Cross-cultural

Approach to Coastal and Marine Protected Area Design in south-eastern Sydney

By

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Declaration

This thesis is submitted to Macquarie University in fulfilment of the requirement for the Degree of Master of Research.

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Kataya Barrett (22/12/2020)

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Abstract

Globally, Indigenous knowledge systems, people, and Country are increasingly being recognised in marine spatial planning. Indigenous coastal communities, on the east coast of Australia, are actively protecting the cultural and ecological values of their ancestral estates and related management practices. Yet, in Australia, codesigned marine spatial planning with Indigenous Peoples, is still in its infancy. In collaboration with the Gamay Rangers, Sydney, we combined Indigenous Science and Western Science to develop a new cross-cultural approach to Marine Protected Area design in an urban setting. A combination of ecological, heritage, and government, along with semi-structured interviews to elicit Indigenous Science, was used to produce a portfolio of Marine Protected Area Marxan scenarios. The scenarios showed that in the absence of Indigenous Science, existing areas protected as National Parks and reserves were selected. When Indigenous Science was included, areas of high cultural value, such as fishing places, burial sites, and dreaming and ceremonial sites were prioritised. Therefore, this comparative marine spatial planning study showed that including Indigenous Science can alter optimal planning scenarios that shift conservation priorities from classical Western values towards Indigenous values which is becoming an increasing focus in conservation planning globally.

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1. Introduction

1.1. Indigenous knowledge and connections to sea country

"Our cultural links with the coast and sea are vital to us. To be able to come here and use them to swim and fish is part of our cultural heritage... Our sense of ownership is continuous". Interview with Mr Merv Gower, Aboriginal Elder, Tasmania in (National Oceans Office, 2002).

Many Indigenous communities have strong cultural identities, intergenerational histories and knowledge tied to coasts and oceans of their ancestral estates (National Oceans Office, 2002; Cisneros-Montemayor et al., 2016). Yet, worldwide, coastal Indigenous communities face ongoing threats to their cultural knowledge and access to Country by the compounding effects of globalisation, western hegemony, changing climates and sea level rise (International, 2009; Miranda, 2010; Searle and Muller, 2019).

Indigenous Knowledge Systems are increasingly being touted as one of the best safeguards humanity has against ongoing environmental change (Johnson et al., 2016). Recent research shows that Indigenous land tenure and management influence occur in 40% of global protected area (Garnett et al., 2018; Schuster et al., 2019), which demonstrates Indigenous people are significant environmental quardians for terrestrial Indigenous Protected Areas (IPAs) (Reed et al., 2020). In Australia, the same trend is occurring where IPAs make up 44% of the National Reserve System (NRS), showing that Indigenous people are exercising their right to reclaim Country and management responsibility (Tran et al., 2020). Indigenous People manage the environment differently to Western approaches (Wohling, 2009; Muller et al., 2019). Indigenous People manage environments in accordance with accumulated and localised biocultural knowledge. Indigenous Biocultural Knowledge (IBK) is holistic as ecosystems are viewed to be interconnected between ecology, culture and spiritual values (Ens et al., 2015). In direct contrast, Western scientific ecological management is typically compartmentalised and often focussed on species (Ens, 2012). IBK has been developing over millennia through a continuous adaption process of integrating new and culturally pertinent information (Raymond et al., 2010)

to "manage" environments (see in (Howitt and Suchet-pearson, 2006)), including coastal and marine environments. It reflects these inherent differences in ontology and management in Euro-centric conservation planning processes, policies and legislation which have until recently, marginalised or ignored Indigenous rights and knowledge (Domínguez and Luoma, 2020). However, Indigenous influenced coastal and marine management is underdeveloped.

1.2. Coastal and Marine Protected Areas and Indigenous interests

Indigenous peoples have vested interested in marine protected areas (MPA). The International Union for Conservation (IUCN) defines protected areas, which MPA need to qualify as, as

"A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Day et al., 2019).

However, the historical premise of protected areas, from a western scientific perspective, was initially to protect nature in a pristine state. The concept of pristine environments is an inherited ideology from the Western dichotomy of humans and nature. This dichotomy of the human/nature separation has roots in Judeo- Christian tradition of 'man will have dominion over nature' (Colchester, 1994). Colonisation of Indigenous communities brought human/nature separatism thinking with it, which Western centric societies has as a foundation in conservation management (Colchester, 1994). Indigenous cultures are eco-centric are as described by David Suzuki in (Parry, 2016):

"The way we see the world shapes the way we treat it. If a mountain is a deity, not a pile of ore; if a river is one of the veins of the land, not potential irrigation water; if a forest is a sacred grove, not timber; if other species are biological kin, not resources; or if the planet is our mother, not an opportunity—then we will treat each other with greater respect. Thus is the challenge, to look at the world from a different perspective." (David Suzuki)

The concept of the excluding human disturbances encapsulates the design of protected areas systems (Brockington and Igoe, 2006). Human disturbance was seen

as a detriment to ecosystems. However, human disturbance usually included the cultural activities of Indigenous Peoples. Hence, Indigenous people are excluded from ancestral lands. The concept of Protected Areas has led to the removal and exclusion of Indigenous people in many colonised countries (Brockington and Igoe, 2006).

Indigenous people do not view the land and water as separate (Rist et al., 2019); however, in Western science and policy, land and water are treated as separated entities (Butterly, 2013). The division of land and sea means that there are separate zoning and management practices. Whilst, there is stronger representation of Indigenous voices in terrestrial zoning plans, there is a lack in marine zoning plans. The first instance of stand-alone marine zoning was on the Great Barrier Reef. However, during the first iteration of planning to create the zoning for the proposed Great Barrier Reef Marine Protected Area (MPA), there was a lack of Indigenous voices (Dale et al., 2016). When the *Great Barrier Reef Marine Park Act 1975* was written, there was no inclusionary mechanism for Indigenous engagement (Dale et al., 2016). The lack of legislation meant Indigenous marine interests were not recognised or taken seriously. The first zoning plan was based on Western stakeholder values and Western scientific information, firmly signalling that Western environmental management was the way forward.

Around Australia there is no co-owned or Indigenous wholly managed MPA recognised by the Australian Government (Rist et al., 2019). Booderee National Park is co-managed between the Wreck Bay Aboriginal Community and the Australian Government (Director of National Parks, 2015). Yet, the marine environment encapsulated in the park is managed by the Department of Primary Industries (DPI) (Director of National Parks, 2015). The collaboration between DPI and the Wreck Bay Community is still of uneven decision-making power. The relationship between DPI and Aboriginal People on Sea Country has been tumultuous, as reflected by an Aboriginal participant in an Aboriginal Engagement Workshop with the Marine Estate Management Authority:

"Native Title rights are not recognised by DPI. We have rights as first people. We're exempt from Marine Park and Fisheries Act. They keep prosecuting our people.

We've got rights already and they need to acknowledge it. We've been educating our people down here about our rights and people are starting to recognise it, but they are still being sent to jail. DPI have started calling our activities trafficking." (Annells, 2017).

Australian Indigenous Protected Areas (IPAs) are voluntary protected area systems where recognised Traditional Owners manage land through a voluntary agreement with the government (Langton et al., 2005). The IPA system is a significant component of Indigenous peoples being able to exercise IBK and self-determination. IPAs help to promote jobs and a "green economy" for Indigenous people (SVA Consulting, 2016). IPAs also provide a societal benefit where Indigenous peoples protecting biodiversity with IPAs contribute to protecting ecosystem services for greater humanity (The Pew Charitable Trusts, 2019). This benefit can also be shown in a marine context, although, not as prevalent as terrestrial IPAs, Sea Country (marine) IPAs have been gaining in number (Smyth et al., 2012) showing recognition of Indigenous ancestral connections and use of marine environments but is still in its infancy (Rist et al., 2019), which is particularly true in Northern Australia (Smyth et al., 2012). The nature of establishing of a Sea Country IPA still needs legal entitlement to an area.

Legal claims for Sea Country can also occur under the *Native Title Act 1993*, which can provide the basis for establishing a Sea Country IPA. Native Title gives legal entitlements to Traditional Owners. However, this approach can be arduous and lengthy as there are strict criteria that need to be met to pursue Native Title Claims (Australian Law Reform Commission, 2015). Starting with the *Mabo v Queensland* case that built the foundation for Indigenous peoples to gain acknowledgement of land rights within a western legal system, there is a growing legal body of Sea Country claims. In 2001, the Croker Island Judgement was the first to grant exclusive rights over sea (Butterly, 2018). In addition, the Blue Mud Bay Judgement in 2008 is another key case that shows rights granted on Sea Country (Butterly, 2018). Most Sea Country rights are being granted in northern Australia. However, in 2018, the Yaegl people of the northern coast of NSW, were the first to gain Native Title over Sea Country in NSW (Pearson, 2017). In 2019, there was a second Native Title granted for Sea Country Rights to the Bundjalung People of northern NSW. These cases are building precedent that Indigenous People have a legal right to Sea Country.

Securing legal rights to Sea Country will provide the foundation for Sea Country IPAs to be established.

MPA and IBK converge within IPA when applied in a Sea Country context. Under the EPBC Act there is space for IBK to be utilised for managing Country within a western legal framework. There are 2 approaches for Indigenous People to create self-determination in conservation of Country; 1. Native Title and 2. Indigenous Protected Areas. Both measures of voluntary Sea Country IPA and Native Title claims, help increase Indigenous Peoples' ability to manage Country and strengthen culture. The rise of Sea Country claims around the country and the potential increase in NSW, is an opportunity to manage Country. The management of country can occur under the framework an integrated planning approach. An integrated planning approach is a way for Indigenous IPA managers to approach Sea Country planning for Protected Areas. In NSW, as there are poor mechanisms for the direction of Indigenous engagement or co-management of marine protected area, there will need to be an integrated approach to MSP.

Further, in Australia, Traditional Use of Marine Resource Agreements (TUMRA) are also increasing where an agreement is made between Traditional Owners and the Government. The TUMRA details the culturally important activities that take place in an identified area and show culturally significant areas (Dobbs, 2007). TUMRA are predominately found in Northern Australia IPA. However, TUMRA could be potentially used by NSW Coastal Indigenous communities. The TUMRA agreement is important for NSW Coastal Indigenous communities to undertake, as the process helps to outline and document culturally important activities and places. The information documented within the TUMRA can help with zoning of Sea Country, ensuring that zoning is culturally relevant. Partaking in TUMRA can be useful preparation prior to undertaking an integrated planning approach. The TUMRA can serve as a reference document to ensure that the outcome of the integrated planning approach and MPA are culturally sound (Barnett and Ceccarelli, 2007).

Though Traditional Owners and Indigenous People view sea country as indivisible from land, Western-centric ontology of environments has deemed that the sea is separate (Farrier and Adams, 2011). Hence, the differing responsibilities of environmental management often cause conflict in co-management arrangements

(Adams, 2004; Adams et al., 2008). Yet, as the Western-centric is the dominant management paradigm, Indigenous IPA managers need to go through government system in order to gain decision-making capabilities. Indigenous IPA managers are hampered by the onslaught of government oversight, and cannot practice biocultural management without gaining approval from these invisible power structures when engaging in a co-management arrangement (Farrier and Adams, 2011)

"Jervis Bay—it is a nightmare to do anything there because the Commonwealth Government is also involved." Anonymous participant (Annells, 2017).

However, there are spaces being forged and made by Indigenous IBK practitioners in Sea Country management. Dhimurru Land Management Aboriginal Corporation is at the forefront of Sea Country management through the establishment of the Dhimurru Sea Country IPA. However, even throughout Dhimurru's history of establishing interest and management of Sea Country, there have been legal and societal barriers. The fundamental barrier stems form of lack of understanding of the Indigenous concept of 'Sea Country' (Yunupingu and Muller, 2009). Western-centric understanding often presents in species-specific approaches or single values, instead of comprehensive ecosystems management approaches. Historically, species-specific management is usually dominant and rooted in natural resource management and economic valuing. However, Dhimurru has approached the management of Sea Country through a cross-cultural sense that is still heavily situated in IBK (Hoffmann et al., 2012).

Nevertheless, in the absence of Indigenous inclusion in coastal and marine protected area management, Sea Country IPAs are a strong avenue for IBK management of marine environments (Rist et al., 2019) as they are a voluntary mechanism that is Indigenous driven and led. In more recent times, there has been a policy evolution of creating more holistic zoning plans that favour ecosystem-based approaches, and not focusing on singular species management (Schorr, 2004; Hickle, 2009). The shift in zoning has also seen an inclusion of socioecological values of marine environments. The change in focus of zoning reflects the trajectory of synergistic development between Western approaches and IBK, it is hoped that the bridgings of these two

approaches will become commonplace in the future. However, as stated by an anonymous participant:

"There is tokenism. Aboriginal people put themselves out, taking people into their country and showing them things, but we're not listened to. A lot of people are taking our knowledge and then not addressing the issues we brought up" (Annells, 2017),

The current inclusion of Indigenous communities is still tokenistic and lacking genuine engagement and will need to increase in order to create equal decisionmaking zoning approaches. An integrated planning approach that can help to facilitate Indigenous inclusion, is the Marine Spatial planning process (Bickford, 2017).

1.3. Marine Spatial Planning and Indigenous Biocultural Knowledge

Marine Spatial Planning (MSP) defined as:

"... a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process" (Ehler, 2009).

MSP has developed in response to the need for a systematic yet flexible process to manage the increasing pressure on marine environments (Jay et al., 2012). One particular reason for MSP wide advocation, is its ability to solve conflicts arising from differing resources management perspectives (Domínguez-Tejo et al., 2016), which has been demonstrated in planning for entire Exclusive Economic Zones (EEZs) for sustainable blue economy (Qiu and Jones, 2013). The differences in outcomes can make it hard to manage expectations and producing a universally accepted solution to MPA zonation. However, MSP can assist by gathering stakeholder data and generating a protected area plan that can inform a fairer allocation of marine resources (Pomeroy and Douvere, 2008).

IBK has been documented and used with MSP prominently in Canada (Ban et al., 2008; Bickford, 2017; Bishop, 2019; Diggon et al., 2019). The increasing integrations of IBK with MSP can provide a platform for Indigenous Peoples to self-determine how their ocean resources are managed (Alexander et al., 2019) to help in a more culturally respectful way. MSP can assist Indigenous people with integrating Western science

into their own management plans. However, translating IBK into an ocean management approach, like MSP, is another challenge that might derail participatory efforts (Alexander et al., 2019) because of misrepresentation or translation of IBK, which can create distrust (Thompson et al., 2020). Mapping can be a helpful tool to communicate MSP and IBK in a culturally respectfully (Ramirez-Gomez et al., 2013; Robinson et al., 2016; Davies et al., 2020).

To communicate the results of spatial data that has been used to develop spatial plans, mapping can display zoning information to stakeholders (Shucksmith and Kelly, 2014). In most endeavours of MSP there are multiple competing objectives and outcomes as conflicting objectives arise from differing values from stakeholders, regarding for example species priorities, economic factors and political agendas (Tuda et al., 2014).

Mapping tools can incorporate stakeholder and ecosystem information into MSP (Lombard et al., 2019; Pinarbasi et al., 2017; Stelzenmüller et al., 2013). Mapping has also been proven as a (Bishop, 2019) useful tool for integrating IBK and Western science to produce a cross-cultural map (Robinson and Wallington, 2012; Robinson et al., 2016). There has been recent research has focussed on mapping of Indigenous marine values in Australia and abroad (Lauer and Aswani, 2008; Bishop, 2019; Davies et al., 2020). However, it is enhanced with the use of Participatory Geographic Information System (PGIS) software to digitise IBK features on maps for analysis (Blake et al., 2017). Yet, when representing IBK features within map design, map producers need to be aware of the challenges and bias inherent to the process of data collection and mapmaking, as mapping is a colonial process (Hunt and Stevenson, 2017; Schultz, 2018). Some of these challenges and biases include: differences in types and timing of data collection, the perspective and experience of the data recorder, the map scale (as IBK is highly place-based) and format (whether topographic or satellite, for example), and the modelling parameters and models used (Mackenzie et al., 2017). Failed acknowledgement of these caveats can cause an inaccurate representation of cultural features and perpetuate colonialism in a subversive form (Hunt and Stevenson, 2017). In MSP, when prioritisation of areas for conservation is the goal, if cultural features are misrepresented then it is possible that the cultural features will

not be adequately or appropriately prioritised.

At the forefront of IBK, facilitation is use of decision support tools with IBK used to drive the objectives and data integration into the analysis. One particular tool that has been highlighted as useful for mapping IBK is *Marxan* and *Marxan with Zones* (Ball and Possingham, 2000; Ball et al., 2009; Bickford, 2017). These are software programs that provide decision-making support by generating several scenarios and site prioritisations under a set of objectives (Pinarbaşi et al., 2017) including socio-cultural aspects. However, the process is still Western-centric if IBK is not placed at the centre of process and conducted in collaboration (co-designed) with IBK holders in a decolonising process (Smith, 2012). The overarching process that Marxan and Marxan with Zones fits into, MSP, is similar to conservation planning (Ehler, 2009). Conservation planning allows the periodic review of results and inputs from stakeholders to fine-tune planning (Pressey et al., 2007). In Australia, the *Healthy Country, Healthy People* management strategy exemplifies use of adaptive management and IBK (Carr et al., 2017).

However, there is an insignificant movement on using Marxan with Indigenous communities to help bring together their cultural knowledge and western science (Ban et al., 2008; Ban et al., 2014). There have been examples where MSP has been utilised to communicate First Nation values and wish for management of marine environments (Ban et al., 2008; Ban et al., 2014). The present study aimed to further this work to co-design a potential cross-cultural MSP, and to move away from conventional top-down MSP approaches, for a highly urbanised area in Sydney, New South Wales, Australia, that is currently being managed by the Indigenous Gamay Rangers.

1.4. Co-design processes: Balancing Indigenous and Western research

MSP has been hailed as a tool to achieve sustainable outcomes and adhering to stakeholder needs and wants (Ehler, 2009). However, there is a still a power structure disparity in using conventional top-down MSP and Indigenous communities, which derives from the fact that MSP is a Western science construct (Flannery et al., 2016). When Indigenous communities are engaged in the process of MSP, they are being asked to take part in a Western process. In engaging in MSP, IBK is essentially

being placed/integrated into a Western scientific framework. When one form of knowledge is the overall framework (Western science) and the other is considered "puzzle pieces" (IBK), there is a distinct disproportionate valuing of knowledge. The lack of decision-making power can be perhaps remedied by shifting the ontology of MSP to co-existence of IBK and Western thinking (Flannery et al., 2016). To help circumvent unbalanced decision making, approaching MSP from a 'bridging' approach (Rathwell et al., 2015), instead of integrating IBK into a western framework (Reid et al., 2020) can help move towards co-design and decolonising the MSP space.

In Australia, there has been a movement towards more participatory planning processes following the historical exclusion of Indigenous Peoples from zoning of marine resources. This movement has been driven by co-designed projects between Western scientists and Indigenous knowledge holders (Parsons et al., 2016). From an Indigenous context, this means placing IBK at the centre of the MSP process. This can be assisted by utilising participatory mechanisms that allow the re-distribution of power amongst stakeholders (Blake et al., 2017). Guidelines such as the AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research that detail the specific cultural and good practice protocols for working with Indigenous Peoples. The crucial difference is the focus of the research output. In western research, the successful output of research is the main, if not only focus (Alexander et al., 2019). However, the principal focus for Indigenous peoples is positive social impact of research (Datta, 2018). The social benefit of research is a higher priority to Indigenous communities than the research itself. With no reciprocity inbuilt into the design of the research project. Indigenous communities feel they become research subjects instead of research collaborators when engaged in a western centric research process (Smith, 2012; Datta, 2018). If the process is shifted to focusing on an Indigenous style of understanding, then decolonising of research can give way to a redistribution of power.

To shift from a western driven process, to a decolonised research space, MSP projects need to embed reciprocity as giving back to the community (Smith, 2012). To decolonise is to place Indigenous ways of doing at the centre of the MSP, and accept that IBK is as scientific as Western Science (Smith, 2012). This process will be

included (though there is not one-size fits all) decolonising of research and the researcher through collaborative research and data collection, collective ownership, collective data acquisition, building ongoing and sustainable relationships, and incorporation and respecting cultural protocol (Datta, 2018). While this will allow Indigenous collaborators to tell their story in their own words, more radical decolonisation will see Indigenous-driven and led projects occurring. This will breakdown the assumed disparities in perception of the quality of knowledge and assert that Indigenous ways of knowing and doing are as valid as western science.

1.5. International to New South Wales policies regarding marine management and Indigenous People

The application of MSP and IBK on a global scale, falls under International Environmental Law (IEL). IEL comprises fragmented and disparate UN conventions and declarations including for example Convention on Biological Diversity (CBD) and United Nations Convention on Law of the Sea (UNCLOS) (Stephens, 2006).

The intersectionality of IBK and MSP with IEL and other global level policies is becoming increasingly commonplace (Ban et al., 2008; Ban and Klein, 2009; Ban et al., 2013; Ban and Frid, 2018). The process of globalisation is forcing discrete social groups, like Indigenous peoples and First Nation states, to engage with global policy and legislation (Charters, 2010). Engagement with IEL is significant for Indigenous peoples, who can be unfairly affected by policy and legal developments from the United Nations (Jonas et al., 2012). Conventions like the United Nations Declarations of the Rights of Indigenous People can help secure and solidify Indigenous Peoples autonomy and self-determination as Indigenous People were key in its formulation through consultation, especially for management of environmental resources (Giunta, 2019). However, Indigenous peoples do not have power in the ratification of UN declarations and resolutions. To participate in the ratification of UN Conventions, one must have the status of 'State'. Indigenous peoples and communities do not possess the status of State and therefore cannot take part in the ratification of UN declarations as easily as states (Miranda, 2010). Most Indigenous peoples live in colonised countries. Further evidence of exclusion of Indigenous Peoples from decision-making process, on a global scale, highlights the power imbalance of which

favours Western legal and cultural structures.

These policies formed by the UN, flow on to shape how national level policies and legislation are designed. From this process, there are consequences for Indigenous people's ability to look after Country. There is a record of ideological mismatch between the goal of Law's and Indigenous People's rights and Cultural Lore (Butterly and Pepper, 2017). A prominent example is the goal of 'conservation of species' and 'marine protected area designation'. These two examples that guide the legal and policy outcomes have been shown to disadvantage Indigenous peoples (Colchester, 2004) when they try to take care of Country (Butterly and Pepper, 2017). This can occur as restricted access to culturally significant lands, and outlawed practicing of Indigenous approaches to land and sea management (Ban et al., 2008; Lee, 2016b). These policies favour Western approaches to environmental management while alienating Indigenous approaches to managing Country (Pendleton et al., 2020).

International policies and legislation influence the domestic law of Australia (Holly, 2012). Australia is a signatory to legally binding legal instruments United Nations Convention on Law of the Sea (UNCLOS) and These two legal instruments have legal obligations that signatories have to incorporate and enforce domestically (Convention on Biological Diversity, 2020). Incorporation will occur through systemic legal structures at the national, state and local level. At the national level, Commonwealth environmental law is influenced by the CBD in various ways. In Australia, the CBD goals and priorities are reflected in the *Australia's Strategy for Nature* (Commonwealth of Australia, 2019). This strategy structures what the national response to supporting the conservation of biodiversity will be. The Strategy is then upheld and enforced by Australia's main environmental legal framework, the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In 2011 at Aichi, signatories to the CBD, including Australia, agreed that 10% of the global ocean be protected under a protected area management system (Sala et al., 2018). However, in 2020, a target of 30% was proposed for consideration at the next Conference of the Parties in 2021 (Convention on Biological Diversity, 2020). The target set by the CBD will influence the amount of marine environment to be protected under Australia legislation. One of the most significant imprints of the CBD on

Australia's national environmental policy, is the change in approach to protected area management by establishing a categorical system of protected areas (Bates, 2016): the National Reserve Systems (NRS) and The National Reserve System of Marine Protected Areas (NRSMPA). These two protected areas systems brought a consistent approach to how protected areas are to be established and managed throughout Australia's states and territories. The EPBC Act has a referral system in place in order to nominate areas to be included in the NRS. The CBD implores that signatory countries implement a protected area system (Bates, 2016).

The *Marine Estate Management Act 2014* is the main legislative framework for NSW zoning and management for MPA (Brooks et al., 2020). The zoning detailed in the *Marine Estate Management Act 2014* (MEM Act) is guided by IUCN protected areas categories. The four NSW MPA zone categories are: Sanctuary, Habitat protection, General use, and Special purpose. Each of the zones has particular purpose and protection levels. MSP processes fall under the MEM Act, considering the particular zoning categories. There is no specific mention of Aboriginal inclusion on zoning matters in the MEM Act but there is facilitation for input into the management of MPAs through Indigenous nomination to the advisory committee of each MPA (Wescott and Fitzsimons, 2016). This can form the basis for an Aboriginal Advisory committee for each of the MPA's at the request of Aboriginal communities (Wescott and Fitzsimons, 2016). However, this is still within a western political framework and where much of the decision-making power resides with the Australian Government. However, another set of relevant zoning policies are those related to coastal management in NSW.

The Coastal Management Framework in NSW refers to several documents with the most relevant to this study being the *Coastal Management Act 2016* (CM Act), State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) and the NSW Coastal Management Manual. The CM Act and the CM SEPP mainly focus on the creation and implementation of coastal management plans, which link to the objectives of the MEM Act. The CM Act explains that coastal wetlands and littoral rainforest, coastal vulnerability, coastal environmental and coastal use areas make up the 'coastal zone'. The CM SEPP focuses on integrated planning of coastal zones to meet the objectives of the CM Act. Whilst, the CM Act and the CM SEPP do not

make specific mention of zoning or protected areas, both acknowledge Indigenous connection to coastal zones. Yet, there are no specific inclusionary pathways for Indigenous people or knowledge.

MPAs in the NRSMPA are zoned based on a bioregion approach, which covers 60% of Commonwealth designated waters. The description of bioregions is contained within the Integrated Marine and Coastal Regionalisation of Australia (IMCRA). IMCRA outlines the criteria for the bioregions. The IMCRA is a non-legislative tool that can be used in conjunction with the EPBC Act in managing marine environments that are a part of Australia's International commitments. The IMCRA 4.0 categorisation are based on regionalisation: benthic and pelagic. The benthic regionalisation is based on the biogeography of fish. Whereas the pelagic regionalisation is based on oceanographic characteristics. The planning units of these regionalisation categories are made at regional scale planning. Yet, the bioregion approach and IMCRA does not mention, nor take into consideration, Indigenous Peoples' ontology of the environmental management.

The fragmented legislation and policy for the management of the marine environments make it difficult to situate Indigenous Sea Country IPAs and planning. This creates barriers to meaningful participation of Indigenous People in marine environmental management processes. The *Oceans Act* report by the Environmental Defenders Office and Humane Society International had explicitly mentioned the recognition of Sea Country and the place of Indigenous People in management (EDO NSW and Humane Society International Australia). There is movement in policy and legislation to recognise that Coastal Indigenous Communities have a right and a place in decision making for marine environments. The combination of bringing MSP and IPAs together offers a platform for Indigenous peoples to advocate for Indigenous managed Sea Country estates whilst fulfilling their cultural and Western legal obligations.

1.6. Research Questions and Aims

To bring together the elements of international and domestic obligations, advance the inclusion of Indigenous voices in marine protected area planning within NSW, this research aimed to work with the Gamay Rangers of Botany Bay to develop a co-

designed MSP using Marxan but will concentrate on conservation prioritisation. The research questions were:

- 1. Where and what are the culturally significant sites and resources within Dharawal Country?
- 2. Which areas are significant to the Gamay Rangers?
- 3. What would the marine spatial planning scenarios look like when using: a) Conventional planning data; b) Conventional planning data plus the NSW government registered Aboriginal sites; and c) Conventional planning data, NSW government registered Aboriginal sites and Gamay Rangers values and priorities?
- 4. How does the Gamay eco-cultural marine management plan differ to the conventional data approaches?

2. Methods:

2.1. Study region

The study area encompasses Botany Bay and the Hacking River in southern Sydney, NSW, Australia, which is the main of area of interest for the Indigenous Gamay Rangers (Figure 1). Gamay is the Dharawal word for Botany Bay. The study site contains different land usage and occupancy histories. In Botany Bay, there is currently a mixture of highly dense residential areas, industrial zones and Australia's busiest airport, Sydney airport, which all impact the surrounding marine and coastal ecosystems (Sydney Airport Corporation Limited, 2019) (Figure. 2). The extent of the study area was selected by using a shapefile layer of the outline of the NSW coastline and estuary (cropped to the Botany Bay and Hacking River area) and then applying a 2.5km buffer to coastline to incorporate coastal features. To avoid selecting highly built-up areas in the prioritisation such as at the Sydney Airport shipping channel, these areas were locked out of the Marxan analysis (Figure. 2). The Hacking River is heavily urbanised on the northern side and relatively undisturbed on the southern side, which forms part of Australia's first National Park, the Royal National Park. Prior to colonisation, this region was occupied by the Dharawal People (Bursill et al., 2007; Troy, 2019).



Figure 1. A satellite map of the study location showing the Botany Bay and Hacking River, which are highly diversified in land usage.

Botany Bay and the Hacking River are culturally significant to the Dharawal People. The Dharawal People are coastal people who relied on and have a strong cultural connection to the coastal resources and the ocean (National Oceans Office, 2002; Bursill et al., 2007). The Dharawal Nation covers the Botany Bay Area, the Georges River and a portion of south-eastern New South Wales (NSW) (Fig 3). However, this study did not include the Georges River region because of complexities of Aboriginal Local Land Council boundaries and jurisdictions.



Figure 2. Map of study area showing the key habitat features, government cultural data and current aquatic reserves. The AHIMS data points have purposefully left uncategorised due to cultural sensitivity and sovereignty.



Figure 3. The occupation area of the Dharawal/Tharawal People.

2.2. Data collection and processing

2.2.1. Biophysical and socioeconomic data

Using freely available biological and socioeconomic, we derived spatial data layers for important marine and coastal conservation features, socioeconomic considerations and costs (Ban and Klein, 2009) (see Appendix for Data Summary for list of data sources). A total of 31 conservation features (i.e. features to be conserved in protected area network) were identified for the Marxan protection analyses (Table 1). Only surface variables were included in the conservation features as we did not have data on submersed features, and this was out of scope of this thesis.

Table 1. The conservation features selected to be protected with the source dataset, and the cost layer inputs See Appendix A.4 for the full listing of datasets, formatting and original source.

Category	Data source	Input in Marxan		
Habitat	Habitat			
Beach	Department of Planning, Industry and Environment	Conservation feature		
Islands	Department of Planning, Industry and Environment	Conservation feature		
Mangroves	Department of Planning, Industry and Environment	Conservation feature		
Reef and shoal	Department of Planning, Industry and Environment	Conservation feature		
Rocky intertidal	Department of Planning, Industry and Environment	Conservation feature		
Saltmarsh	Department of Planning, Industry and Environment	Conservation feature		
Seagrass	Department of Planning, Industry and Environment	Conservation feature		
Subtidal sand	Department of Planning, Industry and Environment	Conservation feature		
Halophila	Department of Planning, Industry and Environment	Conservation feature		
Mangrove 2	Department of Planning, Industry and Environment	Conservation feature		

Mangrove/Saltmarsh	Department of Planning, Industry and Environment feature	
Posidonia	Department of Planning, Industry and Environment	Conservation feature
Posidonia/Halophila	Department of Planning, Industry and Environment	Conservation feature
Posidonia/Zostera	Department of Planning, Industry and Environment	Conservation feature
Posidonia/Zostera/Halophila	Department of Planning, Industry and Environment	Conservation feature
Saltmarsh 2	Department of Planning, Industry and Environment	Conservation feature
Zostera	Department of Planning, Industry and Environment	Conservation feature
Zostera/Halophila	Department of Planning, Industry and Environment	Conservation feature
Littoral Rainforests	Department of Planning, Industry and Environment	Conservation feature
Rocky reef	Department of Planning, Industry and Environment	Conservation feature
Beach/dune sand/gravel	Department of Planning, Industry and Environment	Conservation feature
Exposed reef/outcrop	Department of Planning, Industry and Environment	Conservation feature
Sand	Department of Planning, Industry and Environment	Conservation feature
Sand veneer/bare reef	Department of Planning, Industry and Environment	Conservation feature
Seagrass 2	Department of Planning, Industry and Environment	Conservation feature
Geomorphology		
Harbor	Department of Planning, Industry and Environment	Conservation feature
Estuary	Department of Planning, Industry and Environment	Conservation feature
Catchment	Department of Planning, Industry and Environment	Conservation feature
Bay	Department of Planning, Industry and Environment	Conservation feature

Tide dominated	Department of Planning, Industry and Environment	Conservation feature	
Ocean embayment	Department of Planning, Industry and Environment	Conservation feature	
Socioeconomic			
Agricultural land	Department of Planning, Industry and Environment	Cost	
Defence land	Department of Planning, Industry and Environment	Cost	
Defence facilities	Department of Planning, Industry and Environment	Cost	
Mining	Department of Planning, Industry and Environment	Cost	
Managed resource	Department of Planning, Industry and Environment	Cost	
Manufacturing facilities	Department of Planning, Industry and Environment	Cost	
Land in transition	Department of Planning, Industry and Environment	Cost	
Roads	Department of Planning, Industry and Environment	Cost	
Waste transport	Department of Planning, Industry and Environment	Cost	
Urban residential	Department of Planning, Industry and Environment	Cost	
Railways	Department of Planning, Industry and Environment	Cost	
Service	Department of Planning, Industry and Environment	Cost	
Transport	Department of Planning, Industry and Environment	Cost	
Utilities	Department of Planning, Industry and Environment	Cost	
Boating Ramps	Department of Planning, Industry and Environment	Cost	
Fishing areas	Department of Planning, Industry and Environment	Cost	
Shipping channel	Department of Planning, Industry and Environment	Cost	
Overfishing north	Gamay Ranger mapping and interviews	Cost	
Overfishing south	Gamay Ranger mapping and interviews	Cost	

Recreational boating	Gamay Ranger mapping and interviews	Cost
Shipping channel	Gamay Ranger mapping and interviews	Cost
Proposed new terminal	Gamay Ranger mapping and interviews	Cost
Oil refuelling	Gamay Ranger mapping and interviews	Cost
Cooks River pollution	Gamay Ranger mapping and interviews	Cost

2.2.2. Cultural values data

Two of the planning approaches included cultural values data. Cultural values data is any feature which can include species, habitats, geographical features and areas that are important to Indigenous people.

2.2.2.1. Secondary data from NSW Government AHIMS data

Registered Aboriginal cultural heritage data for the study region were acquired from the NSW Government's Aboriginal Heritage Information Management System (AHIMS). AHIMS data includes sparse information about sites including: Site type, latitude/longitude. Several papers have noted the overall poor quality of this data including that it is dated, not routinely checked (so site condition is not clear), is point based, and does not reflect the spatial or the cultural dimensions of the sites (Attenbrow, 1991; Guthrie and Kohen, 2005).

The AHIMS data for the study region included 17 different categories of cultural heritage sites. The data was cleaned and regrouped into 10 categories using a process of removal of redundant and amalgamation of similar data, as follows (Table 2). Two sites marked as invalid in AHIMS were removed: 'Earth Mound' and 'Stone Arrangement'. 'Potential Archaeological Discovery' was also eliminated due time constraints having to ascertain details on this site. Similar categories were amalgamated: 'Hearth' was combined with 'Habitation Structure' as it would have been located nearby; 'Ochre Quarry', 'Stone Quarry' and 'Water Hole' are all resources and were re-grouped into 'Quarry and Waterholes'. A total of 1783 NSW

Government registered AHIMS cultural sites were identified in the study region (Figure 2). This data was included as a surrogate for cultural values.

Table 2.	AHIMS	Cultural	sites
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Category	Data source	Scenario
Aboriginal Culture and Dreaming	AHIMS	2 and 3
Aboriginal Resource and Gathering	AHIMS	2 and 3
Art	AHIMS	2 and 3
Artefact	AHIMS	2 and 3
Burial	AHIMS	2 and 3
Grinding	AHIMS	2 and 3
Habitation	AHIMS	2 and 3
Modified Tree	AHIMS	2 and 3
Non-human remains	AHIMS	2 and 3
Shell	AHIMS	2 and 3

2.2.2.2. Gamay Rangers collaborators: primary cultural values data

To determine the local biocultural conservation priorities of the Gamay Rangers, knowledge was elicited using semi-structured interviews and participatory mapping (Blake et al., 2017). There were a mixed age range of 14-40's and five male rangers (two senior rangers, one ranger and two trainee rangers) and one female ranger (one trainee ranger). The two senior rangers and ranger had been with the Ranger group since the start, which was a little over two years ago. The three trainee rangers had each been with the group approximately six months. Each of the Rangers that participated in the interviews had grown up on Dharawal Country and were still connected to the area. All the Rangers came to Dharawal Country every day either for cultural, social or employment reasons. So, each Ranger had an intimate understanding of Dharawal Country and the study region. However, the Rangers do not represent the views of the Dharawal community as a whole.

To be culturally respectful when collecting Indigenous Knowledge, it is preferred to do so in person and with time to build trust and respect (AIATSIS, 2020). Although, this

project had Human Research Ethics approval (MQ Ref: 52020634714117) (Appendix A.2) for this, due to COVID-19 restrictions and timeline constraints, smaller face-to-face workshops were held. Interviews were conducted over three sessions: initially to record and map cultural places and resources, secondly to map threats and changes to cultural areas, and thirdly to complete the semi-structure interviews. The Rangers were interviewed as a group on all occasions and gave group responses. The semi-structured interview questions were reviewed to make sure that questions were detailed enough to elicit high-quality information and to allow the participating rangers to produce a group response. The semi-structured interview questions are provided in Appendix A.1.

To determine the Gamay Rangers value of the different AHIMS categories, the Analytical Hierarchy Method (AHP) was used with the semi-structured interviews. The AHP was implemented by getting Gamay Rangers' interview participants to assign a value to each of the AHIMS categories. The results of the AHP questionnaire would assign cumulative values from all the Rangers' responses to determine the weight of importance for each of the categories.

To facilitate the participatory mapping of the Gamay Rangers' cultural values, A1 sized laminated topographic and satellite maps were used. Map scale, style and format (digital or paper based) can influence mapping outcomes (Davies et al., 2020). In our study, the satellite map was included to allow for ease of identifying environmental features around Botany Bay and the Hacking River, and the Georges River. The Topographic map assisted with navigating across the built environment and existing protected areas. The maps were both laminated to allow for annotation in permanent marker pens by the participating rangers. The scale of the maps was 1:110000 (Botany Bay) and 1:90000 (Hacking River). The resolution was determined based on the amount of fine scale spatial detail that could be observed without sacrificing the inclusion of the entire planning regions.

The four base maps (2 x maps of Botany Bay (topographic and satellite) and 2 x maps of the Hacking River (topographic and satellite)) were used. During the interviews, six hours of mapping and two hours of interviews were conducted. The interview questions and the AHP forms were emailed to the Rangers prior to the online mapping workshops. This was done to allow time for the Rangers to review

the questions and consider prior to the meeting, what information could be recorded during the mapping process. The mapping workshops occurred before the interviews to so that the maps could be used as part of the interview process as a reference. This also allowed for cross-checking of responses within the group and with the interviewer.

On the maps, the Rangers were asked to mark out any culturally significant site (historical and contemporary) on the topographic map in different coloured markers. Rangers were asked to identify culturally significant and information they were comfortable sharing. Rangers were assured the post-processing of the maps would de-identify sites to protect sensitive cultural information and increase cultural data sovereignty. This was done for the Botany Bay and Hacking River maps. The topographic map was used to record culturally significant sites and values, as features were more identifiable than on the satellite map. Each individual site was numbered and catalogue in a spreadsheet. The same process was followed for marking out threats and changes on the satellite map for the Botany Bay and Hacking River. The satellite map was used to map threats as it showed more environmental features. However, this was done in a general sense instead of asking the Rangers to mark out threats and changes to each site as recorded on the Topographic map. Details of threats and changes were catalogued in a spreadsheet for easier data processing.

After the mapping, the Rangers were interviewed as a 'focus group' instead of individually. A focus group style allowed the Rangers to communicate and prompt one another to produce 'consensus' data. This was also done to give the younger Rangers a chance to participate. The response to the group interviews were audio recorded and then transcribed. The semi-structured interview questions were arranged in a stepwise nature to allow the response to each previous question to build on the following question in the interview. Part of the interviewing process gathered information about the importance of AHIMS sites. The AHP method was integrated into the interview structure to determine the relative importance of cultural sites. This was conducted as the interviewee sample size was small and not representative of the entire community (O.Nyumba et al., 2018). The results from the AHP were used to determine the weights of cultural site importance for Marxan

analyses.

Finally, the Rangers were asked to identify management objectives to guide reserve selection. This 'Objective setting' was used to inform the objectives and targets used for Marxan scenario three.

2.3. Planning scenarios and objectives

Marxan software (Ball et al., 2009) was used to run three different reserve selection scenarios (Table 3). The three different scenarios were:

- 1. Conventional conservation planning
- 2. Conventional + NSW government AHIMS data
- Conventional + NSW government AHIMS data + Gamay Rangers cultural values

Scenario	Planning Approach	Description
1	Conventional conservation planning exercise	This scenario used socioecological data (See Table 1 for a list of Conservation features and cost data) typically found in top-down approaches to conservation planning
2	Conventional planning exercise with cultural values from government data	This scenario used socioecological data (See Table 1 for a list of Conservation features and cost data) and secondary data from the NSW government AHIMS cultural data
3	Conventional planning exercise with cultural values obtained through collaborative planning with Gamay Rangers	This scenario used socioecological data (See Table 1 for a list of Conservation features and cost data) and secondary data from the NSW government AHIMS cultural data as well as Gamay Rangers cultural data and priorities

Table 3. Description of planning scenarios

Each of the scenarios shared the same planning unit file. However, the scenarios had different configurations of conservation features and costs (see Appendix A.3 and A.4). All costs were treated equally, except for 'mining' and 'transport'. Mining and transport had a 10x multiplier applied to the final cost to avoid placing MPAs near areas of high traffic and extractive activities. The individual scenarios were designed around meeting the Objectives (Table 4). The Objectives were informed by international policies for biodiversity conservation (post-2020 framework of the CBD)

ecological design principles (Green et al., 2009; Foley et al., 2010) for marine planning and the input of the Gamay Rangers Indigenous collaborators.

Objectives	Scenario 1	Scenario 2	Scenario 3
Ecological	<u> </u>	1	
Create a network of protected areas that are representative by conserving 30% (under the revised CBD recommendation) of all habitat features of coastal and marine ecosystems	X	X	Х
Avoid areas that could reduce the effectiveness of coastal and marine protected areas	X	X	Х
Consider sea and land use, particularly proximity to threats and other protected areas	Х	X	X
Social, economic and political			
Minimize conflicting use of areas, particularly ecotourism activities and extractive use.	X	X	Х
Accommodate existing shipping infrastructure (wharves, channels) in marine protected area design (avoid placing highly protected areas near these areas)	X	X	Х
Cultural			
Prioritise protection of cultural areas that overlap with key ecosystems		X	Х
Conserve marine resources that Indigenous peoples identify as highly important to their livelihood			Х
Protected zones for Indigenous people that are managed by traditional custodians that reflect culturally important fish species			X
Protect areas that have key cultural features (e.g., art, burial areas) identified by Indigenous			X
Incorporate Indigenous local knowledge, traditional fisheries management and conservation practices			X

Table 4. The Objectives used to guide each of the Scenarios

2.4. Data processing for Marxan

All conventional and AHIMS data layers described above were re-projected into a consistent spatial reference system (WGS 84 / Pseudo-Mercator EPSG:3857) using QGIS software (version 3.10.6 (QGIS Development Team, 2020)). Planning Units for Marxan were created as hexagons so that boundary for each unit shared an equal boundary with other surrounding planning units (Green et al., 2009). I chose 0.5km² as the area covered by each planning unit to correspond with the spatial resolution of the environmental and biological data.

The AHIMS data was provided as point data with collection notes in an excel spreadsheet. The density of AHIMS cultural sites was determined for each planning unit using the "extract by location" tool in QGIS.

To digitise the Gamay Rangers' cultural values and threat maps the physical marked up maps were collected from the Rangers and digitised. Photos were taken of each map using a Nikon D7200 with a Sigma 50mm lens. The photos were then imported into QGIS and geo-referenced with a minimum of 10 points and at a minimum accuracy of 10m². Another shapefile was created and overlayed on the top of the geo-referenced image. Polygons were traced over each of the individual cultural sites for each of the section maps (Botany Bay and the Hacking River). The same steps were performed for the 'threat and changes' satellite maps, making for new shapefiles: 1. Botany Cultural Sites, 2. Hacking River Cultural Sites, 3. Botany Bay Threats and Changes, and 4. Hacking River Threats and Changes. The information recorded during the mapping workshop was entered into each of the shapefile attribute tables.

The results from the AHP forms were entered into a spreadsheet and the weights calculated for each AHIMS category. These weights were then entered into the attribute table of the corresponding shapefile.

2.5. Marxan Settings

Existing MPAs with a >50% overlap with planning units were locked in. After calibration, we used the BLM 1 to increase clumping of selected planning units due to the urban nature of the study area. For each scenario, we ran Marxan 100 times, and maximised the achievement of conservation objectives by adjusting the species

penalty factor.

2.6. Data Analyses

Spatial analyses were conducted using GIS and Marxan to determine the optimal MPA design and calculate how much of the conservation features and cultural values (government data and Indigenous) were represented in each of the three different planning scenarios. The best solution for each Marxan scenario was used to undertake a gap analysis of representation compared to the international habitat conservation benchmark of 30%.

To compare the scenarios, the best solution was used to visually and qualitatively describes the differences between each of the three scenarios.

3. Results:

3.1. Conventional ecological conservation planning scenario (Desktop ecological design)

The Marxan output for the conventional planning scenario met the target of 30% for conservation features.



Figure 4. The best solution output for the conventional planning approach.

The areas that were included in the conventional planning scenario (Fig 4) were located away from urban and developed areas (high-cost areas) and with areas already locked in to the reserve system, such as the Royal National Park and Towra Point Reserve. In this analysis, new areas were identified as important for conservation on the northern side of Botany Bay, around the La Perouse Headland, La Perouse beach and Yarra Bay based on the combination of coastal and marine habitat features. Conservation areas near Kurnell headland and the subtidal area off Cronulla Beach were identified, as was the entrance to the Hacking estuary as it contained reef, shoal and seagrass, values respectively. Further up the Hacking estuary, planning units were selected primarily in the middle and upper parts of the estuary based on known Mullet spawning sites from the AHIMS data.

Isolated planning units were identified to make the 30% target for the following conservation features: estuary. The single planning unit identified in the Cooks River was likely driven by the low proportion of estuary planning units across the region



3.2. Conventional + AHIMS planning scenario (Desktop eco-cultural design)

Figure 5. The best solution output from Marxan for the conventional + AHIMS cultural data.

When these were added to the conventional Marxan planning model, the potential reserve (Fig 5) that met the 30% target for most conservation features and all the cultural features covered a slightly larger area and incorporated some new areas for consideration in a desktop eco-cultural reserve design.

Addition of the AHIMS sites to the conventional scenario added planning units around Little Bay and the Botany Bay headland. On the southern side of the Bay, near Boat Harbour, more planning units were captured to protect the middens that occur there. In the middle/upper reaches of the South West Arms Creek, there is a high number of cultural sites that were captured in the plan based on density of sites.
3.3. Desktop + Gamay Rangers values scenario (Gamay Eco-cultural design)

3.3.1. Gamay Rangers interviews

The Gamay Rangers were interviewed to elicit local cultural priorities for conservation in the study area to produce a more respectful and contextual ecocultural design. Each of the Rangers that participated in the interviews had grown up on Dharawal Country and were still connected to the area. All the Rangers came to Dharawal Country every day either for cultural, social or employment reasons. So, each Ranger had an intimate understanding of Dharawal Country and the study region.

3.3.2. Gamay priorities for conservation in the study site (interview data)

The Gamay Rangers prioritised sites that were multidimensional in value for the local Aboriginal community (Fig 6). Sites that supported the health of the local La Perouse Aboriginal community were especially significant. For example, the Senior Ranger stated that the Towra Point Mangrove was important "because it's a spawning ground, spawning area for many of our fish species that are critical to our community's health. You've got blue swimmer crabs, whiting, bream, mullet, cockles, oysters. So, for me, that's the most critical part of the bay."

Other top priorities for site protection were those that were historical and scarce. For example, Muddy Creek was considered a priority as it signified change in the local cultural practices of tool production and resource usage, as a Senior Ranger confirmed: "… meeting of settlers and exchanging…, or whatever of those tools, different tools, but the different materials. So for us, it's the only one that we're aware of. So, it's [importance] really high, really significant area".

Burial sites were rated highly among the Rangers for protection due to the scarcity and spiritual value attached to the few remaining sites. Whereas, sites types that were more prevalent, such as middens were not prioritised as highly: "*at the end of the day its kitchen waste, and there's a lot of them around*".

Sites that were traditionally significant with access restriction in a present-day context had prioritisation of mixed levels. Bomborra Point was a site utilised for freshwater but presently it is highly contaminated and not used as a Senior Ranger

confirmed "Nowadays, it's probably not as significant and it's not a freshwater source for us now. Historically, it used to be important. So as a site you'd have to say it would be somewhere between a three and a four." Sites that were no longer active but were important for revitalisation of cultural practices of oyster collect as a food source "Traditionally are important because they're a source of food. They're only in the early stages of rebuilding them because they were listed as extinct, almost extinct or endangered. So, again, I would say they're a four because the evidence in the middens is pretty much all the oysters from that area. So traditionally that'd be of pretty high importance."

Site Type	Protection Level
Aboriginal Culture and	60%
Aboriginal resource and Gathering	70%
Art	100%
Artefacts	90%
Burial	100%
Grinding grove	90%
Habitation	90%
Modified Tree	100%
Non-human remains	60%
Shell	80%

Table 5. Protection levels the Gamay Ranger assigned to AHIMS site types

The protection levels elicited from the Rangers are not priorities in conventional conservation planning. One of the senior Rangers said *"if you haven't got the resources you need, you'll starve"* when the group gave a protection rating of 70%. For site types that were more sacred, like scar trees (which come under the Modified Tree site type), a Ranger reasoned that *"you would want to save 100% of those because they are few and far between and they're really important."*

The Rangers knew that the protection levels they had determined were high and may be difficult to enforce. However, the Rangers differentiated between how much they would like protected and how much they are able to protect. One of the Senior Rangers had justified the protection levels "*I mean, you know, for me, it*'s aiming high, and hopefully you get as close as you can. Yeah. Rather than aiming low, and

just having that as a pass mark. You know I mean, some of it might be possible. Yeah. I'd aim a little bit higher and reach for it".

3.3.3. Adding Gamay priorities (Gamay Eco-cultural design)

The Gamay Rangers had specific targets for each cultural value (Table 5). Adding these to the previous conventional plus AHIMS data model (Scenario 2) contextualised the reserve design for local marine managers. The Marxan output for this scenario (Figure 8) was able to meet all targets except for four Gamay sites which fell in the excluded area.



Figure 6. The best solution output from Marxan for the Gamay Feature of that the Gamay Rangers

The Whale and calf carving was also an underperforming target, which was due to reaching as close to that the target amount and not considering target met status.

The other features (Conservation and Cultural) followed the same target and selection pattern in the previous scenarios.

In Scenario 3, there was an increase in planning units near Little Bay and along the Botany Bay headland accounting for the mullet fishing areas, blue swimmer crab spawning sites, traditional fish traps and intertidal collecting sites identified by the Rangers. The selected planning units at Brighton-Le-Sands beach were due to a multi-species fishing resource. In this scenario, more of the Towra Point Reserve was captured, accounting for the higher prioritisation of seagrass by the Rangers. Around the opening of the Hacking River and into South West Arms Creek, there were increased allocation of planning units due to the increase in sites of cultural significance, cave shelter, and multi-species fishing sites. The upper reaches of the Hacking estuary also featured more strongly due to engraving sites, middens, and mullet fishing.

In Scenario 3, the isolated planning units that were selected are very important for the Gamay Rangers as they feature blue swimmer crab spawning sites, burial site, that according to their cultural priorities must all be protected.

3.3.4. Gamay Rangers' knowledge of threats, changes and management

The Rangers showed that there were several threats within Dharawal Country that were detrimental to culturally significant sites. The Rangers listed 10 major forms of threats: pollution from oil spills, recreational, boat use, potential cruise ship terminal, dredging, species mismanagement, erosion, overfishing, airstream pollution, pollution from Cooks River.

The potential cruise ship terminal was collectively seen as the most significant threat as stated by a Senior Ranger "... *if you got a seven*" on a scale out of 5. The Rangers linked the construction of the cruise ship terminal with several other threats such as dredging. However, the Rangers knew that dredging happens in relation to other shipping activities in the bay. Seagrass was one of the culturally significant environmental resources most affected by the cruise ship terminal and associated dredging. The Rangers mentioned that the cruise ship terminal would "*alter the wave pattern directly into that site*" and the associated dredging would "*choke fish and*

marine life, blocks out the sunlight for that seagrass... the potential damage would be significant... even catastrophic."

Another highly rated threat was pollution the Cooks River. Rising sea levels and temperature were threats that the Rangers had pinpointed that were not mapped in the previous mapping workshop. The climate change threats were of high concern as the Rangers identified *"those intertidal areas would change"* due to sea level rise and increasing sea temperature would change cool temperature habitats that would become *"potential threats because some of our species are only cold-water species."*

The Rangers expressed damaged done to Country due to these threats "*it's just horrible*." One of Rangers lamented, "*It's our country, we should be looking after it for it to look after us*." The Rangers were all keenly aware of the current management strategies in place on their Country. However, as a Group, the Rangers stated they "... want to have voices heard, don't we. We want to have concerns taken seriously." The Rangers conveyed that "we want our... traditional cultural fishing rights acknowledged... and control returned."

The Rangers had specified management strategies they would like to implement to help support the targets. The Rangers had suggested seasonal closure focused on culturally significant species' seasonal patterns. An example of this is the "*Blue swimming crabs coming in the bay in October, maybe a seasonal ban on taking all blue swimmer crabs in October. So maybe some seasonal fishing restrictions in place on certain species*", as suggested by one of the Rangers. However, in this project seasonal closures could not be reflected in the outputs, as we were using Marxan and not Marxan with Zones.

A common theme in the management strategies suggested by the Rangers was more control through the Land Council to determine how to manage certain sites. One Ranger had suggested "... total closures, to unauthorised persons. That way Land Council can authorise us or someone else" to manage the sites. It was also suggested that "maintenance be carried out by traditional custodians of this area". These statements show the Rangers aspiration for determination over the management of their Country. Where, a Ranger stated they would like to see "more protection zones and more control for Aboriginal People" which was echoed by a

Senior Ranger "I'd like to have us have more say in how these areas are managed and protected and have some kind of authority to ensure that's happening."

3.4. Current Protection Level of Conservation Features and Cultural Values

The gap analysis showed that 3/8 conservation features in the study area were already protected at the 30% target (or above) within existing aquatic reserves (Table 6). Conservation features that were well protected were Mangroves (75.7%) and Seagrass (50.4%). However, the percentage of Reefs and Catchment were low due to being predominantly located outside of the aquatic reserve. Reefs were protected 13.7% and catchment were 0% protected.

The gap analysis showed that none of the AHIMS cultural features were currently adequately protected (Table 6). The cultural value feature with the highest current protection level was burial sites at 19.05%, which were within the Towra Point aquatic reserve. No art sites or modified trees were protected within existing reserves.

The gap analysis showed 2/7 of the Gamay identified features were adequately protected above 30% (Table 6). Towra Mangroves feature had a protection level of 66.4% and the majority were located within the current aquatic reserve. Sites that were land based such as the whale and calf carving, Audley Cave Stencil and Muddy Creek Engravings were all located outside of the aquatic reserve. These sites all had a protection level of 0%.

Table 6. Results of gap analysis performed to ascertain the current protection level of coastal and marine habitats, geomorphological features, government listed cultural features and Gamay Indigenous cultural features.

Conservation Feature	Total area of feature (sqkm)	Total area of feature (occurrence) Protection in	existing MPAs (%) Protection in existing MPAs	Protection in Scenario 1 (%)	Protection in Scenario 2 (%)	Protection in Scenario 3 (%)
Coastal habitats						

Mangroves	6.93		75.7		76.85	76.98	80.58
Seagrass	7.44		50.4		62.75	63.38	67.59
Reefs	7.96		13.7		30.43	30.19	30.00
Intertidal	0.46		24.18		37.64	31.98	45.65
Geomorphological features			<u> </u>		<u> </u>	<u> </u>	<u> </u>
Beach	0.40		0.1		31.95	30.95	30.14
Catchment	32.71		0		30.01	29.98	29.99
Estuary	17.91	_	57.40		58.95	59.15	58.23
Embayment	76.70	-	27.00		30.01	30.02	33.48
Cultural values - Government Data							
Burial site		21.00		19.05	60.00	60.00	100.00
Resource and Gathering		8.00		14.30	63.75	63.75	75.00
Art		305.00		0.00	0.00	18.10	96.07
Modified Tree		5.00		0.00	0.00	0.00	100.00
Cultural Values - First Nations		1	1	1		1	1
Towra Seagrass	11.02		44.40		48.83	48.83	69.70
Towra Mangroves	0.30	_	66.4		66.40	76.99	72.13
Mullet	0.02		0.00		0.00	70.14	79.15
Blue Swimmer Crab Spawning site	0.01		0.00		0.00	44.23	78.85
Whale and calf carving	0.01		0.00		0.00	0.00	62.86
Audley Cave Stencils	0.00		0.00		0.00	100.00	100.00
Muddy Creek Engravings	0.01		0.00		0.00	28.85	100.00

The representativeness mangroves, seagrass, intertidal, estuary and embayment features increased from scenarios 1 to 3 (Figure. 7 and Figure. 8).



Figure 7. Percentage area of coastal habitats protected in each scenario. The blue bar indicates the %age area protected by existing MPAs, and the grey bars describe the %age area added by Marxan.



Figure 8. Percentage area of geomorphological features protected in each scenario. The blue bar indicates the %age area protected by existing MPAs, and the grey bars describe the %age area added by Marxan.

The representativeness of Cultural Values (Government data and Indigenous) increases across the scenarios (Figure. 9 and Table 6). There is an increase in Burial Sites, Resource and Gathering, and Towra Mangrove protected areas. Towra Seagrass and Towra Mangroves were the only two Cultural Values that were represented in Scenario 1. The majority of the Cultural Values were represented in Scenario 2 except for Modified Tree and Whale and Calf Carving sites. An increase in the projected protected areas was observed for Burial site, Resource and Gathering, Art, Towra Mangroves, Mullet, Blue Swimmer Crab, Audley Cave Stencils and Muddy Creek Engravings (Figure. 10 and Table 6). All Cultural Values were protected in Scenario 3. There were further increases in protected area for the majority of Cultural Values in Scenario 3. Whale and Calf Carving sites, not previously represented in either Scenario 1 or Scenario 2, had a 62.86% protected occurrence result. Burial sites, Modified Trees, Audley Cave Stencils and Muddy Creek Engravings had increased to 100% protected occurrence or area. The best solution for each Marxan scenario was used to undertake a gap analysis of representation compared to the existing MPA protection.



Figure 9. Percentage occurrence of for government listed cultural features and sites protected in each scenario. The blue bar shows the %age area protected by existing MPAs, and the grey bars describe the %age area added by Marxan.



Figure 10. Percentage area of Gamay Indigenous cultural features and sites protected in each scenario. The blue bar shows the %age area protected by existing MPAs, and the grey bars describe the %age area added by Marxan.

4. Discussion

This is the first time MSP and Marxan have been used to build a coastal and marine eco-cultural conservation plan in NSW that takes into consideration ecological, sociological, and local Indigenous cultural priorities. The coastal and marine eco-cultural conservation plan highlights the inadequacy of the current marine, coastal and environmental legislation and policy to protect Indigenous cultures and interests, demonstrating a critical need to further develop approaches to include Indigenous voices in protected area planning. The present research went beyond a desktop conservation planning approach using existing data to integrate local Indigenous perspectives (co-design), in this case the Dharawal Gamay Rangers, in line with international directives (IPBES, CBD). This approach attempts to place Indigenous

perspectives at the centre of design considerations. Intentionally centreing Indigenous values and management aspirations in the eco-cultural conservation plan was conducted to facilitate on-ground application of the research findings. The development of the coastal and marine eco-cultural conservation plan is the first step towards building a co-designed protected area and decolonising the protected area design space.

4.1. Moving from conventional conservation planning to include cultural values and Indigenous inclusion

Using the Gamay Rangers' management area as a case study, a conventional conservation planning desktop assessment (Scenario 1) was undertaken, using existing conservation features (ecological and socio-economic) data. The target for protection of each feature in Scenario 1 was 30% which is in line with the upcoming revision of the CBD target for marine environments (Convention on Biological Diversity, 2020). In the Marxan output for scenario 1, the 30% target was met for most of the conservation features, initially selecting areas already conserved (such as Towra Point). For those features not already protected at 30% of the total known area, new conservation areas were identified to meet the targets, which in this case were primarily for the coastal/marine features of seagrass, ocean embayment, catchment, reef and shoal (Figure 7 and Table 5). The Marxan identification of seagrass as currently inadequately protected is significant as it was noted by the Rangers and other surveys as under threat within Botany Bay (Evans et al., 2018). To adequately protect all conventional ecological features within reasonable socio-economic constraints of this urban setting, Marxan recommended disparate areas right across Botany Bay and the Hacking River (Figure 4) be considered for conservation.

To include cultural values in protected area planning, the NSW government registered cultural sites (AHIMS data) were added to the Scenario 1 analysis to produce Scenario 2 (Figure 5 and Table 5). In this eco-cultural desktop planning exercise, the 30% target for each conservation and cultural feature was met, similar to Scenario 1. Scenario 2 expanded the hypothetical ecological conservation reserve of Scenario 1 to include several new areas for protection of registered cultural sites. Spatial gap analysis of the Scenario 1 and 2 showed that the representation of cultural values in Scenario 1 was poor. The few cultural values that were protected

were values related to cultural environmental resources such as mangroves and seagrass. Sole reliance on Scenario 1 would therefore not adequately protect the Indigenous Cultural Values, as represented by the NSW registered cultural sites. This showed the need to expand the conventional Marxan analysis to include the cultural site data, if the objective is to be more inclusive of Indigenous cultural values.

When the AHIMS cultural sites were added to the Marxan analysis (Scenario 2) notable benefits were the increase in protection of Research and Gathering sites and Burial Sites from zero to 60% of the total (Figure 6 and Table 5). In the Gamay Rangers interviews, they noted the Burial sites as highly significant, so Scenario 2 presents a more culturally acceptable reserve design compared to Scenario 1 for this feature. In Scenario 2, the spatial distribution of the selected planning units (hypothetical eco-cultural reserve) increased in density along the South West Creek. There is a large concentration of AHIMS registered sites in this area, which can be attributed to the lack of urban development and protection by the Royal National Park since 1879. It must be noted that the protection afforded by the Royal National Park was coincidental and it was not the direct intention of the Park to protect First Nations cultural heritage sites.

Although there was enhanced protection of many AHIMS sites in Scenario 2, Art and Modified Tree (Scar Trees) sites were not adequately protected. Art and Modified Trees were identified by the Gamay Rangers as very important for protection. This is an example of mismatch in government and Indigenous priorities. If the NSW Government agency were to use AHIMS data to integrate cultural values into environmental planning using this remote, desktop-based approach, they would fail to adequately capture Indigenous cultural priorities. This suggests that there were data flaws for Scenario 2 as use of the AHIMS data, which many researchers have critiqued (see (Attenbrow, 1991; Guthrie and Kohen, 2005), would be outdated, inaccurate, spatially biased and not representative of contemporary Indigenous cultural values. In the present study, I found that the AHIMS data had no values attached to the dataset, leaving values for AHIMS sites left up to interpretation. This means that cultural values can be placed into incorrect management context, which

is reflected in the mismatch in cultural values between the AHIMS sites selected in Scenario 2 and protection preferences from the interviews with the Gamay Rangers.

To address the limitations of the AHIMS data and push towards a collaborative codesigned and decolonised approach, we interviewed the Gamay Rangers to identify local management priorities and strategies. To incorporate the elicited values and management priorities the Gamay Rangers participatory mapping data was incorporated into the Marxan analysis which is presented as a Scenario 3. In Scenario 3, there is increased coverage of the AHIMS sites as the Rangers gave higher percentage preferences for protection than the standard 30% target adopted in Scenario 2. This resulted in a larger area identified for protection which included the existing Towra Point Reserve and extensive areas along the headland of La Perouse which is in proximity to the Gamay Rangers base and the local Aboriginal La Perouse community.

The representation of Indigenous values is far strongest in Scenario 3 (Figure 12). The scenario could protect the sites and mapped sites at the target levels that the Gamay Rangers nominated. Scenario 3 also achieved 30% protection of each type of habitat and geomorphological feature as prioritised by conventional ecological planning methods (Table 4) indicating that Scenario 3 could deliver significant representation of Indigenous cultural values without compromising the standard 30% target for conservation features. In fact, for Mangroves and Intertidal areas Scenario 3 presented improved protection compared to Scenario 1 and Scenario 2. Therefore, the eco-cultural approach of Scenario 3 presented the best scenario for protection of Indigenous and conservation features.

The outputs from Scenario 3 could not have been achieved without the collaboration or input from the Gamay Rangers. The input from the Gamay Rangers was the most significant factor shaping the priorities for Scenario 3. Yet, this is only the first iteration of the eco-cultural conservation plan. Continued in-depth research with other Dharawal Elders would likely reveal deeper cultural values and refine the plan.

4.2. Contributions to Marine Spatial Planning

The results of this study can potentially provide a framework, or starting point, to creating a culturally appropriate foundation for co-design of an eco-cultural coastal

and marine protected area. MSP has a highly flexible scope (Allnutt et al., 2012). However, this project also substantially benefited from use of Systematic Conservation Planning (SCP) paradigms and use of Marxan software which is data driven and hence can be argued as evidence-based (Kirkman et al., 2019; Schumacher et al., 2020), which is increasingly needed for shifts in Western ideology and policy (Schumacher et al., 2020). While, the primary purpose of MSP is to avoid areas of conflict, the goal of data-driven conservation in SCP can be used to respectfully represent the knowledge of the Gamay Rangers (Aporta et al., 2020). The interviews with the Gamay Rangers gave a critical insight into the different priorities that can exist between Indigenous and 'conventional' or Western approaches to MSP. The eco-cultural priorities and values of the Gamay Rangers were multidimensional and often overlapped. The multidimensional values were place based and steeped in generations of connection and hunting and gathering of materials on Dharawal Country. These differences in priorities and connection to place require understanding from conservation planners that data, government and expert opinion cannot substitute for Indigenous voices when aiming to protect First Nation interests. Indigenous perspectives are integral in the MSP and SCP process to create equitable coastal and marine Eco-cultural protected area plans.

The process that was undertaken during this study is only the first step in creating a participatory framework that can be adapted to work with Indigenous people who want to produce culturally respectful marine management solutions. The exploratory Gamay Eco-Cultural Conservation Plan presented in this thesis illustrates, using data, the cultural context that MSP and SCP can adapt to. However, although this research project showed that that MSP and SCP can be vehicles for Indigenous inclusion, without policy and legal support, implementation of this inclusive Eco-Cultural Conservation plan will be limited (Kidd and Shaw, 2014). This is especially the case in urban environments where there are many competing interests (Kidd and Shaw, 2014).

4.3. Policy relevance

The Eco-cultural approach to coastal and marine protected area design presented here highlighted that inclusion of cultural planning priorities actually improved not only Indigenous cultural value protection, but also conventional ecological values

protection. International policy directives implore nation states to incorporate aspirations of Indigenous people into environmental management (Ens et al., 2015). However, policies and legislation in Australia is lacking in explicit statements regarding the decision-making power of Indigenous people. Current policies, such as the NSW MEM Act and CM Act mention or allude to protecting Indigenous cultural heritage, but no inclusionary mechanisms are mentioned.

Globally, the construction of coastal and marine protected areas is based on the IUCN categories, which are inherently targeted to Western science and policy focuses (Shafer, 2015; Lee, 2016a; Mallarach and Verschuuren, 2019). In NSW, the MEM Act could benefit from inclusion of provisions for more explicit eco-cultural planning. From a coastal management perspective, there is no mention of Indigenous people values or inclusion in planning in the CM Act and in the SM SEPP. Coastal Management in Australia is poorly reflective of Indigenous values and interest (Rockloff and Lockie, 2006; Stocker et al., 2016). These three NSW Acts could all benefit from reviews to include Indigenous people in designing zoning and management plans, which as this research showed can simultaneously enhance ecological conservation outcomes. To support Indigenous people in pursuit of self-determination, in line with Australian and national policies, co-designing policies and marine spatial plans can help decolonise coastal and marine management spaces.

4.4. Importance of co-design in contemporary marine spatial planning Referring to Indigenous people to as participants or stakeholders, renders Indigenous people secondary in the planning process and it does not give the full weight to Indigenous people (as rights holders or potential rights holders) (Bull et al., 2019) to determine how to manage their Country or Sea Country. This is a common occurrence for Indigenous peoples that live within colonised countries where the dominant Western systems see Indigenous culture as a secondary concern (Nursey-Bray and Jacobson, 2014). Colonial law places lower preference on Indigenous values and higher preference on Western values that are less likely to disrupt current Western capitalist systems, such as economics and development (Domínguez and Luoma, 2020). The clash between Indigenous people trying to conserve their ancestral lands and waterways and the Colonial drive for economic development of

those lands, is a prevalent tale and reality for First Nation people around the world (Nursey-Bray and Jacobson, 2014).

However, the world is paying attention to Indigenous Biocultural Knowledges (IBK) to enhance sustainable development and protect Earth (Yunkaporta, 2019). IBK cannot work when removed completely from Indigenous people and Country. For IBK to continue work, knowledge sovereignty for Indigenous people needs to be paramount. Indigenous people need to be intimately engaged through the process of knowledge sharing and keep control over how the knowledge is applied. Hence, codesign processes that have strong participatory elements weaved in are significant in the planning and in this case, the MSP space. To avoid a scenario of potentially decontextualizing cultural knowledge, co-design needs to become integral to MSP when collaborating with Indigenous people. This process can look like many things, as there is no one size fits all. Yet, the key elements are power-redistribution and design-making sharing. Creating a co-design process that facilitates equal power and decision-making responsibilities would allow for an equitable protected area plan to be created and implemented. Co-design can help facilitate equitable planning, which can lead to further de-colonisation of planning practices (Kidd and Shaw, 2014; Flannery et al., 2016).

Co-design processes can allow for extra space to be given to refocus Indigenising ways of doing (Parsons et al., 2016; Bull et al., 2019). Specifically, focusing on and recentring Indigenous ways of thinking and doing around how 'science' is done, will contribute significantly to decolonising Western science. Understanding that Indigenous people have different concepts of time and space from a Western sense. Understanding, that Indigenous People may have a different concept of planning where Indigenous people, do not see any divisibility between Country (land) and Sea Country (ocean) (Rist et al., 2019). However, Western protected area planning has divided land and ocean. If the process of co-design is implemented with humility, there are many instances where MSP can be decolonised and facilitate meaningful engagement with Indigenous peoples.

4.5. Research challenges and limitations

Where there is a meeting of two distinct ways of thinking there will inevitably be conflict. Trying to create an equitable bridge between Indigenous and Western Science is where the first most significant benefit and challenge can lay. The approach in this project tried to create as fair approach working with COVID limitations. However, the lack of in person contact required to foster and develop the relationship meant that discussion around melding Indigenous ways of thinking and doing with Western Science, was lacking. In conjunction, with the infrequent contact, there was not a lot of time to delve into the richness of cultural stories and histories associated with the sites the Gamay Rangers mapped, or indeed other Dharawal Knowledge Holders. This might mean that understanding the planning needs for these sites was not fully understood. This could have also increased the chance of mistranslation when digitising the maps and running Marxan. A closer collaboration could have improved the certainty of the final outcomes.

When working with the Rangers in such an infrequent nature, there was a division of researcher and the Rangers in some meetings. This division may have caused changes in how the Rangers said or stated certain things about cultural information. This could have been address pre-COVID conditions by spending more time with the Rangers on Country to build trust, respect and comfortability as suggested in the AIATSIS Code for Indigenous Research (AIATSIS, 2020).

Time was a large limiting factor for this method. There was an inability to translate into Marxan some objectives the Rangers stated. More conversations and meetings were needed to gather more information to incorporate the objectives correctly. An example of this was working with Seasonal Closure for certain species. As we were using Marxan, we could not differentiate between zones. Other programs such as 'Marxan with Zones' would facilitate implementation of those objectives. However, the time investment required to learn and implement 'Marxan with Zone' was beyond the Masters timeline.

The nature of how Marxan aims to protect conservation features is controlled by a minimum user set objection, which could be conflicting with Indigenous world view and ways of doing as the minimum cost" directive of the software is often not seen as adequate by Indigenous people who want adequate protection of their cultural

values, despite the cost. The 'user set' objective to protect the minimum could be seen as a limiting factor in some circumstances. However, in a highly urbanised study location, where there are multiple western threats that are all associated with environmental costs, Marxan reduces conflict between marine resource usage while protecting cultural features, would justify the use of Marxan in this study. Although use of Marxan was informative in this initial analysis, users need to be mindful of using Marxan in significant collaborations with Indigenous Peoples. Indigenous Peoples need to be the ones to determine the amount of protection levels assigned to conservation and cultural features and this may need to be irrespective of the financial cost.

COVID disruptions had inhibited the research. This prevented the consultation of the wider Dharawal community. Essential voices such as Elders, were lacking in this study. Rangers were interviewed as representatives of the community. Assumptions were made by the researcher on how to best bring together Western Science and Indigenous Science for the eco-cultural plan. However, the lead ranger was happy for the researcher to process the results for this initial study. Yet, researcher engaged in this type of research need to have explicated conversation with collaborators about data processing methods to produce a cross-cultural assessment of values. Though, the aim for this methodology, if applied to future research projects, would be to increase the degree of co-design. In order to increase co-design, there would need to be more in person workshops with the wider Dharawal community, more time spent building trust and for the Dharawal community to review the plans would increase the level of co-design this project was trying to achieve prior to the COVID19 disruptions

4.6. Implications for management

The outputs from this research, from a management context, have shown that Indigenous values are currently not reflected in the management and planning for the Botany Bay and Hacking River area (Dharawal Country). For the NSW government, this research highlights the critical need to review current policy and legislation to remedy the lack of Indigenous inclusion in decision making regarding management of Country. It also highlights a potential pivot towards integrated land and sea planning approaches, which are not commonly seen in western environmental planning.

This could take the form of increasing support for Ranger groups along the NSW coast, increased legislative rights to determine how Country is managed, streamlining the process for Country and Sea Country claims, and provide infrastructure to build capacity for Rangers to manage Country from a Western and biocultural perceptive.

At the local government level, this research showed that it is possible to respectfully engage with Indigenous groups and produce mutually beneficial protected areas plans. Local government could invest time and resources into consulting and developing culturally respectively and ethical practices for engaging with First Nation's people in research projects. Local governments could also create space and pathways for Firsts Nations representatives to comment on local environment programs to make them more culturally inclusive.

For the Gamay Rangers these plans can help direct their efforts and resources into high priority areas of planning and protection of biocultural resources. This could help empower the Rangers to make the best use of their resources for management and planning purpose. It also provides the Rangers with a data-driven tool to advocate and have their voices heard regarding preferred cultural management strategies. Eco-cultural conservation plans can empower the Rangers to design marine management solutions in a way that is culturally relevant to them. The mapping outputs can also be a tool for the Rangers to demonstrate that there is a stark difference in planning priorities of current protected areas on Dharawal Country.

5. Conclusions

Indigenous people have managed coastal and marine environments sustainably prior to colonisation. Presently, Coastal Indigenous communities are still trying to reclaim their rights obligations to manage Sea Country. There is an urgency for Coastal Indigenous peoples to manage their Country, as current policies do not reflect cultural importance or Indigenous ways of doing. This study demonstrated

that there is a difference in management priorities between conventional planning approaches and the Gamay Rangers. The Gamay Rangers were explicit that their cultural management concerns were not catered for within current coastal and marine management policy. It successfully highlights the increasing need to meaningfully included Indigenous peoples in coastal and marine management. However, engagement with Indigenous peoples needs to occur in a participatory nature. If participatory engagement does not occur, colonialism will be continually perpetuated within coastal and marine management. This study has also demonstrated a foundational methodology (as guidelines) on how to conduct a cross-cultural approach to marine spatial planning. For the eco-cultural plan developed here is only the first stage and there will need to be long-term investment to honour a fully co-designed eco-cultural coastal and marine protected area.

Most importantly, this study was Indigenous led. Showing that there is space for Indigenous people in academia. It contributes to decolonising MSP by emphasising and highlighting Indigenous voices. This study shows cultural resistance by aiming to centre IBK and Indigenous ways of doing in all phases of the research.

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Appendix

A.1 Semi-structured interview questions

Identifier Questions:

- 1. What are your names?
- 2. How old are each you?
- 3. How long has each of you been employed as a Gamay Ranger?

4. Which Indigenous language group do you identify with? (ie Dharawal) Knowledge of Gamay/Botany Bay:

- 1. Did you all grow up here?
- 2. How often do all you come to Gamay?

Identifying Cultural Places and Cultural Resources Using an A1 laminated Topographic map (described further below), identify the cultural places that are important to the Gamay Rangers group (The Group) and note the following for each place: For each place identify the location on the Topographical Map by drawing a polygon (blobs/ circles/ rectangles to represent the general area) (Use a different coloured permanent marker for each place) *If the area is quite small use a coloured sticker to mark the location

1. What cultural knowledge or activity occurs there?

2. Can you all say on a scale of 1-5 how important are each activity/place is to the Group?

3. How often does the Group visit and how much time is spent per visit? Select one answer: 1. More than once a week, 2. Once a week, 3. Once a fortnight, 4. Once a month, 5. A few times a year, 6. Once a year.

Observed changes and threats to the cultural areas: Using the A1 laminated Satellite map (described further below)

1. Has the Group noticed any change, in the last 10 years, at each of these culturally significant sites and resources?

2. Does the Group know when the changes occurred? A.1 Semi-structured interview questions

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3. If so, what does the Group think might be causing these changes?

• a. Are the changes caused by natural phenomenon or human activities?

• b. Could you tell me more about these threats to the cultural knowledges by identifying their locations on the Satellite Map. You can draw polygons (blobs/ circles/ rectangles to represent the general area) (Use a different coloured marker for each place). *If the area is quite small use a coloured sticker to marker the location

4. How damaging are these threats? Between 1-5 (1 minimal threat to 5 being a significant threat)

5. How do these threats make the Group feel?

6. Does the Group know of any effort to manage these areas?

7. What are the specific management actions taken to protect these areas?

8. What does the Group want to do anything about them?

9. Does the Group know of any efforts to prevent changes to these areas?

10. Are you, as a group, concerned that sea level rise and the condition/value of the cultural site/activities? (options: not at all; slightly; moderately; very; extremely) Objective Setting for Planning If we were to develop a plan to protect and manage the area of Botany Bay and Hacking River:

1. What cultural sites and resources do you as a Group consider the most important?

Rate each on a scale 1 (minimal importance) and 5 (significantly importance)

2. How much of these cultural sites and resources do you as a Group want to protect (0-100%)?

3. What kind of access or other restrictions would the Group accept/allow in areas with these values?

4. What are the other considerations you would like to inform the planning (e.g., minimise conflicting uses, maximise protection of areas that have high degrees of overlap of different values)?

A.2 Human Ethics Approval Letter

Office of the Deputy Vice-Chancellor (Research)

Research Services Research Hub, 47 Wally's Walk Macquarie University NSW 2109 Australia T: +61 (2) 9850 7987 http://www.research.mg.edu.au/ AnN 90 952 801 237 CRICOB Froderer No 000021



24/02/2020

Dear Dr Emilie-Jane Ens,

Reference No:52020634714117

Title: 6347 NSW Marine Cultural Values mapping

Thank you for submitting the above application for ethical and scientific review. Macquarie University Human Research Ethics Committee HREC Humanities & Social Sciences Committee considered your application.

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted by Dr Emilie-Jane Ens and other personnel: Ms Kataya Barrett.

Approval Date: 21/02/2020

This research meets the requirements set out in the National Statement on Ethical Conduct in Human Research (2007, updated July 2018) (the National Statement).

Standard Conditions of Approval:

- 1. Continuing compliance with the requirements of the *National Statement*, which is available at the following website: <u>http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research</u>
- 2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.
- 3. All significant safety issues, that adversely affect the safety of participants or materially impact on the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.
- 4. Proposed changes to the protocol and associated documents must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

The HREC Humanities & Social Sciences Committee Terms of Reference and Standard Operating Procedures are available from the Research Office website at: https://www.mg.edu.au/research/ethics-integrity-and-policies/ethics/human-ethics

The HREC Humanities & Social Sciences Committee wishes you every success in your research.

Yours sincerely,

Dr Karolyn White Chair, HREC Humanities & Social Sciences Committee

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC)National Statement on Ethical Conduct in Human Research (2007, updated July 2018) and the CPMP/ICH Note for Guidance on Good Clinical Practice

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A.3 Flow chart of Marxan Scenario



A. 4 Data Summary

File Name Code	Descripti on	Unit	Typ e	Instrument/Insti tute	Original Spatial Resoluti on - Scale	CRS (Original)	CRS (Re- projecte d)	Temporal Range	Primary Data Source	URL
State Maps'	This shape file has the borders of Australian States and Territory. USE - Was used to make the original layer for the region of interest. Does not need to be included in Marxan	Mete rs	Polyg on				WGS 84 / Pseudo- Mercator EPSG:385 7		Departmen t of Planning, Industry and Environme nt	
3857Coastal_Wetland_20181217	This shape file shows the locations of wetlands in NSW. USE -	Mete rs	Vector	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2018	SEPP (Coastal Manageme nt) 2018	https://datasets.seed.nsw.gov.au/dataset/ 7096e6e8-fa40-49fa-8fb9-a794277eb332
3857Coastal_Wetland_Proximity_Area_2 0181217	This shape file shows the outline and area of coastal wetlands in NSW. USE -	Mete rs	Vector	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2018	SEPP (Coastal Manageme nt) 2018	https://datasets.seed.nsw.gov.au/dataset/ 7096e6e8-fa40-49fa-8fb9-a794277eb332
3857Estuaries1	This shape file shows the environment type (ie bay, catchment), geographica I grouping of estruine	Mete rs	Polyg on	Department of Planning, Industry and Environment	50m	EPSG:47 33 - Wake Island 1952 - Geograp hic	WGS 84 / Pseudo- Mercator EPSG:385 7		Departmen t of Planning, Industry and Environme nt	

	types, estuaries location, catchment location					GDA94 EPSG: 4 283				
3857Estuaries_MacrophyteDetail	This shape file shows catchment location, environment type (bay, estuary), estuary name and environment type, habitat type (mangrove, halophila), macrophyte type, estuarine location	Meters	Polyg on	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2008	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ 51de3d40-0a1b-495c9697-6030c9f5c37d
3857EstuaryDrainageCatchments	This shape file shows the groups of estuary hydrology and catchments	Mete rs	Polyg on	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2007	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ 1e1d5de5-2557-4355-82baa99dc0274556
3857EstuaryEcosystems2002	This shape file shows names/locat ion of estuaries, groupings of estuaries by bioregion, ecosystem types, estuary opening type, estuary age	Mete rs	Polyg on	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2002	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ d1a9bc3f-bd48-4776-a461f163fb87668b

3857Littoral_Rainforest_20181217	This shape files shows location of littoral rainforests and other jurisdictions	Mete rs	Polyg on	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4238	WGS 84 / Pseudo- Mercator EPSG:385 7	2018	SEPP (Coastal Manageme nt) 2018	https://datasets.seed.nsw.gov.au/dataset/ 7096e6e8-fa40-49fa-8fb9-a794277eb332
3857Littoral_Rainforest_Proximity_Area_ 20181217	This shape file shows the outline and area of littoral forests	Mete rs		Department of Planning, Industry and Environment			WGS 84 / Pseudo- Mercator EPSG:385 7		Departmen t of Planning, Industry and Environme nt	
3857MarineHabitats2002	This shape file shows the marine habitat types	Mete rs	Vector	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2002	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ 4e2214df-df3b-4d7c-b263-a41d8b001af5
3857nearshore_features	This shape file shows the division of land and submerged area, feature type, category type of exposed or submerged feature,	Mete rs		Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4284	WGS 84 / Pseudo- Mercator EPSG:385 7	01/11/20 10 - 16/03/20 17	Departmen t of Planning, Industry and Environme nt	
3857NSW_Marine_Protected_Areas	This shape file shows the location and zoning information for MPA and Aquatic Reserves in NSW. It shows location name, zoning type, IUCN info, NRS info	Mete rs		Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4285	WGS 84 / Pseudo- Mercator EPSG:385 7		Departmen t of Planning, Industry and Environme nt	
3857NSWLanduse2017v1p2	This shape file shows varying spatial scales land use; Tertiary, Secondary, and Commodity. Note specifies the specific Value and Business Name	Mete rs	Vector	Department of Planning, Industry and Environment	1:10,000,	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2013	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ 143f54f4-f357-4819-9437-ed1166f20532
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3857OceanEcosystems2002	This shape file shows the offshore bioregion information, ecosystem information based on depth, and bioregion and jurisdiction	Mete rs	Vector	Department of Planning, Industry and Environment	1:none	GDA94 Geographic ESPG: 4283	WGS 84 / Pseudo- Mercator EPSG:385 7	2002	Departmen t of Planning, Industry and Environme nt	https://datasets.seed.nsw.gov.au/dataset/ 5dbfd4f3-8fd0-4eb0-ac93656bb7f74ba0