates that providing *maritime archaeology training* to divers can develop higher levels of awareness amongst divers about the importance of protecting underwater cultural heritage. It also equips divers with the skills to contribute to locating, recording and researching sites. Divers with these skills are able to participate in formal maritime archaeology projects, and can develop and operate their own projects. Therefore, offering and promoting these courses to divers is an opportunity to better integrate divers into underwater cultural heritage management.

Collaboration and consultation with divers regarding management of sites visited by divers is also recorded in the literature as being valuable. Heritage managers can take a collaborative approach with divers to develop management strategies for sites. A collaborative approach is likely to achieve higher levels of acceptance of rules because it enables divers to contribute to solutions to site management problems, and this demonstrates that managers are receptive to input from divers. If collaboration is not possible, meaningful and engaging consultation can also achieve positive results.

The Wreck Diver Motivations Model developed in this research presents opportunities for the enhanced integration of divers and the management of cultural heritage. When managers understand the complexity and diversity of diver motivations they are better placed to understand the types of experiences sought by different segments of the wreck diving community. This provides managers with insights into the effect management decisions may have on diver experiences and preferences, and how different segments of the wreck diving community may be affected by management decisions that limit access to sites. It also provides opportunities for managers to provide divers with high quality diving experiences that better align with their needs and aspirations, when developing and implementing heritage management strategies.

Similarly, the Wreck Diver Opposition to Management Controls and Wreck Diver Support for Management Controls Models present opportunities to enhance the integration of divers and management of underwater cultural heritage. The models highlight the diversity and complexities inherent in diver attitudes, allowing managers to identify the segments of the wreck diving community that are likely, for example, to be opposed to or to support specific management controls. Management controls not supported by divers are likely to receive low levels of voluntary compliance, while those supported are likely to gain higher levels of voluntary compliance. Managers who rely on management rules not supported by divers are likely to disenfranchise these divers. Disenfranchised divers may mean not only lower levels of voluntary compliance, but may ultimately result in reduced political support for the protection of underwater cultural heritage.

Another key outcome of this research regarding wreck diver attitudes, is the finding that *divers want access to wrecks*. It is advantageous to enable divers to visit wrecks because having access to sites allows divers to appreciate and hopefully, in turn, value underwater cultural heritage. This is important because it can ultimately provide wider political support for the protection of underwater cultural heritage.

12.4 Contributions made by this research

This research makes contributions to heritage management, scuba research and outdoor recreation research. There are five key contributions.

- *This research presents empirical data on actual wreck diver behaviour*. As such, it provides the first systematic description and analysis of wreck diver behaviour. Importantly, this research demonstrates that the majority of wreck divers behave responsibly. It also identifies primary sources of behaviours that contribute to negative impacts on underwater cultural heritage, and factors that influence wreck diver behaviour. This research provides baseline data for future studies of wreck diver behaviour. Furthermore, this study appears to be the first systematic study of diver *non*-contact behaviour. The findings of this aspect of the study make a contribution to the study of scuba divers more broadly.

- *This research presents a novel conceptual model of wreck diver motivations*. This model enriches understanding of wreck diver motivations by moving understanding of motivations beyond averaged motivations to a more nuanced understanding that engages the diversity and complexity involved in motivations. The *Wreck Diver Motivations Model* identifies and highlights the diver profile variables that have the most influence over diver motivations, and, in doing so, recognises two key groups of divers with distinct motivation preferences.

- *This research presents two novel conceptual models of wreck diver attitudes*. Both models enhance understanding of wreck diver attitudes to management controls by shifting understanding beyond averaged attitudes to a more nuanced understanding that engages the diversity and complexity of wreck diver attitudes, specifically in relation to the management of shipwreck heritage. The *Wreck Diver Opposition to Management Controls Model* and the *Wreck Diver Support for Management Controls Model* identify and highlight the segments of the wreck diving community who oppose or support specific management controls. This allows managers to gain an appreciation of how specific management controls are likely to be received by various segments of the wreck diving community and, in turn, likely levels of voluntary compliance with the controls.

- *The research critiques wreck diver motivations and attitudes through the lens of recreation specialisation theory*. There were three key findings regarding recreation specialisation and wreck divers:

    - First, the *high resource dependency of the more specialised wreck divers*, indicates that these divers will be most affected by management controls that restrict access to sites.

    - Secondly, an *inverse relationship between level of diver specialisation and support for management controls* demonstrates that more specialised divers showed less support for management controls than less specialised divers.

    - Third, *recreation specialisation alone is not sufficient for understanding the diversity and complexities of wreck diver motivations and attitudes*. Other variables, including gender and country of residence of the divers also play a pivotal role.

- *This research contributes a new method of inquiry for studying divers – the use of head-mounted cameras for first-person observation*. The method used to undertake first-person observations was novel and is demonstrated to yield insightful evidence of diver behaviour. It also combined the use of first-person behavioural observations with third-person behavioural observations to provide context for the first-person observations, and to assist in determining which behaviours were not visible in the first-person recordings. This method is transferrable to other diving contexts and other types of outdoor recreation.

- *This research contributes a novel method of inquiry of motivations and attitudes that may be applicable to other types of outdoor recreation* – specifically, the use of motivations to understand the effects of management decisions on recreationists' needs and aspirations, and understanding attitudes to gauge support for management rules.

12.5 Future research directions

A number of matters have emerged from this research that warrant further investigation. These are presented below in two categories. In the first group are four key higher order research opportunities, which are more conceptual in nature, and in the second group are five other more detailed and applied matters for future examination.

Key future research opportunities:

- The method of inquiry used in this study was inspired by issues arising from another type of outdoor recreation, in that instance in a terrestrial setting. This implies that there is value in other studies to assess the applicability of this method to other types of outdoor recreational activities in different settings. Such studies may include an assessment of the approach used here to develop the conceptual models of motivations and attitudes, and its potential for adaptation to other recreational settings.

- Testing of the applicability of the three conceptual models presented in this thesis against other samples of divers, including other types of special interest divers.

- Investigating whether the findings regarding recreation specialisation and support for management rules apply to *actual* diver behaviour compliance with management rules.

- This research did not examine diver behaviour in the context of other behavioural theory, such as the theory of planned behaviour or norm activation theory. It would be useful to examine how such theoretical frameworks for predicting behaviour translates to actual diver behaviour or what further insights into wreck diving behaviour may emerge from such analysis.

Other future research opportunities:

- The findings of this study indicated that diver behaviour may be influenced by different diving environments. It would be beneficial to undertake more systematic studies of wreck diver behaviour at a range of sites, in a range of different environments, to gain a more comprehensive understanding of wreck diver behaviour. In particular, further investigation into diver behaviour at submerged aircraft sites to better understand what is occurring at these sites.

- Examining and critiquing the underwater behaviour of the less committed and casual wreck divers at sites suitable for less experienced wreck divers, and the range of divers visiting artificial reef wrecks.

- Investigating the drivers of diver contacts with artefacts and how divers respond to different types of artefacts, including human remains, and the ethics associated with the handling of human remains.

- Examining the benefits, disadvantages and implications to heritage management of having artefact clusters available for divers to view and interact with.

- Investigating the meanings divers ascribe to their underwater behaviour and the wreck diving experience.
- Further investigating the level and nature of influence of dive guide behaviour on divers.
- Testing whether the inverse relationship found between the level of wreck diver specialisation and support for management rules is a characteristic of scuba diving.

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Appendices

Appendix 1 Survey questionnaire

Recreational Diver Survey

Invitation to Participate

If you are a recreational scuba diver I am keen to hear from you. I am interested in knowing about your motivations and attitudes towards diving. This research is part of my post graduate research studies at Charles Sturt University in Australia that seek to gain a better understanding of recreational diver demographic characteristics, motivations and attitudes.

The survey should take no more than 15-20 minutes for you to complete. Knowing more about divers is important because it can help resource planners and managers, as well as dive and tourism operators to better understand divers and to plan and offer the types of dive experiences you are seeking.

You need to be at least 18 years of age to participate. Participation in this survey is voluntary and you can terminate the survey at any time.

*** 1. Are you interested in participating in this survey?**

- Yes, please tell me more about the study.
- No thanks.

Page 1

Recreational Diver Survey

INFORMATION STATEMENT

About the research

The aim of this research is to gain a better understanding of recreational scuba divers, in particular their demographic characteristics and motivations for diving. It also seeks to gain more specific information about wreck divers, their motivations for wreck diving, attitudes to the types of management controls used to protect wrecks and their feelings about wrecks which are deliberately sunk as artificial reefs for scuba divers. Gaining a better understanding of divers is important because it helps resource planners and regulators, dive and tourism operators plan for and offer the types of dive experiences divers are seeking.

This survey is the method being used for collecting information about divers. The study does not collect any information that will identify individuals, and responses will remain anonymous. The data collected by this survey will be analysed and form part of a PhD. The results of the analysis may also be published in academic publications and presented at conferences. The data collected will be stored securely and kept until the research has been completed and results published. At the end of this period, all electronic records of the data will be deleted and any hard copies of the data will be destroyed.

Principal investigator:
Joanne Edney,
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The study has been approved by the Charles Sturt University Human Research Ethics Committee. Should you have any concerns about the ethical conduct of this research project, please contact:

Executive Officer,
Human Research Ethics Committee,
Office of Academic Governance,
Charles Sturt University,
Panorama Avenue,
Bathurst, NSW, 2795,
Australia;
Phone: +61 2 6338 4628 or
Email: ethics@csu.edu.au.

Participation in this survey is voluntary and you can terminate the survey at any time without penalty

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Recreational Diver Survey

or discriminatory treatment. This research will not cause the invasion of privacy, or cause any physical or psychological stress, embarrassment or anxiety to any participant.

***2. If you would like to participate in this survey, please indicate your consent to the following:**

- I give my consent to participate in the recreational diver survey.
- I have read and understood the purpose of the research, including the details of how the survey data will be used.
- I acknowledge that I understand that I can withdraw from this survey at any time.
- I declare that I am 18 years of age or older.

- Yes, I consent.
- No

Recreational Diver Survey

DEMOGRAPHIC INFORMATION

Some information about you.

***3. What age group are you in?**

- under 25 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55-64 years
- 65-74 years
- over 74 years

***4. What is your gender?**

- Male
- Female

***5. What is your highest level of education?**

- Primary school
- Secondary School
- Trade qualification
- Diploma
- Bachelor or Higher degree

***6. What is your country of residence?**

- Australia
- China
- Japan
- Korea
- Russia
- United States
- Other

If you selected 'Other', please specify.

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Recreational Diver Survey

***7. What is your country of birth / nationality?**

- Australia
- China
- Japan
- Korea
- Russia
- United States
- Other

If you selected 'Other', please specify.

***8. Where do you live?**

- A major city or town
- A rural or regional area

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Recreational Diver Survey

Diving Information

*9. How many dives do you estimate you have completed?

- 5 or less
- 6-20
- 21-50
- 51-100
- 101-250
- 251-500
- 501-1,000
- more than 1,000
- Don't know

*10. What is your highest level of dive certification?

- Open water
- Specialty course
- Advanced open water
- Master Scuba Diver
- Divemaster or equivalent
- Instructor
- Master Instructor
- Technical diving

Please specify your technical diving certification:

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Recreational Diver Survey

***11. How many years is it since you obtained your first dive certification?**

- 5 or less years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26-30 years
- 31-35 years
- 36-40 years
- More than 40 years
- Don't know

Recreational Diver Survey

Why do you dive?

***12. We would like to know your primary motivations for diving.**

How important are the following to you when you go diving?
(1 is not important, 5 is very important)

	1 - Not important	2	3	4	5 - Very important	Don't know
A change in everyday life	○	○	○	○	○	○
Because of the sense of discovery	○	○	○	○	○	○
For the benefit of my friends/family	○	○	○	○	○	○
I enjoy the company of the group	○	○	○	○	○	○
The challenge	○	○	○	○	○	○
To see new things	○	○	○	○	○	○
To escape the pressures of work	○	○	○	○	○	○
To gain a better appreciation of nature	○	○	○	○	○	○
To gain a better appreciation of our heritage	○	○	○	○	○	○
To relax	○	○	○	○	○	○
To see artefacts underwater	○	○	○	○	○	○
To do something my friends/family would like	○	○	○	○	○	○
To show myself I can do it	○	○	○	○	○	○
Peace & tranquillity of the underwater environment	○	○	○	○	○	○
To see the underwater animal & plant life	○	○	○	○	○	○
Other	○	○	○	○	○	○

Please specify any other important motivations for diving.

***13. Do you dive shipwrecks?**

○ Yes

○ No

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Recreational Diver Survey

Wreck diving

***14. How often do you dive shipwrecks?**

- Frequently
- Occasionally
- Rarely
- Less than 5 times

***15. How important are the following to you when wreck diving? (1 is not important, 5 is very important)**

	1 - Not important	2	3	4	5 - Very important	Don't know
The clear water						
Peace & tranquillity of the underwater environment						
Seeing marine life						
Seeing historically significant shipwrecks						
Seeing artefacts						
Photography						
Researching or learning more about a wreck						
Penetrating a wreck						
Searching for artefacts						
Exploring & discovering machinery & fittings						
Collecting artefacts &/or fittings						
Complexity & size of the wreck						
Observing effects of time (decay) on the wreck						
Other						

Please specify any other things that are important to you when wreck diving.

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Recreational Diver Survey

Wreck diving

***16. There are often controls put in place to protect wrecks.**

Can you please indicate your opinion of the following statements about controls? (1 is strongly disagree, 5 is strongly agree)

	1 - Strongly disagree	2	3	4	5 - Strongly agree	Don't know
There should be no controls on what divers do on wrecks	○	○	○	○	○	○
A dive briefing is enough to control diver behaviour	○	○	○	○	○	○
An underwater guide should control what divers do underwater	○	○	○	○	○	○
Moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site	○	○	○	○	○	○
Only divers who have special certification should be allowed to dive on wrecks	○	○	○	○	○	○
Divers should be required to have permits to dive some wrecks	○	○	○	○	○	○
Some accessible wrecks should be off-limits to divers	○	○	○	○	○	○
Harsh penalties should be imposed on some divers who take things from wrecks	○	○	○	○	○	○
Wrecks (except wrecks deliberately sunk as artificial reefs) should be protected from all visitation	○	○	○	○	○	○

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Recreational Diver Survey

Wreck diving

***17. How important do you think it is it to protect a wreck site that has cultural values associated with the following?**
(1 is not important, 5 is very important)

Cultural values associated with:

	1 - Not important	2	3	4	5 - Very important	Don't know
A war grave	○	○	○	○	○	○
A war	○	○	○	○	○	○
A tragic event where human remains are present	○	○	○	○	○	○
A tragic event where people were killed	○	○	○	○	○	○
A tragic event with no loss of human lives	○	○	○	○	○	○
An historic event	○	○	○	○	○	○

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Recreational Diver Survey

Wreck diving

***18. How important do you think it is to protect a wreck site <u>that has direct links to your culture / country</u>? (1 is not important, 5 is very important)**

	1 - Not important	2	3	4	5 - Very important	Don't know
A war grave	○	○	○	○	○	○
A war	○	○	○	○	○	○
A tragic event where human remains are present	○	○	○	○	○	○
A tragic event where people were killed	○	○	○	○	○	○
A tragic event with no loss of human lives	○	○	○	○	○	○
An historic event	○	○	○	○	○	○

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Recreational Diver Survey

Deliberately sunk shipwrecks

For the purposes of this study, a deliberately sunk shipwreck is one that has been sunk intentionally as a recreational resource, including for diving, fishing and surfing; and for other purposes such as marine engineering, environmental restoration, or disposal.

*** 19. Have you ever dived on a deliberately sunk shipwreck?**

- Yes
- No

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Recreational Diver Survey

Deliberately sunk shipwrecks

For the purposes of this study:

A deliberately sunk shipwreck is one that has been sunk intentionally as a recreational resource, including for diving, fishing and surfing; and for other purposes such as marine engineering, environmental restoration, or disposal.

An accidentally sunk ship is one that has been sunk as a result of an accident or misadventure (such as storms, running aground, foundering, collision) or as a result of war.

***20. We would like to know your opinions about deliberately sunk shipwrecks.**

Can you please indicate you opinion about the following statements?
(1 is strongly disagree, 5 is strongly agree)

	1 - Strongly disagree	2	3	4	5 - Strongly agree	Don't know
I would prefer to dive deliberately sunk ships than accidentally sunk ships	○	○	○	○	○	○
I would prefer to dive a deliberately sunk ex-military wreck than all other types of deliberately sunk wrecks	○	○	○	○	○	○
Deliberately sunk ships offer more interesting dive experiences than accidentally sunk ships	○	○	○	○	○	○
Deliberately sunk ships can offer more challenging if not better dive experiences than accidentally sunk ships	○	○	○	○	○	○
Deliberately sunk ships should be used to take the pressure off historic shipwrecks	○	○	○	○	○	○
Deliberately sunk ships offer better opportunities for developing wreck diving skills and training than other wrecks	○	○	○	○	○	○
I am interested in diving deliberately sunk ships because I can observe marine life colonising these wrecks over time	○	○	○	○	○	○
Some deliberately sunk ships should be zoned only for scuba diving so that other uses such as fishing are excluded	○	○	○	○	○	○
There are enough opportunities for me to dive on deliberately sunk shipwrecks	○	○	○	○	○	○
There should be no controls over what divers do on deliberately sunk ships	○	○	○	○	○	○
Deliberately sunk ships have more historical interest to me than accidentally sunk ships	○	○	○	○	○	○
Deliberately sunk ex-military ships have more	○	○	○	○	○	○

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Recreational Diver Survey

historical interest to me than other types of
deliberately sunk ships

Recreational Diver Survey

Wreck diving

***21. Thinking about the wrecks you dive regularly and / or enjoy the most, please indicate your opinion of the following statements about management controls that may be put in place to protect these wrecks.**

	1 - Strongly disagree	2	3	4	5 - Strongly agree	Don't know
There should be no controls on what divers do on wrecks	○	○	○	○	○	○
A dive briefing is enough to control diver behaviour	○	○	○	○	○	○
An underwater guide should control what divers do underwater	○	○	○	○	○	○
Moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site	○	○	○	○	○	○
Only divers who have special certification should be allowed to dive on wrecks	○	○	○	○	○	○
Divers should be required to have permits to dive some wrecks	○	○	○	○	○	○
Some accessible wrecks should be off-limits to divers	○	○	○	○	○	○
Harsh penalties should be imposed on some divers who take things from wrecks	○	○	○	○	○	○
Wrecks (except wrecks deliberately sunk as artificial reefs) should be protected from all visitation	○	○	○	○	○	○

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Appendix 2 **Information sheet**

Charles Sturt University

FACULTY OF SCIENCE
School of Environmental Sciences

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www.csu.edu.au/ses/
ABN: 83 878 708 551

Information sheet – diver photography

Principal investigator:	Joanne Edney, PhD candidate, School of Environmental Sciences, Charles Sturt University, Australia. Contact email: jedney@csu.edu.au, phone + 61 451 459 909.
Principal supervisor:	Associate Professor Jonathon Howard, School of Humanities and Social Sciences, Charles Sturt University, Australia. Contact email jhoward@csu.edu.au, phone + 61 2 6933 2610.

The aim of this research is to gain a better understanding of wreck divers, including the demographic characteristics of wreck divers, their motivations for wreck diving, their attitudes to management controls, and what they like to see and do when wreck diving. A survey collects data about diver characteristics, motivations and attitudes. The divers wearing head-mounted video cameras will collect data which shows what divers look at and what holds their attention while wreck diving. Head-mounted video cameras will allow the data to be collected from the perspective of divers rather than the researcher.

Gaining a better understanding of wreck divers is important as it can help resource planners and regulators, dive and tourism operators plan for and offer the types of dive experiences divers are seeking.

The study does not collect any information that will identify individuals, and participants will remain anonymous. The data collected by this photography will be analysed and form part of a PhD. The results of the analysis may also be published in academic publications and presented at conferences. Any images used in publications will be altered to ensure that individuals are not identifiable. The data collected will be stored securely and kept until the research has been completed and results fully published. At the end of this period, all electronic records of the data will be deleted and any hard copies of the data will be destroyed. The only images that may be retained are those used in the thesis, publications or presentations and will be altered so that individuals are not identifiable.

The study has been approved by the Charles Sturt University Human Research Ethics Committee. Should you have any concerns about the ethical conduct of this research project, please contact the Executive Officer, Human Research Ethics Committee, Office of Academic Governance, Charles Sturt University, Panorama Avenue, Bathurst, NSW, 2795, Australia; phone +61 2 6338 4628 or email ethics@csu.edu.au.

Participation in this survey is voluntary and you can withdraw without penalty or discriminatory treatment. This research will not cause the invasion of privacy, or cause any physical or psychological stress, embarrassment or anxiety to any participant.

Results of the study will be made available to participants after completion of the research. If you are interested in the results please visit www.wreckexperience.net where the results will be posted.

Appendix 3 Consent form – video data

Charles Sturt University

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www.csu.edu.au/ses/
ABN: 83 878 708 551

Consent to participate in wreck diver research – head mounted photography

Principal investigator: Joanne Edney, PhD candidate, School of Environmental Sciences, Charles Sturt University, Australia. Contact email: jedney@csu.edu.au, phone + 61 451 459 909.

Principal supervisor: Associate Professor Jonathon Howard, School of Humanities and Social Sciences, Charles Sturt University, Australia. Contact email jhoward@csu.edu.au, phone + 61 2 6933 2610.

1. I acknowledge that I understand that my participation in this research is voluntary and I am free to withdraw my participation in the research at any time, and that if I do I will not be subjected to any penalty or discriminatory treatment.
2. I have read and understood the purpose of the research, including the details of how the data will be used and stored.
3. I declare that I am 18 years of age or older.
4. I give my consent to wear a head mounted camera on a dive.
5. I understand that the camera will be recording video images and herewith give the researcher the right and permission to use these images for analysis and publication of this research.
6. I understand that I do not have a copyright claim to any of the images collected and I waive the right to approve any images (video or stills) used.

Name: ....

Signature: ....

Date: ....
Country of residence: ....

The study has been approved by the Charles Sturt University Human Research Ethics Committee. Should you have any concerns about the ethical conduct of this research project, please contact the Executive Officer, Human Research Ethics Committee, Office of Academic Governance, Charles Sturt University, Panorama Avenue, Bathurst, NSW, 2795, Australia; phone +61 2 6338 4628 or email ethics@csu.edu.au.

Appendix 4 List of World War II shipwrecks inside Chuuk Lagoon visited by divers

Table 43 World War II shipwrecks inside Chuuk Lagoon visited by divers

Name of vessel	Type – pre WWII	Type – when sank	Tonnage (GRT)	Length (metres)	Depth to seabed (metres)	Shallowest depth (to upper deck or hull - metres)	Orientation	Location	Video data collected for this study	Dived by researcher
Aikoku Maru	Passenger - cargo	Naval auxiliary transport	10,438	152 (now 106) – foreship missing)	65	49	Upright	4th Fleet anchorage	#	✓
Amagisan Maru	Passenger - cargo	Auxiliary transport	7,620	137	43-60	30	Upright with a 65° list to port	6th Fleet anchorage	^ #	✓
Fujikawa Maru	Passenger - cargo	Transport	6938	133	30-35	18	Upright	4th Fleet anchorage	^ #	✓
Fujisan Maru	Merchant tanker	Naval tanker	9524	150	52-61	46	Upright with a 45° list to port	4th Fleet anchorage	#	✓
Fumitzuki	Mutsuki Class Destroyer	Mutsuki Class Destroyer	1,590	98	38	30	Upright with a 25° list to port	Approx 8.5 km West of Weno		✓
Gosei Maru	Coastal freighter	Naval miscellaneous auxiliary	1,931	83	10-34	3	Lying on port side	6th Fleet anchorage	^ #	✓
Hanakawa Maru	Passenger - cargo	Type 1B Passenger - cargo	4,739	112	24-34	18	Upright	East of Tol Island		✓
Heian Maru	Passenger – cargo	Submarine tender	11,614	155	35	14	Lying on port side	Combined Fleet anchorage	#	✓
Hino Maru No. 2	Transport	Naval miscellaneous auxiliary	998	61	9-21	1 (bow gun)	Upright with a 10° list to starboard	6th Fleet anchorage		✓
Hoki Maru	Passenger – cargo	Naval miscellaneous auxiliary	7,112	137 (now 108)	45-50	25	Upright	4th Fleet anchorage		✓

Table 43 (continued)

Name of vessel	**Type – pre WWII**	**Type – when sank**	**Tonnage (GRT)**	**Length (metres)**	**Depth to seabed (metres)**	**Shallowest depth (to upper deck or hull - metres)**	**Orientation**	**Location**	**Video data collected for this study**	**Dived by researcher**
Hokuyo Maru	Passenger – cargo	Naval miscellaneous auxiliary	4,217	109	64	50	Upright	4th Fleet anchorage		
Hoyo Maru	Tanker	Naval tanker	8,691	145	15-34	3	Capsized	Combined Fleet anchorage		✓
I-169 (Shinohara)	Class I 168, Kaidia Type 6A Cruiser submarine	Class I 168, Kaidia Type 6A Cruiser submarine	1,785	103 (now 99)	37-45	34	Upright with 30° list to port	Combined Fleet anchorage	^	✓
Katsuragisan Maru	Cargo	Naval miscellaneous auxiliary	2,427	87	70	62	Upright	Approx. 800m inside north-east pass		
Kensho Maru	Passenger – cargo	Naval miscellaneous auxiliary	4,862	117	34-40	18	Upright with 20° list to port	Combined Fleet anchorage	^ #	✓
Kikukawa Maru	Passenger - cargo	Naval miscellaneous auxiliary	3,833	108 (now 88)	37	20	Almost capsized (160° list to starboard)	4th Fleet anchorage		✓
Kiyosumi Maru	Passenger - cargo	Special transport	8,614	138	35	12	Lying on port side	Combined Fleet anchorage	^ #	✓
Lighter	Water tanker	Lighter	300-350	40	25	19	Upright with an 8° list to port	6th Fleet anchorage		
Momokawa Maru	Passenger - cargo	Naval miscellaneous auxiliary	6,829	108	45	27	Lying on port side	4th Fleet anchorage	#	✓
Nagano Maru	Passenger - cargo	Army cargo	3,824	105	67	49	Upright with a 20° list to port	4th Fleet anchorage		
Nippo Maru	Cargo	Naval auxiliary, water tanker	3,764	108	45-50	31	Upright with a 20-30° list to port	4th Fleet anchorage	^ #	✓

Table 43 (continued)

Name of vessel	Type – pre WWII	Type – when sank	Tonnage (GRT)	Length (metres)	Depth to seabed (metres)	Shallowest depth (to upper deck or hull - metres)	Orientation	Location	Video data collected for this study	Dived by researcher
Oite	Naval Kamikaze Class Destroyer	Naval Kamikaze Class Destroyer	1,523	100 (broken in half and approx. 10m distance between the two parts)	65	55	Aft section upright with a 10-15° list to starboard, forward section capsized (160° list to port)	North Pass		✓
Ojima	Tategami Class Salvage tug	Tategami Class Salvage tug	812	49 (blown into two parts, scattered over approx. 200m)	50	36	Foreship section Upright with 30-40° list to port, aft section upright with 30-40° list to starboard	4th Fleet anchorage		
Reiyo Maru	Passenger - cargo	Naval Miscellaneous auxiliary	5,446	122	66	53	Upright	4th Fleet anchorage	#	✓
Rio de Janeiro Maru	Passenger - cargo	Naval Transport	9,626	141	36	12	Lying on starboard side	6th Fleet anchorage	^ #	✓
San Francisco Maru	Passenger - cargo	Naval Miscellaneous auxiliary	5,831	117	64	50	Upright	4th Fleet anchorage	^ #	✓
Sankisan (Yamakisan) Maru	Cargo	Army Cargo	4,776	113 (now 95 – stern section separated)	46	15	Upright	6th Fleet anchorage	^ #	✓
Sapporo Maru	Special deep-sea fishing trawler	Naval XAF (Provision storeship)	361	49	25-28	20	Upright with slight list to starboard	Combined Fleet anchorage		✓

Table 43 (continued)

Name of vessel	Type – pre WWII	Type – when sank	Tonnage (GRT)	Length (metres)	Depth to seabed (metres)	Shallowest depth (to upper deck or hull - metres)	Orientation	Location	Video data collected for this study	Dived by researcher
Seiko Maru	Cargo	Naval Miscellaneous auxiliary	5,385	120	52	35	Upright	4th Fleet anchorage	#	✓
Shinkoku Maru	Tanker	Naval Tanker	10,020	152	39	20	Upright	North-west of Fefan Island	^ #	✓
Shotan Maru	Standard Type 1D Cargo steamer	Naval Miscellaneous auxiliary	1,999	87	51	39	Upright	4th Fleet anchorage	#	✓
Susuki (Patrol Boat No. 34)	Kuri Type Momi Class Destroyer	No. 31 Type Patrol Boat	935	84	18	3	Upright with a 20° list to port	Combined Fleet anchorage	#	✓
Taiho Maru	Standard Type 1C Steam cargo	Naval Miscellaneous auxiliary	2,827	98 (Broken into two pieces approx. 200m apart)	50	29	Foreship capsized, aft section on port side	6th Fleet anchorage		
Unkai Maru No. 6	Cargo	Naval Miscellaneous auxiliary	3,220	101	45	28	Upright	6th Fleet anchorage		✓

Table 43 (continued)

Name of vessel	Type – pre WWII	Type – when sank	Tonnage (GRT)	Length (metres)	Depth to seabed (metres)	Shallowest depth (to upper deck or hull - metres)	Orientation	Location	Video data collected for this study	Dived by researcher
Yamagiri Maru	Passenger - cargo	Naval Miscellaneous auxiliary	6,438	134	35	15	Lying on port side	Combined Fleet anchorage	^ #	✓
Yubae Maru	Cargo	Army cargo	3,217	93	31-37	16	Almost capsized (lying on port side)	6th Fleet anchorage		

Table compiled from Bailey (2000), Jeffery (2006, 2012; 2007), Lindemann (1991), MacDonald (2014) and personal observations of the researcher. It is not an exhaustive list of the shipwrecks but represents the main ones visited by divers.

Key:

GRT	Gross Registered Tonnage
Used in this study	^ data collected by participants # data collected by researcher

Notes:

4th Fleet anchorage is located between east of Tonoas Island

6th Fleet anchorage is located between around Uman Islands (also referred to as Uman Island anchorages)

Combined Fleet warship and repair anchorage is located between Tonoas and Fefan Islands

The majority of the larger World War II shipwrecks been located, and most have been identified. Not all of the smaller vessels have been located or identified (Bailey, 2000; Jeffery, 2004a, 2004b, 2006, 2012).

Appendix 5 List of World War II submerged aircraft inside Chuuk Lagoon visited by divers

Table 44 World war II submerged aircraft inside Chuuk Lagoon visited by divers

Allied reporting name	Aircraft type	Length (metres)	Wingspan (metres)	Depth to seabed (metres)	Orientation	Location	Video data collected for this study	Dived by researcher
Betty	Mitsubishi GM4 Bomber	20	25	15-20	Upright	South-west of Etten	#	✓
Emily	Kawanishi H8K Flying boat	28	38	16	Broken into three pieces, forward part upright, main fuselage & tail sections upside down	South-west of Tonoas	#	✓
Jill	Nakajima B6N2 Torpedo Bomber	11	15	38	Upright	North-eastern end of Etten		
Judy	Yokosuka D4Y Dive Bomber	10.4	11.5	5	Upright	North-eastern end of Etten		
Myrt	Nakajima C6N Reconnaissance	11	15	15		South-western of Weno		
Zeke	Mitsubishi A6M Reisen Zero	9	11	3	Upside down	North-eastern end of Etten		
Zeke	Mitsubishi A6M Reisen Zero	9	11	8	Upside down	Western end of Etten		✓

Compiled from Bailey (2000), Jeffery (2006, 2012; 2007), Lindemann (1991), MacDonald (2014)and personal observations of the researcher.

Key:

Used in this study # data collected by researcher

Note: The No. 2 hold of the *Fujikawa Maru* contains the fuselages of five Mitsubishi A6M Reisen Zero (Zeke) aircraft fuselages, and another fuselage that is considered likely to be a Mitsubishi A5M (Claude) aircraft with sections of its wings attached. These aircraft are also popular with divers.

Appendix 6 Demographic profile – all divers

Table 45 Demographic profile for all divers - frequencies

Demographic variable	All divers Frequency (N)	All divers Frequency (%)	Non-wreck divers Frequency (N)	Non-wreck divers Frequency (%)	Wreck divers Frequency (N)	Wreck divers Frequency (%)
Gender						
Female	226	26.7	34	35.8	186	25.7
Male	622	73.3	61	64.2	538	74.3
Total	**848**	**100**	**95**	**100**	**724**	**100**
Age						
< 25 years	45	5.3	6	6.3	36	5.0
25-34 years	175	20.6	26	27.4	142	19.6
35-44 years	215	25.4	21	22.1	187	25.8
45-54 years	176	20.8	20	21.1	149	20.6
55-64 years	168	19.8	10	10.4	153	21.1
65-74 years	60	7.1	9	9.5	51	7.1
> 74 years	9	1.0	3	3.2	6	0.8
Total	**848**	**100**	**95**	**100**	**724**	**100**
Level of education						
Primary school	4	0.5	2	2.1	2	0.3
Secondary school	52	6.1	3	3.2	49	6.7
Trade qualification	95	11.2	2	2.1	86	11.9
Diploma	136	16.0	19	20.0	109	15.1
Degree/higher degree	561	66.2	69	72.6	478	66.0
Total	**848**	**100**	**95**	**100**	**724**	**100**
Country of residence						
Australia	210	24.8	19	20.0	187	25.8
China	4	0.5	1	1.1	3	0.4
Japan	55	6.5	18	18.9	33	4.6
Korea (South)	4	0.5	0	0	3	0.4
Russia	10	1.2	2	2.1	5	0.7
USA	340	40.0	33	34.7	299	41.3
Other	225	26.5	22	23.2	194	26.8
Total	**848**	**100**	**95**	**100**	**724**	**100**
Country of birth / nationality						
Australia	170	20.0	14	14.7	154	21.3
China	57	6.7	20	21.1	33	4.6
Japan	6	0.7	1	1.1	4	0.6
Korea (South)	1	0.1	0	0	1	0.1
Russia	10	1.2	0	0	6	0.8
USA	334	39.5	34	35.8	292	40.3
Other	270	31.8	26	27.4	234	32.3
Total	**848**	**100**	**95**	**100**	**724**	**100**
Geography of residence						
Major city or town	630	74.3	79	83.2	530	73.2
Rural or regional area	218	25.7	16	16.8	194	26.8
Total	**848**	**100**	**95**	**100**	**724**	**100**

Appendix 7 Country of residence (other) – all divers

Table 46 Country of residence (other) - all divers

Region	Country	Frequency (N)	Frequency of Other (%)	Frequency of all respondents (%)
Africa	South Africa	13		
	Total	**13**	**5.8**	**1.53**
Asia	Brunei	1		
	Hong Kong	1		
	Indonesia	4		
	Malaysia	2		
	Philippines	4		
	Singapore	36		
	Taiwan	1		
	Thailand	8		
	Total	**57**	**25.3**	**6.72**
Pacific	Commonwealth of the Northern Mariana Islands	1		
	Fiji	2		
	Guam	1		
	New Zealand	1		
	Total	**5**	**2.2**	**0.59**
Caribbean	Bahamas	1		
	Bonaire	1		
	Cayman Islands	4		
	Trinidad & Tobago	2		
	Total	**8**	**3.6**	**0.94**
North America	Canada	75		
	Total	**75**	**33.4**	**8.84**
Europe	Belgium	2		
	Finland	1		
	France	2		
	Germany	1		
	Ireland	3		
	Malta	1		
	Norway	2		
	Slovenia	1		
	Spain	2		
	Sweden	2		
	Switzerland	1		
	The Netherlands	1		
	Ukraine	3		
	United Kingdom	31		(3.65)
	Europe (country not stated)	1		
	Total	**54**	**24**	**6.36**
Middle East	Kingdom of Saudi Arabia	1		
	Lebanon	1		
	United Arab Emirates	1		
	Total	**3**	**1.3**	**0.35**
Other	Ascension Island	1		
	Brazil	1		
	Mexico	3		
	Not stated	5		
	Total	**10**	**4.4**	**1.17**
	Grand total	**225**	**100**	**26.5**

Appendix 8 Country of birth or nationality (other) – all divers

Table 47 Country of birth or nationality (other) – all divers

Region	Country	Frequency (N)	Frequency (%)
Africa	South Africa	18	
	Uganda	1	
	Total	**19**	**7.1**
Asia	Brunei	1	
	Hong Kong	2	
	Indonesia	2	
	Malaysia	3	
	Philippines	3	
	Singapore	31	
	Taiwan	1	
	Total	**43**	**15.9**
Pacific	New Zealand	9	
	Total	**9**	**3.3**
Caribbean	Cuba	1	
	Trinidad & Tobago	2	
	Total	**3**	**1.1**
North America	Canada	67	
	Total	**67**	**24.8**
Europe	Austria	2	
	Belgium	2	
	Denmark	2	
	Finland	2	
	France	4	
	Germany	5	
	Greece	1	
	Ireland	5	
	Italy	1	
	Malta	1	
	Norway	3	
	Poland	1	
	Portugal	1	
	Slovenia	1	
	Spain	1	
	Sweden	2	
	Switzerland	1	
	The Netherlands	7	
	Ukraine	3	
	United Kingdom	65	
	Total	**110**	**40.8**
Middle East	Bahrain	1	
	Syria	1	
	United Arab Emirates	1	
	Total	**3**	**1.1**
Other	Brazil	4	
	Guyana	1	
	Mexico	2	
	Not stated	1	
	Total	**8**	**5.9**
	Grand total	**270**	**100**

Appendix 9 Dive experience profile – all divers

Table 48 Dive experience profile for all divers - frequencies

Experience variable	All divers Frequency (N)	All divers Frequency (%)	Non-wreck divers Frequency (N)	Non-wreck divers Frequency (%)	Wreck divers Frequency (N)	Wreck divers Frequency (%)
Number of dives						
≤ 5	8	0.9	4	4.2	4	0.6
6-20	40	4.7	15	15.8	23	3.2
21-50	64	7.6	18	18.9	46	6.4
51-100	90	10.7	7	7.4	82	11.3
101-250	134	15.9	15	15.8	115	15.9
251-500	146	17.4	14	14.7	127	17.5
501-1,000	143	16.9	9	9.5	127	17.5
>1,000	217	25.7	12	12.6	199	27.5
Don't know	2	0.2	1	1.1	1	0.1
Total	844	100	95	100	724	100
Highest level of certification						
Open water	62	7.3	28	29.5	32	4.4
Specialty course	20	2.4	4	4.2	16	2.2
Advanced open water	250	29.6	40	42.1	205	28.3
Master scuba diver	63	7.5	3	3.1	59	8.2
Divemaster or equivalent	129	15.3	7	7.4	118	16.3
Instructor	94	11.1	6	6.3	82	11.3
Master Instructor	43	5.1	2	2.1	40	5.5
Technical diving	183	21.7	5	5.3	172	23.8
Total	844	100	95	100	724	100
Years diving						
≤ 5	247	29.2	46	48.4	193	26.7
6-10	155	18.3	16	16.8	136	18.8
11-15	112	13.3	9	9.5	97	13.4
16-20	81	9.6	6	6.3	71	9.8
21-25	81	9.6	6	6.3	72	9.9
26-30	54	6.4	4	4.2	50	6.9
31-35	42	5.0	1	1.1	40	5.5
36-40	31	3.7	3	3.2	28	3.9
>40	41	4.9	4	4.2	37	5.1
Total	844	100	95	100	724	100

Appendix 10 Technical diving qualifications

Table 49 Technical diving qualifications

Technical diving qualification	Frequency (n)	Comments
Basic technical and decompression diving	45	Includes decompression procedures
Cave diver	44	Includes advanced cave, sump & DPV* cave diver
Cavern diver	6	Includes sinkhole
Closed circuit rebreather	47	
Ice diver	2	
Nitrox/Advanced nitrox	46	
Search and recovery (including Blackwater)	1	
Semi-closed circuit rebreather	1	
Sidemount	4	Including sidemount with mixed gases
Trimix/Advanced trimix	73	
Scientific diver / Occupational diver	2	
Commercial	6	Including commercial saturation
Military	1	Saturation
Unspecified	1	
Gas blending	3	
Surface supplied air diving	1	
Technical instructor	13	Includes Instructor trainer
Closed circuit rebreather instructor	6	Includes Instructor trainer
Nitrox/Advanced nitrox instructor	1	
Trimix/Advanced trimix instructor	11	Includes Instructor trainer
Cave diving instructor	3	
Cavern diving instructor	1	
Gas blending instructor	1	

* DPV – diver propulsion vehicle

Appendix 11 **Motivations to scuba dive**

When the means of all responses were compared (Table 50), seeing underwater plant and animal life (mean 4.54), new things (4.50), enjoying the peace and tranquillity of the underwater environment (4.44), a sense of discovery (4.38), relaxing (4.29), and gaining a better appreciation of nature (4.16) were the top motivations for scuba diving. Thirteen of the 15 motivations scored above the neutral score of 2.5, suggesting most of the listed motivations were important to divers. Two of the social aspects of diving, for the benefit of my friends/family (2.14) and to do something my friends and family would like (2.28), were the least important motivation for scuba diving, while the other social factor enjoying the company of the group scored a little higher (3.37), and ranked 10th.

Table 50 Motivations for scuba diving

Motivation factor	N	Mean*	SD
To see the underwater plant and animal life	775	4.54	.82492
To see new things	806	4.50	.76531
Peace and tranquillity of the underwater environment	791	4.44	.91895
Because of the sense of discovery	808	4.38	.86732
To relax	803	4.29	1.00486
To gain a better appreciation of nature	803	4.16	1.02359
A change in everyday life	805	3.81	1.20673
The challenge	809	3.75	1.16070
To see artefacts underwater	808	3.73	1.21674
I enjoy the company of the group	809	3.37	1.24641
To escape the pressures of work	809	3.37	1.44130
To gain a better appreciation of our heritage	802	3.10	1.36224
To show myself I can do it	809	2.63	1.43830
To do something my friends/family would like	809	2.28	1.29480
For the benefit of my friends/family	796	2.14	1.20427

* Value is the mean score on a 5 point scale ranging from 1 = not important to 5 = very important

The ‘other’ motivations category was not included in the analysis of means because it covered a variety of themes and was therefore not directly comparable to the statements listed for scoring. Some of the motivations participants listed in this category reiterated those listed in the survey instrument, and others were different. Details of the other motivations category are listed in Appendix 12. The most prevalent themes in this category included photography and videography, enjoying different aspects of the marine environment and wrecks, the feeling of weightlessness and being able to move in three dimensions, challenge and exhilaration. Some examples of responses that encapsulate how these factors motivated participants include:

> ‘Underwater photography is a massive challenge that spurs me to dive’

> ‘Through my photographs and stories, help my non diving friends appreciate the beauty of ocean creatures, especially sharks’

> ‘see the marine life before it deteriorates further’

> ‘Wrecks! I love wrecks’

> ‘The lust for rust…Aka shipwrecks’

> ‘Diving is exhilarating. It is the closest thing to flying I have experienced…it is possible to visit an incredible alien world by “flying” within it. Soaring, hovering, motionless…did I say exhilarating?’

> ‘The challenge and discipline of completing deep and potentially dangerous wreck and cave dives’.

Some participants listed work as a motivating factor, but this work was also pleasure, for example:

> ‘I am a marine biologist and underwater videographer so diving is part of my work…and I love what I do’.

Significant differences were found in motivations to scuba dive between wreck and non-wreck divers, and between genders. Non-wreck divers placed higher levels of importance on the appreciation of nature ($\chi^2 = 10.157$, df = 4, $p = .038$) and enjoying the company of the group ($\chi^2 = 14.911$, df = 4, $p = .005$) than wreck divers. Seeing artefacts was more important to wreck divers ($\chi^2 = 22.958$, df = 4, $p < .001$). Females were more neutral to enjoying the company of the group ($\chi^2 = 10.632$, df = 4, $p = .031$) than males. As noted in section 7.3.2, the inclusion of these motivations in the survey served another purpose and is not the focus of this study, therefore there is no further discussion or analysis of motivations to scuba dive.

Appendix 12 Motivations to scuba dive – Other

Table 51 Motivations to scuba dive - other

Motivation factor	Frequency (n)	Comments
Challenge / Adventure	10	
Excitement / Exhilaration	5	
Exploration / Discovery	4	
Seeing / doing things not many others get to see / do	9	
Discipline	2	Particularly in regards to deep, wreck, cave and technical diving
Dive equipment and technical aspects of diving	3	
Skill development and mastery	4	
Fun / Enjoyment	6	
Escape / Freedom	8	
Relaxation	4	
Peace and quiet	5	Tranquillity also mentioned
Weightlessness, three dimensional movement and freedom of movement	13	Includes the feeling of flying, neutral buoyancy
Being in / under the water	10	
New experiences and learning new things	1	
Physical activity / Exercise	5	
Travel	7	
Photography / Videography	25	
Marine environment	20	
Enjoying the beauty	1	
Discovering undescribed species	1	
Experiencing the uniqueness of the underwater world	4	
Seeing and interacting with marine life	8	
Seeing natural and anthropogenic changes	3	
Learning about it	2	
Seeing underwater geomorphological features	1	
Helping others enjoy and appreciate the underwater environment	2	
Wrecks	16	
Discovering new wrecks	2	
General	6	
Researching / recording / learning about	6	
Seeing wrecks function as artificial reefs	1	
Seeing history	1	Including tragedies
Social aspects of diving	12	Being with and sharing with friends and family, and other divers, camaraderie, sharing post dive stories
Caves	2	Including recording undocumented cave systems
Television programs / Movies	1	
Collecting and searching for artefacts	8	
Fishing / Hunting	12	
Collecting marine life	2	Including shells
Miscellaneous	1	Cooling off after a hot day
	1	Encouraging others to discover & appreciate the marine environment
	2	Encouraging others to discover/appreciate underwater cultural heritage
	1	Providing alternative revenue to coastal communities
	1	An activity able to participate in with limitations due to injuries
	1	Physical sensations
	1	Intellectual stimulation
	1	‘It is all I have ever wanted to do’
	1	Addicted to diving
	1	Sense of connectedness with the world
Work	14	Educating divers, archaeology, marine biology, photography/videography
Career development	2	Dive qualifications to assist in getting a different job

Appendix 13 Differences in frequency of participation in wreck diving

Kruskal-Wallis tests found significant differences between the demographic and dive experience of wreck divers and frequency of wreck diving.

Demographics

There was a difference between some age group categories and frequency of wreck diving, $H(5) = 11.715$, $p = .039$. Pairwise comparisons with adjusted *p*-values found that wreck divers aged 45-54 years dived wrecks more frequently than those ages 25-34 years ($p = .022$).

A difference was also found between countries of residence and frequency of participation in wreck diving, $H(6) = 33.312$, $p <.001$. Pairwise comparisons with adjusted *p*-values found divers residing in Japan dived wrecks less frequently than those residing in Australia ($p > .001$), the United States ($p > .001$), and countries in the other countries category ($p > .001$).

Dive experience

There was a difference between the number of dives completed and frequency of wreck diving, $H(6) = 126.746$, $p > .001$. Pairwise comparisons with adjusted *p*-values found wreck divers who had completed >1,000 dives dived wrecks more frequently than those who had completed ≤ 20 dives ($p < .001$), 51-100 dives ($p < .001$), 101-250 dives ($p = .011$) and 501-1,000 dives ($p = .011$). Pairwise comparisons with adjusted *p*-values also found wreck divers who had completed 501-1,000 dives were more frequent wreck divers than those who had completed 51-100 dives ($p < .001$), divers with 251-500 dives dived wrecks more frequently than those who had completed ≤ 20 dives ($p < .001$) and those with 51-100 dives ($p < .001$), and divers who had completed 101-250 dives dived wrecks more frequently than those who had 21-50 dives ($p > .001$) and 51-100 dives ($p > .001$).

A difference was found between levels of dive certification and frequency of participation in wreck diving, $H(6) = 156.754$, $p < .001$. Pairwise comparisons with adjusted *p*-values found technical divers dived wrecks more frequently than divers with all other levels of certification: open water ($p < .001$), specialty ($p < .001$), advanced open water ($p < .001$), master scuba diver ($p = .002$), divemaster ($p < .001$)

and instructors/master instructors ($p < .001$). Pairwise comparisons with adjusted p-values also found instructors/master instructors were more frequent wreck divers than open water ($p < .001$) and advanced open water divers ($p < .001$); divemasters dived wrecks more frequently than open water ($p = .002$), specialty ($p = .011$) and advanced open water divers ($p = .001$); and, master scuba divers were more frequent wreck divers than open water ($p = .003$), specialty ($p < .001$) and advanced open water divers ($p = .007$).

Finally, differences were found between the number of years diving experience and frequency of wreck diving $H(6) = 39.914$, $p < .001$. Pairwise comparisons with adjusted p-values found divers with ≤ 5 years of diving experience were less frequent wreck divers than those with >30 years ($p < .001$), 26-30 years ($p = .013$), 21-25 years ($p = .005$), 11-15 years ($p < .001$) and 6-10 years ($p = .017$) of diving experience.

Appendix 14 Motivations to wreck dive – Other

Table 52 Motivations to wreck dive - other

Motivation factor	Frequency (n)	Comments
Challenge / Adventure	4	
Excitement / Exhilaration	1	
Exploration / Discovery	4	
Skill development / mastery	4	
Variety	5	Including variety in diving and variety of wrecks
Seeing something different / unique / unusual	2	
Locating / discovering new wrecks	3	
Researching / recording / learning about	4	
Wreck history and stories associated with the wrecks	10	Including seeing/experiencing history, historical significance, why it sank, human dimensions of the wreck
Type of wreck	6	For example, World War I or II, wooden etc., shipwreck or artificial reef wreck, different methods of construction
Condition of the wreck	5	
Orientation of the wreck	2	For example, upright
Location / environmental conditions	6	For example, water temperature, currents, depth, fresh or salt water
Seeing / experiencing marine life associated with wrecks	11	
Observing the colonisation process	8	Including how the aquatic environment affects the wreck and how the wreck affects the aquatic environment
Photography / Videography	3	Including the wreck as a subject of photo/video
Fishing / hunting	5	
Collecting artefacts	2	
Collecting shells	1	

Appendix 15 Differences in motivations to wreck dive

Statistically significant differences were found between diver profiles and frequency of wreck diving, and motivations for wreck diving. These differences are reported by thematic cluster.

History/heritage cluster

Chi square analysis found a significant difference between genders in the level of importance placed on seeing historically significant shipwrecks and artefacts. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives completed, certification level, years diving, and frequency of wreck diving, and levels of importance placed on all motivations in the history/heritage cluster.

<u>Historically significant shipwrecks</u>

A difference was found between genders and the level of importance given to seeing historically significant shipwrecks (χ^2 = 15.878, df = 4, p = .003). This motivation was very unimportant to female wreck divers.

There was a difference between countries of residence and the importance of seeing historically significant shipwrecks, $H(6)$ = 18.743, p = .005. Pairwise comparisons with adjusted p-values found seeing historically significant shipwrecks was more important to people residing in Japan than those residing in Australia (p = .019) and the United States (p = .007).

A difference was found between levels of certification and the importance of seeing historically significant shipwrecks, $H(6)$ = 20.487, p = .002. Pairwise comparisons with adjusted p-values found seeing historically significant shipwrecks was more important to technical divers than open water divers (p = .009).

There was a difference between frequency of wreck diving categories and the level of importance of seeing historically significant shipwrecks, $H(3)$ = 41.278, p < .001. Pairwise comparisons with adjusted p-values found this was more important to frequent wreck divers than those who occasionally (p = .003) and rarely (p < .001) dived wrecks. It was also more important to those who occasionally dived wrecks than it was to those who rarely dived wrecks (p < .001), and more important to those who had dived wrecks < 5 times than it was to those who rarely wreck dive (p = .006).

Artefacts

A difference was found between genders in the level of importance placed on seeing artefacts (χ^2 = 17.264, df = 4, p = .002). This was more important to males than females.

There was a difference between countries of residence and the importance of seeing artefacts, $H(6)$ = 13.644, p = .034. Pairwise comparisons with adjusted p-values found seeing artefacts was more important to people residing in Japan than those residing in the United States (p = .030).

A difference was found between levels of certification and the importance given to seeing artefacts, $H(6)$ = 15.968, p = .014. Pairwise comparisons with adjusted p-values found seeing artefacts was more important to technical divers than to advanced open water divers (p = .019).

There was a difference between frequency of wreck diving categories and the level of importance placed upon seeing artefacts, $H(3)$ = 38.341, p < .001. Pairwise comparisons with adjusted p-values found this was more important to frequent wreck divers than those who dived wrecks occasionally (p = .001) and rarely (p < .001). It was also more important to occasional wreck divers than to those who rarely dived wrecks (p = .003), and more important to those who had dived wrecks < 5 times than those who rarely dived wrecks (p = .014).

Researching and learning

A difference was found between levels of certification and the importance assigned to researching and learning more about a wreck, $H(6)$ = 31.319, p < .001. Pairwise comparisons with adjusted p-values found advanced open water divers placed less importance on researching and learning more about a wreck than technical divers (p < .001), and instructors/master instructors (p = .040).

There was a difference between the categories of wreck diving frequency and the level of importance placed upon researching and learning, $H(3)$ = 57.548, p < .001. Pairwise comparisons with adjusted p-values found this was more important to frequent wreck divers than those who dived wrecks occasionally (p < .001), rarely (p

$< .001$) or < 5 times ($p < .001$), and more important for occasional wreck divers than those who had wreck dived < 5 times ($p < .001$).

Environmental cluster

Chi square analysis found significant differences between genders in the level of importance given to seeing marine life, enjoying the peace and tranquillity of the underwater environment and clear water. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives, dive certification level, years diving, and frequency of wreck diving, and the level of importance placed on all of the motivations in the environmental cluster: seeing marine life, enjoying the peace and tranquillity of the underwater environment, clear water and observing the effects of time and decay on a wreck.

<u>Marine life</u>

There was a difference found in the importance of seeing marine life between genders ($\chi^2 = 29.143$, df = 4, $p < .001$). This was more important to females.

A difference was found in the importance of seeing marine life and countries of residence $H(6) = 24.041$, $p = .001$. Pairwise comparisons with adjusted p-values found seeing marine life was more important to wreck divers residing in the United States than those residing in countries in the other countries category ($p = .005$).

A difference was found between the number of dives completed and the importance of seeing marine life, $H(6) = 26.064$, $p < .001$. Pairwise comparisons with adjusted p-values found divers with ≤ 20 dives placed more importance on seeing marine life than those with 501-1,000 dives ($p = .038$), and it was more important to divers who had completed 21-50 dives than to those with 501-1,000 dives ($p = .006$) and >1,000 dives ($p = .003$).

There was a difference between levels of certification and the level of importance placed upon seeing marine life, $H(6) = 60.256$, $p < .001$. Pairwise comparisons with adjusted p-values found technical divers placed less importance on seeing marine life than all of the other certification groups: open water ($p < .001$), specialty ($p < .001$), advanced open water ($p < .001$), master scuba diver ($p < .001$), divemaster ($p < .001$), and instructor/master instructor ($p = .004$).

A difference was found between the number of years diving experience and the importance placed upon seeing marine life, $H(6) = 15.671$, $p = .016$. Pairwise comparisons with adjusted *p*-values found this was more important to divers with ≤ 5 years diving experience than it was to those with 11-15 years-experience ($p = .014$).

There was a difference between frequency of wreck diving categories and the importance of seeing marine life, $H(3) = 36.012$, $p < .001$. Pairwise comparisons with adjusted *p*-values found seeing marine life was less important to those who were frequent wreck divers than those who had dived wrecks < 5 times ($p < .001$), rarely ($p < .001$) and occasionally ($p < .001$).

<u>Peace and tranquillity of the underwater environment</u>

A difference was found between genders in the importance of enjoying the peace and tranquillity of the underwater environment ($\chi^2 = 15.756$, df = 4, $p = .003$). This was more important to females.

There was a difference between countries of residence and the importance of the peace and tranquillity of the underwater environment, $H(6) = 29.832$, $p < .001$. Pairwise comparisons with adjusted *p*-values found enjoying the peace and tranquillity of the underwater environment was more important to wreck divers residing in Japan than residents of Australia ($p < .001$), the United States ($p < .001$) and countries in the other countries category ($p = .001$).

There was a difference between the number of dives completed and the level of importance placed upon enjoying the peace and tranquillity of the underwater environment, $H(6) = 29.030$, $p < .001$. Pairwise comparisons with adjusted *p*-values found divers with ≤ 20 dives placed a higher level of importance on peace and tranquillity than divers with 501-1,000 dives ($p = .045$) and divers with >1,000 dives ($p = .008$). It was also more important to divers who had completed 21-50 dives than it was to those with >1,000 dives ($p = .006$), and more important to those with 51-100 dives than to those with >1,000 dives ($p = .042$).

A difference was found between level of certification and the importance given to enjoying the peace and tranquillity of the underwater environment, $H(6) = 32.540$, $p < .001$. Pairwise comparisons with adjusted *p*-values found technical divers placed less importance on peace and tranquillity than open water divers ($p = .036$), advanced open water divers ($p < .001$), and instructors/master instructors ($p = .048$).

There was a difference found between years diving experience and the level of importance given to enjoying the peace and tranquillity of the underwater environment, $H(6) = 30.237$, $p < .001$. Pairwise comparisons with adjusted *p*-values found this was more important to divers with ≤ 5 years diving experience than to those with 6-10 years ($p = .027$), 11-15 years ($p = .013$), 16-20 years ($p = .012$), 26-30 years ($p = .002$) and >30 years ($p = .001$) diving experience.

There was a difference between frequency of wreck diving categories and the level of importance given to enjoying the peace and tranquillity of the underwater environment and frequency of wreck diving, $H(3) = 23.659$, $p < .001$. Pairwise comparisons with adjusted *p*-values found this less important and those who wreck dived frequently than those who had dived wrecks < 5 times ($p < .001$), rarely ($p = .020$) and occasionally ($p = .027$), and less important to those who dived occasionally than to those who had wreck dived < 5 times ($p = .041$).

Clear water

There was a difference in the importance of clear water between genders ($\chi^2 = 11.231$, df = 4, $p = .024$). Clear water was more important to females.

A difference was found between countries of residence and clear water $H(6) = 25.534$, $p < .001$. Pairwise comparisons with adjusted *p*-values found clear water was more important to wreck divers who reside in Japan than residents of Australia ($p = .004$), United States ($p = .007$) and countries in the other countries category ($p = .001$).

There was a difference between number of dives and the level of importance of clear water, $H(6) = 75.252$, $p < .001$. Pairwise comparisons with adjusted *p*-values found clear water was more important to divers who had completed ≤ 20 dives than those with 251-500 dives ($p = .021$), 501-1,000 dives ($p = .003$) and >1,000 dives ($p < .001$). It was also more important to divers who had completed 51-100 dives than it was to divers who had completed 500-1,000 dives ($p = .009$) and >1,000 dives ($p < .001$).

A difference was found between levels of dive certification and the importance of clear water, $H(6) = 95.179$, $p < .001$. Pairwise comparisons with adjusted *p*-values found clear water was more important to open water divers than master scuba divers ($p = .037$), technical divers ($p < .001$), divemasters ($p = .015$) and instructors/master instructors (p = .002). Clear water was more important to specialty divers than technical divers (p = .002). It was also more important to advanced open water divers than it was to technical divers ($p < .001$), and instructors/master instructors (p = .002). Clear water was more important to master scuba divers than technical divers (p = .007). Divemasters placed a higher level of importance to it than technical divers ($p < .001$). Clear water was also more important to instructors/master instructors than technical divers (p = .003).

There was a difference between the number of years diving experience and the level of importance given to clear water, $H(6) = 25.370$, $p < .001$. Pairwise comparisons with adjusted p-values found clear water was more important to divers with ≤ 5 years diving experience than those with 6-10 years (p = .002), 11-15 years (p = .017), and >30 years (p = .001).

A difference was found between frequency of wreck diving categories and the importance of clear water, $H(3) = 71.275$, $p < .001$. Pairwise comparisons with adjusted p-values found clear water was more important to divers who had dived wrecks < 5 times than those who dived wrecks occasionally (p = .001) and those who frequently wreck dived ($p < .001$). It was also more important to those who rarely dived wrecks than those who occasionally (p = .011) and frequently wreck dived ($p < .001$). Additionally, clear water was more important to occasional wreck divers than those who frequently wreck dived ($p < .001$).

<u>Observing the effects of time (decay) on wrecks</u>

A difference was found between levels of certification and the importance placed on observing the effects of time and decay on a wreck, $H(6) = 20.634$, p = .002. It was more important to divemasters than it was to advanced open water divers (p = .026).

There was a difference found between frequency of wreck diving categories and the importance assigned to observing the effects of time and decay on wrecks, $H(3)$ = 33.335, $p < .001$. Pairwise comparisons with adjusted p-values found this was more important to frequent wreck divers than those who dived wrecks occasionally (p = .011), rarely ($p < .001$) or < 5 times (p = .013). It was also more important to occasional wreck divers than those who rarely wreck dived (p = .005).

Structure and technology cluster

Chi square analysis found a significant difference between genders in the level of importance placed on motivations in the structure and technology cluster. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, and frequency of wrecks diving and levels of importance given to the structure and technology cluster motivations.

<u>Complexity and size of a wreck</u>

There was a difference between genders in the level of importance given to the complexity and size of a wreck (χ^2 = 32.487, df = 4, p < .001). It was more important to males.

A difference was found between the age of the diver and the importance of wreck size and complexity H(5) = 13.507, p = .019. Pairwise comparisons with adjusted p-values found the complexity and size of a wreck was more important to divers < 25 years of age than those aged 55-64 years (p = .021).

There was a difference between levels of education and the importance given to the complexity and size of a wreck, H(3) = 9.650, p = .022. Pairwise comparisons with adjusted p-values found the complexity and size of a wreck more important to wreck divers with trade qualifications than those with a bachelor or higher degree (p = .024).

A difference was found between certification levels and the importance of the complexity and size of a wreck, H(6) = 38.098, p < .001. Pairwise comparisons with adjusted p-values found this factor was more important to technical divers than specialty divers (p = .029) and advanced open water divers (p < .001).

There was a difference between categories of wreck diving frequency and the importance of the complexity and size of a wreck, H(3) = 55.305, p < .001. Pairwise comparisons with adjusted p-values found this more important to frequent wreck divers than those who dived wrecks occasionally (p = .001), rarely (p < .001) and < 5 times (p < .001). It was also more important to occasional wreck divers than those who rarely dived wrecks (p = .011) and those who had dived wrecks < 5times (p = .001).

Exploring and discovering machinery and fittings

There was a difference between genders in the level of importance placed on exploring and discovering machinery and fittings (χ^2 = 50.723, df = 4, p < .001), which was more important to males than females.

A difference was found between levels of education and the importance of exploring and discovering machinery and fittings $H(3)$ = 11.727, p = .008. Pairwise comparisons with adjusted p-values found exploring and discovering machinery and fittings was more important to divers with trade qualifications than those with a bachelor or higher degree (p = .026).

There was a difference between levels of certification and the importance of exploring and discovering machinery and fittings, $H(6)$ = 51.768, p < .001. Pairwise comparisons with adjusted p-values found exploring and discovering machinery and fittings was more important to technical divers than divers with open water (p = .002), specialty (p = .007), advanced open water (p < .001), and master scuba diver (p = .044) certifications.

A difference was found between frequency of wreck diving categories and the importance given to exploring and discovering machinery and fittings, $H(3)$ = 64.314, p < .001. Pairwise comparisons with adjusted p-values found this activity was more important to frequent wreck divers than to those who dived wrecks occasionally (p < .001), rarely (p < .001), and < 5 times (p < .001). It was also more important for occasional wreck divers than those who rarely dived wrecks (p = .032).

Technique/challenge cluster

Wreck penetration was the only motivation in the technique/challenge cluster where significant differences were found between genders. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, and country of residence and levels of importance placed on wreck penetration.

Wreck penetration

There was a difference between genders in the level of importance given to wreck penetration (χ^2 = 27.988, df = 4, p < .001). This activity was more important to males.

A difference was found between countries of residence and the importance of wreck penetration, $H(6)$ = 18.094, p = .006. Pairwise comparisons with adjusted p-values found penetrating shipwrecks was more important to wreck divers residing in Australia than to those residing in the United States (p = .003).

There was a difference between the number of dives completed and importance placed on penetrating a wreck, $H(6) = 15.580$, $p = .016$. Pairwise comparisons with adjusted p-values found wreck penetration was more important to divers who had completed >1,000 dives than those who had completed 21-50 dives (p = .046).

A difference was found between levels of certification and the importance of wreck penetration, $H(6) = 63.527$, $p < .001$. Pairwise comparisons with adjusted p-values found wreck penetration was more important to technical divers than open water divers ($p < .001$), specialty divers ($p = .001$), advanced open water divers ($p < .001$), master scuba divers ($p = .022$), and divemasters ($p < .001$). It was also more important to instructors/master instructors than open water divers ($p = .027$).

Another difference was found between frequency of wreck diving categories and the importance given to being able to penetrate a wreck, $H(3) = 44.609$, $p < .001$. Pairwise comparisons with adjusted p-values found this was more important for frequent wreck divers than those who dived wrecks occasionally ($p < .001$), rarely ($p < .001$) and < 5 times ($p < .001$).

Treasure hunting cluster

Chi square analysis found a significant difference between genders in the level of importance placed upon searching for artefacts. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence and frequency of wreck diving, and levels of importance placed on both motivations in the treasure hunting cluster.

Searching for artefacts

There was a difference between genders in the importance of searching for artefacts ($\chi^2 = 9.517$, df = 4, $p = .049$). It was very unimportant to female wreck divers

A difference was found between levels of education and the importance of searching for artefacts $H(3) = 15.652$, $p = .001$. Pairwise comparisons with adjusted p-values found searching for artefacts was more important to divers with trade qualifications than those with a degree or higher degree ($p = .011$), and more important to divers with a bachelor or higher degree than those with a diploma ($p = .026$).

There was a difference between certification levels and the importance of searching for artefacts, $H(6) = 33.574$, $p < .001$. Pairwise comparisons with adjusted *p*-values found technical divers placed a higher level of importance on this than advanced open water divers ($p < .001$), and master scuba divers ($p = .003$).

A difference was found between wreck diving frequency categories and the level of importance placed on searching for artefacts, $H(3) = 53.781$, $p < .001$. Pairwise comparisons with adjusted *p*-values found this more important to frequent wreck divers than occasional wreck divers ($p < .001$), those who dived wrecks rarely ($p < .001$), and those who had wreck dived < 5 times ($p = .001$). It was also more important to occasional wreck divers than those who rarely wreck dived ($p < .001$) and those who had dived wrecks < 5 times ($p = .001$).

Collecting artefacts

There was a difference between countries of residence and the importance of collecting artefacts, $H(6) = 19.372$, $p = .004$. Pairwise comparisons with adjusted *p*-values found collecting was more important to wreck divers residing in the United States than those residing in countries in in the other category ($p = .008$).

A difference was also found between frequency of wreck diving categories and the level of importance given to collecting artefacts and fittings, $H(3) = 12.528$, $p = .006$. Pairwise comparisons with adjusted *p*-values found this more important for frequent wreck divers than it was for those who occasionally ($p = .047$) or rarely ($p = .014$) dived wrecks.

Appendix 16 Attitudes to management controls: Shipwrecks dived regularly or enjoyed by participant

Attitudes to management controls were grouped into clusters based on the relative level of control or restriction: high, moderate and low. The high restriction cluster includes management actions that are invasive and highly controlling, the moderate cluster includes management actions that are controlling but to a lesser degree than those in the high cluster, and the low cluster includes management actions often referred to as indirect, such as information and education, and also no restrictions. The final cluster, knowledge, is related to the level of knowledge divers have about the effect their actions may have on the impairment of site integrity.

The results of the responses to the question about attitudes to management controls over shipwrecks dived regularly or enjoyed by participants are presented in Table 53.

Table 53 Attitudes to management controls over shipwrecks dived regularly or enjoyed by participant

Statement	Cluster	N	Mean*	SD
Harsh penalties should be imposed on some divers who take things from wrecks	High restriction	610	3.98	1.33159
Divers should be required to have permits to dive some wrecks	Moderate restriction	613	3.16	1.41249
Only divers who have special certification should be allowed to dive on wrecks	Moderate restriction	619	2.79	1.40557
Some accessible wrecks should be off-limits to divers	Moderate restriction	612	2.60	1.42718
An underwater guide should control what divers do underwater	Moderate restriction	614	2.47	1.28541
A dive briefing is enough to control diver behaviour	Low restriction	618	2.33	1.08100
There should be no controls on what divers do on wrecks	Low restriction	616	1.83	1.19150
Moving artefacts around on a wreck site is okay so long as the artefacts remain at the wreck site	Knowledge	610	1.65	1.00108
Wrecks (except wrecks deliberately sunk as artificial reefs) should be protected from all visitation	High restriction	615	1.45	.83709

* Value is the mean score on a 5 point scale ranging from 1 = strongly disagree to 5 = strongly agree

Although there were slight differences in the means between the two questions about attitudes to management controls, the ranking of levels of agreement to the statements was the same for both questions, and the standard deviations were also very similar. No further analysis of the question about attitudes based on a wreck dived regularly or enjoyed by the diver was undertaken and there is no further discussion related to this question. The reason for this was outlined in section 7.3.6.

Appendix 17 Differences in attitudes to management controls

Statistically significant differences were found between diver demographics, level of diving experience and frequency of wreck diving, and attitudes towards management controls to protect shipwrecks. These differences are reported on by cluster.

High restriction

Chi square analysis found significant differences between genders in the level of agreement to both of the management controls in the high restriction cluster: the use of penalties and protecting shipwrecks from all visitation by divers. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives, dive certification level, years diving, and frequency of wreck diving, and the level of level of agreement with both management controls in the high restriction cluster.

Harsh penalties

There was a difference between genders in their level of agreement to the use of harsh penalties being imposed on divers who take items from wrecks ($\chi^2 = 14.550$, df = 4, $p = .006$). Males strongly disagreed to this management control.

A difference was found between countries of residence and the level of agreement with the use of penalties, $H(6) = 65.902$, $p < .001$. Pairwise comparisons with adjusted p-values found wreck divers residing in Australia had higher levels of agreement with this statement than those residing in the United States ($p < .001$). Divers residing in Japan agreed more with this statement than residents of United States ($p < .001$). Residents of countries in the other category had higher levels of agreement to this statement than those residing in the United States ($p < .001$).

There was a difference between level of dive certification and agreement to the use of penalties, $H(6) = 25.850$, $p < .001$. Pairwise comparisons with adjusted p-values found divemasters had higher levels of agreement to this statement than open water ($p = .029$) and technical divers ($p = .019$). Instructors/master instructors and higher levels of agreement to penalties than open water ($p = .033$), specialty ($p = .033$), and technical divers ($p =.021$).

A difference was found between the number of years diving experience and level of agreement to the use of penalties, $H(6) = 25.053$, $p < .001$. Pairwise comparisons with adjusted *p*-values found divers with >30 years-experience had lower levels of agreement to penalties than divers with ≤ 5 years ($p < .001$), 6-10 years ($p = .026$), 11-15 years ($p = .004$) and 21-25 years ($p = .001$).

There was a difference found between frequency of wreck diving categories and agreement with the use of penalties, $H(3) = 8.011$, $p = .046$. Pairwise comparisons with adjusted *p*-values found higher support for the use of penalties from occasional wreck divers than frequent wreck divers ($p = .038$).

<u>No visitation</u>

A difference was found between genders in their agreement with some wrecks being protected from all visitation by divers ($\chi^2 = 10.069$, df = 4, $p = .039$), with strong disagreement to this statement from male wreck divers.

There was a difference between level of certification and agreement to no visitation, $H(6) = 22.278$, $p = .001$. Pairwise comparisons with adjusted *p*-values found advanced open water divers had higher levels of agreement to this management control than advanced open water divers ($p < .001$).

A difference was found between frequency of wreck diving categories and level of agreement to some wrecks being protected from any visitation by divers, $H(3) = 20.096$, $p < .001$. Pairwise comparisons with adjusted *p*-values found lower levels of agreement with this management control from frequent wreck divers than occasional wreck divers ($p = .003$) and those who rarely wreck dived ($p = .001$).

Moderate restriction

Chi square analysis found a significant difference between genders in their level of agreement to three of the management controls included in the moderate restriction cluster: the use of permits to dive some wrecks, some accessible wrecks being off-limits to divers and the use of underwater guides to control diver behaviour. Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives, dive certification level, years diving, and frequency of wreck diving, and the level of level of agreement to all of the management controls included in the moderate restriction cluster: the use of permits to dive some wrecks, a requirement for special certification to dive wrecks, some accessible wrecks being off-limits to divers and the use of underwater guides to control diver behaviour.

Permits

There was a difference between the genders in their level of agreement to the use of permits to dive some wrecks (χ^2 = 20.270, df = 4, p < .001). Females had a higher level of agreement to this management control.

A difference was found between wreck diver age categories and their level of agreement to the use of permits, $H(5)$ = 16.739, p = .005. Pairwise comparisons with adjusted p-values found divers aged 25-34 years had higher levels of agreement to this statement than those aged 45-54 years (p = .021).

There was a difference between countries of residence and level of agreement to permits, $H(6)$ = 19.160, p = .004. Pairwise comparisons with adjusted p-values found higher levels of agreement from divers residing in Japan than residents of the United States (p = .009).

A difference was found between years diving experience and the level of agreement to the use of permits, $H(6)$ = 19.860, p = .003. Pairwise comparisons with adjusted p-values found a higher level of agreement to this management control by those who had been diving for ≤ 5 years than divers with >30 years-experience (p = .006).

There was a difference between frequency of wreck diving and agreement to the use of permits, $H(3)$ = 12.436, p = .006. Pairwise comparisons with adjusted p-values found divers who had dived wrecks < 5 times had higher levels of agreement to this management control than frequent wreck divers (p = .017).

Special certification

There was a difference between wreck diver age categories and their level of agreement to the use of special certifications to dive wrecks, $H(5)$ = 40.605, p < .001. Pairwise comparisons with adjusted p-values found higher levels of agreement to this statement from divers aged < 25 years than those aged 45-54 years (p = .001), 55-64 years (p = .006) and ≥ 65 years (p < .001). There was higher agreement from those aged 25-34 years than those aged 45-54 years (p = .009) and ≥ 65 years (p = .001). Divers aged 35-44 years agreed more to special certification than those aged 45-54 years (p = .008) and ≥ 65 years (p < .001).

A difference was found between countries of residence and level of agreement to special certification, *H*(6) = 39.268, p < .001. Pairwise comparisons with adjusted *p*-values found wreck divers residing in Japan had higher levels of agreement with this statement than residents of Australia (*p* = .011), the United States (*p* < .001). Divers residing in countries in the other countries category agreed more with this statement than residents of the United States (*p* < .001).

There was a difference between the number of dives completed and level of agreement to a requirement for special certifications, *H*(6) = 30.438, *p* < .001. Pairwise comparisons with adjusted *p*-values found higher levels of agreement from divers who had 51-100 dives than those with >1,000 dives (*p* = .002), and also more agreement from divers with 101-250 dives than those with >1,000 dives (*p* < .001).

A difference was found between level of certification and agreement to special certification, *H*(6) = 16.436, *p* = .012. Pairwise comparisons with adjusted *p*-values found divemasters has a higher level of agreement to this management control than open water divers (*p* = .009).

There was a difference in level of agreement to the use of special certifications and years diving experience, *H*(6) = 39.682, *p* < .001. Pairwise comparisons with adjusted *p*-values found higher levels of agreement from divers with ≤ 5 years diving experience than those with 26-30 years (*p* = .018) and >30 years (*p* < .001). Divers with 6-10 years had higher levels of agreement to special certifications than those with >30 years (*p* = .004), and divers with 11-16 years-experience agreed more with this than divers with >30 years (*p* = .013).

<u>Some wrecks off-limits to divers</u>

A difference was found between genders in their level of agreement to some wrecks being off-limits to divers (χ^2 = 13.846, df = 4, *p* = .008). Females agreed more strongly than males.

There was a difference between diver age and levels of agreement to some wrecks being off-limits to divers, *H*(5) = 11.935, *p* = .036. Pairwise comparisons with adjusted *p*-values found higher levels of agreement to this management control from divers aged 25-34 years than those aged 45-54 years (*p* = .014).

A difference was found in agreement to some accessible wrecks being off-limits to divers and level of education, *H*(3) = 19.245, *p* = .001. Pairwise comparisons with adjusted *p*-values found divers with a bachelor or higher degree had higher levels of agreement to this statement than those with trade qualifications (p = .001).

There was a difference between countries of residence and level of agreement to some wrecks being off-limits to divers, $H(6) = 18.645$, $p = .005$. Pairwise comparisons with adjusted *p*-values found wreck divers living in countries in the other countries category had higher levels of agreement to this statement than those from Australia (p = .013).

A significant difference was found between number of dives completed and level of agreement to some wrecks being off-limits to divers, $H(6) = 15.068$, $p = .020$. Pairwise comparisons with adjusted *p*-values found higher levels of agreement with this management control by divers who had completed 51-100 dives, than those who had >1,000 dives (p = .007).

There was a difference between levels of certification and agreement with some wrecks being off limits to divers, $H(6) = 15.104$, $p = .019$. Pairwise comparisons with adjusted *p*-values found that advanced open water divers agreed more with this statement than technical divers (p = .016).

There was a difference found between frequency of wreck diving categories and level of agreement with some wrecks being off limits, $H(3) = 13.794$, $p = .003$. Pairwise comparisons with adjusted *p*-values found lower levels of agreement to this statement by frequent wreck divers than those who occasionally (p = .036) or rarely (p = .023) dived wrecks.

<u>Underwater guide</u>

A significant difference was found between the genders in their level of agreement with the use of underwater guides to control diver behaviour ($\chi^2 = 16.350$, df = 4, $p = .003$), with a stronger level of agreement from females.

There was a difference based on the wreck diver age and their level of agreement to the use of underwater guides, $H(5) = 28.289$, $p < .001$. Pairwise comparisons with adjusted *p*-values found divers aged <25 years agreed more with this statement than divers aged 45-54 years (p = .031) and divers aged 55-64 years (p = .043); there were higher levels of agreement with this statement from divers aged 25-34 years than those aged 45-54 years (p = .004) and 55-64 years (p = .007); divers aged 45-54 years and 55-64 years had higher levels of agreement than those aged ≥65 years (p = .029 and p = .042 respectively).

A difference was found in levels of agreement to the use of dive guides between countries of residence, $H(6) = 56.072$, $p < .001$. Pairwise comparisons with adjusted p-values found wreck divers residing in Japan had higher levels of agreement to this statement than those residing in Australia ($p < .001$), the United States ($p < .001$), and countries in the other countries category ($p < .001$). Pairwise comparisons with adjusted p-values also found divers residing in countries in the other category had higher levels of agreement to this statement than those from Australia ($p = .001$).

There was a difference between the number of dives completed and level of agreement to the use of dive guides, $H(6) = 38.931$, $p < .001$. Pairwise comparisons with adjusted p-values found higher levels of agreement from divers who had completed 21-50 dives than those with 501-1,00 dives ($p = .002$) and >1,000 dives ($p = .002$). Divers with 51-100 dives had higher levels of agreement to this statement than divers with 501-1,000 dives ($p = .003$) and >1,000 dives ($p = .002$). This was also the case for divers who had completed 101-250 dives than those who had done 501-1,000 dives ($p = .015$) and >1,000 dives ($p = .012$).

A difference was found between level of dive certification and agreement to the use of underwater guides, $H(6) = 67.437$, $p < .001$. Pairwise comparisons with adjusted p-values found technical divers had lower levels of agreement to this statement than open water divers ($p = .014$), advanced open water divers ($p < .001$), master scuba divers ($p < .001$), divemasters ($p < .001$), and instructors/master instructors ($p < .001$).

There was a difference between years diving experience and agreement with the use of dive guides, $H(6) = 32.898$, $p < .001$. Pairwise comparisons with adjusted p-values found divers with ≤ 5 years diving experience agreed more with this management control than most other age groups: 6-10 years ($p = .027$), 11-15 years ($p = .023$), 21-25 years ($p = .028$), 26-30 years ($p = .003$) and >30 years ($p < .001$).

A difference was found between frequency of wreck diving categories and agreement with the use of dive guides, $H(3) = 49.418$, $p < .001$. Pairwise comparisons with adjusted p-values found frequent wreck divers had lower levels of agreement to this management measure than occasional wreck divers ($p < .001$), those who rarely dive wrecks ($p < .001$), and those who have dived wrecks < 5 times ($p < .001$). Occasional wreck divers also had lower levels of agreement to this statement than those who had completed < 5 wreck dives ($p = .004$).

Low restriction

Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives, dive certification level, years diving, and frequency of wreck diving, and the level of level of agreement with both management control statements included in the low restriction cluster: a dive briefing being sufficient to control diver behaviour and no controls over what divers do on wrecks.

Dive briefing

There was a difference between countries of residence and agreement to the use of dive briefings to control diver behaviour, $H(6) = 17.584$, $p = .007$. Residents of Japan had higher levels of agreement to this statement than divers residing in countries in the other countries category ($p = .010$).

There was a difference between frequency of wreck diving categories and level of agreement to the use of dive briefings, $H(3) = 9.171$, $p = .018$. Pairwise comparisons with adjusted p-values found divers a higher level of agreement to this statement from divers who had completed < 5 wreck dives than those who frequently wreck dived ($p = .023$).

No controls

A difference was found in the level of agreement to no controls being in place for diver on wrecks based on countries of residence, $H(6) = 20.663$, $p = .002$. Pairwise comparisons with adjusted p-values found higher levels of agreement to this statement from divers residing in the United States than those from countries in the other countries category ($p = .001$).

There was a difference between the number of years diving experience and agreement with no controls, $H(6) = 20.034$, $p = .003$. Pairwise comparisons with adjusted p-values found divers with >30 years-experience had higher levels of agreement to this statement than divers with 11-15 years ($p = .002$) and 16-20 years ($p = .048$) experience.

Knowledge

Kruskal-Wallis tests found significant differences between the different age groups, levels of education, country of residence, number of dives, dive certification level, years diving, and frequency of wreck diving, and the level of level of agreement to the statement in the knowledge cluster: ‘moving artefacts around on a wreck site is okay so long as the artefacts remain at the site.

Moving artefacts

A difference was found between diver age and moving artefacts around on a wreck site, $H(5) = 17.474$, $p = .004$. Pairwise comparisons with adjusted p-values found higher levels of agreement to this statement from divers aged 45-54 years than those aged 35-44 years ($p = .005$).

There was a difference between countries of residence and levels of agreement moving artefacts, $H(6) = 15.700$, $p = .015$. Pairwise comparisons with adjusted p-values found more agreement to this statement from divers residing in the United States than residents of countries in the other category ($p = .046$).

A difference was found between number of years diving experience and agreement to moving artefacts around, $H(6) = 16.185$, $p = .013$. Pairwise comparisons with adjusted p-values found divers with >30 years-experience agree more with this statement than divers with 11-15 years-experience ($p = .032$).

Appendix 18 Differences in importance of shipwreck cultural values

Statistically significant differences were found between diver demographics, level of diving experience, and frequency of wreck diving and diver attitudes to the protection of wrecks that had different cultural values associated with them (general response). Chi square analysis found differences between the genders in the importance given to the protection of wrecks with certain cultural values. Kruskal-Wallis tests found statistically significant differences between the age and countries of residence of wreck divers and the importance of protecting wrecks with certain cultural values. These differences are reported by category of cultural value.

War graves

There was a difference between the number of dives completed and the level of importance of protecting war grave wrecks, $H(6) = 18.486$, $p = .005$. Pairwise comparisons with adjusted *p*-values found dives who had completed 501-1,000 dives placed a higher level of importance on the protection of war grave wrecks than those who had completed >1,000 dives ($p = .010$).

There was a difference between certification levels and the importance placed on protecting war grave wrecks, $H(6) = 22.490$, $p = .001$. Pairwise comparisons with adjusted *p*-values found specialty divers placed more importance on protecting war grave wrecks than technical divers ($p < .001$).

A difference was found between years diving experience and the level of importance given to protecting war grave wrecks, $H(6) = 15.587$, $p = .016$. Pairwise comparisons with adjusted *p*-values found divers with >30 years-experience placed less importance on protecting war grave wrecks than divers with ≤ 5 years-experience ($p = .024$) and those with 11-15 years-experience ($p = .028$).

War

A difference was found between diver age and the importance placed on protecting wrecks with cultural values associated with wars, $H(5) = 21.789$, p = .001. Pairwise comparisons with adjusted *p*-values found divers aged 25-34 years placed higher levels of importance on cultural values associated with wars than those aged 45-54 years ($p = .002$) and 55-64 years ($p = .014$).

There was a difference found between levels of certification and the level of importance of protecting wrecks associated with wars, $H(6) = 14.706$, $p = .023$. Pairwise comparisons with adjusted *p*-values found divemasters attached more importance to this than technical divers ($p = .009$).

A difference between years diving experience and the importance placed on protecting wrecks associated with wars was found, $H(6) = 18.348$, $p = .005$. Pairwise comparisons with adjusted *p*-values found divers with >30 years-experience had lower levels of support for the protection of wrecks with these values than divers with ≤ 5 years-experience ($p = .005$).

Tragic event – human remains present

Females placed higher levels on importance to the protection of wrecks associated with a tragic event where human remains are present ($\chi^2 = 10.366$, df = 4, $p = .035$).

There was a difference between number of dives completed and level of agreement to the protection of wrecks associated with a tragic event where there are human remains present, $H(6) = 18.351$, $p = .005$. Pairwise comparisons with adjusted *p*-values found this was more important to divers who had completed 251-500 dives than to those with >1,000 dives ($p = .022$).

There was a difference found between levels of certification and the level of importance placed on wrecks associated with a tragic events where human remains were present, $H(6) = 24.059$, $p = .001$. Pairwise comparisons with adjusted *p*-values found this was of less importance to technical divers than specialty ($p = .001$) and advanced open water ($p = .005$) divers.

A difference was found between years of diving experience and the level of importance given to the protection of wrecks associated with tragic events and have human remains present, $H(6) = 14.519$, $p = .024$. Pairwise comparisons with adjusted *p*-values found divers with >30 years diving experience placed less importance on the protection of these wrecks than divers who had been diving for 11-15 years ($p = .009$).

There was a difference between categories of wreck diving frequency and level of importance assigned to wrecks that contained human remains, $H(3) = 13.918$, $p = .003$. Pairwise comparisons with adjusted *p*-values found this was less important to frequent wreck divers than those who occasionally (p = .035) or rarely (p = .005) dived wrecks.

Tragic event – people killed

Females placed higher levels on importance to the protection of wrecks associated a tragic event where people were killed (χ^2 = 20.035, df = 4, p < .001).

A difference was found between levels of certification and the importance placed on the protection of wrecks associated with tragic events where people were killed, H(6) = 12.803, p = .046. Pairwise comparisons with adjusted p-values found divemasters placed more importance on this than technical divers (p = .026).

There was a difference found between categories of wreck diving frequency and the importance of protecting wrecks associated with a tragic event where people were killed, H(3) = 13.035, p = .005. Pairwise comparisons with adjusted p-values found frequent wreck divers considered the protection of these wrecks less important than those who rarely (p = .013) wreck dived.

Tragic event – no loss of human lives

Females placed higher levels of importance on the protection of wrecks associated a tragic event where there was no loss of life (χ^2 = 23.722, df = 4, p < .001).

There was a difference between diver age and the protection of wrecks with cultural values associated with tragic events with no loss of human lives H(5) = 14.117, p = .015. Pairwise comparisons with adjusted p-values found divers aged 25-34 years placed higher importance on these values than divers aged 55-64 years (p = .037).

Historic event

Females placed higher levels of importance on the protection of wrecks associated an historic event (χ^2 = 14.583, df = 4, p = .006).

There a difference between countries of residence and the importance placed on protecting wrecks with cultural values associated with an historic event, H(6) = 21.893, p = .001. Pairwise comparisons with adjusted p-values found wreck divers residing in Japan placed higher importance on the protection of wrecks with these cultural values associated with them than divers residing in Australia (p = .009), the United States (p < .001), and countries in the other countries category (p = .004).

Appendix 19 **Camera failures – researcher data collection**

Dive number	Date	Dive site name	Video data collected	Comment
1	7/11/14	*Hoyo Maru*	No	Camera failure, not specified.
2	8/11/14	*Fujikawa Maru*	No	Camera failure, not specified.
3	8/11/14	*Shinkoku Maru*	Partial	Data collected for most of the dive, battery discharged prematurely.
4	9/11/14	*Rio De Janeiro Maru*	Yes	
5	9/11/14	*Rio De Janeiro Maru*	Yes	
6	9/11/14	Emily	No	Battery discharged from previous dive. This was an unexpected additional dive, therefore no spare battery on board dive boat.
7	10/11/14	*Kiyosumi Maru*	Yes	
8	11/11/14	*Kensho Maru*	No	Fail of camera or SD card – no data on card but camera was on.
9	11/11/14	*Yamagiri Maru*	No	Camera stopped early into dive and was restarted but no data on SD card.
10	12/11/14	*San Francisco Maru*	Yes	
11	12/11/14	*Yamagiri Maru*	No	Camera shut down near the end of the dive & unable to restart. No data on SD card.
12	13/11/14	*Fujikawa Maru*	No	Camera failure, not specified.
13	13/11/14	*Heian Maru*	Yes	
14	15/11/14	*Shinkoku Maru*	No	Camera failed, not specified.
15	15/11/14	*Sankisan Maru*	Yes	
16	16/11/14	*Rio De Janeiro Maru*	Yes	
17	16/11/14	Betty Bomber	Yes	
18	16/11/14	Emily	Partial	Camera shut down during dive & unable to restart.
19	17/11/14	*Kensho Maru*	Yes	
20	17/11/14	*Gosei Maru*	Partial	Camera shut down during dive, restarted once, then shut down a second time & unable to restart.
21	18/11/14	*Nippo Maru*	Yes	
22	18/11/14	*Yamagiri Maru*	Yes	
23	19/11/14	*Seiko Maru*	Yes	
24	19/11/14	*Fujikawa Maru*	Yes	
25	20/11/14	*I-169*	No	Camera appeared to be working throughout dive, but no data on SD card.
26	21/11/14	*San Francisco Maru*	No	Camera shut down during dive & unable to restart. No data on SD card.
27	23/11/14	*Amagisan Maru*	No	Camera stopped early in dive & unable to restart. No data on SD card.
28	23/11/14	*Shinkoku Maru*	No	Camera failed, not specified.
29	24/11/14	*Aikoku Maru*	Yes	
30	24/11/14	*Sankisan Maru*	Yes	
31	25/11/14	*Fujisan Maru*	Yes	
32	25/11/14	*Fujikawa Maru*	Yes	
33	26/11/14	*San Francisco Maru*	No	Camera would not turn on, although was working before boarding the dive boat.
34	27/11/14	*Nippo Maru*	Yes	
35	29/11/14	*Shinkoku Maru*	Yes	
36	29/11/14	*Kensho Maru*	Yes	
37	30/11/14	*Hoki Maru*	No	Camera shut down during dive & unable to restart. No data on SD card.
38	1/12/14	*Shotan Maru*	Yes	
39	1/12/14	*Susuki*	Yes	
40	2/12/14	*Reiyo Maru*	Partial	Shut down during dive & unable to restart.
41	2/12/14	*Momokawa Maru*	Yes	
42	3/12/14	*Aikoku Maru*	Yes	
43	3/12/14	*Fumitzuki*	No	Camera failed, not specified.
44	4/12/14	*Amagisan Maru*	Yes	
45	4/12/14	*Shinkoku Maru*	Yes	

Appendix 20 **Duration of participant behaviour (seconds)**

Behaviour	**Duration (seconds) i.e. time**																						
	Observation number																						
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Look at feature of wreck	1279.42	1435.94	1158.83	439.16	1291.56	651.00	935.52	1053.36	2215.6	1784.38	1363.07	807.56	2658.8	1841.6	2320.54	1881.84	2526.94	1972.1	1423.76	1523.63	1244.59	1228.3	1160.27
Inside a wreck	228.92	299.43	360.69	158.79	674.86	168.13	302.16	267.86	924.51	-	486.71	152.72	799.15	641.23	693.21	444.34	442.83	507.66	547.54	557.21	-	282.81	290.42
Look at marine life	2.20	243.94	295.42	-	268.5	19.09	727.71	429.15	1095.57	661.85	763.38	101.6	700.39	450.74	1199.21	95.39	1208.28	564.55	3.50	90.39	1420.66	707.49	989.30
Use camera	-	-	222.19	344.63	-	29.23	-	501.98	-	-	86.49	-	-	492.42	-	414.78	-	2.34	14.21	-	654.58	-	-
Total of non-contacts	**1510.54**	**1979.31**	**2037.13**	**942.58**	**2234.92**	**867.45**	**1965.39**	**2252.35**	**4235.68**	**2446.23**	**2699.65**	**1061.88**	**4158.34**	**3425.99**	**4212.96**	**2836.35**	**4178.05**	**3046.65**	**1989.01**	**2171.23**	**3319.83**	**2218.6**	**2439.99**
Sit on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.50	-	-	-	-
Stand on wreck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			3.67	-		13.24	-
Hold onto wreck	-	74.74	-	43.78	11.44	-	15.01	2.50	3.67	1.57	-	-	2.67	40.37	-	-	0.70	8.88	10.34	1.17	4.97	53.75	35.03
Touch artefact	-	60.96	-	-	-	-	-	-	119.35	-	-	-	-	-	-	-	-	-	70.01	-	-	287.08	50.22
Unintentional contact	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.64	-
Touch marine life	-	16.32	-	-	-	-	-	-	10.58	13.61	-	-	-	-	-	-	-	-	-	-	-	48.38	11.28
Total of contacts	**0**	**152.02**	**-**	**43.78**	**11.44**	**-**	**15.01**	**2.5**	**133.6**	**15.18**	**-**	**-**	**2.67**	**40.37**	**-**	**-**	**0.70**	**8.88**	**118.52**	**1.17**	**4.97**	**406.09**	**96.53**
Total	**1510.54**	**2131.33**	**2037.13**	**986.36**	**2246.36**	**867.45**	**1980.4**	**2254.85**	**4369.28**	**2461.41**	**2699.65**	**1061.88**	**4161.01**	**3466.36**	**4212.96**	**2836.35**	**4178.75**	**3055.53**	**2107.53**	**2172.4**	**3324.8**	**2624.69**	**2536.52**

Notes: Observations 2 &22, 3&23, and 5&6 were recorded by the same divers
There is no duration data for hand pulling – wreck and marine life because these behaviours are point event data.

Appendix 21 **Use camera modifiers duration in seconds**

Use camera modifiers	Duration (seconds) i.e. time										Total (secs)	Average duration (secs)
	Observation number											
	3	4	6	8	11	14	16	18	19	21		
Artefacts	53.39	162.09	6.44	103.13	47.25	147.38	17.48	-	-	1.57	538.73	67.34
People & artefacts	-	13.98	0.97	58.06	-	10.78	-	-	-	-	83.79	20.95
Wreck fabric	120.12	76.34	16.25	100.83	7.61	180.54	171.27	-	-	57.26	730.22	91.28
People & wreck	8.91	92.22	5.57	99.16	19.62	10.78	195.63	-	14.21	-	446.10	55.76
Marine life	24.99	-	-	140.80	12.01	142.94	30.40	2.34	-	595.75	949.23	135.60
Undetermined	14.78	-	-	-	-	-	-	-	-	-	14.78	14.78
Total - Use camera	**222.19**	**344.63**	**29.23**	**501.98**	**86.49**	**492.42**	**414.78**	**2.34**	**14.21**	**654.58**	**2762.85**	

Appendix 22 Touch artefacts modifiers duration in seconds

Touch artefact modifiers	Duration (seconds)					Total	Mean duration (seconds)
	Observation number						
	2	9	19	22	23		
Clean	4.37	54.92	-	33.23	-	**92.52**	**30.84**
Pick up & clean	31.36	17.38	13.88	33.17	-	**95.79**	**23.95**
Pick up & hold up	-	-	19.19	-	-	**19.19**	**19.19**
Pick up & inspect	24.66	47.05	33.50	208.10	50.22	**363.53**	**72.71**
Pick up & move	0.57	-	-	12.58	-	**13.15**	**6.58**
Pick up & pass to other diver	-	-	3.44	-	-	**3.44**	**3.44**
Total	**60.96**	**119.35**	**70.01**	**287.08**	**50.22**	**587.62**	

Note: Observations 2 &22 were recorded by the same diver.

Appendix 23 Wreck diver demographic profile comparisons

Table 54 A comparison of recent wreck diver survey demographic profiles

Demographic variable	This study (n = 724) Frequency (%)	2010 Survey of Australian wreck divers (n = 863) Frequency (%)	2009 Survey of wreck divers at Chuuk (n = 122) Frequency (%)
Gender			
Female	25.7	25.5	27
Male	74.3	74.5	73
Total	**100**	**100**	**100**
Age			
< 25 years	5.0	8.1	1
25-34 years	19.6	23.6	10
35-44 years	25.8	28.7	22
45-54 years	20.6	25.9	43
55-64 years	21.1	11.2	20
> 64 years	7.9	2.5	4
Total	**100**	**100**	**100**
Level of education			
Primary school	0.3	0	0
Secondary school	6.7	13.3	17
Trade qualification	11.9	14.5	3
Diploma	15.1	15.8	5
Degree/higher degree	66.0	56.4	75
Total	**100**	**100**	**100**
Country of residence			
Australia	25.8	100	-
Australia/New Zealand	-	-	14
Asia	-	-	2
China	0.4	-	-
Japan	4.6	-	-
Korea (South)	0.4	-	-
Russia	0.7	-	-
USA	41.3	-	-
North America	-	-	67
Other	26.8	-	17
Total	**100**	**100**	**100**

Key:
* Edney (2012b)
\# published in Edney (2011b)

Appendix 24 Wreck diver dive experience profile comparisons

Table 55 A comparison of recent wreck diver survey demographic profiles

Experience variable	This study	2010 survey of Australian wreck divers*	2009 survey of divers at Chuuk#
	Frequency (%)	Frequency (%)	Frequency (%)
Number of dives			
≤ 5	0.6	0.1	0
6-20	3.2	3.2	0
21-50	6.4	9.2	3
51-100	11.3	12.1	7
101-250	15.9	15.6	25
251-500	17.5	19.5	21
501-1,000	17.5	15.9	-
>500	-	-	44
>1,000	27.5	24.0	-
Don't know	0.1	0.4	-
Total	**100**	**100**	**100**
Highest level of certification			
Open water	4.4	9.8	4
Specialty course	2.2	9.9	26
Advanced open water	28.3	30.0	13
Master scuba diver	8.2	10.4	7
Divemaster or equivalent	16.3	19.5	19
Instructor	11.3	12.3	16
Master Instructor	5.5	8.1	15
Technical diving	23.8	-	-
Total	**100**	**100**	**100**
Years diving			
≤ 5	26.7	29.5	24
6-10	18.8	19.9	21
11-15	13.4	14.6	12
16-20	9.8	10.4	12
21-25	9.9	8.6	10
26-30	6.9	6.7	7
31-35	5.5	4.2	7
36-40	3.9	2.5	3
>40	5.1	3.4	4
Don't know	-	0.2	-
Total	**100**	**100**	**100**

Key:
* Edney (2012b)
# published in Edney (2011b)