



Saving two fish with one wreck: Maximizing synergies in marine biodiversity conservation and underwater cultural heritage protection

Natali Pearson ^{a,*}, Benjamin S. Thompson ^{b,2}

^a Sydney Southeast Asia Centre The University of Sydney, Room 638, Brennan-MacCallum Building (A18), NSW 2006, Australia

^b School of Social Sciences, Faculty of Arts, Monash University, VIC 3800, Australia

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ABSTRACT

The oceans harbor critical areas of marine biodiversity and underwater cultural heritage, both of which require active protection and preservation for the future. Here, we consider how the presence of underwater cultural heritage can be used to bolster the conservation of marine biodiversity, and vice versa. We perform spatial analyses showcasing where sea-space of high cultural and natural value overlaps. Subsequently, we identify three potential synergies that could lead to better outcomes for underwater cultural heritage and marine biodiversity: (1) overlap in the definitions of world heritage, Marine Protected Areas (MPAs), and other effective area-based conservation measures (OECMs); (2) synergies between shipwreck management and fisheries management; and (3) synergies around sustainable tourism and livelihoods. We then contextualize our argument using a case study in Indonesia involving the governance of the HMAS *Perth* (I) wreck and its Maritime Conservation Zone. Our discussions are relevant to marine managers and policy makers, as well as practitioners involved in economic activities that benefit from, and can impact, marine biodiversity and underwater cultural heritage, such as fishing and dive tourism.

1. Introduction

The oceans are under severe threat from natural and anthropogenic disturbances, with dire implications for marine biodiversity, food security, and human livelihoods [1]. On average, marine vertebrates have declined in abundance by 22% since the 1970s, with many populations now too small to perform their functional role within ocean ecosystems [2]. Global marine fisheries remain “in crisis” [3] with approximately 35% overexploited and 60% being fished at their maximum level [4], while some parts of the ocean are now labelled “last chance to see” tourism destinations due to escalating marine degradation [5].

Relatedly, our oceans are also home to an abundance of underwater cultural heritage (UCH), defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as all traces of human existence of a cultural, historical or archeological nature which, for at least 100 years, has been partially or totally immersed, periodically or permanently, under the oceans and in lakes and rivers [6]. Although it is impossible to quantify this UCH, estimates from UNESCO suggest that the ocean is home to at least three million ancient shipwrecks, with

actual figures far higher if contemporary wrecks are included. Nor does this figure account for the full breadth of UCH, such as submerged landscapes or sunken cities. These archeological and historical remains also face threats from opportunistic looting and industrial-scale salvaging, impacts from coastal development and deep-sea infrastructure, and damage caused by fishing trawlers and other extractive industries. These threats are increasing, because while many sites were previously inaccessible by virtue of their depth, technological developments now allow humans to venture further, and stay submerged for longer, than previously possible.

Although national governments conflate UCH and marine biodiversity as “marine resources,” management approaches to protect and conserve each have historically been separate endeavors. In academia, maritime archeologists and marine biodiversity conservation scholars have largely operated in isolation, and seldom considered how UCH and marine biodiversity can bolster support for each other in areas where they co-exist. In this article, we argue that this is a missed opportunity because of three main synergies that can be gained by considering the two together.

* Corresponding author.

E-mail address: Natali.Pearson@sydney.edu.au (N. Pearson).

¹ ORCID: 0000-0001-9424-6615

² ORCID: 0000-0002-2277-7932

The aim of this article is to assess the opportunities and potential efficiencies arising from the co-occurrence of UCH and marine biodiversity. We develop our argument in sections two and three, positing the potential impacts of joint conservation and sustainable development initiatives that will protect marine biodiversity and UCH in tandem. We then consider this with reference to an example from Indonesia, specifically the wreck of Australian warship HMAS *Perth* (I), in order to demonstrate the synergies of an integrated approach to, in this case, shipwreck and fisheries management. We contribute to the literature by demonstrating how addressing these marine resources together, rather than in isolation, can contribute to more sustainable, optimal, and resource-efficient outcomes for the ocean. In so doing, we provide insights for conservation practitioners interested in UCH, marine biodiversity, and perhaps increasingly, both.

2. Study context

This section provides further context on UCH and marine biodiversity, with particular attention on current management approaches to both. It then combines geospatial data to reveal to what extent UCH and marine biodiversity hotspots co-occur.

2.1. Underwater cultural heritage and its preservation

The establishment of a regulatory framework to protect and preserve UCH is a relatively recent development. Historically, the adjudication of shipwrecks had been governed by traditional maritime laws such as the law of finds, pertaining to lost and abandoned ships, and the law of salvage, relating to the perceived need to rescue life or property in peril and provide fair compensation for risks taken [7]. The primary intention of these traditional maritime laws, which date to antiquity, was to adjudicate property rights rather than to protect or preserve archeological or historical context. With the emergence of the modern nation state, however, came a change in the way ocean space was conceived. Rather than being viewed as a site for unhindered trade and navigation, the sea was increasingly recognized as a place where borders could be imposed and sovereignty exercised.

These changing attitudes towards the ocean informed the development of the United Nations Convention on the Law of the Sea (UNCLOS), which was adopted in 1982 and came into force in 1994. UNCLOS sought to establish consensus around public international maritime law, including navigation rights and jurisdiction over coastal waters [8]. However, archeology was a secondary consideration in the UNCLOS deliberations, and the two articles that do address archeological and historical objects at sea, Article 303 and Article 149, were only added to the Convention late in its development. The ambiguity and even inadequacy of these articles, and a lack of consensus on their interpretation, laid the basis for a more fully developed international protocol on managing archeological sites and objects in the ocean [9,10]—one that brought together three different spheres: the newly articulated law of the sea, traditional maritime laws, and cultural heritage law [11].

Subsequently, work on an international convention began in the 1990s, with UNESCO's Convention on the Protection of the Underwater Cultural Heritage (henceforth the 2001 UNESCO Convention) adopted in 2001 and coming into effect in 2009. The 2001 UNESCO Convention, which has now been ratified by 71 countries, is centered around a number of key principles, including a ban on commercial exploitation, a preference for in situ preservation, and the obligation for States Parties to work together [12]. However, ratification rates in some regions have been slow, particularly in Southeast Asia.³ Unlike terrestrial heritage, which is fixed in place, a vessel at sea is defined by movement. A sinking vessel comes to rest on the seabed regardless of which maritime zone it finds itself in. Not only are the origins of a vessel, and the place in which

it is wrecked, frequently different, there is also the question of where the people and property on the ship come from or belong to. Additional complexities emerge if the vessel is a warship, as military vessels remain the sovereign property of the flag state regardless of where they sink [13, 14]. Shipwrecks are also, increasingly, subject to territorial dispute [15]. In such situations, which are on the rise in the South China Sea, the question of who owns a shipwreck can have profound implications for territorial claims, sovereign rights, and protection and management [16].

Additionally, some states have taken proactive steps to regulate and manage the heritage in their waters. For example, Australia's *Underwater Cultural Heritage Act (2018)* provides for protected zones to be declared around significant UCH in Australian territorial waters (Table S1). The size of Australia's Protected Zones ranges from 500 m to 3200 m radii from the heritage in question (equivalent to an area of 78.5 ha to 3217 ha respectively) [17]. However, not all states have followed Australia's lead in seeking to protect and preserve shipwrecks: some, such as Indonesia, brought in laws that authorized the commercial salvage of shipwrecks in its waters (Table S1). The 1989 legislation prioritized the economic, rather than the cultural, value, of these wrecks, and directed 50% of the salvaged objects—or the profits from their sale—to the Indonesian Government [18]. In 2016, Indonesia introduced a moratorium on the commercial survey and salvage of its shipwrecks in its waters, offering hope to those who opposed this management approach. Those hopes were dashed in 2020, however, when the Indonesia Government's new Job Creation Law effectively overturned the moratorium. The status of commercial salvage in Indonesia remains in flux [18].

2.2. Marine biodiversity and its conservation

Marine biodiversity encompasses the variability of ocean-based organisms at the genetic, species, population, community, and ecosystem levels [19]. This definition is broadening to incorporate ecological interactions (for example, predator-prey relationships) and biological, chemical, or physical functions performed by individuals up to the whole ecosystem level [19]. Marine biodiversity is under severe threat from global to local scales due to chemical pollution, plastic pollution, illegal fishing, illegal coral harvesting (for example, for the aquarium trade), predator outbreaks (for example, crown-of-thorns starfish), and myriad climate change impacts [20–22].

Protected and Conserved Areas (PCAs) is a catch-all term for two area-based approaches that collectively dominate efforts to safeguard marine biodiversity—in addition to the fishing regulations that exist in unprotected ocean areas [23]. PCAs can also help to rebuild over-exploited fisheries [24] and support sustainable marine and coastal tourism [25,26]. This has led to an international target, agreed to by over 50 countries, to protect 30% of ocean area by 2030, and a strong focus on ensuring the effective and equitable management of PCAs [27–29]. Yet, PCAs currently occupy only 8.16% of ocean area [30] with poor governance often prevalent [31].

The most widely known type of PCA is the 'Marine Protected Area' (MPA), which comes in six management categories (one with a subdivision) ranging from 'Strict nature reserves' (Category Ia) where human visitation, use, and impacts are strictly limited, to those that actively promote the 'sustainable use of natural resources' (Category VI) [32]. MPAs are formally recognized under national and international law and represent a top-down approach to marine biodiversity conservation. By 2021 there were almost 18,000 MPAs globally [33]. However, implementing MPAs is resource intensive and insufficient to prevent the most egregious threats to marine resources. This is where Other Effective area-based Conservation Measures (OECMs), the second type of PCA, are of relevance. OECMs are areas that are not formally recognized but include private, local, community-managed, or non-statutory areas where protection levels are increased for biodiversity conservation or resource management, thus complementing MPAs

³ Cambodia is the only Southeast Asian signatory.

[28]. For example, recent research indicates that OECMs have a potentially significant role to play in supporting marine area-based conservation in Indonesia [33]. Developing and managing PCAs may involve marine spatial planning, zonation, monitoring, enforcement, restoration, and community engagement, education, and outreach.

2.3. Spatial co-occurrence

Spatial data on the global locations of World War II shipwrecks and marine and coastal protected areas (representing primarily formally recognized areas of ocean protection) were sourced and mapped using ArcGIS Online. The results, shown here for illustrative purposes, demonstrate that numerous protected areas and shipwrecks are co-located (Fig. 1). While only 8.16% of the oceans are currently under formal protection, the target of 30% by 2030 means that this overlap is likely to increase further in the coming years. Ultimately, it is this spatial co-occurrence that underpins our arguments outlined in the next section.

3. Argument: UCH and marine biodiversity synergies can bolster ocean conservation

In this section we argue that the spatial co-occurrence of UCH and marine biodiversity warrants greater attention by practitioners seeking to protect the oceans and its resources. We believe it could be beneficial for sites where high cultural heritage value and high biodiversity value co-occur to be used strategically to garner stronger support for formal protection. Even in areas where the co-occurrence is not so pronounced, the presence of one may create de facto protection for the other, depending on permitted levels of access and use of the sea-space. We elaborate below, with our arguments touching on three main synergies for UCH and marine biodiversity: (1) definitional synergies around area-based ocean protection, (2) synergies between wreck management and fisheries management, (3) synergies for sustainable tourism and livelihoods.

3.1. Definitional synergies around area-based ocean protection

The way we think about heritage, and its categories, has been profoundly shaped by UNESCO [34]. A common starting point for

conceptualizing heritage is by thinking of it as either ‘cultural,’ ‘natural,’ or ‘intangible,’ within and across which are other sub-categories. Cultural heritage is that which is physical and material, and can be either immovable (such as monuments, sites and buildings) or movable (illuminated manuscripts, ceramic artefacts, paintings). Natural heritage includes culturally significant landscapes and biodiversity. These two categories are defined under the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage. The 1972 Convention also provides for ‘mixed’ heritage, where both cultural and natural values are present. It is from this Convention that the UNESCO World Heritage List, which now numbers over 1150 properties, derives. To be inscribed, a property must be of outstanding universal value and meet at least one of ten selection criteria. The first marine site was inscribed in 1981, and the list now includes 50 marine and coastal world heritage sites across 37 countries. Of these, 46 are natural and 4 are mixed. Five are in Southeast Asia, including one in Vietnam and two each in Indonesia and the Philippines.

Since the establishment of the 1972 UNESCO Convention, however, there has been a growing awareness that a range of practices and knowledge systems are not adequately captured by the categories of ‘cultural,’ ‘natural’ or ‘mixed’. To this end, the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage was introduced to recognized practices, rituals, ways of knowing, performances, skills and events. These are inscribed on the UNESCO representative list of the intangible cultural heritage of humanity and include Gamelan (Indonesian percussion orchestra), *tais* (traditional textiles of Timor-Leste) and Nora (dance drama, southern Thailand).

Shipwrecks problematize these categories of cultural, natural and intangible, and can arguably span all three categories. Unlike the 1972 World Heritage or the 2003 Intangible Heritage conventions, the 2001 UNESCO Convention does not provide for inscription on a representative list. Although the word “shipwreck” is not used once in the 2001 UNESCO Convention, a shipwreck is an example of UCH. Shipwrecks sit under the broader category of cultural heritage, and, within that, as both immovable (the hull) and movable (the cargo). A wrecked vessel can also be understood in terms of its natural values, as a home for fish and other marine species, and as intangible heritage, in terms of the knowledge systems used in its construction [35]. Thus, while general categories such as natural, cultural and intangible are a useful starting point for thinking about what constitutes heritage, they must be

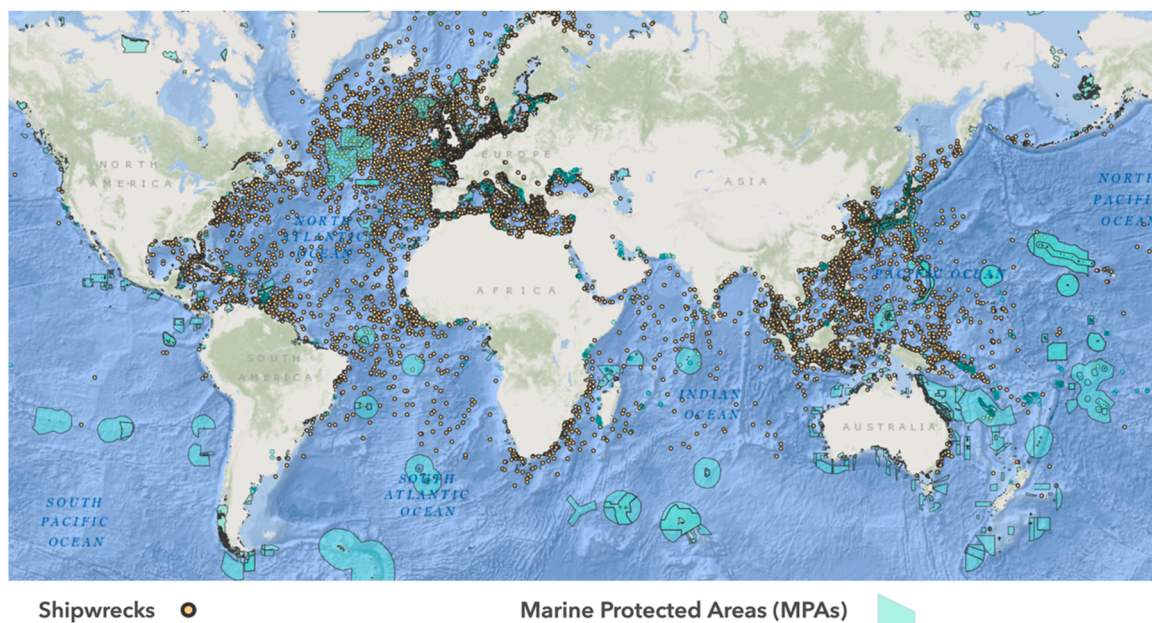


Fig. 1. Locations of WWII shipwrecks (data from Ships_v1 ArcGIS), marine and coastal protected areas (data from WDPA) across the world.

understood as mutable and institutionally conceptualized. For the purposes of our current discussion, the implication is that the legislative terminology around shipwrecks is broad enough to enable their inclusion within an array of protected area-based conservation tools.

As noted in Section 2.2, from the perspective of biodiversity conservation, these area-based tools comprise MPAs and OECMs. While shipwrecks span multiple heritage categories, the definitions of some MPA categories-particularly V and VI [36]-also include provisions for UCH (emphasis added):

- V Protected seascape: Where the *interaction of people and nature over time* has produced a distinct character with significant ecological, biological, *cultural and scenic value* and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and *other values*.
- VI Protected areas with sustainable use of natural resources: Areas which conserve ecosystems, *together with associated cultural values* and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non-industrial natural resource use compatible with nature conservation is seen as one of the main aims.

Furthermore, category III Natural monument or feature is defined as “Areas set aside to protect a specific natural monument, which can be a landform, sea mount, marine cavern, geological feature such as a cave, or a living feature such as an ancient grove.” As we propose, a century-old shipwreck could also be considered as an important natural or ‘living’ home for fish and other marine species. Meanwhile, OECMs are defined by the Conference of the Parties to the Convention on Biological Diversity as “a geographically defined area other than a protected area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity with associated ecosystem functions and services *and where applicable, cultural, spiritual, socio-economic, and other locally relevant values*” (emphasis added) [37]. Some scholars have further identified subclasses of OECM, which include “Protected sites managed for other purposes, but which deliver high conservation benefits through ancillary conservation (e.g., *Scapa Flow historic fleet wrecks and war grave*)” [38], again supporting our argument.

This section demonstrates that there are sufficient provisions relating to the categorizations of shipwrecks within relevant cultural heritage laws to render their protection either (i) outright, (ii) as part of a broader mixed protected area with some natural value, or (iii) as one of the key ‘ecosystems’ supporting marine biodiversity. In this latter example, the protected area would likely be in the form of a category III, V, or VI MPA or an OECM. This gives credence for conservationists from across UCH and marine conservation to collaborate in identifying these ‘synergy sites’ and ‘synergy zones’ and lodge joint applications for their combined protection.

3.2. Synergies between wreck management and fisheries management

We argue that the management of shipwrecks and fisheries should be better integrated amid compelling evidence of myriad inter-relationships between the two. For example, Sanchez-Caballero et al. performed a study of an MPA in California where artisanal and recreational fishing are permitted in most of the natural reefs, while the shipwrecks serving as artificial reefs are fully protected [39]. These authors found that while total fish abundance was only 20% higher on the natural reefs, the shipwrecks harbored the highest species richness (83 species, of which 21 were exclusive to the shipwrecks). Due to the lower fishing pressure, the shipwrecks were considered to provide an alternative and safer habitat to commercially important fish species such as Snappers and Groupers.

Similarly, Sreekanth et al. [40] found that fish species richness and

abundance were significantly higher on shipwrecks than natural reefs in India, while shipwrecks are also well-known to encourage the growth of Sponges and Scleractinia coral species, which further attract fish species [41]. Furthermore, wreckfishes (Polyprionidae) have been so-named due to their preference for inhabiting shipwrecks [42]. Our argument is further supported by Krumholz & Brennan’s study in the Aegean Sea, which found that wrecks in poorer physical condition had around 50% lower species richness and abundance than wrecks in pristine condition-signaling a direct link between wreck conservation and marine biodiversity conservation [43]. Their study corroborates our broader argument that MPAs and OECMs around shipwrecks can both protect UCH while also contributing to greater marine biodiversity. While not a substitute for natural coral reef ecosystems [44], the positive impacts of shipwrecks on fisheries and marine biodiversity should be maximized in management efforts in areas where these co-occur [41].

Integrating the management of shipwrecks and fisheries is also critical in order to minimize the negative impacts of this co-occurrence, such as the threat of pollution. This pollution threat will vary based on the vessel depth, vessel age at the time it was sunk, its length of time on seafloor, and the stability of the seabed [45]. The nature of the vessel itself is also relevant, with warships posing a specific risk in terms of unexploded ordnance [46,47]. More generally, modern shipwrecks pose a pollution threat to fisheries management and marine biodiversity due to the gradual, eventual, or immediate leaking of oil and chemicals. Beyond their pollution risks, there is also the potential for shipwrecks to cause fish populations to become more concentrated. If the site is not a protected area, the presence of high volumes of fish stock could in fact, attract more fishing activities [48]. While a somewhat perverse outcome in cases where fishing regulations or enforcement are weak, UCH could bolster fish abundance and by extension catch-per-unit-effort, in fisheries that are sustainably managed.

The presence of sustainable fishing regulations can offer *de facto* protection for UCH. For example, unsustainable fishing activities such as bottom trawling and blast fishing can cause damage to UCH-both its physical form and its cultural integrity [43,49]. This is especially true for shipwrecks “in deep waters that are below the reach of divers and the impact of storms, but within reach of fishing activities” [43]. Hence, the above examples and factors demonstrate that fisheries management and wreck management should be increasingly integrated, to drive collaborative management that can mitigate conflicts between the fishing industry and maritime archeologists.

3.3. Synergies around sustainable tourism and livelihoods

Recreational diving and snorkeling often occurs inside MPAs because these areas have high biodiversity value that is attractive to tourists, while the user fees paid by recreationists can support management of the MPA [50,51]. However, management of dive operations-both inside and outside MPAs-can be challenged by the negative impacts on the marine ecosystem such as disturbance to marine life and physical damage to coral reefs [52]. Recreational diving and snorkeling also occurs at UCH sites such as submerged ruins, aircrafts, and shipwrecks [53,54]. UCH enhances recreational diving opportunities by diversifying the array of dive sites in an area beyond natural coral reefs, and, in line with Section 3.2, exhibiting a different array of marine biodiversity (possibly at higher concentrations) compared to other proximal sites [51,55]. While natural reefs may be able to regenerate from damage or disturbance, UCH is a non-renewable resource subject to diver impacts ranging from boat anchor and mooring, contact with the UCH structures leading to a gradual weakening, and exhaled air bubbles inside enclosed spaces which accelerates corrosion [53,55]. In this regard, it has been argued that some UCH may become “sites of interest to be consumed by tourists” [54], with insufficient consideration for, or education on, the need for preservation.

The synergies between UCH and marine biodiversity for dive tourism extend to the livelihoods of local people. For example, community

managed dive tourism operations can be successful in providing an array of income sources for local entrepreneurs through activities ranging from dive tours to homestays [56]. Yet, while shipwrecks can provide such benefits to coastal communities, the key challenge is how to ensure these benefits are sustainable and equitable. Tourism provides a starkly preferable alternative to the opportunistic removal and sale of valuable items from shipwrecks, which can provide short-term financial benefits to local communities but diminish what is a finite resource. A more sustainable approach is to protect the integrity of the wreck, thereby creating the conditions for marine ecosystems to develop and flourish, in turn supporting local livelihoods through dive tourism. Not only do such activities ensure a long-term income stream for coastal communities, they also create opportunities for these communities to develop and promote their own maritime cultural identity through their relationship with the sea.

Considering the above, the nexus between UCH, marine biodiversity, and ocean protection is apparent, and these synergies can be harnessed for the effective management of dive tourism operations. For example, artificial reef wrecks-defined as vessels that are “sunk intentionally as a recreational resource” [55]-have been used strategically by marine managers to reduce the impact of dive tourism on both natural coral reefs and UCH. Innovative technologies are also emerging, such as ‘virtual dive trails’, which can increase visitation from non-divers [57]. Knowledge Awareness Centers are also being used to change mindsets and inform visitors of the importance of both marine biodiversity and UCH [58]. These approaches offer further opportunities for the co-occurrence of UCH and marine biodiversity to support sustainable tourism and livelihoods in tandem.

4. Application: HMAS *Perth* (I) and its maritime conservation zone, Indonesia

To demonstrate the potential benefits of an integrated approach to heritage and marine biodiversity management, this section focuses on Indonesia, and particularly the wreck of HMAS *Perth* (I), which sank under Japanese attack in 1942. This wreck brings together many of the sensitivities and challenges associated with effective protection of UCH management, and is also of contemporary relevance to coastal communities in Banten Bay, for whom the wreck is a source of income through fishing and, in the future, potential dive tourism. Beyond *Perth*, we also draw on the circumstances and events at the proximal Thousand Islands National Park which is a popular domestic tourism destination, particularly for residents of nearby Jakarta. We begin with an overview of the *Perth* case study before demonstrating its relevance to our three synergies.

HMAS *Perth* (I) (see Fig. 2a) is an Australian naval shipwreck sunk in Banten Bay, Indonesia in early 1942 [59]. *Perth* and its companion, USS *Houston*, were attempting to make their way through the Sunda Strait to the relative safety of Java’s south coast when they encountered the incoming Japanese Western Invasion Fleet late in the evening of 28 February. Both *Perth* and *Houston* were sunk by gun- and torpedo-fire in the early hours of 1 March, with more than 1000 men killed in the ensuing battle, including 353 of 681 men from *Perth*. Those who survived were taken as Japanese prisoners of war, enduring years as enslaved laborers in Thailand, Burma and Japan. News of their fate remained unknown for years. Just 218 of *Perth*’s crew made it home alive following World War II.

Following their rediscovery in 1967, both wrecks were subjected to human interference over many decades. Initially this interference took the form of opportunistic looting and targeted souveniring of small, portable objects such as bells, propellers and even musical instruments [60,61]. In recent years, however, this interference has become industrial in scale. In 2017, a joint site survey (see Fig. 2c) by Indonesian and Australian maritime archeologists found that less than 40% of *Perth* remained in situ [62]. The wreck had been heavily salvaged by what are believed to be Chinese-flagged salvage barges equipped with a grab

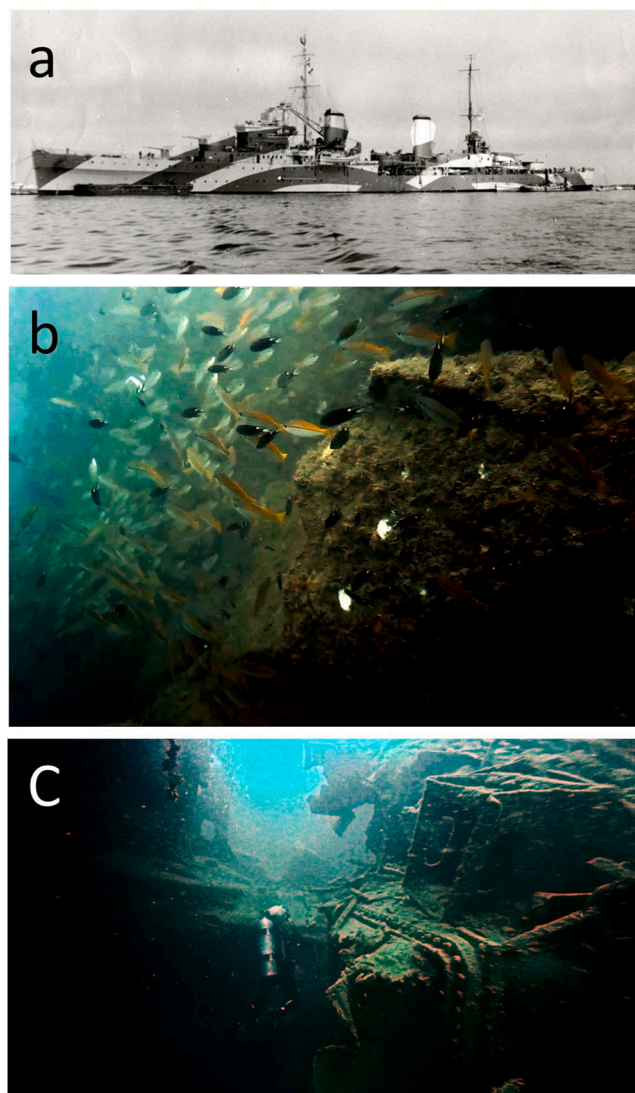


Fig. 2. showing HMAS *Perth* (I) at sea during World War II (circa December 1940–November 1941) (a), surrounded by fish (b), and being surveyed by a maritime archeologist in 2017 (c). Image credits: George Hatfield (a) and the Australian National Maritime Museum (b and c).

claw. The presence of human remains had not deterred the salvagers, who instead prioritized *Perth*’s scrap-metal value.

The survey results were used by advocates in both Australia and Indonesia to lobby for legal protection of *Perth*. On 28 February 2018, the Minister of Marine Affairs and Fisheries, Susi Pudjiastuti, approved a Ministerial Decree designating the wreck of HMAS *Perth* (I) and its surrounding waters as a Maritime Conservation Zone (*Kawasan Konservasi Maritim*) [63]. The Decree provides a legal basis for site protection. It establishes a Maritime Conservation Zone, consisting of a ‘core’ zone of 9180 m² around the wreck itself, which lies within striking distance at a depth of 35 m, and a larger ‘limited use’ zone of 99.94 ha. Only limited activities are permitted within the core zone: surveillance patrols, research and non-extractive development, and educational activities. The larger zone of limited utilisation permits a wider range of activities for the benefit of local communities, including pilgrimages or religious ceremonies, water-based tourism, fishing and aquaculture. Highly damaging activities such as the use of explosive and poisonous chemicals are banned throughout the Zone. The Decree vests responsibility for site management at the provincial level, meaning Banten Provincial Government are responsible for developing and implementing a comprehensive management plan for *Perth*. The location of HMAS

Perth, along with other shipwrecks and current marine and coastal protected areas in and around Indonesian waters, can be seen in Fig. 3.

4.1. Defining protection: Multiple types of ‘conservation zone’

In 2010, Indonesia introduced Law No.11 on Cultural Heritage. Law No.11/2010 provides for cultural heritage “on land and/or water,” and also for intangible heritage. To be considered as cultural heritage, the following criteria needed to be met: at least 50 years old; represent a specific stylistic period of at least 50 years, possess important value for history, science, education, religion and/or culture; and possess important value for *strengthening national identity* (Article 3 (c), emphasis added). It mandates that cultural heritage is “entirely and primarily for the people’s welfare” while also needing to “maintain[...] its sustainability” [64]. Conservation is not just about preservation but also about

utilisation [64]. Law No.11/2010 provides National Criteria for assessing and inscribing Indonesian cultural heritage properties (Article 5). To list a UCH site, a team of cultural conservation experts can make a recommendation to the local government. However, as of 2021, no UCH had been inscribed as Cultural Heritage under this law [64].

In Indonesia, ‘National Conservation Areas’ are designated by the Ministry of Marine Affairs and Fisheries, and can be established for biodiversity, important fish habitat, and historic shipwrecks. These Areas are subdivided into Parks, Reserves, or Maritime Conservation Zones, respectively. The steps for determining a Maritime Conservation Zone are similar. Under Ministry of Marine Affairs and Fisheries Regulation 17/2008, proposals can be submitted by individuals, community groups, universities, research institutes, legal entities, or local governments. The Governor of the province within which the proposed site is located conducts an assessment of the site’s eligibility by collecting and

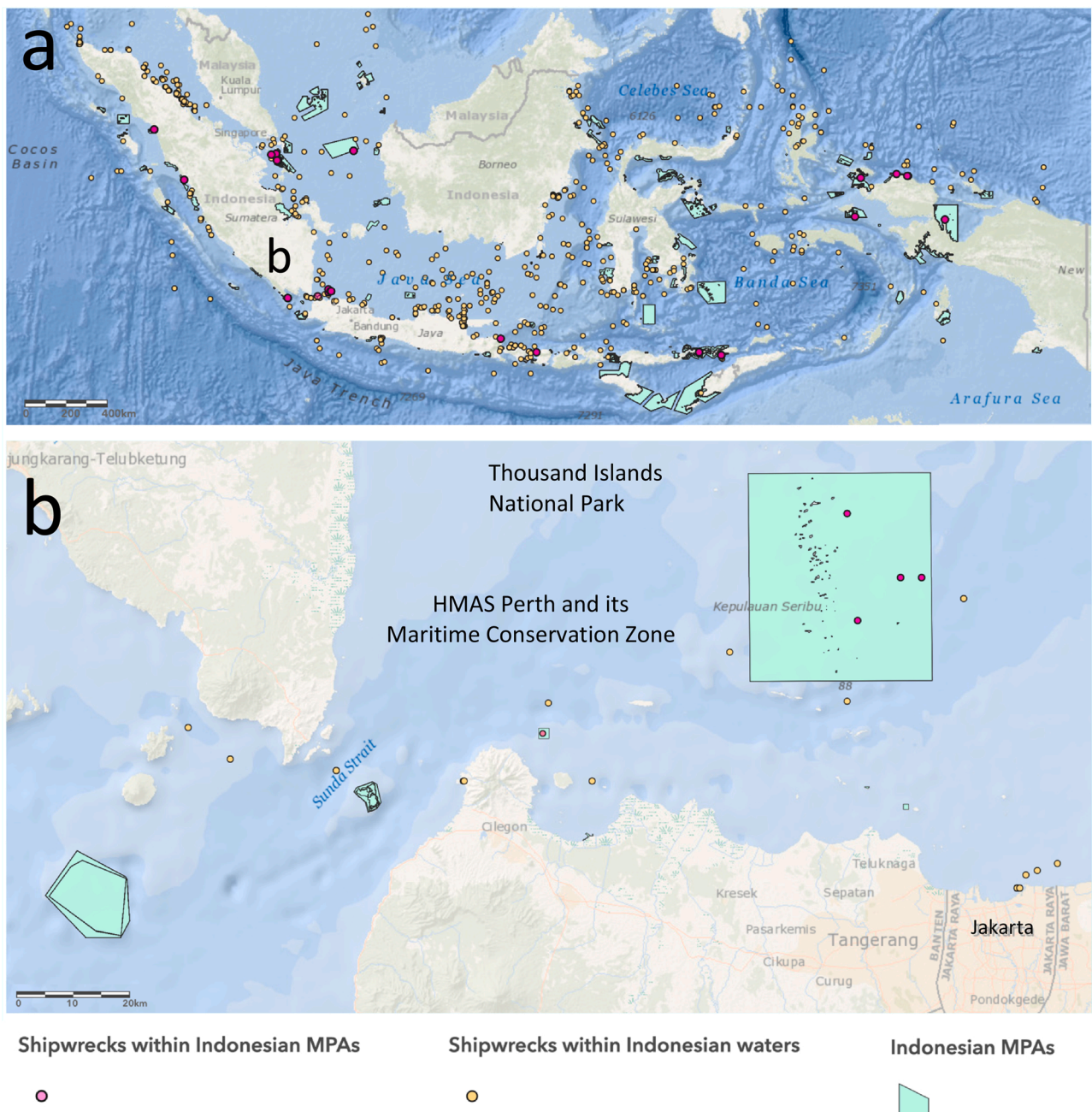


Fig. 3. Location of WWII shipwrecks (data from Ships_v1 ArcGIS) and marine and coastal protected areas (data from WDPA) in Indonesia (a), and the Sunda Strait region including Thousand Island National Park and HMAS Perth with its Maritime Conservation Zone (b).

analyzing data and preparing a feasibility report. The Minister of Marine Affairs and Fisheries assesses the recommendations and makes a decision.

Notably, *Perth* was protected as a maritime conservation, not as a cultural heritage, zone. Although it is tempting to surmise that this was a political decision connected to a reluctance on the part of Indonesia to recognize a foreign warship as cultural heritage, the reason for this is more practical, and instead is connected to the inadequate implementation of Law No.11/2010 on Cultural Heritage, which provides for the inscription of cultural heritage sites [65]. As of 2021, no Government Regulations (*Peraturan Pemerintah*) had been issued to implement Law No.11/2010 [64]. Local informants have indicated that the delay in issuing operational guidelines is due to the difficulties associated with determining and attributing value to underwater sites. In the case of cultural heritage under Law No.11/2010, these values pertain to history, science, education, religion and culture; for marine conservation areas, these values related to archeology, history, science, culture, religion and custom [64].

To enact any sort of protection over HMAS *Perth* (I), authorities had to be flexible and creative in their approach. Listing *Perth* as a Maritime Conservation Zone at least established *some* sort of formal mechanism over the site. It also enabled the recognition that *Perth* is a new habitat for fish [66]. The designation sought to guarantee the sustainable preservation of the wreck as UCH, to optimize the potential use of the wreck site, and to improve the welfare of the coastal communities in the vicinity of the Zone through, potentially, wreck tourism.

The Ministerial Decree governing the designation defines a Maritime Conservation Zone as a protected area of maritime custom and culture with special historical and archeological value, a maritime historical site, or a place of religious ritual or custom, together with conservation efforts on the coast and small islands. By monitoring the marine biodata regularly, including fish and marine debris, officials from the Research Institute for Coastal Vulnerabilities and Resources (within the Ministry of Marine Affairs and Fisheries) also monitor the ship's condition [67]. Their presence, regardless of purpose, deters looters and salvagers, and demonstrates the potential efficiencies and synergies to be found. The presence of national level officials also provides a useful complement to site monitoring activities at the provincial level, which are impeded by limited funding and resources.

Indonesia and Australia recognize the importance of preserving the *Perth* wreck and are working together proactively to manage the site for the future. This includes supporting local officials within the Banten Provincial Government to implement a comprehensive management plan, and developing a high-level bilateral agreement on maritime heritage cooperation. Meanwhile, Indonesian authorities are also working towards listing USS *Houston* as a Maritime Conservation Zone. *Houston* has not suffered from the same degree of industrial scale salvaging as *Perth*, largely due to its proximity to the shore. Once *Houston* is listed, there will be yet more efficiencies to be found due to the proximity of the two wrecks and their conservation zones.

4.2. Combining wreck management and fisheries management

In the decades following its sinking, *Perth's* marine ecosystem flourished. Dive reports from the 1960s noted the presence of sharks, gropers, octopus, dozens of green turtles and hundreds of varieties of fish, as well as Gorgonia coral [68]. These dives confirmed what the local fishermen already knew: *Perth* was “splashed with living color; covered with the innocent, unprejudiced rainbow growth of animal and vegetable in harmony affirming indefeasible life-to-come” [68]. This thriving marine eco-system offered economic opportunities to local fishermen, while the presence of birds hunting the waters around the wreck also provided useful navigational references for coastal communities and seafarers (see Fig. 2b). In recent years, however, the destruction of *Perth* by salvaging has also had negative impacts on this fishery. However, the reverse-fishing activities negatively impacting the

wreck is not an issue since the fishing gears used in this area are dominated by gill nets, longlines, and fishing poles [69], all of which are deployed at the top of the water column and will not come into contact with *Perth*.

Legislation around Maritime Conservation Zones contains provisions for both a ‘core zone’ representing e.g., the shipwreck, where *only* research is permitted, and a broader ‘Limited Use Zone’, which can permit capture fisheries, mariculture, and tourism activities-the latter of which is significant for Section 4.3. With salvaging now banned, the Banten Provincial Government has identified potential within the marine and fisheries sector in Banten Province, with *Perth's* Maritime Conservation Zones contributing to this. Biophysical monitoring conducted in September 2020 identified at least 21 different species in the *Perth* conservation zone, some of which are commercially viable [70]. Banten Province is home to an estimated 27,645 fishers, 36,805 fish cultivators, 4020 fish processors and 29,327 vendors [70]. Furthermore, Banten Province has a sea water area of 1486 km², a shoreline of 896 km [70], and includes Thousand Islands National Park which contributes around 21% of the Java Sea's total fish landings by volume [69].

Besides the importance of identifying synergies in the management of *Perth's* Maritime Conservation Zones and Thousand Islands National Park for both fishing and UCH stakeholders, further synergies can be identified in cases where threats to both emanate from the same source. In this case, an issue gaining increased notoriety is that of marine litter which enters Banten Bay, and waters beyond, via one of 13 rivers, many of which pass through Jakarta [67,69]. Marine litter has a clear environmental impact for fisheries, for example through fish entanglement [71], but it also causes a major cultural impact for *Perth*, as a warship graveyard, since marine litter can degrade the esthetics of the site during regular flower sowing ceremonies held in honor of its lost crew members [67]. This double impact is one example of how collaboration and co-ordination between fishing and UCH stakeholders could help build a stronger case for actions that reduce marine litter throughout Banten Province and the Java Sea.

4.3. Sustainable tourism and livelihoods

Perth's tourism potential remains both undeveloped and controversial due to the sensitivities associated with the presence of human remains [72–74]. However, authorities are eager to create opportunities to bolster local incomes while at the same time creating incentives to monitor and protect the wreck, and, as shown in Fig. 3, *Perth* is one of several wrecks in the vicinity.

Indeed, researchers and practitioners are actively developing initiatives to support the establishment of marine ecotourism development areas in Thousand Islands National Park [75], where several historic shipwrecks are home to coral reefs and marine ecosystems (Fig. 3b). Dillenia et al. completed Site Significance Assessments of four of these shipwrecks-the *Shinta*, *Tabularasa*, *Poso*, and *Papatheo* wrecks-based on factors such as their depth, age, condition, bathymetry, sediment, coral cover, water quality, and pre-existing tourism infrastructure [75]. While not all meet the 100-year-old age requirement of UCH, some were greater than 50 years old and deemed to be of high potential for marine ecotourism and dive tourism. Such infrastructure is high, as is the dive tourism market due to proximity with Indonesia's capital city of Jakarta; indeed, the Thousand Island's flagship tourist spot, Pramuka Island, is labelled “A Paradise for Diver in Jakarta” [76].

These initiatives build on the Maritime Tourism Village (*Desa Wisata Bahari*) program that has been rolled out in multiple coastal villages across Indonesia in recent years by the Ministry of Marine Affairs and Fisheries [77]. The program responds to the downturn in income caused by the COVID-19 pandemic, and frames Indonesia's natural heritage as a key driver of economic recovery. It seeks to involve and empower coastal communities by encouraging them to contribute to ecosystem conservation in order to drive maritime tourism, which in turn will improve the welfare of the community. This shows that Indonesia has a

sufficient institutional framework at the national level to support the development of tourism in villages around the Sunda Strait that may leverage the presence of *Perth* and the other shipwrecks in these waters.

Considering livelihoods more broadly, a 2014 survey of officials from the Ministry of Marine Affairs and Fisheries found that local people view historic shipwrecks and their cargoes as akin to a natural ecosystem—that is, as a marine resource that can be “used and managed for the sake of community wellbeing” [78]. There is certainly potential to develop the economic potential of HMAS *Perth* (I) in a more sustainable manner, for example through specialist diving tourism focusing on wartime heritage, or working with local communities on Pulau Panjang to support livelihoods (through anchovy and lobster fishing and shell art in particular) [70]. Such initiatives would represent a longer-term solution to the question of how to best manage *Perth* for the future, and stand in stark contrast to the short-term exploitation that has taken place at the hands of illicit salvagers.

5. Conclusion

In this paper, we have analyzed the synergies between efforts to protect and preserve UCH, and those to support marine biodiversity, in the world’s oceans. We have done so with reference to three specific synergies, namely definitional overlaps, shipwreck and fisheries management, and the potential for better tourism and livelihood outcomes in areas where UCH and marine biodiversity co-exists. As the case of *Perth* demonstrates, protection of one aspect—whether it is the cultural or, in this case, the natural, aspect-of the sea-space can have correspondingly positive outcomes for the other aspect, and indeed, overall.

Underpinning these outcomes are a range of additional factors including local stakeholder engagement, effective long-term monitoring and enforcement mechanisms, proactive dialog and collaboration between agencies and with communities, and marine education initiatives. In this regard, our arguments have broader relevance for scholars interested in these multiple aspects of ocean governance. For example, several studies demonstrate the positive impact that ocean literacy and marine education can have on the attitudes and behaviors of students, tourists, and stakeholders. However, such studies have focused on UCH [54], marine litter [79], or marine biodiversity [80], and done so largely in isolation. Hence, we would advocate future marine education studies and initiatives that explore and expound the relationships between these often highly interrelated aspects of ocean stewardship – as demonstrated by our HMAS *Perth* case study.

Further study and collaboration around the monitoring and enforcement of sites where UCH and high marine biodiversity co-occur will also be paramount. In practice, this will require maritime, marine resource, environmental, and tourism agencies to collaborate to effectively manage what could well become increasingly multi-use seaspaces. For instance, it will be important to ensure that fishing bans are enforced to prevent the disgruntlement of tourist divers at wreck sites [81] and to monitor UCH dive sites to verify whether dive tourism is accelerating wreck degradation [81]. Similarly, the monitoring of wreck condition, water quality, and fish health also need to be considered in unison. Some recent studies have shown significant differences between pollutant levels between both sediments and fish collected in shipwreck sites and control sites [82]. Technological advances in the form of Remotely Operated Vehicles could help drive future research and practice in this regard and help promote our outlined synergies for wreck and fisheries management, and by extension, those around tourism and livelihoods.

Amid calls to develop a new discipline of Maritime Heritage Ecology [83] and the December 2022 introduction of the Kunming-Montreal Global Biodiversity Framework reinforcing area-based ocean protection targets, we hope this study will offer valuable insights for those charged with marine governance, including national and local officials, policy makers, and practitioners—whilst also spurring further conversations and collaborations between UCH and marine biodiversity scholars in the future.

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CRedit authorship contribution statement

Natali Pearson: Conceptualization, Methodology, Writing – original draft, Writing – review & Editing, Funding acquisition. **Benjamin S. Thompson:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Visualization.

Declaration of Competing Interest

none.

Data availability

No data was used for the research described in the article.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2023.105613](https://doi.org/10.1016/j.marpol.2023.105613).

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