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# 'Out of sight, out of mind' - towards a greater acknowledgment of submerged prehistoric resources in Australian science-policy as part of a common heritage

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There is growing awareness of the need for greater acknowledgement of underwater prehistoric cultural resources as part of management and regulation of the seabed around many maritime countries, especially those with large indigenous populations and history such as Australia. Prehistoric cultural places and landscapes inundated by Post-glacial sea-level rise on Australia's continental shelf remain largely out-of-sight and out-of-mind, hence awareness and hence legal protection of this resource is lacking. There is a clear need for greater integration of archaeology and cultural heritage management within the marine sciences as well as a greater awareness of this resource as part of a common heritage more generally. This paper explores some of the dichotomies between Western and Indigenous cultures in valuing and managing the seabed. We argue that in developing science-policy, an attempt at least needs to be made to bridge both the gap between the nature and culture perspectives, and the jurisdictional divide between land and sea. Part of the answer lies in a convergence of Indigenous knowledge with Western science approaches, focused around our understanding of physical processes impacting past and present coastal landscapes and on the seabed itself. We explore several case studies from northern and Western Australia that are trying to do this, and which are helping to provide a greater appreciation of the inundated landscapes of the inner shelf as part of a common heritage.

## KEYWORDS

cultural heritage management, submerged cultural resources, marine science, geoarchaeology, Indigenous, Western Australia

## Introduction

Indigenous occupation in Australia dates from 65,000 years b.p. (Clarkson et al., 2017) but the most significant part of this – over 55,000 years and more than 2 million km<sup>2</sup> of the continental landmass – is now underwater, drowned by sea-level rise over the last 20,000 years. Prehistoric cultural places and landscapes inundated by Post-glacial sea-level rise on Australia's continental shelf have to date been largely out-of-sight and out-of-mind. This article reflects on submerged prehistoric cultural heritage resources as part of a 'common heritage', and as part of sustainable marine management. Distinction is made here between submerged landscapes as part of the global commons<sup>1</sup> from those that are part of the cultural heritage of Traditional Owners. The former holds that the sea and seabed within the Exclusive Economic Zone (EEZ) are "common to all men", with individual nation states sharing in its management and the benefits of its exploitation (Guntrip, 2003; see also Smyth and Isherwood, 2016). The latter relates to the Indigenous understanding of the sea as an inseparable extension of the land (e.g., Yunupingu and Muller, 2009; James, 2019) and hence subject to the same aspects of custodianship, exclusive resources and customary law. Hence "Sea Country" and "Saltwater Country" refers to any environment within broader traditional estates that are associated with the sea or saltwater—including coastal areas, estuaries, beaches, marine areas and islands and their living and non-living natural resources (Rist et al., 2019).

We argue that in developing ocean science and ocean science-policy for Australia, greater attempt needs to be made to bridge the gap between Western science and Indigenous knowledge and also the jurisdictional divide between land and sea (see also Yunupingu and Muller, 2009), not least because sea level has changed over the 65,000-year period of human occupation. This necessarily includes an emphasis on the past and present physical (seabed) landscape but also the more challenging realm of perception of seascapes in cultural heritage management (Kikiloi et al., 2017; Wickham-Jones, 2019). Currently, an upfront integration between cultural heritage and marine sciences is lacking (Trakadas et al., 2019). We explore a number of case studies from northern and Western Australia that attempt to combine these ideas, and which are helping to provide a greater appreciation of the submerged landscapes of the inner shelf – and natural and cultural elements of these, as something of 'common concern of humankind' (aka Forrest, 2007).

Our approach is largely an interrogation of the literature around a broader topic of marine science, cultural heritage and the seabed, as there are very few studies that deal directly with

the question of science policy on submerged prehistoric landscapes. As emphasis of this, a Scopus search using the keywords of marine, prehistoric, cultural, science, policy yielded zero results. A Scopus search using the keywords indigenous, submerged, landscape, policy yielded two results (Ward et al., 2018; McCarthy et al., 2022), whilst indigenous, submerged, landscape, science produced only one result (Flatman and Evans, 2014). Marine, indigenous, cultural, science, policy yielded 16 results, most of which were related to inclusion (e.g., Kikiloi et al., 2017; Johri et al., 2021; Worm et al., 2021) and none of which directly referred to the seabed or submerged landscapes. Whilst ocean-science policy is arguably directed towards regulators and developers, it is driven by values and interests as much as by evidence and research. Raising awareness of novel topics, such as submerged landscapes, is key (Zuercher et al., 2022) and the general lack of awareness of submerged prehistoric cultural resources means that this discussion is relevant to all who have a value and interest in the marine environment.

## Past and present sea country

Over the 65,000 years of Aboriginal occupation of Australia, sea levels have fluctuated, rising from a peak low of -120 m at around 21,000 years ago relative to present levels and resulting in inundation of vast areas the continental shelf. Indigenous people witnessed, adapted to and "remember" many phases of falling and rising sea-level and associated geomorphological change along the coastline, particularly across northern Australia's low gradient continental shelf. Change and adaptation – and not just to climate or sea level, is a constant feature, rooted in history and time and connected to country and everything relating to it (Nurse-Bray et al., 2019). The Gunggandji people of North Queensland, for example, "have lived through a 10-metre rise in sea level, great changes in rainfall, the arrival of new plant and animal species and the great upheavals caused by volcanic activity as river courses changed and new land forms emerged" (Gunggandji Land and Sea Country PBC Aboriginal Corporation, 2013). Many Indigenous people still relate to land that was inundated by sea-level rise and before current coastal ecosystems began to establish when sea level stabilized about 5000 years ago (Smyth, 2002), with marine sacred sites recorded up to 80 km off the Northern Territory coast (Peterson and Rigsby, 1998; see also Kearney & Bradley, 2009). Visual narratives and oral histories involving mythological creatures that affect coastal and landscape change provide another form of agency to relate to and make sense of the evolving landscape, with oral histories dated on the basis of correlation with sea-level curves to at least 12,600 years ago (Nunn and Reid, 2016; Nunn, 2018; see also Wickham-Jones, 2019).

Compared to Western understandings of the coastal and offshore zone, Indigenous ways of knowing and managing Sea

<sup>1</sup> Under UNCLOS the seabed and ocean floor within each nations' EEZ is viewed as the 'common heritage' of mankind (United Nations 1982).

Country are more geospherical (earth-centered) and emphasize the interconnectedness of people and nature, land and sea, and of physical (tangible) and metaphysical (intangible) elements within these (Kwaymullina and Kwaymullina, 2010; Korf, 2019; Tilot et al., 2021).<sup>2</sup> These physical elements extend beyond specific economic resources (flora, fauna, geology) to detailed knowledge of oceanography (e.g., tides and currents) with the implicit emphasis on understanding of process and change (see also Lee, 2016; Stevens and Paul Brake, 2021). The latter pairs place and memory, including through songlines or 'Dreamings'<sup>3</sup> and language, so that knowledge is grounded in landscape and landscape evolution. Ancestral journeys often commence out at sea then move closer to land, creating seascapes - islands, reefs, rocks, sand banks, cays, patches of seagrass - and travel on to create emergent landscapes. Extant connections exist from named places in the sea (reefs, rocks, etc.), including named zones of the sea defined by water depth (Chase and Sutton, 1981) and named bodies of water associated with ancestral dreaming tracks (Myers et al., 1996; Peterson and Rigsby, 1998). The Mayala people of the West Kimberley, for example, know the complex tides and tidal currents (*loo*) and travel on the *noomoorr*, which resembles a saltwater highway (Mayala Inninalang Aboriginal Corporation, 2019). Similarly, the Yanyuwa language or 'Tiger shark language' originates from a 40,000-year-old relationship with the tiger shark and the ocean (Kearney and Bradley, 2009)<sup>4</sup>.

Indigenous understandings of Sea Country also counter conventional Western notions of the shoreline as a boundary marking the divide between land and sea, often with separate jurisdictional arrangements. Western convention, including the UN *Convention on the Law of the Sea* (UNCLOS), uses defined baselines, such as the high-water mark as the upper boundary of territorial waters and the EEZ. As such, this has to be recalibrated at regular intervals to allow for sea-level change and anthropogenic structures that may extend the agreed land area of a state (Zacharias and Ardron, 2020)<sup>5</sup>. Notably, some of those jurisdictions were originally related to the defence of a state, for example, the area controlled by cannon-fire from the land. This is in large contrast to the way Indigenous peoples

define their lands. For many such peoples across Australia (e.g., Kearney and Bradley, 2009; James, 2019; Mayala Inninalang Aboriginal Corporation, 2019) and also the Pacific Islands (Tilot et al., 2021), the sea is not only a physical and temporal space, but also a mental map of ancestral journeys and ritual renewals with a view to nurturing and passing on place-based knowledge and its biological, cultural, and linguistic endowment to future generations (see also Vierros et al., 2020). This is truly a sustainable view of ocean use by society and perhaps broader than that envisaged by the UN Sustainable Development Goals. Although arguably a recent distinction (Wickham-Jones, 2010), the Western separation of land and sea as conceptual and physical entities is, Henderson (2019) argues, ultimately responsible for the underappreciated role of the importance of the sea in human history. This is particularly at odds for an island nation such as Australia whose history and ecology were shaped by the sea, and whose 200-nautical-mile exclusive economic zone (EEZ) is greater than the land mass of the nation itself (Figure 1; Symonds et al., 2009).

As studies across various maritime nations with large Indigenous histories, and especially those in the Southern Hemisphere, are revealing, these shelf areas offer new insights into past coastal and ecological dynamics and, by inference, new understandings of past human occupation and dispersal, as well as potentially of seafaring and maritime trade (Henderson, 2019; Ward et al., 2022a and references therein). However, as in other parts of the world (e.g., Quig, 2004; Wickham-Jones, 2010), the lack of research and sometimes even the lack of awareness of the cultural and ecological value of submerged landscapes is a serious hindrance to good management. In the Kimberley, for example, the coastal area between the shoreline (defined as Mean High Water Mark) and 2 km inland was found to be disproportionately valued over areas 20 km and even 200 km landward or seaward (Kobryn et al., 2018). In addition, of the thirty critical research needs identified for the Kimberley marine environment in Western Australia, submerged cultural heritage was not identified by any of the Healthy Country<sup>6</sup> managers, natural resource managers or scientists (Cviyamovoc et al., 2021). However, as Kobryn et al. (2018) identify, places that are not mapped should not be interpreted as the absence of values, but simply places that require greater research effort, which we argue includes submerged cultural landscapes. All marine protected areas, including Sea Country IPAs (Figure 1), recognized by the International Union for the Conservation of Nature (IUCN) are obliged to protect the associated cultural values of those areas, which includes the seabed. Hence to achieve a better understanding of the ocean and its common heritage, we need to merge various types of evidence and give

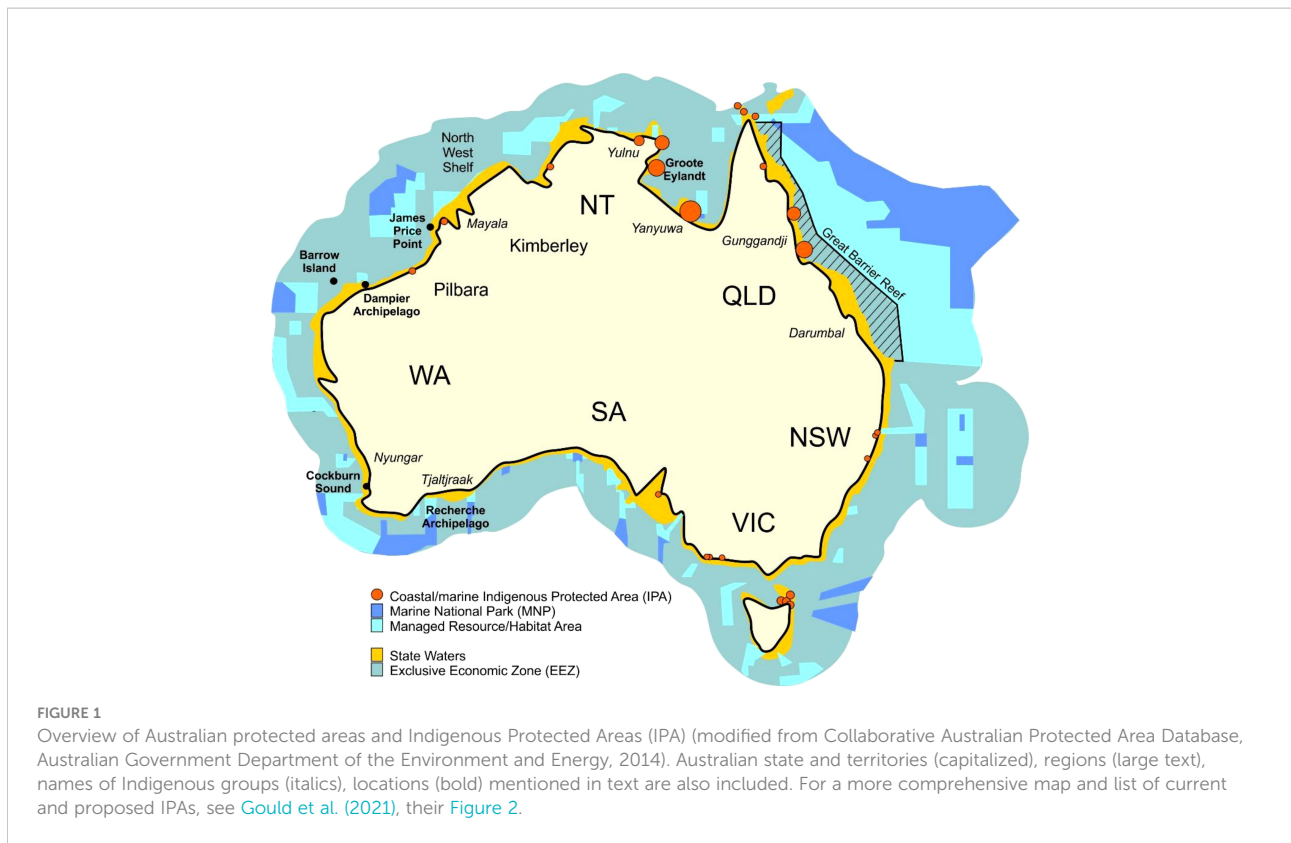
<sup>2</sup> See also [https://nntc.com.au/news\\_latest/the-state-of-intangible-cultural-heritage-in-australia/](https://nntc.com.au/news_latest/the-state-of-intangible-cultural-heritage-in-australia/)

<sup>3</sup> Songlines or dreaming tracks are maps of the land that show the connectedness between places and Creation events, and a central part of Australian Indigenous culture (see also Malcolm and Willis 2016).

<sup>4</sup> See also <https://www.bbc.com/travel/article/20180429-australias-ancient-language-shaped-by-sharks>

<sup>5</sup> For the current jurisdictional zones of Australia's marine environment, see <https://soe.environment.gov.au/science/soe/2011-report/6-marine/1-introduction/1-1-the-jurisdictions>

<sup>6</sup> Healthy Country Planning (HCP) is an adaptation of the Conservation Standards used and adopted by Aboriginal land management teams across Australia (see Carr et al. 2017).



greater credibility to cultural knowledge systems such as that passed down in oral-histories.

## The (un)known cultural heritage resource

### Establishing a baseline

The National Marine Science Plan 2015-2025<sup>7</sup> states that to improve the management of Australia's marine estate, marine science needs to improve the collection of data relevant to resource allocation, particularly for Indigenous use and rights and other social and economic attributes. A resource or system cannot be managed unless it is measured or mapped ([Borja and Elliott, 2021](#)), or as Indigenous elder Edvard [Hviding \(2005\)](#) explains, “*those who cannot name the good things of sea and land, cannot find them, and therefore cannot eat or otherwise benefit from them, nor will they know how to look after them well*”. This ultimately leads to a need for systematic assessment of ecological and cultural heritage resources – both known and unknown in coastal and marine settings (e.g., [Gee et al. 2017](#)),

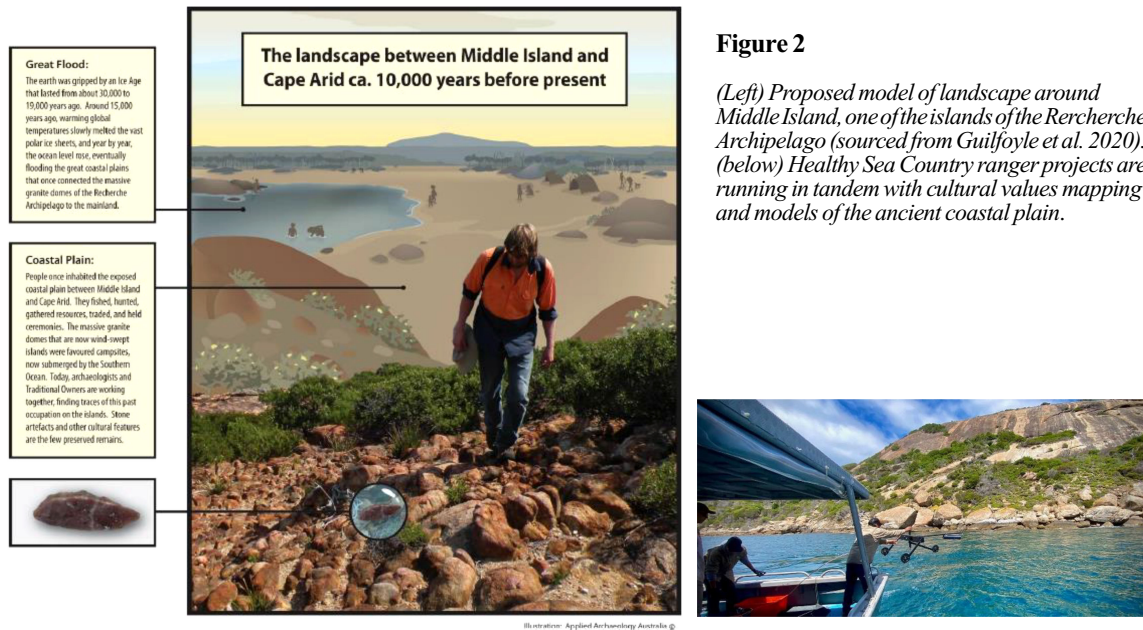
<sup>7</sup> National Marine Science Committee (2015) <https://www.marinescience.net.au/nationalmarinescienceplan/>

such as was done for Groote Eylandt ([Davies et al., 2020](#)) and is being done for the Recherche Archipelago ([Guilfoyle et al., 2019](#)) (see locations on [Box 1](#)). The community-led study in the Recherche Archipelago is exploring the transformation of the coastal plain from the late Pleistocene, including traditional creation stories of the islands, to the more recent historical use of the archipelago ([Box 1](#): Recherche Archipelago). Indigenous perspectives and traditional knowledge can be integrated with western approaches to document this drowned landscape as a new form of ecosystem-based science and shared solutions for its future management.

For Western Australia, this baseline understanding is very uneven, as identified in a statewide review of coastal waters for potential marine conservation ([CALM, 1994](#)). The latter report recommended areas of protection but also highlighted the lack of scientific research available to justify that decision. A more recent report undertaken for the southern coast similarly found it difficult to identify areas of higher conservation value – whether ecological, geological or cultural, due to the lack of information ([Sutton and Day, 2021](#); see also [Smith, 2021](#)), and made no mention of coastal or submerged prehistoric cultural heritage. A robust analysis of the cultural goods and benefits, both current and past, for the area would also help create an inventory of its value. There are now many indicators of such cultural goods and benefits ([Atkins et al., 2015](#)), although consideration also needs to be given as to whether identifying the

### Box 1 | Ancient corridors, continuous connections, Recherche archipelago.

Coastal and offshore landscapes are cultural places that are protected by cultural customs as well as heritage legislation. The Recherche Archipelago is situated along the southern coast of Western Australia, and is bordered on either side by Commonwealth Marine Parks (Figure 1). A proposed south coast marine park, incorporating the Recherche Archipelago, is being proposed that will be jointly managed between Department of Biodiversity Conservations and Attractions (DBCA) and the area's Traditional Owners - Wudjari. Accordingly, Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC), on behalf of the Wudjari Traditional Owners, have embarked on a community-led, multi-disciplinary programme to study, monitor and protect Sea Country across the entire Recherche Archipelago. The programme involves collaboration with the Federal statutory body Parks Australia to implement shared Healthy Country Plans and Australian Marine Park Management Plan priorities. The health of the marine life, the island habitats, and the cultural places of this seascape is of paramount importance to the Elders and the wider community. A member of the Circle of Elders was paraphrased as saying, "We know that the only way to live well and flourish on Boodja (land and Sea Country) is to know it well." So, making Sea Country (Boodja) healthy is also making it well understood. The remoteness of the region has up till now resulted in limited coordinated investment in research in this area, hence the renewed focus on addressing baseline data gaps on cultural and natural values that will support effective management of the ancient coastlines.



**Figure 2**

*(Left) Proposed model of landscape around Middle Island, one of the islands of the Recherche Archipelago (sourced from Guilfoyle et al. 2020). (below) Healthy Sea Country ranger projects are running in tandem with cultural values mapping and models of the ancient coastal plain.*

The Ancient Corridors project (Guilfoyle 2019) will integrate palaeoenvironmental, archaeological and ecological data with cultural knowledge to explore human-environment dynamics over the last 15,000 years. This cultural knowledge includes cultural stories and Songlines that extend from the mainland and across the Archipelago, and demonstrate ongoing connections to the sea and coast. At the peak of the last Ice Age, approximately 21,000 years ago, the coastline would have extended 80 – 100 km further offshore. Archaeological evidence for the use of the now submerged plain is in the form of stone artefacts, middens, man-made structures and other cultural features located on the islands of the Archipelago and also on the mainland from at least 13,000 years ago (Guilfoyle 2019).

With post-glacial sea-level rise, the vast coastal plain flooded to create the 105 islands of Recherche Archipelago that stretch 230 km from east to west and to 50 km offshore (Jackson 2008). The Tjaltjraak Rangers are working with specialists to explore the potential for sites of cultural significance and natural biodiversity through high-resolution coastal and seabed mapping, including of drowned reefs, palaeo-channels and submerged shorelines. The Ancient Corridors programme recognises that cultural systems in the past were interwoven with the landscape and its ecosystems, just as today the cultural landscape is an inherent part of the natural landscape. Hence effective management of the modern coast necessarily involves an understanding of how the processes of climate and sea-level change, and human occupation have affected and influenced the biodiversity and ecology over time. The Ancient Corridors project is just one of a range of collaborative research projects are underway in tandem with an adaptive management worksprogram led by the Tjaltjraak Rangers.

location of a cultural places(s) and quantifying those goods and benefits would increase or decrease the likelihood of desecration.

The terrestrial archaeological record holds many examples of the past use of marine resources in the form of midden sites, coastal fish traps, shell artefacts, rock art depicting marine motifs, and other parts of the material record where an association with the marine environment can be made (e.g., McNiven, 2003; Ward et al., 2018; see also Feary, 2015). Similar site types are likely preserved on the shelf, even though the past landscape context may differ (Ward et al., 2022a and references therein). Part of the

scientific or global commons perspective for investigating similar sites on the continental shelf is how they might reflect change in marine, coastal and terrestrial ecosystems and landscapes and traditional resource exploitation and management of these. For many traditional owners, the existence and acceptance of such sites is not a discovery but rather validation of the continuing existence of ancestral spirits in the present and ongoing custodial responsibilities to Sea Country (McNiven, 2016). Hence what Western science offers the Indigenous community is in the opportunity to add to an existing body of traditional knowledge

to better understand and manage Sea Country (see also [Box 3](#)). It also arguably provides relevance, credibility and legitimacy for Western purposes of a cultural landscape that warrants management, protection and potentially even implied ownership. At present the invisibility of submerged prehistoric cultural heritage means that it is what [Larcombe and Morrison-Saunders \(2017\)](#) might describe as 'out of sight – out of mind'.

## Mapping submerged cultural landscapes

Increasing resolution in seabed mapping data and their manipulation ([O'Leary et al., 2020](#); [Lebrec et al., 2022](#)) shows that the shelf is not featureless and, in some parts, has well-preserved remnants of former coastal landscapes and hence potential prehistoric cultural places. The North West Shelf (NWS) of Australia ([Figure 1](#)) is an extensive shallow marine region up to 220 km wide with extensive oil and gas reserves ([Longley et al., 2002](#)) and a range of unique coastal, reef and offshore environmental features from periods of lower sea level that have significant economic, ecological, cultural, social and geoheritage values ([Wilson, 2013](#); [Brooke et al., 2017](#); [Lebrec et al., 2022](#)). These remnant geomorphic features have had a significant influence on the pattern of biodiversity and species endemism over extensive areas of shelf ([Nichol and Brooke, 2011](#); [Wilson, 2013](#)), as well as shaping the landscape and coastal resources that humans formerly accessed, occupied and utilized, as early as 50,000 years ago ([Veth et al., 2017](#)). Further south in the Esperance region, remnant low relief (< 2 m) linear calcarenite deposits representing drowned shorelines form important habitats for sessile organisms ([Ryan et al., 2014](#)). Similar to the cemented shoreline deposits of James Price Point in the Kimberley (see [Box 2 - Case Study 2: James Price Point](#)), these have high cultural potential.

Pleistocene sea-level fluctuations have also left a clear genetic signature in phylogeographic patterns of iconic species such as the dugong, *Dugong dugon* ([Blair et al., 2014](#)), common pig-eye shark, *Carcharhinus amboinensis* ([Tillett et al., 2012](#)) and some freshwater fishes ([Shelley et al., 2020](#)) across northern Australian waters (see also [Ludt and Rocha, 2015](#)). These distributions in turn relate to former seagrass meadows, turbid coastal waters and freshwater streams respectively, and by inference the cultural environments that people once occupied. Hence identifying these sedimentary and geomorphic contexts is important towards identifying and resolving past natural and cultural landscapes. However, the marine sedimentary record is discontinuous and there are large knowledge gaps. Amongst the palaeoecological unknowns for the Barrow Island region, for example, is the shelf location of the early sedimentary record of mangroves, even though the zooarchaeological records indicate foraging of fauna from these environments from as early as 15,000 years ago ([Ditchfield et al., 2018](#)) and a near absence of them today.

Whilst high-resolution mapping is useful for deeper settings, in shallower waters local knowledge can be as important to revealing (or hiding and protecting) cultural heritage. For example, a blog post from the Deep History of Sea Country (DHSC) project team members indicates it was local knowledge rather than systematic survey (c.f. [Benjamin et al., 2020](#); [Wiseman et al., 2021](#)) that directed scientists to the submerged stone features in the Cape Bruguieres channel in the Dampier Archipelago ([CRARM, 2020](#)) ([Figure 1](#)). Claims that the Cape Bruguieres site represents the first *in situ* submerged archaeological site in Australia ([Benjamin et al., 2020](#)) have unfortunately not stood up to scientific scrutiny, with the site almost certainly representing a secondary (i.e., reworked) and ponded artefact scatter, i.e., artefacts accumulated in ponded water above lowest tide level ([Ward et al., 2022b](#)). This re-analysis emphasizes the importance of understanding the evolution of the physical seascape and of past and present physical processes to interpreting site formation ([Ward et al., 2014](#); [Ward et al., 2015](#); [Larcombe et al. 2018](#)) and not emphasizing the significance of a site for merely being under water ([Lemke 2020](#)). Arguments that this discovery has helped highlight the lack of awareness of submerged cultural heritage in Australia are less valid when the credibility of the science and the understandings are questioned, and further erodes science as an arbiter of good policy in cultural resource management. At worst, such poorly justified interpretations are in danger of changing the traditional narrative around such sites.

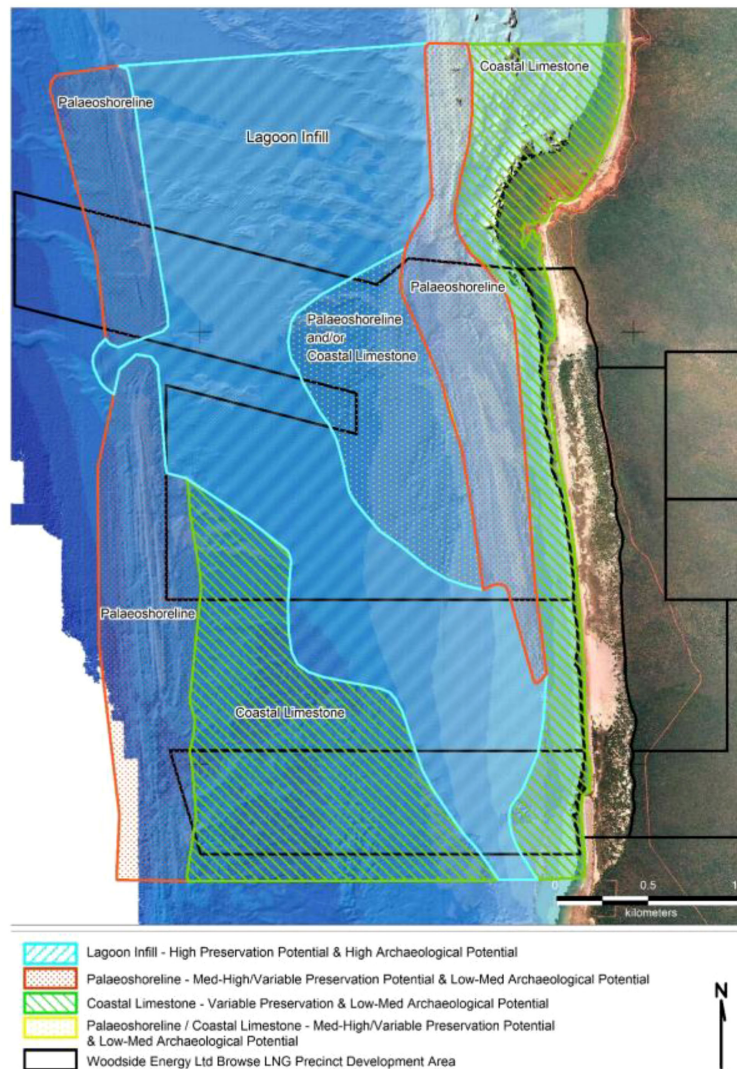
There are good arguments for greater integration with, and even prioritization of, Indigenous cultural values over Western scientific approaches as part of cultural heritage assessment and sustainable management ([Tutchenner et al., 2020](#); [Tutchenner et al., 2021](#)), a key aspect of which is the emphasis given to landscapes rather than to the artefact or site. Landscapes that are 'rare' and therefore significant, contain remnant (i.e., pre-colonial) or unusual landforms or other geographic or environmental characteristics. All archaeological material in such landscapes is considered rare and to have a high level of significance ([Tutchenner et al., 2021](#)) but the presence of tangible cultural material is not necessarily a criterion for significance and the presence of oral histories needs to be regarded as adequate evidence of that significance (see also [McNiven, 2003](#)). These criteria overlap with those used for geoheritage significance, with archaeology and cultural heritage linked by sedimentary units that comprise these landforms ([Brocx and Semeniuk, 2007](#); [Brocx, 2008](#); [Ward et al., 2014](#)) both in terrestrial and marine contexts.

## Looking below the seabed

Due to climate, sea level and environmental changes, former natural and cultural landscapes of the shelf are not always preserved at the seabed surface but are often buried beneath it

### Box 2 | Case study 2: James price point, Western kimberley coast.

Around James Price Point (Figure 3), northern WA, high-resolution mapping undertaken as part of the pre-development survey for a Liquid Natural Gas (LNG) facility revealed well-preserved drowned shoreline features, likely formed in the early-mid Holocene. At least two series of north - south trending palaeoshoreline features exist with relief of up to 5 m of more above the surrounding seabed, and are associated with a former lagoon and fossil intertidal flats. These palaeogeographic features have significant geoheritage value and systematic investigation is likely to contribute to our understanding of early maritime adaptation and resource use in this region. Important here is the recognition that landforms and stratigraphic features can represent sites of cultural significance, or natural sites of significance independently of the presence or absence of cultural material.



**Figure 3**  
The IMAP developed for the inner shelf off James Price Point, north of Broome (Ward et al. 2016).

The marine component of the Archaeological Impact Study (AIS) was not initially part of any brief but was subsequently requested by the Goolarabooloo Jabirr Jabirr Native Title Claimant Group to be included as an extension of the onshore desk-based assessment. Raw survey data and sediment core samples were not made available, hence cultural heritage was assessed from the nature of the depositional environments as likely sites of occupation and/or concentrations of archaeological artefacts. This was based on documented geological, bathymetric and sedimentary data, the past and present sedimentary processes, as well as existing archaeological information (including fish-traps, midden sites, and stone artefact scatters) on the current coast and adjacent hinterland. As subsequent studies in the James Price Point area identify (Clifford and Semeniuk 2019), the sedimentary bodies and stratigraphic units form a template with which to locate and interpret archaeological sites in the context of coastal occupation, coastal stability and sea-level change.

The result of this was an Indicative Map of Archaeological Potential (IMAP, Figure 3) that identifies specific areas of the coastal and marine zone interpreted as having relatively low, medium or high potential for the presence of archaeological remains in primary and secondary (reworked) depositional contexts (Figure 3; see also Ward and Larcombe, 2008; Cohen et al. 2014). Those areas designated as low potential, and with no visible or known archaeology may still yield archaeological remains. Similarly, areas marked as having the potential for containing artefacts in primary context may also contain artefacts in secondary context, including those eroded from the modern cliff-face (Ward et al. 2016). These then become part of the complex coastal history, linking onshore and offshore, and part of the geoheritage story (Clifford and Semeniuk 2019). The IMAP can then be further refined as archaeological, sedimentological and geomorphological information becomes available and as Indigenous perspectives are incorporated into the assessments.

(e.g., Ward et al., 2015; see also Box 3). Hence, in order to understand these landscapes, we have to look beyond the seabed surface to the underlying stratigraphy. Despite six decades of fieldwork on the NWS (Kirkendale and Richards, 2019), this buried landscape is mostly unknown. Biodiversity and habitat surveys by government, industry and academic groups have to date focused almost entirely on the shallow seabed (Lyne et al., 2006; Kirkendale and Richards, 2019), and often overlook physical sedimentary controls on these (Larcombe and Morrison-Saunders, 2017). Whilst scientific knowledge on marine physical processes does exist, it needs to be understood as a critical element in resolving past and present ecological dynamics and is also pivotal to many studies exploring human-environmental dynamics and sea-level change (see also Cawthra et al., 2020). Even today, there are questions around future sea level rise and how it may impact Traditional customs and use of coastal ecosystems (Zander et al., 2013; Sloane et al., 2019)<sup>8</sup> and also cultural heritage (Carmichael et al., 2018). Both involve identifying and understanding both the physical processes impacting modern coasts and also Indigenous cultural heritage and values.

The sedimentary archive is key to increasing our understanding. Unfortunately, national archives of marine sediment cores out to the 120 m bathymetric contour, which broadly represents the last glacial lowstand (exposed seabed) are sparse (Figure 4), were usually acquired for purposes other than submerged palaeolandscapes or cultural heritage research and hence are often of limited use. The value of targeted marine surveys, including high resolution seabed mapping and sub-bottom seismic profiling ground-truthed by core sampling, has been demonstrated worldwide (e.g., Vos et al., 2015; Brown et al., 2018; Marean et al., 2020; Bailey and Cawthra, 2021; Dupont et al., 2022). Hence, there is clear scope to progress similar targeted work, including through Indigenous collaboration and industry partnerships, on the NWS and other parts of the Australian continental shelf.

A good example of this is the Westport development in Cockburn Sound (see Box 3: Westport development), which benefits from previous marine survey and vibrocoreing by Geoscience Australia that identified and dated the identified landsurface 3 m below the seabed surface and which was flooded by sea level rise around 9300 years ago. This flooding event is recorded in Nyungar oral history, providing a connection to a lived landscape but also to the present islands and associated geomorphology. Thus what lies below the water and below the seabed is as much a component of the cultural present as it is the cultural past and, as Diver (2017) notes, contributes generations of knowledge of the land and tradition in this country. Marine geophysical survey data can be combined with analysis of marine core material to re-envisage this lived landscape and its ecology,

and to provide a physiographic context for the geoprospection of possible archeological sites that might otherwise remain unknown and unprotected. Research evidence that combines Western science and Indigenous knowledge can thus be used to define criteria for assessment and as the rationale for policy intervention.

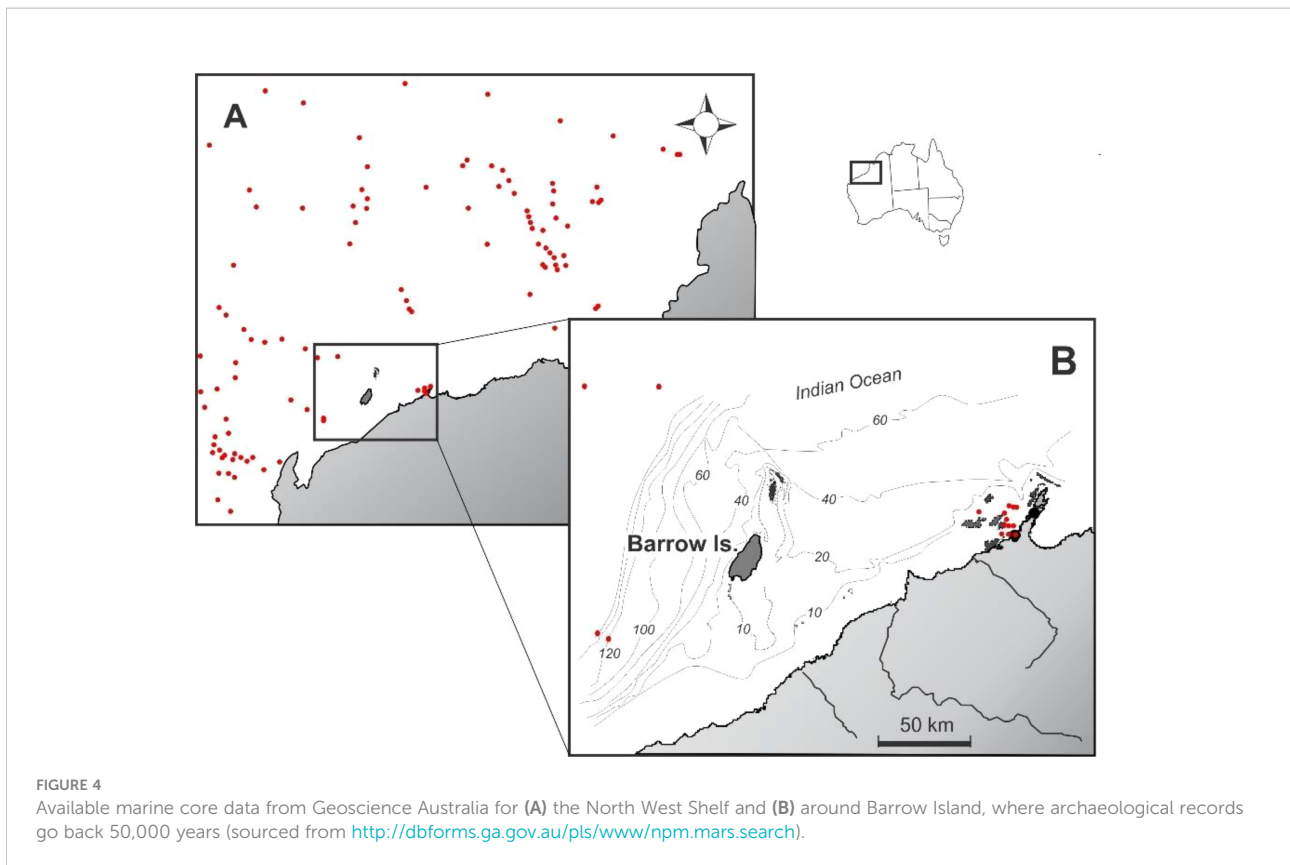
## Australian legislation

Marine management has to encompass many spatiotemporal realms and regimes, with each maritime state being responsible for the coastal baseline (often the high-water mark) out to the extent of the territorial waters (often 12 nautical miles), then the seabed out to the extent of the 200 nm EEZ and, in some cases to the further limit of the continental shelf (UNCLOS 1982). Hence that management has to encompass local/state, regional, national and international legislation (e.g., Delgado et al., 2022; see also Boyes and Elliott, 2014), with democratic marine governance also factoring in community-based management and international environmental agreements (Techera, 2012). The attribution under UNCLOS of the EEZ seabed as ‘common heritage’ (UNCLOS 1982) was the first to incorporate economy and societal needs, and concepts of conservation (UNCLOS Articles 116–120). UNCLOS also provides that modern states also have a duty to protect ‘objects of an archaeological or historic nature’ out to 200 nm (UNCLOS Article 303). Arguably this does not equate to submerged cultural *landscapes* which, in acknowledging the mobility of hunter-gatherer societies, can be argued to be as much a part of common heritage as any object, site or structure (Ward et al., 2018; see also Bird et al., 2019). As Quig (2004) outlines, for any native title claim it is uncertain whether Indigenous people would have to demonstrate that they physically used and occupied the submerged lands in question through the erection of permanent structures (e.g., fish traps), for activities such as the gathering of marine economic resources (e.g., fish, shellfish), or by simply by engaging in fishing, navigation and spiritual activities. Irrespective of this, UNCLOS does not recognize Indigenous rights and, to be compliant with international law, a state may have to dilute or even negate Indigenous rights over offshore areas for economic interests (Kaye, 2001; see also Quig, 2004; Zacharias and Ardron, 2020).

Marine (and estuarine) ecosystems are the sites of many human influences such as tourism, commercial shipping, fisheries, oil and gas exploration and production, offshore wind farms as well as many traditional activities both contemporary as well as in the past (Borja and Elliott, 2021; Figure 7). Marine ecosystems may be considered from their extrinsic (e.g., economic) or intrinsic (e.g., scientific, historical, spiritual, cultural) value with protection provided through the implementation and maintenance of laws and legislation (Boyes and Elliott, 2014; Cormier et al., 2022). For example, activities may be permitted in areas after being legally sanctioned following a planning application and an

<sup>8</sup> See also <https://ourworld.unu.edu/en/sea-level-rise-in-kowanyama>





Environmental Impact Assessment (EIA), or they may be allowed and legally defended in areas where they have been ‘traditionally practiced’. As an example of this, under European legislation, bathing waters may be protected given a common history of practice rather than a legally enforced boundary dictated according to a set of criteria such as the number of people bathing at any one time. Similarly, some Indigenous or ‘customary’ practices, particularly fishing (Evans, 2004; Hiriart-Bertrand et al., 2020), although not legally sanctioned, may also be recognized within national and interstate frameworks and hence have similar protection. However, the characterization of Indigenous marine interests in Australia’s Marine Science Plan 2015-2025 as solely “Indigenous fishermen” (Figure 7) relegates Traditional Owners of Sea Country to a user group rather than a people with a comprehensive cultural, social, spiritual and knowledge-based relationship with Sea Country. Indigenous marine interests also include scientific, conservation and sovereign matters and failure to acknowledge all these values within marine policy development can lead to tensions (e.g. Hiriart-Bertrand et al., 2020). Smyth and Isherwood (2016), Rist et al., (2019) and Leary et al. (2021) provide comprehensive explanations on Indigenous Australian’s legal rights in marine areas.

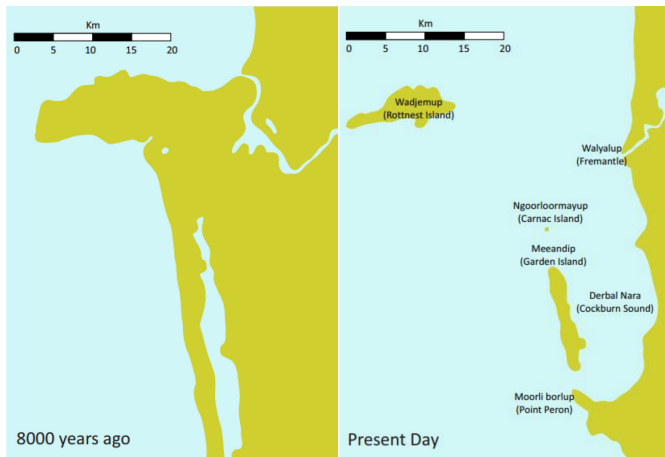
Furthermore, there has always been the debate regarding the provenance of records relating to the use of an area by any

group, including Indigenous people. In the Western legal system, documented sources of evidence in languages using written (including observational records by non-Indigenous people of Indigenous traditions and customs) or pictogram communication may be regarded more highly and less open to challenge than spoken/oral, story-based information. In contrast, Indigenous legal systems value the spoken word (Gray, 1998), and any formal acknowledgement of a traditional law or custom is ultimately an objective one (Smyth, 2002). Recently, however, there was a landmark agreement in the Land Court of Queensland for First Nations people to be allowed to present their evidence against a mining application on their island in the Torres Strait, with the presiding judge stating, “written evidence from a First Nations witness is a poor substitute for oral evidence given on country and in the company of those with cultural authority.” The First Nations groups argued the mining project would contribute to climate change and sea level rise, which will have a negative impact on their human rights to practice cultural activities (Maddison, 2022).

The Western Australian *Aboriginal Cultural Heritage Act* 2021 (WA Act 2021) also recognizes Aboriginal cultural heritage as ‘the tangible and intangible elements that are important to the Aboriginal people of the State, [and are recognized] through social, spiritual, historical, scientific or aesthetic perspectives’

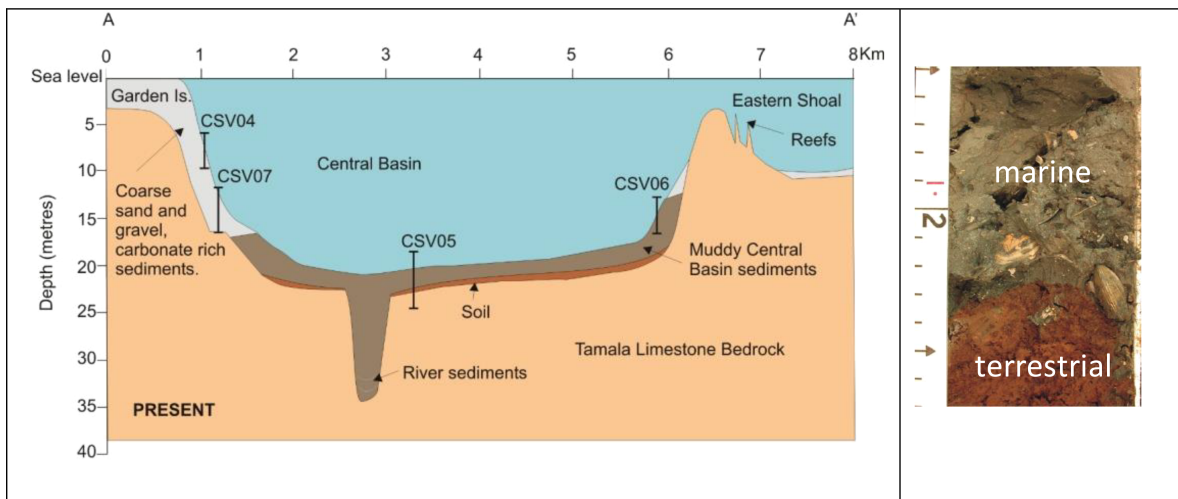
**Box 3 | Case study 3: Westport development, Underwater cultural heritage**

In 2020, the Western Australian Government announced a new development project for a new port in Cockburn Sound (Figure 5), to be called Westport. Derbal Nara means Estuary of the Salmon and is the Nyungar name for Cockburn Sound (see also <https://derbalnara.org.au/>). Gabee-wodin or warden (sea) is of great spiritual significance to the coastal Nyungar, who have used the resources of the coastal plain for food, shelter, ceremonies and trade for tens of thousands of years as recognised under Native Title. As part of this, a Westport Noongar Advisory Group has been established to provide ongoing specific input, knowledge and the endorsement of the Aboriginal cultural content incorporated into the Westport development. The Nyungar people explain how Derbal Nara formed through a fight between the Waugal (rainbow serpent) and the Spirit Crocodile, with the sea waters rushing in as they rolled and tumbled. The Waugal won the fight, biting the tail of the Spirit Crocodile and placing it at the mouth of the Swan River to prevent salt water coming up the river. The tail became a limestone sand bar, which is still present today.



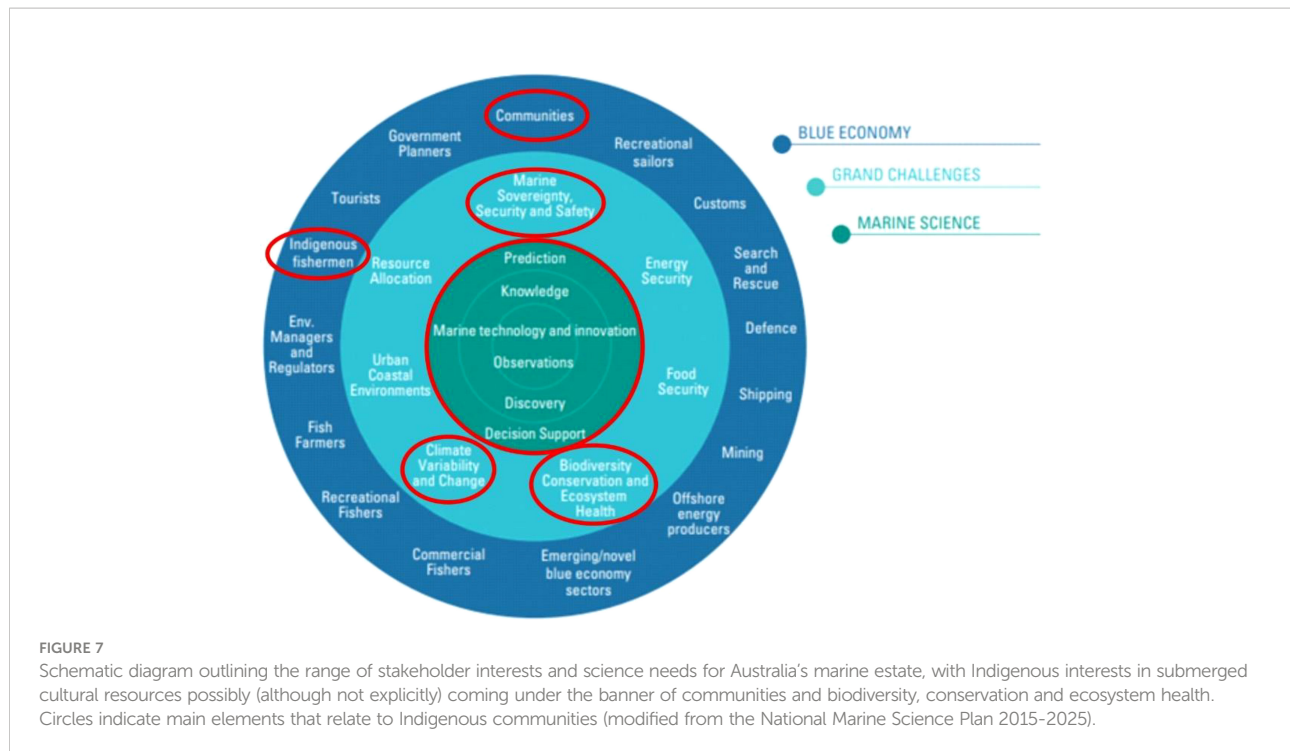
**Figure 5**  
Schematic outline of the landscape around *Derbal Nara* before rising sea levels formed the current line of remnant islands and submerged reef that extends from Point Peron to Rottnest Island (sourced from <https://derbalnara.org.au/>).

From a Western science perspective, the fight between the Waugal and the Spirit Crocodile is interpreted as relating to post-glacial sea level rise and flooding of the shelf. Geomorphic, stratigraphic and sedimentological data obtained by Geoscience Australia indicate that flooding occurred around 9300 years ago, with the clay soil of the former terrestrial land surface now preserved beneath a layer of marine mud in the central basin (Figure 6).



**Figure 6**  
Stratigraphic cross section of Cockburn Sound, incorporating data obtained from vibrocores (sourced from and reproduced with permission from Skene 2005; their Figures 21 and 17E respectively). Scalebar on right is in cm increments.

In late 2021, the State Government allocated \$13.5 million to a three-year research programme to manage and support the Cockburn Sound marine environment. The 30 different funded projects include programmes relating to key ecological and biological processes, and to social values research and protection strategies. The latter ideally include research aimed at integrating Western scientific and local Indigenous knowledge to reveal the submerged landscape and past and present ecology, helping to inform future EIAs and the future management of Cockburn Sound. At the same time, such research can help people from the Stolen Generation (Tatz 1999) rebuild intergenerational identity as well as providing a means of validating cultural sites and landscapes as needed under Western governance.



(Section 12(a)) and specifically includes an Aboriginal place or cultural landscape (Section 12(b)). This Act is very recent, hence has yet to be applied to any underwater cultural site or landscape. It could, for example, be applied to any mythological site within the area of Cockburn Sound in Western Australia that relates to Indigenous narratives (recorded by Armstrong in 1836 and Moore in 1884) describing the separation of the islands from the mainland as influenced by the Rainbow Serpent (Waugal). In 2004, the Aboriginal Cultural Material Committee (Resolution 2004/082) reassessed this mythological site (Department of Indigenous Affairs (DIA) Site 3776) and deemed it 'Not a Site' under the Aboriginal Heritage Act (1972). Under the new WA Act 2021, Aboriginal people could register the area in an Aboriginal Cultural Heritage Management Plan (ACHMP) or apply to make it a Protected Area. Potential impacts or 'activities' in the area would then be graded under four tiers (levels), with the latter built into a ACHMP between a proponent and local Aboriginal cultural heritage services (LACHS). A similar Special Area Management Plan (or Ocean SAMP) exists for Rhode Island in New England, and combines stakeholders, including native Narragansett interests, with the best available science to develop a regulatory framework for the management and protection of Rhode Island ocean heritage (Fugate 2012; Olsen et al., 2014).<sup>9</sup> However, what many consider

a shortfall in the current draft of the ACHMP is the ability of the Minister of Aboriginal Affairs to override these agreements for the 'wider public interest' (e.g., economic gain). Whilst there is uncertainty with regard to what and where submerged cultural resources exist, current statutory and regulatory regimes will continue to govern the use and management of coastal and marine zones (Quig, 2004). In the meantime, there is the continued need to engage with traditional owners and improve our understanding of these shared natural and cultural landscapes.

## The way ahead - Ecosystem-based and community-led management

Successful and sustainable marine management needs to cover all the natural and social aspects of the seas. These can be described as the 10-tenets, nine of which relate to the socio-economic system and include human behavioral aspects of all parts of society (Elliott, 2013; Barnard and Elliott, 2015). A culturally-inclusive tenet was added particularly to accommodate countries with large indigenous populations such as Australia, New Zealand and Canada. All of the tenets rely on having a broad range of natural and social sciences and a fit-for-purpose understanding of the way policy and science interlink. This includes the need to obtain and use knowledge, data and understanding from all areas, both conventional

<sup>9</sup> See also <http://seagrant.gso.uri.edu/oceansamp/>

‘Western-type’ science as well as Indigenous knowledge and other stakeholder inputs.

Whilst based on terrestrial forest management with the Xáxli’p community in British Columbia, [Diver \(2017\)](#) nevertheless provides an excellent example of the mutual benefits of integrating Indigenous knowledge in science-policy that can be easily translated to the marine environment. Amongst the things that [Diver \(2017\)](#) lists in terms of shaping environmental science-policy are:

- \* acknowledging differences in cultures and worldviews but at the same time, generating strategic knowledge linkages between the two,
- \* training community members in scientific methods and technologies alongside cultural training,
- \* documenting and quantify specific components of Indigenous knowledge, and
- \* encouraging greater creativity in developing sustainable land (or marine) management policies

There are good examples in Australia where ecosystem-based management has been aligned with Indigenous rights and Indigenous expertise ([Weiss et al., 2013](#); [Davies et al., 2020](#); [Goolmeer et al., 2021](#); [Macpherson et al., 2021](#)), and this simply needs to be extended to include historic and prehistoric marine cultural heritage, such as in the community-led archaeological research program in the Recherche Archipelago (see [Box 1 – Recherche Archipelago](#)). As [Guilfoyle et al., \(2019\)](#) notes, the strength of this program is that the researchers, traditional owners and volunteers involved all bring different perspectives while sharing the same goal: to learn how best to understand, manage and protect these shared natural and cultural landscapes.

In contrast to the USA ([Olsen et al., 2014](#)), Canada<sup>10</sup> ([Quig, 2004](#); [Jones et al., 2021](#); see also [Garrison and Hale, 2020](#)) and the United Kingdom ([Wickham-Jones, 2010](#)), prehistoric cultural heritage in Australia has yet to be acknowledged as a critical resource in any part of the coastal or marine planning process, or in any nationally-coordinated seabed mapping, marine benthic studies or other related research. If the Australian commitment towards holistic marine management is to be achieved, then some revision is needed of environmental legislation within the marine environment. This includes adding cultural heritage assessments (potential or known) to any coastal and marine development work as a form of compliance or regulatory and industry monitoring, such as EIAs, best practice guidelines, or equivalent Ocean

SAMPs. There are many exemplar studies of EIA’s that accommodate Indigenous perspectives (e.g., [O’Faircheallaigh, 2007](#); [McKay and Johnson, 2017](#); [Muir, 2018](#))<sup>11</sup> that can be applied to marine prehistoric cultural heritage and to marine spatial planning (e.g., [Gee et al. 2017](#); [Diggon et al. 2022](#)).<sup>3</sup>The plethora<sup>4</sup> of marine governance illustrated by [Boyes and Elliott \(2014\)](#) also shows that there is a place for marine archaeology in European marine management and that it implicitly or explicitly is included in existing legislative instruments whether Acts or Regulations. However, such features are required to be identified and assessed before being protected. For the most part, this kind of assessment has fallen under the banner of self-monitoring, e.g., Ports Authorities and traditional owner groups ([Guilfoyle et al., 2019](#)), or investigative monitoring by researchers, increasingly with Indigenous involvement, showing the importance of citizen science (see also [Borja and Elliott, 2021](#)).

Similarly, as demonstrated for the Salish Sea in North America, political and administrative boundaries are often artificial and can lead to segmenting of ecosystems, with the alternative and preferred approach involving the use of ecological planning units such as catchments or estuaries, and direct stewardship by traditional owners ([Jones et al., 2021](#)). Whilst the catchment approach has yet to be considered, custodial rights of some Native Title groups along Australia’s coasts are being extended from the land to adjacent waters in the form of joint management agreements with regulatory Marine Parks bodies. These at least provide scope to explore any ecological or cultural continuum between onshore and offshore areas. Successful Traditional Use of Marine Resources Agreements (TUMRAs) exist for parts of the Queensland coast, with the largest recently set up with the Darumbal people on the southern Great Barrier Reef. Similar Indigenous Land Use Agreements (ILUA) exist for the Wagyl Kaip and Southern Noongar traditional owners, with new agreements being set up along other parts of southern Western Australia ([Guilfoyle et al., 2019](#)). For most parts, non-exclusive sea rights of Native Title holders largely limit them to being stakeholders rather than resource custodians in conventional (i.e., Western) commercial or ecosystem management ([Kaye, 2001](#)).

Progress has also been made towards integrating cultural management with other policies such as Australia’s Ocean Policy 1998, as well as supporting Indigenous people to develop their own management goals through Healthy Country Planning (as part of Conservation Action Planning)<sup>12</sup>, the Ocean Discovery and Restoration Program<sup>13</sup> and associated government grant schemes<sup>14</sup>, as well as the Indigenous Protected Areas (IPAs) designation ([Smyth et al., 2016](#); [Rist et al., 2019](#); [Gould et al., 2021](#)). The latter is part of a positive shift towards the more-

<sup>10</sup> <https://coastalfirstnations.ca/our-sea/collaborative-governance-and-reconciliation-with-first-nations/a-first-nations-marine-planning-and-management-reconciliation-table/>

<sup>11</sup> <https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/overview-indigenous-engagement-partnership-plan.html>

proactive Indigenous-led planning, research, governance and management (e.g., [Mayala Inninalang Aboriginal Corporation, 2019](#)), as opposed to more-reactive Indigenous-engagement initiatives led by government and non-government agencies, mining/exploration companies, researchers amongst others (see also [Smyth et al., 2016](#)). Most marine-based programs and grant schemes fall within the latter, with the development of strategic alliances and partnerships between Traditional custodians and marine science and management agencies, with the shared realization that the integration of traditional knowledge and Western science provides a better way forward (e.g., [Lincoln and Hedge, 2019](#); [Shamsi et al., 2020](#); [Diggon et al., 2022](#); [Murley et al., 2022](#)). Such aims are exemplified in the Australian Marine Parks Indigenous Engagement Program<sup>15</sup> and the Australian Institute of Marine Science (AIMS) Indigenous Partnerships Plan<sup>16</sup> ([Evans-Illidge et al., 2020](#); [Bock et al., 2021](#)). To fully embrace Indigenous perspectives, these schemes need to be inclusive of all Sea Country, including submerged cultural heritage resources, and not separate from traditional terrestrial estates (see also [Henderson, 2019](#)).

There is also an increasing number of global initiatives to which many countries are signatories that aim to create more sustainable oceans for the coming decades ([Borja et al., 2022](#)). For example, the United Nations (UN) Decade on Ecosystem Restoration<sup>17</sup>, the UN Decade of Ocean Science for Sustainable Development 2021–2030<sup>18</sup> (hereafter Ocean Decade), and the Global Sustainable Development Goal #14, Life Below Water<sup>19</sup> are all aimed at sustainable use of ocean resources. The Ocean Decade in particular promotes “the science we need for the ocean we want”, with ocean science broadly encompassing social sciences and human dimensions. The Ocean Decade Heritage Network (ODHN)<sup>20</sup> was later established within the Ocean Decade to more explicitly integrate cultural heritage. The involvement of Indigenous groups in management need to feed into both achieving the Sustainable Development Goals

(notably SDG#14) and those of the Ocean Decade. As population and demands upon the coastal and marine environment increase, marine management becomes increasingly complex (e.g., [Elliott et al., 2020a](#); [Elliot et al., 2020b](#); [Cormier et al., 2022](#)) with cultural values sometimes a secondary consideration to more direct economic benefits and nature conservation ([Atkins et al., 2015](#); [Lee, 2016](#)). Yet, as [Henderson \(2019\)](#) argues, activities in the marine zone can actually be linked to and given context by cultural heritage and, moreover, they can provide economic, social and cultural benefits and contribute to coastal and ocean sustainability (see also [Lepofsky and Caldwell, 2013](#); [Khakzad et al., 2015](#); [Henderston et al., 2021](#); [Yet et al., 2022](#)). Furthermore, indicators have been derived for these aspects and monitoring and management can and should be directed towards the achievement of those indicators ([Atkins et al., 2015](#)).

As the studies above indicate, holistic- and process-based approaches provide a better way forward for investigating and managing underwater environments and their associated cultural heritage, with Indigenous knowledge engaging with the physical science ‘on shared and equal terms’ ([Stevens and Paul-Burke, 2021](#)). Both a top-down regional-scale approach and a bottom-up, site specific approach are needed (e.g., [Gregory, 2015](#)), and may incorporate high-resolution imagery to seamlessly link the seabed with adjacent coastal areas, sub-bottom profiling and sediment coring to investigate past sedimentary contexts, together with a range of oceanographic modeling exercises to identify and interrogate modern physical processes. From a global commons perspective, there should be much more sharing of this kind of data from offshore commercial development. This information can be used to relate past resource use and ecosystem features – and potentially cultural resources - to current geomorphological features and within the context of climate changes and its moving baselines (e.g., [Vos et al., 2015](#)). Furthermore, all of this can be integrated with an Indigenous understanding of landscape and the biophysical changes for maritime spatial planning. The ultimate aim is to “achieve the long-term conservation of values of nature, culture and associated ecosystem services” ([Lee, 2016](#)) for all interested stakeholders and the wider community.

It is important to learn lessons from similar situations worldwide. In New Zealand, this convergence (pūtahitanga) of physical knowledge (mātai) with Indigenous knowledge (mātauranga Māori) and including oral history, provides a set of tools for understanding past and present ocean currents, waves, tides, climate and so on to directly inform biophysical oceanography, ecology ([Stevens et al., 2021](#)) and by inference cultural heritage. In other words, the pūtahitanga allows for a better understanding and application of what science is required, how its results should be applied, and what the wider impacts be. Te pūtahitanga can be equally applied in an Australian context,

<sup>12</sup> <https://www.natureaustralia.org.au/about-us/who-we-are/our-science/conservation-planning/>

<sup>13</sup> <https://parksaustralia.gov.au/marine/management/partnerships/ocean-discovery-and-restoration/>

<sup>14</sup> <https://www.awe.gov.au/agriculture-land/land/indigenous-protected-areas/sea-country-grant-opportunity>

<sup>15</sup> <https://parksaustralia.gov.au/marine/management/programs/indigenous-engagement/>

<sup>16</sup> <https://www.aims.gov.au/indigenous-partnerships>

<sup>17</sup> <https://www.decadeonrestoration.org/>

<sup>18</sup> <https://en.unesco.org/ocean-decade>

<sup>19</sup> <https://www.globalgoals.org/goals/14-life-below-water/>

<sup>20</sup> <https://www.oceandecadeheritage.org/>

incorporating knowledge (*kaartdijin* in Noongar), language and songlines of Sea Country to better identify the Ocean Decade's "science we want for the ocean we need". Hence just as the sea connected communities in the past, it should serve to connect scientific approaches, management approaches, historical narratives, and human activities in the maritime space today (Henderson, 2019).

## Conclusions

The UN Ocean Decade 2021-2030 has the aim of developing the "science we want for the ocean we need" (Borja et al., 2022), which we argue for Australia can be better achieved by being inclusive of underwater prehistoric heritage. Numerous studies demonstrate that cultural knowledge and practices can be integrated with science and policy to create successful management strategies appropriate for both natural and cultural resources (see also Kikili et al., 2017). However, at present, there remains a mismatch between what is known from an ecological and commercial exploration perspective with what is known (or even lost) in terms of the 55,000 years of more of marine prehistoric heritage on the Australian continental shelf. It is difficult, therefore, to delimit areas for protection and marine spatial planning where there is no written documentation or mapped cultural landscapes.

There also remains a mismatch between the protection of the seabed from a Common law perspective (for Australia relating to English Common Law) with that from Traditional lore, and local, passed-down (oral) knowledge. However, for both approaches the notion of commonness is viewed in terms of trusteeship and management participation rather than ownership. Whether on land or under water, traditional patterns of use and occupation constitute the source of Aboriginal title and as such, mandate both our understanding and respect (Quig, 2004). Accordingly, traditional knowledge related to marine ecosystems and seabed resources should be integrated with more conventional (Western) data and information in marine spatial planning and management (Tilot et al., 2021; Diggon et al. 2022). The studies presented aimed to demonstrate that fostering two-way knowledge of the submerged landscape and associated cultural resources allows for a more adaptive and holistic approach to marine governance.

Cultural landscapes are an inherent part of the natural landscape, and both inform each other. As new marine funding schemes are announced and more coastal and offshore areas are given over to Indigenous governance, these demonstrate the growing recognition of the ecological and cultural place of traditional marine management systems. However, a huge missing piece of the puzzle is an awareness and understanding of how these ecological and cultural places have evolved during the period of human occupation. Much of this understanding lies submerged or buried beneath a blanket of

modern sediments, and is only through unearthing this that we can begin to really reveal our common heritage.

## Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding authors.

## Author contributions

IW was the driving force behind the paper and all authors contributed to providing information and drafting and editing the text. The views expressed are those of the authors and not necessarily those of organization that they may represent or advise. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

Author ME is the unpaid Director of International Estuarine & Coastal Specialists Ltd. Author DG is employed by Esperance Tjaltjraak Native Title Aboriginal Corporation.

The remaining author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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