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National Environmental Science Programme

Measures for Social and Economic Monitoring of the Australian Marine Parks

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Milestone 7 - Final costed plan for essential metrics

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EXECUTIVE SUMMARY

Social and economic values are key drivers for marine science, policy and management but are rarely integrated with marine biodiversity monitoring programs. As management plans for 44 newly established Australian Marine Parks (AMPs) came into effect on 1 July 2018, there is a time-critical need to identify and capture key social and economic measures. This report aims to develop a set of robust and easily understood key measures to capture the change in human experience and value of the marine environment resulting from the implementation and management of the AMPs. The suggested measures are designed to be incorporated into adaptive management of the AMPs through the Monitoring, Evaluation, Reporting, and Improvement (MERI) System.

Our measure recommendations are based on a thorough review of approaches to social and economic monitoring of marine parks used nationally, and a selected review of international approaches. We also drew on national experiences with marine park monitoring, hosting regional workshops in six states with marine park managers and experts.

Our review and workshops identified a wide variety of approaches and philosophies to social and economic monitoring of marine parks. We identified 213 social and economic measures for marine parks across Australia. States differed in the types of measures used and the spatial scale at which measures are reported. Through the regional workshops, it was also evident that state agencies differed in opinion about the role of social and economic monitoring of marine parks. Some states viewed social and economic monitoring as a way of collecting data to inform on-going management decisions such as the locations of enforcement patrols, priorities for education and awareness programs and decisions on positioning of infrastructure. Other states emphasised the need to evaluate the benefits and costs of marine parks to inform adaptive management of the marine parks themselves.

Despite these differences, the regional workshops identified a strong desire from all state agencies to increase investment in social and economic monitoring of marine parks. Barriers to conducting more social and economic research included budgetary limitations, but also the perceived difficulty in designing effective social and economic monitoring programs. Clear opportunities exist in increasing cross-institutional collaborations and ideas exchange as well as the development of standardised, low-cost, approaches to social and economic monitoring that can be readily transferred across marine parks.

Several conclusions about specific approaches and their application to the AMPs arose out of the review and regional workshops:

- Monitoring of use of the AMPs must rely either on existing data (e.g. fishing logbooks) or surveys asking respondents to recall details of trips. This is because direct researcher observation approaches such as boat-based surveys commonly used in other marine parks are cost-prohibitive for the AMPs.
- Monitoring of broad-scale indicators of economic activity such as gross regional product, unemployment and business counts have not detected any changes as a result of the implementation of state-based marine parks. As the AMPs tend to be less restrictive than state marine parks for commercial activities, broad-scale economic indicators are not likely to be sensitive enough to detect changes due to the AMPs.
- Revenues of specific sectors are commonly used in marine park economic monitoring. Revenue is widely known to be a poor indicator of economic performance as it does not capture the costs of production. A range of alternative approaches to

measuring producer surplus of marine commercial enterprises are suggested that take advantage of existing data sources.

- Economic assessment of values not traded in markets (i.e. non-market values) is rarely conducted for marine parks. This is despite non-market values making up a substantial portion of the values people hold for marine parks; the general public value knowing that an area is being protected even if they never interact with it. We suggest economic techniques to measure the non-market benefits of the AMPs.

- Two approaches to measuring perceptions of marine parks are commonly used. The first compares perceptions of the state of a value over time through repeated surveys; e.g. respondents' satisfaction with recreational fishing. The second, ask respondents directly for their assessment of the impacts of marine parks on the state of a value; e.g. what effect has the marine park had on your recreational fishing? As far as we are aware no formal research exists comparing these two approaches. For the AMPs, we advise asking for perceived impacts directly as we feel this better captures respondents' subjective attitudes towards the parks.

- Where possible, monitoring perceptions should be matched to an objective measure such as use or economic value to identify where misperceptions exist that should be corrected.

- Monitoring the success of Parks Australia's Indigenous engagement program should consider engagement along three lines: quantity of engagement, equal opportunity of engagement across Aboriginal and Torres Strait Islander groups and depth of engagement.

Based on the review and workshops we have made recommendations for social and economic measures for six user groups: commercial fishers, charter operators (fishing and non-extractive), recreational users (fishing and non-extractive), the general public, Aboriginal and Torres Strait Islanders, and mining and petrochemical industries. Our recommended measures capture the performance of the AMPs, in terms of impacts of the AMPs on use and non-use values or provide context to inform on-going management of the AMPs.

The suggested measures include assessment of changes in use levels and patterns across the parks, measures of perceptions of costs and benefits, overall attitudes towards the AMPs, levels of awareness of the AMPs and associated zoning, and measures of the economic value of the AMPs in terms of consumer and producer surplus. The suggested measures build on previous work, and in some cases are drawn directly from earlier baseline assessments conducted for the AMPs.

The recommendations also aim to minimise the need for further primary data collection. The suggested measures for commercial fishers, Aboriginal and Torres Strait islanders, and mining and petrochemical industries require no additional primary data collection. For user groups requiring additional primary data collection, we present a costed four-part integrated survey approach which includes:

- an online survey targeting the general public, but also identifying recreational fishers and non-extractive recreational users;
- a national boat ramp survey conducted at key locations where the AMPs come close to population centres to target recreational fishers and non-extractive recreational users;
- a targeted survey of recreational fishing clubs and yacht clubs to capture more avid recreational users likely to use offshore waters of the AMPs; and
- a charter operator survey to be conducted with operators that use the AMPs.

The measure suggestions presented here are not intended to be prescriptive or necessarily exhaustive. Parks Australia should consider how evolving management priorities affect

measure selection. Whilst the discussion presented has been tailored to the AMPs, much of the information and conclusions could be readily translated to other marine parks nationally and internationally.

1. INTRODUCTION

Management plans for 44 newly established Australian Marine Parks (formerly Commonwealth Marine Reserves) came into effect on 1 July 2018, adding to the 14 marine parks already established in Commonwealth waters.[1] Together the 58 Australian Marine Parks (AMPs) cover 36% of Australian waters. These AMPs are grouped into the North, North-west, South-west, South-east and Temperate East Networks, and the Coral Sea Marine Park (Figure 1). The marine parks are managed by Parks Australia under the *Environmental Protection and Biodiversity Conservation Act 1999*. The overarching objectives for the Australian Marine Parks are to provide for:

   a) the protection and conservation of biodiversity and other natural, cultural and heritage values of marine parks; and

   b) ecologically sustainable use and enjoyment of the natural resources within marine parks, where this is consistent with objective (a).
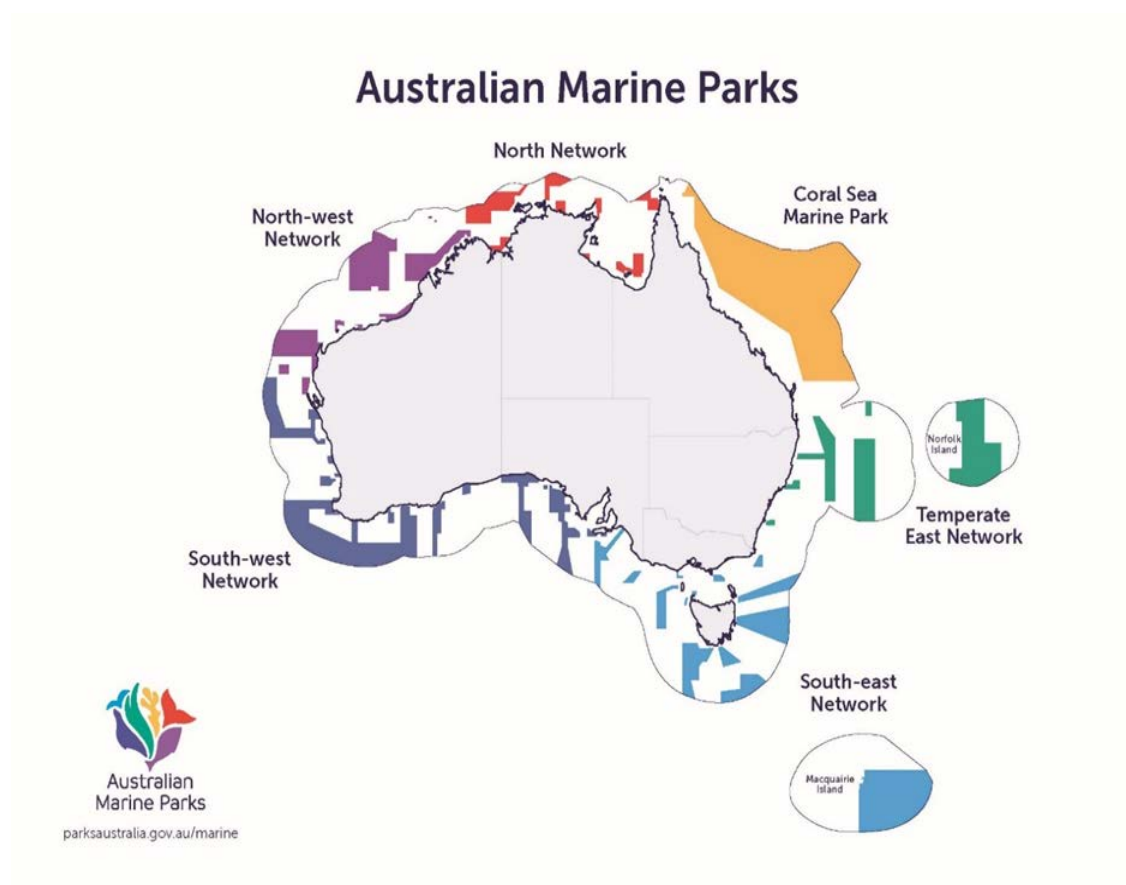
Figure 1. Australian Marine Parks locations and networks.

To complement implementation of the AMPs Parks Australia have also committed to the delivery of seven management programs summarised in Table 1.

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[1] Commonwealth waters includes all waters in the Australian Economic Exclusive Zone more than 5.5 km from shore or offshore reefs and islands.

Parks Australia is developing a Monitoring, Evaluation, Reporting, Improvement (MERI) System to support the adaptive management of the AMPs. A MERI System for the AMPs establishes a nationally consistent process to:

- Assess achievement against the objectives in management plans;
- Enable continuous improvement; and
- Report progress to the Australian community.

The MERI System requires that Parks Australia track their performance using measures that align with their stated objectives.

Table 1. Seven management programs for the Australian Marine Parks.

Management program	Description
Communication, education and awareness program	Actions that improve awareness, understanding and support for marine parks and park management.
Tourism and visitor experience program	Actions that provide for and promote a range of environmentally appropriate, high-quality recreation and tourism experiences and contribute to Australia's visitor economy.
Indigenous engagement program	Actions that recognise and respect the ongoing cultural responsibilities of Indigenous people to care for sea country and support multiple benefits for traditional owners.
Marine science program	Actions to provide necessary scientific knowledge and understanding of marine park values, pressures, and adequacy of responses for effective management.
Assessments and authorisations program	Actions that provide for efficient, effective, transparent and accountable assessment, authorisation and monitoring processes to support sustainable use and protection of marine park values.
Park protection and management program	Timely and appropriate preventative and restorative actions to protect natural, cultural and heritage values from impacts.
Compliance program	Actions that ensure appropriate and high levels of compliance by marine parks users with the rules set out in this plan.

Social and economic values are an important part of the AMPs. Provision for sustainable use is explicitly stated as a core objective of the AMPs. Similarly, social and economic values are specifically targeted in several of the management programs in Table 1 including conducting activities to improve awareness and support for marine parks and activities to promote recreation and tourism experiences. Given the importance of social and economic values to the AMPs and the recent expansion of the AMPs, there is a time-critical need to identify and collect benchmark data on social and economic measures to allow Parks Australia to evaluate and track its performance.

The objective of this paper is to provide information and recommendations to Parks Australia on essential (or key) measures that can be used to track the social and economic **performance** of the AMPs and associated management programs; the extent to which the AMPs have affected (positively or negatively) social and economic values held for the marine environment. A secondary objective of the paper is to identify measures to help understand the social and economic **context** of the AMPs. The recommendations presented are not intended to be prescriptive or necessarily exhaustive, and Parks Australia should consider how evolving management priorities affect measure selection.

2. METHODS

2.1 A note on marine park nomenclature

A wide variety of terms are used to describe marine parks and related management actions. Within Australia alone, areas where all extractive activities are prohibited, are referred to as sanctuary zones, pink zones, green zones, marine national park zones, national park zones, marine sanctuaries and marine reserves. In this paper, we simplify the language by referring to multi-use areas that contain various forms of zoning as marine parks, and areas in which all forms of extraction are prohibited as no-take marine reserves (NTRs). In Victorian and Tasmanian waters where multi-use marine parks are not typically used, we refer to zoning as marine parks if some extractive activities are allowed, and NTRs if all extractive activities are prohibited.

2.2 Approach to measure selection

To make recommendations for social and economic measures we draw on a thorough desktop review of approaches used nationally and internationally and discussions in regional workshops conducted with marine park managers and experts in six Australian states (Figure 2). Our recommendations also consider the availability of existing data and the unique conditions of the AMPs which are outlined below.

The focus of this paper is on measures of the performance of the AMPs. By performance, we refer specifically to the impact of zoning and related management changes on social and economic values. As a secondary objective, we also discuss measures that provide information on the social and economic context of the AMPs; context refers to information on the values that are being realised from the marine park area without attribution to the marine park itself. The distinction between performance and context measures is not made explicit in some previous social and economic monitoring of marine parks. It is our view that this ambiguity has caused confusion and led to some questionable interpretations of collected data. Throughout this report, we endeavour to clearly distinguish between performance and context measures.
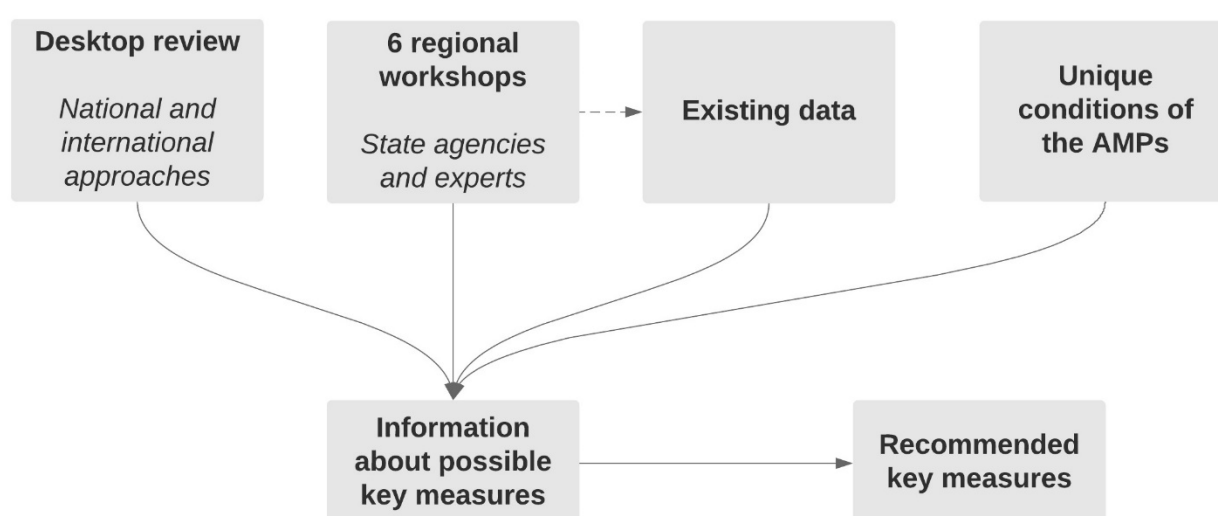
Figure 2. Flow diagram showing the process used to develop measure recommendations.

2.3   Unique considerations of the Australian Marine Parks

Effective social and economic performance measures should account for the local context. This includes the geographic (where are the marine parks?) and temporal (when were they implemented?) context of the marine parks, and the specific management objectives that the marine parks aim to achieve.

Geographically, the AMPs are located offshore in Commonwealth waters, usually at-least 5.5 km from the shore, but often further offshore[2]. Their offshore location makes the AMPs different from all other marine parks implemented in Australia with three major ramifications:

1. The AMPs can only be accessed by boat[3], and are likely to have low and levels of visitation by recreational users. Nationally, Henry and Lyle (2003) estimated that just 4% of recreational fishing trips occurred in offshore waters beyond 5 km from the shore (roughly corresponding to Commonwealth waters); the percentage of trips within the AMPs in offshore waters will be even lower. Relatively high usage may be observed in some locations such as Ningaloo Marine Park (Commonwealth) where the AMPs adjoin state waters Lynch et al. (2019.

2. The level of visitation of the AMPs is likely seasonal, being concentrated around holiday periods, and with many marine users only accessing offshore waters in favourable weather conditions.

3. The AMPs predominantly protect deep-water marine environments that are not well understood by the general public. In a survey of the general public adjacent to the South-east network, 68% of respondents stated knowing nothing about the marine ecosystems in the network (Burton et al., 2015). Most likely many members of the general public will not hold any place attachment for the marine environments in the marine parks or have nuanced opinions about the likelihood that management plans will effectively protect these environments.

It is also important to note that all 58 of the AMPs and their zoning rules are currently in effect. As such, impacts on marine users displaced by the AMP zones are already occurring, and cannot be detected using before-after comparisons without pre-existing data.

2.4   Theoretical framework

Our assessment of social and economic measures is structured around the Total Economic Value framework (TEV, Figure 3). The TEV framework categorises the benefits that people derive from the environment. The main division in the framework is between values derived from physically interacting with the environment (termed *use values*) and values derived independent of any physical interaction (termed *non-use values*). It is the explicit recognition of non-use values in the TEV that makes it well suited to the AMPs; due to its offshore location, much of the value society holds for the AMPs is likely to reflect values for knowing the marine environment is being protected rather than values derived through any physical interaction.

Within use values, the framework further distinguishes between direct use values — which include direct interaction with the environment (fishing, diving, snorkelling), and indirect use values which captures the services that ecosystems provide humans that don't involve direct interaction (e.g. protection against coastal erosion). Non-use values are also further

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[2] Norfolk Island is one exception where the AMPs start at the high-water mark.
[3] Access by shore is possible in the case of Norfolk Island.

categorised as bequest values (the values placed on protecting the environment for future generations), option values (the value placed on having the option to use a particular location in the future), and existence values (values held for the knowledge that the environment exists in a certain state). This TEV framework helps characterise the values people hold for marine environments and changes to it resulting from the AMPs.
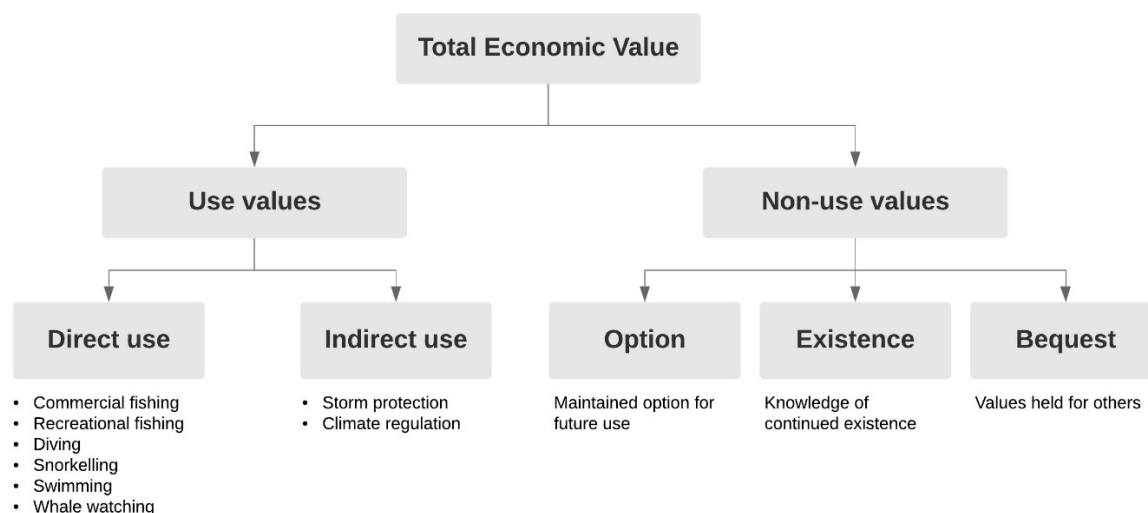
Figure 3. Total Economic Value framework of values humans hold for the environment.

Whilst conceptually useful, the TEV framework fails to explicitly account for some key issues in assessing the impacts of policies on human welfare. Two key topics that are not addressed include:

- Equity: the extent to which benefits and costs are evenly distributed across stakeholders, or at least the extent to which the distribution of benefits and costs is perceived to be just.

- Governance: the suitability of the overarching system, by which decisions concerning the marine park are made and enforcement is conducted.

Both equity and governance have been linked to support for conservation policies and are therefore important to assess the social and economic performance of marine parks (Mascia, 2004; Thorpe et al., 2011; Bennett, 2016).

Another shortcoming of the TEV framework is that it fails to highlight how management actions affects use and non-use values. In Figure 4 we adopt the approach of Ban et al. (2019) who identify two ways in which the marine parks can affect people's use and non-use values:

A Indirect**:** the use and non-use values people hold for changes in the environment resulting from the marine park and its management rules. For example, the non-use values held for increased biodiversity inside the marine park.

B Direct: the change in use and non-use values resulting directly from the management rules independent of any change in ecological state. For example, the change in recreational fishing use-values resulting directly from exclusion from some areas in the marine park.

The process diagram in Figure 4 also highlights a third process:

C Pressures: the effect of the use-values on the magnitude of pressures on the marine environment. Pressures act as feedback from use-values to the environment. Pressures provide a link between the monitoring of social and economic use values and biological monitoring.

The framework in Figure 4 is similar to the widely used Drivers Pressures State Impact Response (DPSIR) framework for environmental systems (Gari et al., 2015; Lewison et al., 2016). However, unlike DPSIR our framework explicitly acknowledges that marine park management directly affects use and non-use values independent of changes in ecological state (i.e. has direct effects).
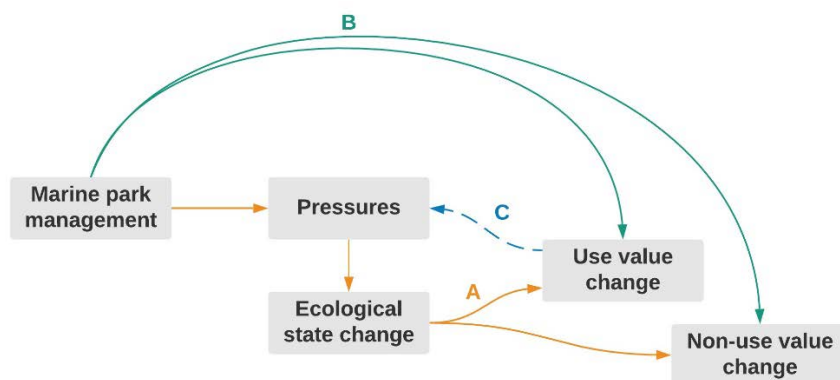
Figure 4. Process diagram showing how the AMPs affects the use and non-use values people hold for marine environments.

2.5   Classifying measures

We refer to measures as the individual constructs used to monitor the social and economic performance of marine parks; e.g. recreational fishers support for the NTRs in a marine park. To provide structure to our discussion we classify measures using the hierarchical system shown in Figure 5. At the top-level, measures are classified into four types: awareness, use, perceptions and economic value. Within each type, measures are further classified into a series of sub-types. Definitions and justifications of each of the measure types and measure sub-types are provided below.
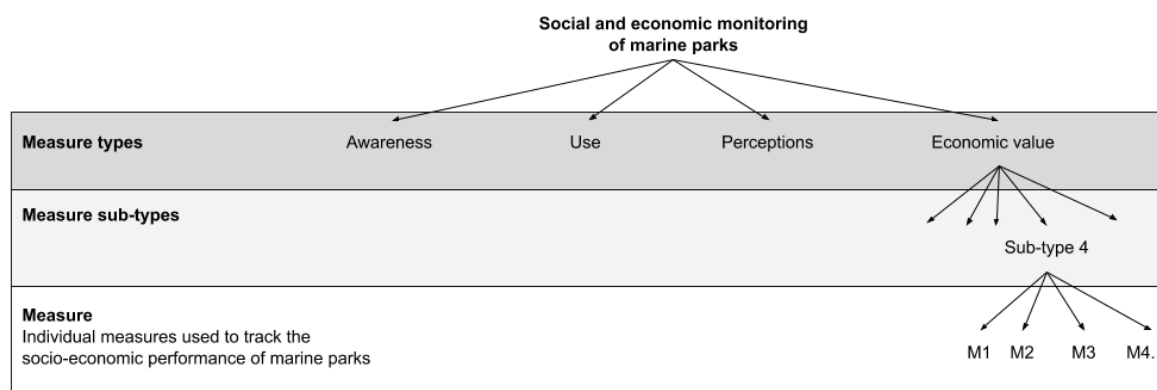
Figure 5. Hierarchical classification of measures for monitoring the social and economic performance of marine parks.

2.5.1 Awareness

Awareness refers to the extent to which people are knowledgeable about the marine park. Whilst awareness is not a direct measurement of use or non-use values (Figure 3), there are three reasons why awareness of the AMPs is important. Firstly, awareness is a desired outcome of Parks Australia's *Communication, education and awareness program*. Secondly, awareness is critical for setting the context for the other elements of social and economic assessment; awareness gaps can cause respondents in surveys to respond inaccurately or flippantly (Millan et al., 2006). Thirdly, knowledge of rules in marine parks is crucial to achieving high compliance levels amongst marine park users (Read et al., 2011).

To further classify awareness measures we treated awareness as a spectrum (Bradburn et al., 2004). This spectrum ranges from low levels of awareness (e.g. awareness of what a marine park is) through to high levels of awareness (awareness of specific zones and their locations). Fewer respondents will be aware of specific aspects of marine parks than more general aspects. For example, in South Australia, 81% of the general public are aware that NTRs exist within marine parks, but just 33% know where the NTRs are in their local area (DEWNR, 2017). We identified five awareness levels to act as awareness sub-types (Figure 6). These include awareness of what a marine park is, what a marine park is for, a specific marine park, the zone types in a specific marine park, and the locations of specific zones in a specific marine park.
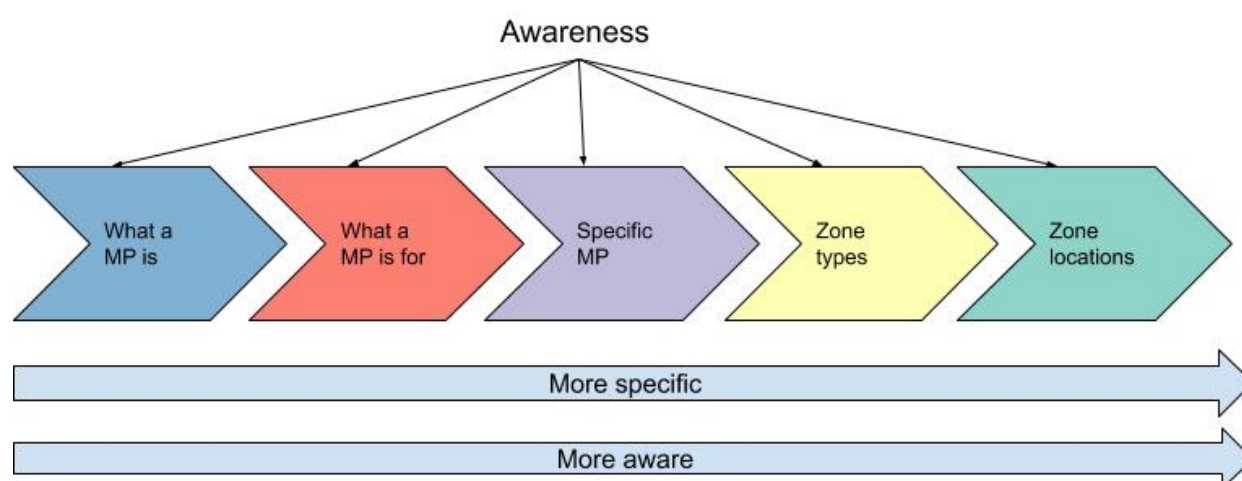
Figure 6. Sub-types of awareness measures.

2.5.2 Use

Use of the AMPs serves two roles in social and ecological assessment. Firstly, use levels can act as a proxy for the levels and types of use-values being derived from an area: people are likely to frequently conduct activities from which they get a lot of value. The second role of use is to improve understanding of the pressures that human activities are placing on the ecological state, and whether management actions have abated some of those pressures (C in Figure 4).

There are several ways to classify use measures into sub-types, but arguably the most important is to identify the spatial scale at which use is reported. We identified three measure sub-types based on spatial scale including spatial patterns of use within a marine park, levels of use of a marine park (e.g. annually), and levels of use of a network of marine parks (Figure 7).

We also identified a fourth use measure: the level of pre-marine park use that is displaced by the marine parks zoning (Figure 7).
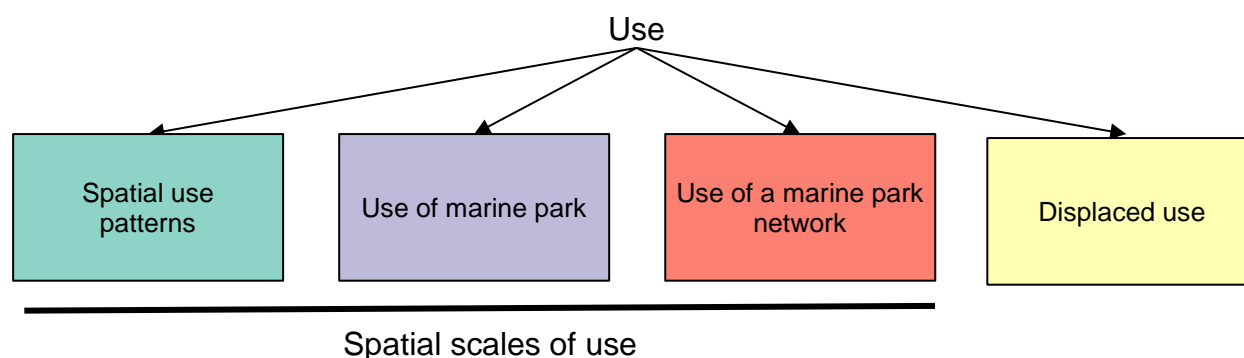
Figure 7. Sub-types of use measures.

2.5.3   Perceptions

Perceptions and attitudes towards marine parks are a useful way of understanding the values people hold for management and resulting changes in environmental state. In the context of marine parks, perceptions refers to the ways people interpret and evaluate a marine park and its outcomes (Bennett, 2016). Perceptions are subjective, they reflect an individual's experiences and contexts, and can change over time (Bennett, 2016; Navarro et al., 2018).

Bennett (2016) identifies four categories of perceptions concerning conservation policies (Table 2).

Table 2. Four categories of perceptions of conservation policies.

Category of perceptions	Description
Management impact	Perceived size and equity of the social and economic benefits and costs.
Ecological outcomes and benefits	Perceived impacts of the policy on the health of ecosystems, their provision of ecosystem services, and the benefits derived from those ecosystem services.
Governance	Perceived quality of the governance procedures used and perceived legitimacy of the policies and the decision-makers who implement them.
Social acceptability	Acceptability of the conservation action given the social context (traditional beliefs, incorporation of local knowledge).

Bennett (2016) describe these categories as determinants of individuals' overall attitudes towards marine parks, including levels of support and associated actions; e.g. compliance, or volunteer engagement. To classify measures of perception we use the four categories of perception suggested by Bennett (2016) (Figure 8). We also add a fifth category, individuals' overall attitude towards marine parks.
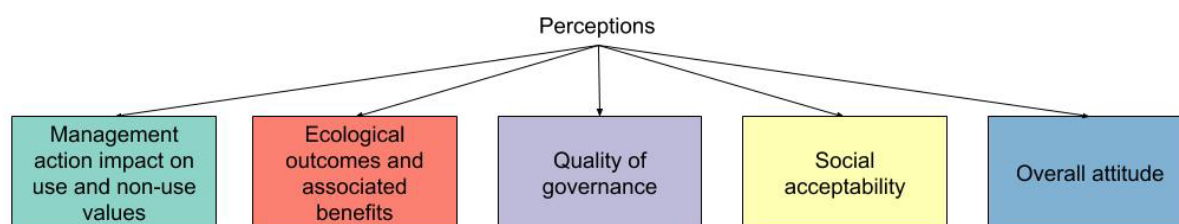
Figure 8. Sub-types of perception and attitude measures.

2.5.4 Economic value

Economic value refers to the measures and indicators expressed in monetary quantities (or some proxy of monetary quantities). It includes monetary estimates of the values placed on changes in use and non-use values that arise due to the AMPs and measures of the level of economic activity.

We classify measures of economic value into five sub-measure types (Figure 9). The first sub-type is the market values measured as change in consumer and producer surplus for goods that are traded in markets. Consumer and producer surplus are economic concepts that measure the value that is gained from transactions for both the producers (e.g. commercial fishers) and the consumers (e.g. fish buyers). Figure 10 shows that at each price point for fish, producers are willing to supply a given quantity (considering their costs), and consumers are willing to purchase a given quantity of fish (considering their budgets and alternatives available). The consumer surplus is the amount consumers are willing to pay at the market traded quantity, less what they do pay. Producer surplus is the revenue the producer makes at the market price and quantity, less what it cost to supply; producer surplus is similar to profit.
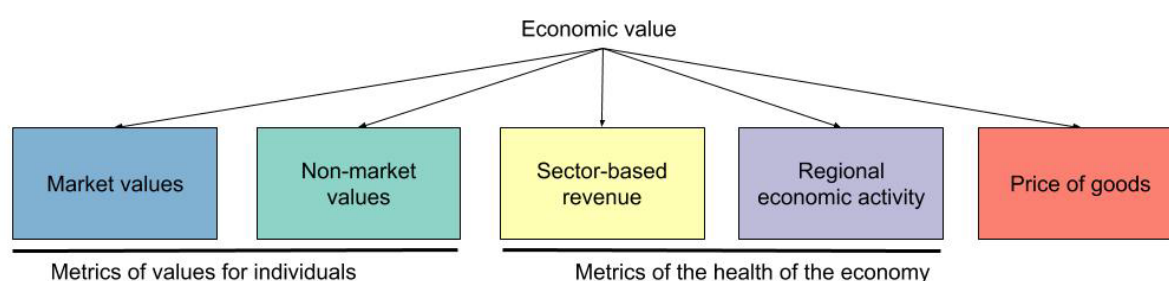
Figure 9. Sub-types of economic measures.
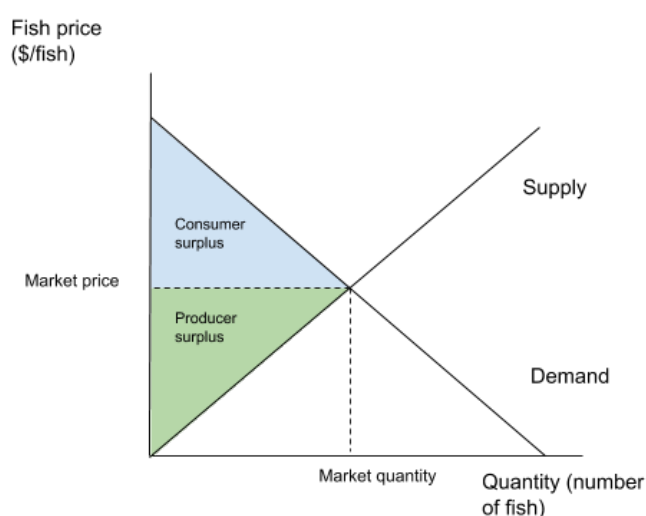
Figure 10. Illustration of market values derived from the sale of fish.

The second measure sub-type is non-market value. In the context of a marine park, non-market values are the benefits and costs induced by the marine park that are not traded in markets. These include non-use values (appreciation of areas being protected) and use values (recreation). Non-market values and their change with a marine park policy can be measured using a range of methods including revealed preference methods (e.g. travel cost), stated preference methods (e.g. contingent valuation and choice experiments), and benefits transfer. Previous articles considering the application of non-market valuation to public policy include a review by the Productivity Commission (Baker and Ruting, 2014) and a review concerning the south-east Marine Parks network specifically (Hassall & Associates, 2001).

The third and fourth economic measure sub-types relate to levels of economic activity. They include estimates of the revenue of sectors of the economy and estimates of the overall level of economic activity in a regional economy. These measures are typically used to measure the effect of marine parks on the "health" of local economies rather than the wellbeing of individuals in it. The final measure type is the price of goods and services (i.e. the price of fish). Fish prices are intended to be an indicator of the impact of marine parks on consumers.

2.6   Desktop review methods

In Chapter 3 we present a desktop review of measures used nationally and internationally to measure the social and economic performance of marine parks and related management actions. Our objective is to identify the set of approaches used for social and economic monitoring of marine parks nationally and internationally and to draw on scientific literature to provide information on the appropriateness of these approaches generally and to the unique circumstances of the AMPs.

The review consisted of a thorough review of all measures used to assess the social and economic outcomes of marine parks in Australia and a selected review of measures used internationally (Table 3). Studies that were not explicitly used for marine park or NTR social and economic monitoring were mostly excluded but are drawn on occasionally where appropriate.

Literature was identified through relevant state agencies as part of regional workshops and surrounding conversations presented in Chapter 4. Additional literature was identified through web searches on google and google scholar as well as the author's personal library. The range of studies includes one-off academic papers and management reports, reports on impact assessments and reports from on-going monitoring programs. Within each study, individual measures were tabulated and are described in the review.

Table 3. Key international case studies used for selected review of approaches to social and economic monitoring.

Management action and context	Key references
Lyme Bay protected area (United Kingdom)	(Mangi et al., 2011; Rees et al., 2015)
New Zealand marine reserve network	(Taylor and Buckenham, 2003)
California Marine Protected Areas	(Hackett et al., 2017; Ordoñez-Gauger et al., 2018)
Channel Islands National Marine Sanctuary	(Leeworthy et al., 2005; LaFranchi and Pendleton, 2008; Leeworthy et al., 2014; Leeworthy and Schwarzmann, 2015)
Florida Keys National Marine Sanctuary	(Leeworthy and Bowker, 1997; Shivlani et al., 2008; Leeworthy and Ehler, 2010)
Gray's Reef National Marine Sanctuary	(Leeworthy, 2013)

3. DESKTOP REVIEW RESULTS AND DISCUSSION

3.1 State and Commonwealth contexts

The marine park social and economic measures used for existing state and Commonwealth marine parks in Australia depend somewhat upon the local context. Before discussing measures, we first provide a brief outline of the monitoring context in each jurisdiction.

3.1.1 Queensland

Queensland has three marine parks, the Moreton Bay Marine Park, the Great Sandy Marine Park, and the Great Barrier Reef Coast Marine Park. Each of the marine parks was zoned at different times and managed under separate management plans. The Great Barrier Reef Coast Marine Park lies adjacent to the Commonwealth managed Great Barrier Reef Marine Park, and the two are often studied together. For simplicity, we report on social and economic measures from both marine parks under Queensland.

The largest program to monitor social and economics of the marine parks in Queensland is the social and economic long-term monitoring program (SELTMP) of the Great Barrier Reef which was launched in 2011 (Marshall et al., 2014; Tobin et al., 2014; Marshall et al., 2016). SELTMP monitors social and economic outcomes using surveys of five groups: tourists (national and international), coastal residents, the general public, commercial fishers and tourism operators (fishing and non-fishing). Questions in these surveys relate to three areas: peoples' use and dependency on the Great Barrier Reef, the wellbeing people derive from the Great Barrier Reef and the cultural context of the reef (how people perceive and relate to the reef).

In addition to the Great Barrier Reef's SELTMP, Queensland also has a series of one-off social and economic reports. These include social and economic impact assessments (Great Barrier Reef Marine Park Authority, 2003; Williams et al., 2007), surveys of awareness and attitudes (Young and Temperton, 2007; Sutton, 2008; Kenyon et al., 2017), measurement of marine park use (Kenyon et al., 2017) and measures of economic flows from marine park areas (Driml, 1999; KPMG Consulting, 2000; Deloitte Access Economics, 2013; Deloitte Access Economics, 2018).

3.1.2 Western Australia

There are 17 marine parks in Western Australian state waters, each established at different times and with independent management plans. These include the Ningaloo Marine Park, the Shark Bay Marine Park, the Jurien Bay Marine Park and the Ngari Capes Marine Park.

No state-wide or marine park level on-going social and economic monitoring has occurred for these marine parks. However, on-going reporting has occurred on the pressures in marine parks, including catch and effort by fishery sector (Holmes et al., 2017). Additionally, social and economic research has been conducted as once-off studies, often surrounding the implementation or rezoning of a marine park (Northcote and Macbeth, 2008; Beckley et al., 2010; Beckley, 2015; Spencer-Cotton et al., 2016; Strickland-Munro et al., 2016; Hastings and Ryan, 2017).

3.1.3 New South Wales

There are six marine parks in New South Wales, each established at different times and with independent management plans. These include the Batemans Bay Marine Park, Jervis Bay Marine Park and Solitary Islands Marine Park.

No state-wide or marine park level on-going social and economic monitoring has occurred in New South Wales marine parks. Most New South Wales studies are once-off and relate to a single marine park, often associated with their establishment or zoning review. These include economic and social impact assessments of marine parks (Powell and Chalmers, 2005; Powell and Chalmers, 2006; AgEconPlus, 2008b; AgEconPlus, 2008a), measures of recreational use (Lynch, 2006; Lynch, 2014) and the non-market values derived from recreational use (Gillespie Economics, 2007).

More recently work has begun at the state-wide level in the implementation of a New South Wales Marine Estate Management Strategy. Of particular note is a state-wide survey of the general publics' perceptions of benefits, threats and opportunities relevant to the management of the marine environment in New South Wales, including some questions on attitudes towards marine parks (Sweeney Research, 2014).

3.1.4 South Australia

There are 19 marine parks in South Australia, all of which were established or rezoned in 2012 and under related management plans. These include the Encounter Marine Park, the Investigator Marine Park, and the Nuyts Archipelago Marine Park.

Social and economic monitoring of marine parks in South Australia is conducted through the state-wide monitoring, evaluation and reporting (MER) program (DEWNR, 2017). This state-wide approach reflects that South Australia's current marine park network was implemented simultaneously. Measures on awareness, use and perception draw largely from regular telephone and online surveys conducted state-wide. The MER program also uses existing data from the Australian Bureau of Statistics, Tourism Research Australia and catch and effort data for commercial fisheries.

3.1.5 Victoria

Victoria differs from most other states in that their network consists of individual NTRs rather than multi-use marine parks. In total there are 24 NTRs across Victoria, mostly established simultaneously in 2002.

Victoria has ongoing monitoring of social and economic outcomes of their NTRs occurring predominantly at the state level, often producing combined measures for all NTRs across the state. The data draw on a series of regular online and telephone surveys of the general public including the Visitor Number Monitor (Newspoll, 2013), Awareness And Usage Of Marine National Parks & Sanctuaries (Maddern, 2012), Community Perceptions Monitor (Roy Morgan Research, 2018) and the Victorian Coastal Council's attitudes and behaviour surveys (Ipsos-Eureka, 2012).

3.1.6 Northern Territory and Tasmania

In Tasmania, seven NTRs have been implemented in state waters. These include the Tinderbox Marine Nature Reserve, Ninepin Point Marine Nature Reserve and Maria Island Marine Nature Reserve. Four of these reserves were implemented in 1991.

In the Northern Territory

In the Northern Territory, there are currently just two multi-use marine parks in state waters, the Cobourg Marine Park, and the Limmen Bight Marine Park. These marine parks were established at separate times, and under separate management plans.

Relatively little marine park and NTR social and economic monitoring has been conducted in the Northern Territory and Tasmania. For simplicity, we don't consider these states further in the literature review. A regional workshop was conducted in Tasmania and is included in discussions in Chapter 4.

3.1.7 Commonwealth waters

Some social and economic research has already been conducted for marine parks in Commonwealth waters. Larcombe and Marton (2018) estimate the potential displacement of commercial fishing catch and resulting impacts on regional economies due to the AMPs; Parks Australia (2018) presents a social and economic impact assessment of the AMPs; Recfish Australia (2010) compile existing information on areas of importance to recreational fishing, and conducted a limited 'opt-in' survey of attitudes towards NTRs in marine parks; Lynch et al. (2019) explore the use of state-collected recreational fishing catch and effort data to estimate catch and effort for the Ningaloo Marine Park (Commonwealth) and Hunter Marine Park (Commonwealth) and trialled methods for estimating recreational fishing use patterns using trail cameras and boat ramp surveys adjacent to the Freycinet Marine Park (Commonwealth); Young and Temperton (2007) conducted a phone diary survey with the general public asking about general attitudes towards the state of marine environments and some questions on the use of marine parks; Burton et al. (2015) conduct general public surveys of awareness, use and perceptions of the South-east Marine Parks Network, and conduct a choice experiment measuring the general public's value for protection of marine parks with different features.

The approaches recommended in this paper will aim to build on these studies and use them as an earlier baseline where possible.

3.2 Desktop review results and discussion

Australia wide, we found 213 measures on the social and economics of marine parks (or related spatial policies). Of these, 51% were collected on an ongoing basis and 49% were associated with once-off studies (Figure 11). Most measures were reported at the marine park scale (78%), followed by reporting at the state scale (16%). Very few measures were reported at the within marine park scale (6%) (Figure 11). Measures on perception were by far the most frequent accounting for 40% of all measures. This was followed by use measures (25%), economic measures (22%), and awareness measures (13%) (Figure 12).

The temporal and spatial scales of measures varied between states. Queensland, South Australia and Victoria predominantly monitor measures over time, whilst Western Australia and New South Wales measures were collected on a once-off basis (Figure 11). Spatially, Queensland, Western Australia and New South Wales typically reported measures at the marine park level. In contrast, South Australia and Victoria often report at the state level.
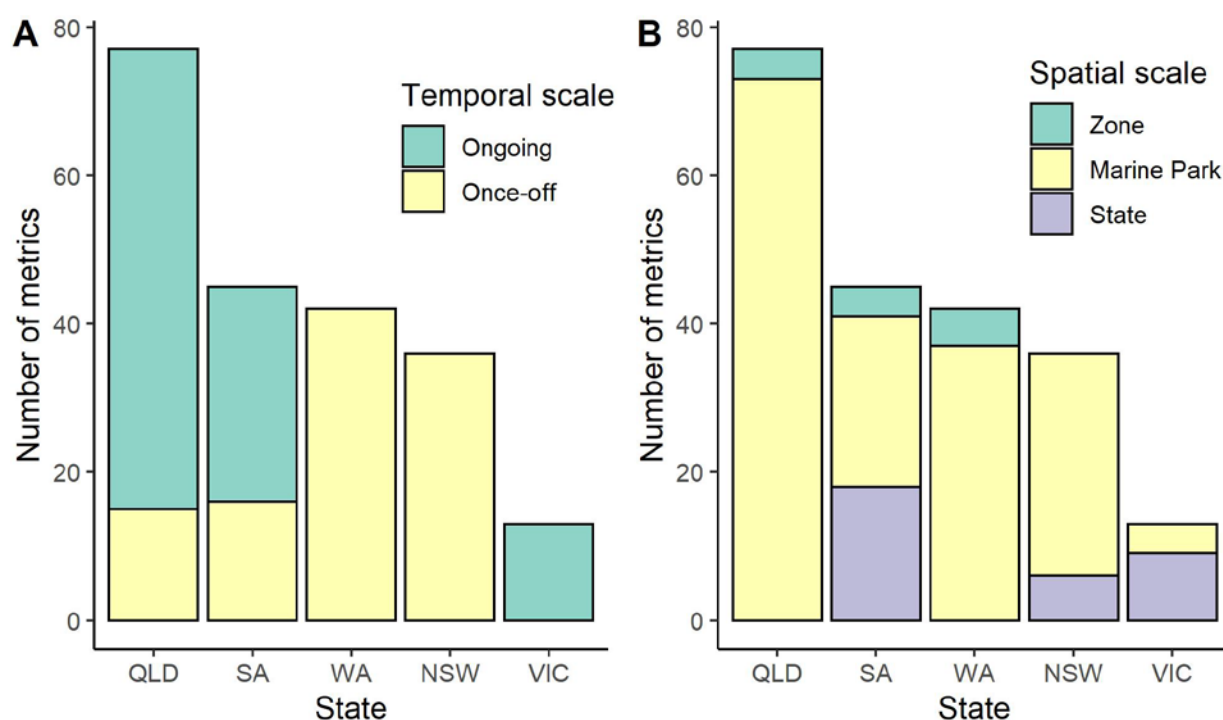
Figure 11. Plots showing the number of measures by state that are part of A) ongoing versus once-off monitoring programs, and B) reported at the zonal, marine park and state levels.

The types of measures collected also vary across states (Figure 12). In Queensland, Western Australia and Victoria perception measures are most common. Economic measures are most common in New South Wales, and use measures most common in South Australia.

The high-level summary statistics in Figure 11 and Figure 12 demonstrates that approaches to social and economic monitoring of marine parks are highly varied within Australia. We will come back to this variability and its implications when discussing the regional workshops in Chapter 4.
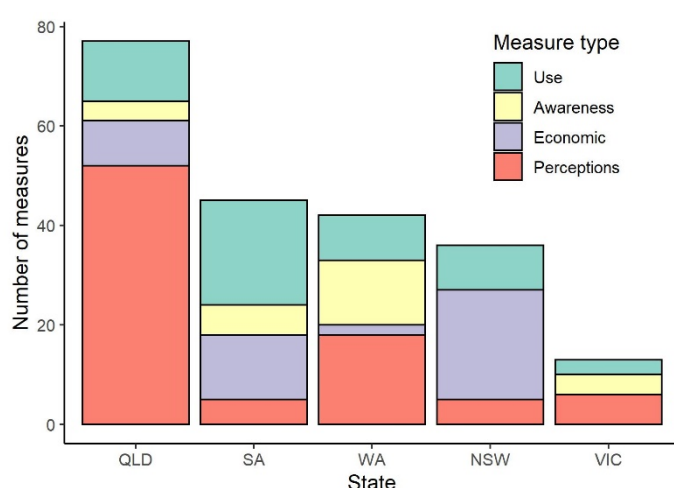
Figure 12. Number of measures in each measure type by state.

3.2.1   Awareness

Nationally, 27 measures on awareness were found, and all were collected through surveys (telephone, online or on-site). A complete list of the awareness measures by state is available in the Appendix. Most awareness measures are measured for the general public (74%), with the remaining (26%) measuring awareness of recreational fishers. No measures of awareness of marine parks were found for commercial fishers or charter operators. This likely reflects that these stakeholder groups are often directly involved in marine park consultation and may be assumed to be aware of the parks and its rules. Whether commercial operators can be assumed to be aware of the AMPs is difficult to determine, particularly as some operators may only occasionally use Commonwealth waters.

Most state-based awareness measures focussed on awareness of different zone-types (44%), followed by an awareness of a specific marine park (30%). Less popular were measures of awareness of what a marine park is (15%), locations of zones in marine parks (7%), and awareness of what marine parks are for (4%).

States differed in the awareness levels they have incorporated into their social and economic monitoring (Figure 13). Queensland and Western Australia have focussed on awareness of zone types and specific marine parks. Victoria focuses on what a marine park is and what marine parks are for. South Australia includes a variety of awareness levels in their monitoring. No awareness measures matching our categories were found in New South Wales, though Martin et al. (2016) measured awareness of penalties for non-compliance in the Port Stephens-Great Lakes Marine Park.
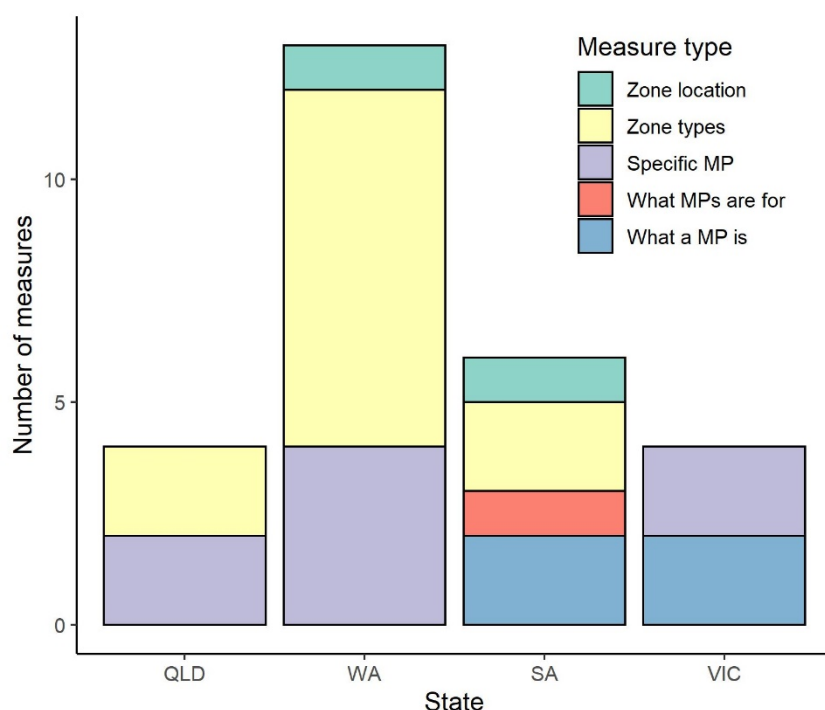
Figure 13. Number of awareness measures by state in each measure sub-type.

Relatively little formal research discusses appropriate levels of awareness to incorporate into marine park monitoring. Partly this reflects that the level of awareness to be monitored should be matched to the management objectives. For example, if managers are interested

in awareness as an indicator of capacity for voluntary compliance, awareness of rules associated with a marine park are most appropriate. In general, higher levels of awareness (e.g. awareness of specific zones) are likely to be more relevant to users of marine parks and lower levels of awareness are likely to be more relevant to the general public.

Three broad survey question types are used to gauge awareness:

- Direct questioning: Asking directly if respondents are aware of a marine park, a specific zone, zoning rules or some other aspect of marine parks. e.g. *"are you aware of the … marine park"*

- Likert scale questioning: Asking for the degree (using Likert scales) that respondents are aware of a marine park, a specific zone, zoning rules or some other aspect of marine parks.

- Testing awareness: Testing respondents' awareness by asking them to name a marine park or specific zone, identify the location of a marine park or specific zone, or identify the purpose of a marine park.

Research suggests that respondents to surveys may attempt to appear more knowledgeable about a given topic than they are (Perry et al., 2014). Some evidence for this comes from recent surveys conducted for the Freycinet Marine Park (Commonwealth) in which roughly half of the respondents reported being aware of the Freycinet Marine Park, but when asked, just 3% were able to name the park (Lynch et al., 2019). To overcome any bias associated with wanting to appear knowledgeable, awareness questions should, where possible, use a test approach asking a question with a known correct answer.

Some previous research has begun to measure awareness levels of the AMPs (Table 4). Young and Temperton (2007) provide a 2007 baseline measure of the general public's awareness of marine parks including Commonwealth marine parks. Burton et al. (2015) measured awareness levels of the general public in 2015 for the former Commonwealth Marine reserves network. Similarly, Lynch et al. (2019) provide a 2018 baseline measurement of recreational fishers' awareness of Freycinet Marine Park. In Chapter 5 we incorporate, where appropriate, these baselines into our recommendations for the AMPs.

Table 4. Previously collected measures on awareness of the Australian Marine Parks.

Management action	Stakeholder	Question wording	Reference
Marine parks generally	General public	*What initiatives does the State or Federal Government have in place to help protect the marine environment? What about laws? Any other initiatives or laws?* [open ended]	(Young and Temperton, 2007)
None	General public	*Are you aware that State Governments are responsible for the regulation of activities in inshore waters out to 3 nautical miles and the Federal Government then has responsibility out to Australia's 200 nautical mile limit?* [yes, no, unsure]	(Young and Temperton, 2007)
Commonwealth marine reserves	General public	*Have you heard about Commonwealth Marine Reserves?*	(Burton et al., 2015)
South-east Commonwealth marine reserves network	General public	*Have you heard about the South-east Commonwealth Marine Reserves Network?*	(Burton et al., 2015)
South-east Commonwealth marine reserves network	General public	*Are you familiar with the different restrictions on activities in the South- east Commonwealth Marine Reserves Network?*	(Burton et al., 2015)
Freycinet Marine Park	Recreational fishers	*Are you aware that there are Australian Commonwealth Marine Parks in the waters off Eastern Tasmania?* [yes, no]	(Lynch et al., 2019)
Freycinet Marine Park	Recreational fishers	*Can you name any Commonwealth Marine Parks in the area?* [open ended]	(Lynch et al., 2019)

3.2.2   Use

Nationally, 54 measures on the use of marine parks were found. A complete list of the use measures by state is available in the Appendix. Most use measures were for commercial fishers (35%), followed by the general public (e.g. visitation rates) (22%), recreational fishers and non-extractive recreational users (22%), and charter operators (15%). Some use measures have also been used for tourism industries (4%) and Aboriginal and Torres Strait Islander people (2%).

Most state measures reported use at the marine park level (54%), followed by use at the states' marine park network level (24%), spatial patterns of use within marine parks (16%), and levels of displaced use (6%). The types of use measures differed across states (Figure 14). Queensland and Western Australia predominantly monitor use at the marine park and within marine park levels, whilst New South Wales, South Australia and Victoria include some monitoring at the state level.
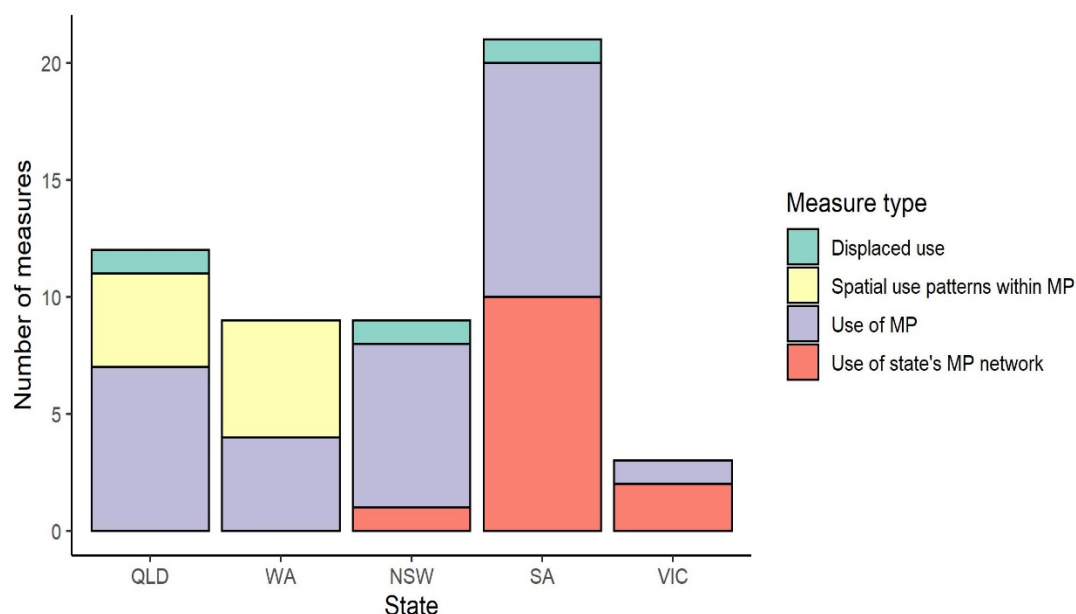
Figure 14. Number of use measures by state in each measure sub-type.

A critical consideration in designing use measures is whether they aim to measure the impact of the marine park on use (referred to in this report as performance), or to provide contextual information on the types and extent of use (i.e. where are people going and, what are they doing?). By far the more challenging of these goals is measuring marine park performance. Our review found three approaches for using use measures to capture the performance of marine parks in Australia (Table 5). The first is to quantify the use (catch/trips) that is displaced by the marine park zoning (Lynch, 2006; Kenyon et al., 2017). This approach is a relatively easy way to predict the impacts of zoning that has not yet been implemented; however, it is vulnerable to over-estimation as some users will be displaced to adjacent areas or fisheries. This displacement approach has already been applied to the AMPs for commercial fisheries (Parks Australia, 2018).

The second approach is to perform a before and after comparison on levels of use. For example, AgEconPlus (2008a) produced a before-after time-series of commercial catch within Jervis Bay Marine Park, and DEWNR (2017) produced a time series of catch for commercial fisheries affected by South Australia's marine park network. Whilst this approach may be simple, it is potentially misleading as the marine parks effect cannot be separated from underlying trends driven by other factors such as changes in quota, changes in beach prices, or changes in interest rates. The potential for before-after comparisons to be misleading means that they should be interpreted cautiously.

The third, and more powerful, way of detecting impacts on use is to use a Before After Control Impact (BACI) design (Underwood, 1994). A BACI design removes the influence of (at least some) of the outside influences by using controls to capture changes in use that would have occurred had marine parks not been established (Underwood, 1994). A major barrier to a BACI approach is that finding appropriate controls is difficult. One of the only BACI assessments of marine parks was performed on the total catch of commercial fisheries in the Great Barrier Reef Marine Park following rezoning (Fletcher et al., 2015). The study was criticised for its use of inappropriate controls, which in this case were commercial fisheries to the South and North of the Great Barrier Reef Marine Park (Hughes et al., 2016). BACI designs for detecting impact of marine parks on use values are powerful but are also challenging.

Internationally, a further four approaches have been used (Table 5). These include measuring increased fishing along the boundary of NTRs, measuring increased use of NTRs by non-extractive users, measuring changes in the size of fish caught adjacent to NTRs, and measuring changes in the extent of spatial overlap of marine users. These five approaches do not capture the overall impact of marine parks on use, but instead, detect some of the ways marine parks can affect use-values. For example, increased fishing along NTR boundaries may indicate adult spillover of fish is occurring from the NTR into the fished area, but it does not necessarily mean that the spill-over benefits exceed costs incurred by being displaced from previous fishing grounds. Nevertheless, determining whether adult spill-over is occurring can be useful for adaptive management, as it at-least shows whether there is a possibility of NTRs benefiting adjacent fisheries.

Table 5. Approaches to detecting the impact of marine park zoning on users of the marine environment.

Name	Description	Limitations
Displaced use	The number of trips or other use measures that are displaced by the implementation of marine park zoning (Lynch, 2006; Kenyon et al., 2017).	May exaggerate impacts as displaced use can be diverted to other areas or activities.
Change in use level (Before After)	Comparison of use levels before and after zoning is implemented (DEWNR, 2017).	Vulnerable to exogenous factors such as changes in fishing quota
Change in use level (Before After Control Impact)	Comparison of use levels before and after zoning is implemented experienced in a marine park area that is not experienced in control areas (Fletcher et al., 2015).	Often difficult to identify appropriate controls.
Change in fishing use level along NTR boundaries	Increased use along NTR boundary may indicate spillover of adult fish from the NTR area (Roberts et al., 2001).	Does not capture the cost of being displaced by the NTR
Change in non-extractive use of NTR area	Increased usage of NTR area may indicate that non-extractive users are benefiting from improvements in biodiversity (Rees et al., 2015).	Vulnerable to exogenous factors such.
Change in size of fish caught adjacent to NTR area	Increased catch of large fish in marine park area may indicate spillover of adult fish from the NTR area (Roberts et al., 2001).	Does not capture the cost of being displaced by the NTR
Change in extent of spatial overlap of users	Decreased overlap between marine park users may indicate reduced use conflicts (Mangi et al., 2011).	Does not capture costs of displacement

Sampling approaches used for measuring use of marine parks can broadly be classified into three types:

- Real-time reporting: data is collected in real-time from marine park users (typically commercial fishers and charter operators) either using automated systems (e.g. Vessel Monitoring Systems), or real-time logbook reporting.

- Researcher observation: researchers visit the marine park and make counts of marine park users from a boat (Lynch, 2006; Kenyon et al., 2011; Lynch, 2014; Kenyon et al., 2017), the air (Beckley et al., 2010; Smallwood and Beckley, 2012) or from the land (Beckley et al., 2010; Smallwood and Beckley, 2012).

- Recall: users of the marine park are asked to recall details about their trip or multiple trips after the fact (Rees et al., 2015; Lynch et al., 2019).

Real-time reporting systems provide accurate up-to-date and often a complete census of use and are favourable over researcher observation and recall approaches.

Researcher observation data involves direct observation of use by researchers. This approach has frequently been used to measure recreational fishing and non-fishing recreational use of marine parks (Lynch, 2006; Beckley et al., 2010; Kenyon et al., 2011; Smallwood and Beckley, 2012; Lynch, 2014; Kenyon et al., 2017). Direct observation methods allow researchers to collect accurate data, particularly emphasising the spatial location of use. However, direct observation is unlikely to be very cost-effective for monitoring the AMPs given their large spatial extent and offshore location.

A recall approach asks marine park users directly for details of past trips over some fixed period. Previous research in the South-east network asked the general public if, to the best of their knowledge, they had visited one of the AMPs, what activities they had conducted, and how often (Burton et al., 2015). A challenge with this approach is that it may be difficult for respondents to know whether they have visited one of the AMPs or not. An alternative recall strategy is to ask users to indicate spatially where on a map they have conducted activities. From these spatial use patterns, use levels of marine parks can be estimated. Lynch et al. (2019) tested this recall approach on recreational fishers at Freycinet Marine Park (Commonwealth) asking respondents to identify areas and details of trips in the area in the last 3 months. Trip locations were recorded using 5-minute grids indicating usage levels of Freycinet Marine Park without fishers having to self-report when they had entered the park. Map-based recall approaches have been used by researchers studying marine parks in Lyme Bay in the United Kingdom (Rees et al., 2015), and marine parks in Northern California (Scholz et al., 2011). Given difficulties in identifying when people are accessing the AMPs, a map-based recall strategy is likely to be useful where real-time reporting data is not available.

Previous research that has assessed use of the AMPs is summarised in Table 6. This research has focussed on the general public, recreational fishers and commercial fishers. As already discussed, Burton et al. (2015) surveyed the general public in the South-west network asking them to recall their use of the AMPs. Larcombe and Marton (2018) estimate displaced commercial fishing catch associated with the implementation of the AMPs. As displaced catch is a static measure (it does not change over time) there is no point in repeating this exercise. Recfish Australia (2010) provide a mainly qualitative description of recreational fishing use of the AMPs. Non-random sampling limits the usefulness of this research as a baseline for on-going monitoring. Lynch et al. (2019) provide a baseline for spatial use levels of recreational fishing in the Freycinet Marine Park from 2018 and use state-based recreational fishing surveys to estimate trip numbers and catch of key species at the marine park scale for Ningaloo Marine Park (Commonwealth) and Hunter Marine Park.

Table 6. Previously collected measures on awareness of the Australian Marine Parks.

Management action	Stakeholder	Description	Reference
South-east Commonwealth Marine Reserves Network	General public	*To the best of your knowledge have you ever been in a marine reserve that forms part of the South-east Commonwealth Marine Reserves Network?*	(Burton et al., 2015)
South-east Commonwealth Marine Reserves Network	General public	*How frequently do you visit any marine reserve in the network for the following activities?*	(Burton et al., 2015)
South-east Commonwealth Marine Reserves Network	General public	*Please indicate which marine reserves you most often visit for each of the following activities?*	(Burton et al., 2015)
Ningaloo and Hunter Marine Parks (Commonwealth)	Recreational fishing	Number of recreational fishing boat days	(Lynch et al., 2019)
Ningaloo and Hunter Marine Parks (Commonwealth)	Recreational fishing	Estimated retained and released catch by common species (and total)	(Lynch et al., 2019)
Freycinet Marine Park (Commonwealth)	Recreational fishing	Estimated spatial distribution of trips in the last 3 months	(Lynch et al., 2019)
AMPs nationally (by marine park)	Commercial fishing	Displaced catch due to AMP zoning	(Larcombe and Marton, 2018)
AMPs nationally	Recreational fishing	Estimated percentage of fishing effort >5km from shoreline from Henry and Lyle (2003)	(Recfish Australia, 2010)
AMPs nationally	Recreational fishing	Estimates percentage of recreational catch by species group taken >5km from the shoreline from Henry and Lyle (2003)	(Recfish Australia, 2010)
AMPs nationally (by network)	Recreational fishing	Qualitative description of targeted fish species in Commonwealth waters	(Recfish Australia, 2010)
AMPs nationally (by region)	Recreational fishing	Qualitative description of Commonwealth waters important for recreational fishing	(Recfish Australia, 2010)
AMPs nationally (by region)	Recreational fishing	Survey targeted at fishing peak body groups: In the last 12 months how often have you fished in Commonwealth waters.	(Recfish Australia, 2010)
AMPs nationally (by region)	Recreational fishing	Survey targeted at fishing peak body groups: What percentage of your overall boat-based fishing has been in Commonwealth Waters in the past 12 months	(Recfish Australia, 2010)

3.2.3   Perceptions

Nationally, 89 measures on perceptions of marine parks were found. A complete list of the perception measures by state is available in the Appendix. All perception measures were collected through surveys (telephone, online or on-site). Most perception measures were measured for the general public (55%), followed by recreational fishers and non-extractive recreational users (22%), commercial fishers (12%), and charter operators (11%).

Most state perception measures reported on use-values (47%), followed by the environment (22%), and overall attitude towards marine parks (15%). Less commonly monitored were the social acceptability of marine parks generally (8%) and issues of governance (8%) (Figure 15).

States differed somewhat in the way they have incorporated perceptions into their social and economic monitoring (Figure 15). All states include some measure of overall attitude towards marine parks. All states also measure impacts of marine parks on use-values. All states except Western Australia included monitoring of the social acceptability of marine parks in general. Measurement of impacts of marine parks on the marine environment was limited to Western Australia and Queensland, and measures of the perceived quality of governance were present in Queensland and Victoria.
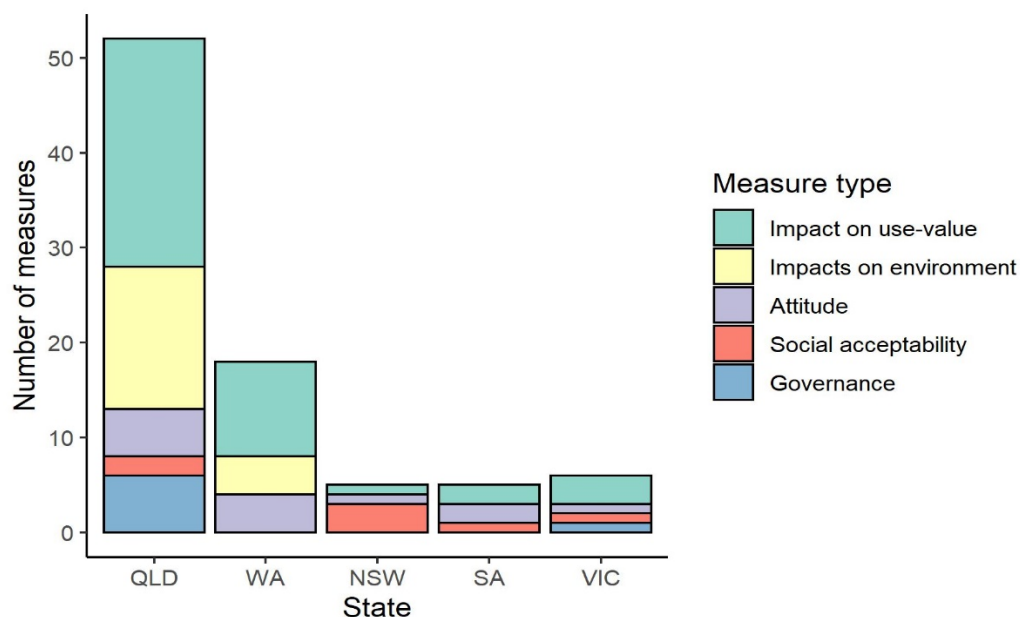
Figure 15. Number of perception measures by state in each measure sub-type.

Using perceptions in social and economic monitoring of marine parks may be questioned by some, as perceptions are subjective reflecting personal experiences, world views and expectations. Countering these criticisms Bennett (2016) identify that the subjectivity of perception measures is a strength, as perceptions drive attitudes and therefore behavioural changes and resulting environmental outcomes. Perceptions have been widely used in social and economic monitoring of marine parks in Australia (Figure 15) and internationally (LaFranchi and Pendleton, 2008; Shivlani et al., 2008; Mangi et al., 2011; Pita et al., 2011; Leeworthy, 2013; Rees et al., 2015; Rodríguez-Rodríguez and López, 2019).

When monitoring the perceived impacts of marine parks on human values or the environment, two approaches are regularly used. The first is to ask directly about the perceived impacts of the marine park. Alternatively, surveys can ask respondents about their

perceived state of values or the environment and compare these perceptions over time; this latter approach is commonly used in Victoria and Queensland. As far as we are aware no research has been conducted to compare the two approaches for conservation policies and both approaches are likely to have limitations. The direct assessment of impacts requires respondents to attribute changes to the marine park zoning. In doing so, some may exaggerate their perceptions to influence decisions (known as strategic bias). Alternatively, monitoring the state of values or the environment fails to capture the more subjective nature of perceptions highlighted as strengths by Bennett (2016). Additionally, over-time comparisons may show trends resulting from changes in expectations rather that changes in states, and as such may not be reliably compared across time. Ultimately, the better approach will depend on whether managers are interested in how their policies are being perceived, or a somewhat more objective assessment of trends, albeit with a sensitivity to changing expectations.

Another consideration is which of the five aspects of perceptions to monitor. In designing short and effective surveys there is almost always a need to prioritise questions. Relatively little academic research is available to guide these decisions, and ultimately topics of perception measures are a management decision. Given the explicit goal of gaining support in Parks Australia's *communication, education and awareness program* we would argue that measures of overall attitudes towards the AMPs are important. Additionally, given a core objective of allowing for sustainable use and enjoyment, measures of perceived impacts (positive or negative) on use values should be a priority. Finally, as the AMPs have largely been implemented for biodiversity conservation and associated non-use values determining whether people perceive these areas as protecting marine environments is important.

Previous research that has assessed perceptions of the AMPs is summarised in Table 7. Recfish Australia (2010) presents the results of a small (n=175) non-randomised online survey. They ask about several aspects on the social acceptability of marine parks generally, and impacts of marine parks, but the small sample size and some leading question wording makes the results relatively unsuitable as baselines. Young and Temperton (2007) conducted a larger (n=725) phone survey with the general public around Australia. The questions may be of some use as a baseline of social acceptability of marine parks, but do not include specific questioning about the AMPs. Burton et al. (2015) ask members of the general public in the South-east network about their overall attitudes towards the Commonwealth Marine Reserves, perceptions of whether the protection is sufficient for different pressures, and perceived importance of different objectives of the Commonwealth Marine Reserves.

Table 7. Previously collected measures on perceptions of the Australian Marine Parks.

Management action	Stakeholder	Description	Reference
AMPs nationally	Recreational fishers	Level of agreement with multiple-use marine parks are preferable to reserves that lock recreational fishers out of areas.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Level of agreement with any zoning (especially no-take/no-fishing zones) must be risk assessed and evidence-based.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Level of agreement with any loss of access must be mitigated for (i.e. buyout commercial effort, artificial reefs, exclusive recreational fishing only areas).	(Recfish Australia, 2010)

National **Environmental Science** Programme

Marine Biodiversity Hub

Management action	Stakeholder	Description	Reference
AMPs nationally	Recreational fishers	Level of agreement with marine parks are an important principle for provision of some reference areas for scientific research.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Level of agreement with marine parks are important to protect vulnerable habitats or species against an identified risk.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Agree with marine parks are an important part of overall marine management.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Level of agreement with marine parks are a tool that allows the avoidance of real habitat management issues.	(Recfish Australia, 2010)
AMPs nationally	Recreational fishers	Level of agreement with marine parks do no good at all.	(Recfish Australia, 2010)
AMPs nationally	General public	Level of agreement with I believe Marine Protected Areas are important in preserving the ocean environment and its creatures.	(Young and Temperton, 2007)
AMPs nationally	General public	I support Marine Protected Areas in Australian Government waters.	(Young and Temperton, 2007)
AMPs nationally	General public	I support the Federal Government creating more Marine Protected Areas in the oceans around Australia.	(Young and Temperton, 2007)
AMPs nationally	General public	Do you think the creation of Commonwealth Marine Reserves is a good thing?	(Burton et al., 2015)
AMPs nationally	General public	Level of agreement with there are not enough restrictions on commercial fishing in the reserves.	(Burton et al., 2015)
AMPs nationally	General public	Level of agreement with there are not enough restrictions on mining in the reserves.	(Burton et al., 2015)
AMPs nationally	General public	Level of agreement with there are not enough restrictions on recreational activities in the reserves.	(Burton et al., 2015)
AMPs nationally	General public	Level of agreement with the level of protection given to these reserves is not enough to guarantee conservation of marine ecosystems.	(Burton et al., 2015)
AMPs nationally	General public	Level of agreement with there is not enough enforcement of restrictions in reserves to guarantee protection of marine ecosystems.	(Burton et al., 2015)
AMPs nationally	General public	Allocation of importance of AMP management objectives: scientific knowledge, protect marine environments, enforcement, public knowledge, indigenous involvement, and evaluation.	(Burton et al., 2015)

3.2.4   Economic value

Nationally, 46 economic measures of marine parks were found. A complete list of the economic measures by state is available in the Appendix. Most economic measures were collected for the economy as a whole (41%), followed by commercial fishers (22%), the tourism industry (13%), recreational fishers/non-extractive recreational users (13%) and charter operators (11%).

Most economic value measures monitored revenues of sectors in the economy (50%), and the level of economic activity in the economy overall (39%). Very few measures monitored non-market values (9%) and no measures report on market values (e.g. profits or consumer surplus from purchases).

States were broadly similar in the economic measures they have incorporated into their social and economic monitoring, generally monitoring a combination of regional economic activity, and sector-based revenue (Figure 16). New South Wales also included monitoring of non-market values, and South Australia the price of fish.
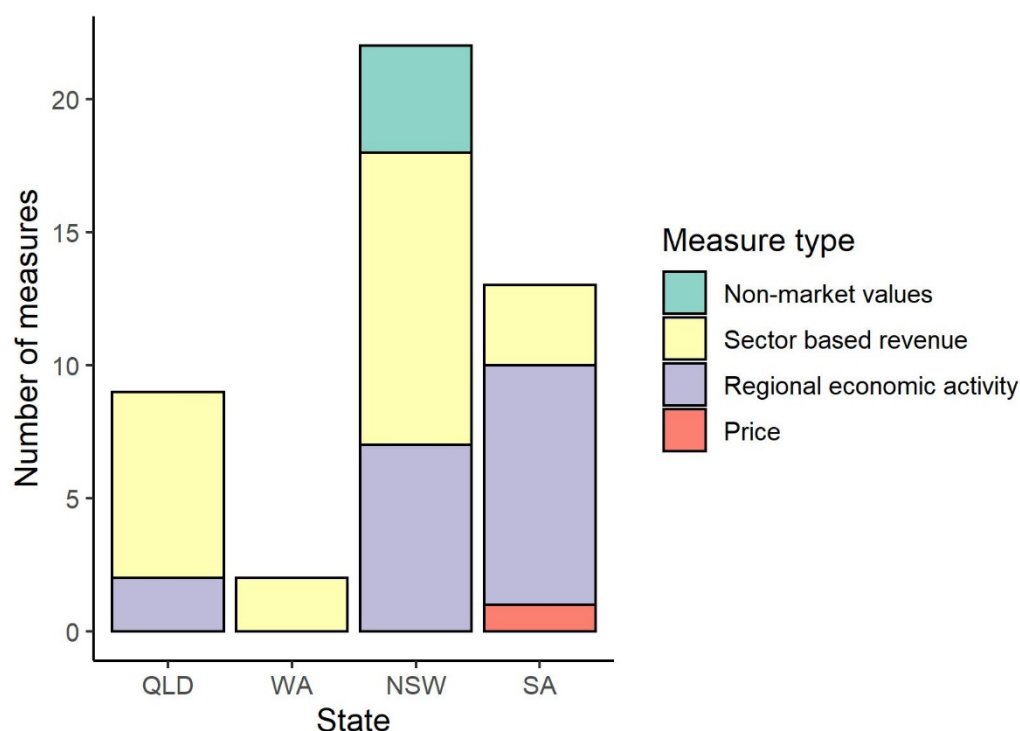
Figure 16. Number of economic measures by state in each measure sub-type.

The strong focus on measures of sector-based revenue in marine park reporting is somewhat problematic. Revenue captures neither the contribution that the sector makes to local economies (as downstream multiplier effects are not accounted for and intermediate costs are included), nor does it capture the benefits that the sector itself receives from the activity (as costs have not been subtracted) (Edwards, 1990; Pascoe et al., 2016). As such revenue is widely considered a poor measure of economic value (Edwards, 1990; McPhee and Hundloe, 2004).

The next most common economic measure is regional economic activity. This has been measured using two approaches. The first is input-output modelling in which the effect on local economies of changes in sector revenue is simulated (KPMG Consulting, 2000;

DEWNR, 2017). This type of analysis has already been conducted for the AMPs (Larcombe and Marton, 2018).

The second approach is to track measures of regional economic activity over time including gross regional product, house sale prices, unemployment rates, and tourism business counts (Powell and Chalmers, 2005; DEWNR, 2017). Tracking measures of economic activity over time suffers from many of the challenges of monitoring use; it is difficult to attribute changes to a marine park being implemented. Previous monitoring of economic activity over time hasn't detected any trends with the implementation of state marine parks (DEWNR, 2017). As the AMPs are less restrictive than state marine parks, we expect that monitoring of economic measures over time is unlikely to be sensitive enough to detect the effects of the AMPs. Instead, we suggest that economic monitoring should focus at the sector level.

Given that neither sector-based revenue nor regional economic activity measures are likely to be useful for on-going monitoring of the AMPs it is worth considering alternative approaches. Table 8 provides a summary of economic approaches and measures used to measure the market and non-market impacts of marine parks.

Two sets of approaches are available to measure the non-market values of marine parks. The first are known as stated preference techniques, including choice experiments and contingent valuation. Stated preference techniques are the only means of quantifying the non-use values that marine parks provide. As highlighted above, non-use values held for knowledge of an area's protection are likely to form a significant portion of the economic value of the AMPs.

The second set of approaches are known as revealed preference techniques, which use actual behaviour of individuals to infer the use-values held for an area. A form of revealed preference technique known as random utility modelling can also be used to simulate the effects of modified site access on use-values, including those resulting from marine park zoning (Haab et al., 2008). Changes in values are expressed in monetary terms.

The market value approaches highlighted in Table 8 aim to measure the producer surplus of commercial activities in marine environments (Pascoe et al., 2016; Ogier et al., 2018). Producer surplus is the revenue minus the costs (including the opportunity cost of unpaid labour). Revenue is often easily calculated; in commercial fisheries, it is the catch multiplied by the beach price of fish. A variety of methods have been used to calculate costs. Pascoe et al. (2016) conduct surveys with commercial fishers to determine costs. Ogier et al. (2018) use two approaches. For the rock lobster fishery in Tasmania, they use the quota lease price as a proxy for producer surplus per kg. The second approach was used for the Tasmanian abalone dive fishery where the main cost, diver labour, is already expressed in a per harvest form at approximately $7 per kg.

Another relatively simple measure relevant to consumer surplus is the amount of market capitalisation in fisheries (Pascoe et al., 2016; Ogier et al., 2018). This is calculated as the total value of licences in a fishery and should approximate the total discounted expected future profits in the fishery. This licence value is a forward-looking measure and will reflect expectations and uncertainty in management (Pascoe et al., 2016; Ogier et al., 2018).

Two previous studies have investigated the economic value of the AMPs (Table 9). Larcombe and Marton (2018) calculate displaced commercial fishing revenue from the AMPs and investigate implications for the wider economy using input-output modelling. Burton et al. (2015) conduct a choice experiment of the general public, measuring non-use values associated with different features of the AMPs including protection of bioregions, seafloor types, important ecological areas, important areas for white shark populations and areas less

than 1500 m depth. The work does not, however, calculate the resulting value held for the current protection in the AMPs.

Table 8. Approaches to measuring the economic value of marine parks and their limitations.

Name	Description	Limitations
Non-market values		
Travel cost method	The use-value of a destination is inferred by modelling the number of trips as a function of the travel cost (Hassall & Associates and Gillespie Economics, 2004).	Need to be conducted before and after to infer the impact of marine park.
Travel cost - Random Utility Model	Change in recreational use value with implementation of site access restrictions is inferred from site choice behaviour (Haab et al., 2008).	Does not capture the effects of changes in fish population dynamics.
Choice experiment	Value of marine parks is inferred from observations in experiments in which respondents are asked to select preferred management actions out of a set (Davis et al., 2019). Particularly well suited to measuring non-use values.	Based on hypothetical scenarios.
Contingent valuation	Value of marine parks asked from respondents directly (Bennett and Gillespie, 2010). Particularly well suited to measuring non-use values.	Based on hypothetical scenarios.
Market values		
Producer surplus	Profit excluding interest payments and leasing costs (Pascoe et al., 2016).	Need a means of estimating costs or the difference between costs and revenue.
Licence value	A measure of expected discounted future profits (Pascoe et al., 2016).	Requires data on leasing and licence costs.

Table 9. Previously collected measures on the economic value of the Australian Marine Parks.

Management action	Stakeholder	Description	Reference
AMPs nationally	Commercial fishers	Gross value product of displaced commercial fishing.	(Larcombe and Marton, 2018; Parks Australia, 2018)
AMPs nationally	Commercial fishers	Change in regional economic activity and full-time equivalent jobs due to displaced commercial fishing.	(Larcombe and Marton, 2018; Parks Australia, 2018)
South-east Commonwealth Marine Reserves Network	General public	Value attached to features protected in the AMPs: bioregions, seafloor types, important ecological areas, important areas for white shark populations and areas less than 1500m depth.	(Burton et al., 2015)

3.2.5   Aboriginal and Torres Strait Islander people

In this section, we discuss approaches to social and economic monitoring for Aboriginal and Torres Strait Islander people. The scope of this review and resulting recommendations is limited to measures of economic, educational and experiential opportunities created by the AMPs and particularly delivery of Parks Australia's Indigenous Engagement Program. Opportunities will include:

- collaborating with indigenous rangers, traditional owners, land councils, and indigenous advisory committees to undertake marine park management activities;

- supporting opportunities to provide scientific and monitoring training to increase capacity for Aboriginal and Torres Strait Islander people to participate in marine park management;

- supporting opportunities for Aboriginal and Torres Strait Islander people to enjoy their sea country; and,

- supporting opportunities to improve Aboriginal and Torres Strait Islander livelihoods consistent with national 'closing the gap' commitments

It is important to note that this report does not consider the spiritual and cultural values that Aboriginal and Torres Strait islanders hold for the marine environment and how the AMPs affects these values.

We identify three factors that are relevant to the success of the Indigenous Engagement Program. The first and simplest is the extent of the program measured as the number of engagement activities conducted. The second is the representativeness of opportunities. This is the degree to which engagement opportunities have been diversified across Aboriginal and Torres Strait Islander groups. It is important to note that some Aboriginal and Torres Strait Islander groups may not be interested in participating. The third is the depth of engagement. Previous consultations with Aboriginal and Torres Strait Islanders have emphasised the desire for the creation of long-term opportunities for employment and involvement in management (National Oceans Office, 2002; DSEWPAC, 2013). Measures should broadly capture trends in all three dimensions of engagement; identifying progress towards more, and deeper levels of engagement across more groups.

4. REGIONAL WORKSHOPS

In 2019 regional workshops were held with marine park managers and experts across six Australian states. These workshops provided an opportunity to learn from previous experiences of state agencies and translate lessons on to Parks Australia. Many of the outcomes of these workshops have been incorporated into our review of measures in Chapter 3. These include:

- Preference of awareness measures that test awareness

- The importance of controls in measuring the impacts of marine parks on use

- The pros and cons of approaches to measuring perceptions, particularly comparisons of perceived state of values over time versus direct assessment of the impact of the marine park on a value

- The limitations of revenue as a measure of economic value

- The importance of non-use values for marine parks

- The lack of sensitivity of regional economic activity measures produced by tracking economic measures over time (e.g. unemployment)

In the remainder of this chapter, we discuss three themes that emerged from workshop discussions.

The first theme was the importance of social and economic monitoring of marine parks and a desire to conduct more of it. Several marine park managers described not having adequate information on the social and economic values of their parks to inform decisions or respond to requests. Barriers to conducting more social and economic research included budgetary limitations, but also the perceived difficulty in designing effective social and economic monitoring programs. The desktop review in Chapter 3 highlighted that states approaches to social and economic monitoring varied drastically, with very little cross-institutional seeding of ideas and consensus on approaches. Opportunities exist in increasing cross-institutional collaborations and ideas exchange as well as the development of standardised, low-cost, approaches to social and economic monitoring that can be readily transferred across marine parks.

A second theme was a difference in opinion about the role that social and economic monitoring of marine parks should play. There was general agreement across states that social and economic monitoring should be linked to management actions. However, opinions differed on what that management action should be. In several workshops, social and economic monitoring was perceived as a means of informing on-going management decisions such as the locations of enforcement patrols, priorities for education and awareness programs and decisions on positioning of infrastructure. Alternatively, social and economic monitoring was sometimes perceived as a means of understanding the impacts of marine park zoning itself on use and non-use values (referred to as marine park performance in this report), with the linked management action being a long-term plan to review the zoning and management plans for the parks. Interestingly, focus on marine park performance was emphasised in states with plans to review management plans in the near-term (NSW MEMA, 2019) or with a strong emphasis on adaptive management (DEWNR, 2017).

The third theme was the desire to capture the benefits of marine parks. Several workshops participants felt that impacts of marine parks on use and non-use values often emphasised costs. For example, the costs to commercial and recreational fishers of reduced access, and the flow-on effects for local economies. In contrast, the benefits that marine parks provide

are often left unmeasured. This includes the non-use values provided by marine parks, the benefits that marine parks provide to non-extractive recreational users and charter operators and resulting benefits for local economies, adult and larval spill-over benefits to fisheries and benefits in terms of reduced spatial conflicts between marine environment users. Our review in Chapter 3 and recommended measures in Chapter 5 attempt to capture these benefits for the AMPs.

5. METRIC RECOMMENDATIONS

In this section, we identify suggested measures for social and economic monitoring of the Australian Marine Parks. These recommendations draw on the insights provided by the desktop review and regional workshops. They also incorporate existing data and consider the cost-feasibility of data collection. For any measures requiring additional primary data collection a data collection plan is presented in Chapter 6.

The measure recommendations are structured around six user groups: commercial fishers, charter operators, recreational users, the general public, Aboriginal and Torres Strait Islanders and mining and petroleum industries.

5.1 Commercial fishers

Commercial fishers are arguably one of the groups most affected by the implementation of the AMPs. Whilst the AMPs have been designed to allow continued access in most cases, some fishing has been displaced by the implementation of zoning, particularly Sanctuary Zones, National Park Zones, Recreational Use Zones and Habitat Protection Zones.

Larcombe and Marton (2018) estimate that the implementation of the 44 new AMPs displaced $4.12 million of revenue annually (measured as gross value product). The largest displaced catches are for the Western Rock Lobster Fishery (Western Australia) ($0.82 million), Eastern Tuna and Billfish Fishery (Commonwealth) ($0.48 million), and the Southern Demersal Gillnet and Demersal Longline Managed Fishery (Western Australia) ($0.36 million) (Parks Australia, 2018). Regionally, 9 of the 10 most-affected fisheries are Western Australian or Commonwealth managed fisheries (Parks Australia, 2018).

To offset these costs Parks Australia is providing support to impacted commercial fishers through a $35 million Fisheries Assistance and User Engagement Package (Parks Australia, 2019). This package includes grants to compensate commercial fishers who previously operated in the AMPs for lost income (Fishing Business Assistance grants), grants to assist commercial fishers and representing organisations to contribute to marine park management (Our Marine Parks grants), support for the adoption of new vessel monitoring systems (VMS) technology (Vessel Monitoring System Assistance) and voluntary licence buyouts for fishers in the trawl or trap sectors of the Commonwealth managed Coral Sea Fishery. These compensation mechanisms are designed to reduce the impacts on commercial fishers. They also have implications for marine park monitoring as vessel buy-outs or changes in fishing behaviour are likely to affect catch and effort.

Available data for commercial fishers that may be used for AMP social and economic research is summarised in Table 10. Of these, reported catch and effort records are likely to prove the most useful, as they provide a means of spatial disaggregation of use, and provide a consistent long-run time series.

Several data sources provide real-time data on vessel locations. Automatic identification system (AIS) data is readily available from most fisheries and could be incorporated into marine park monitoring; however, vessels may turn AIS equipment off, particularly to maintain privacy about use of fishing grounds. Given this, further research is needed to determine whether AIS data can reliably be used to understand usage patterns of commercial fisheries. For the same reason, more research is also needed to understand the reliability of data provided by the global fishing watch which takes AIS data and classifies data points involved in active fishing. All vessels in Commonwealth fisheries and many in state fisheries are also required to provide location data via VMS. Unlike AIS, VMS data must

be provided at all times; however, VMS data is protected for data privacy reasons, and while it will be used to detect illegal activity, it is unlikely to be made available for monitoring broader commercial fishing use in AMPs.

Other data sources for commercial fisheries listed in Table 10 include data collected as part of the Great Barrier Reef SELTMP and industry reports on the economic status of commercial fisheries. The SELTMP data is unlikely to be useful for AMP reporting as the data relates specifically to the Great Barrier Reef. Commercial fishing industry reports including those conducted by EconSearch for South Australian fisheries provide useful measures on the economic performance of fisheries (including producer surplus); however, measures are reported at the fishery scale which limits their use for marine park reporting.

Table 10. Existing data sources on commercial fishers. For brevity the following abbreviations are used: Western Australia (WA), South Australia (SA), Tasmania (TAS), Victoria (VIC), New South Wales (NSW), Queensland (QLD) and Northern Territory (NT).

Name	Description	Potential uses and limitations
Commonwealth and NT commercial fishing logbook data	Commonwealth and NT fisheries agencies collect shot-by-shot catch and effort data.	Shot-by-shot level data can be used to provide fine-scale estimates of commercial fishing use.
WA, SA, QLD, NSW, TAS, VIC commercial fishing logbook data	WA, SA, QLD, NSW, TAS, VIC fisheries collect catch and effort data at various spatial scales including 60, 30, 10, 5 and 6-minute grids depending on the fishery.	Relative coarse spatial reporting makes it difficult to identify fishing inside the AMPs.
Automatic identification systems (AIS) data	Many commercial fisheries including Commonwealth fisheries require vessels to carry AIS for navigational purposes.	Vessels do not need to leave their AIS on at all times and often turn them off when fishing to conceal locations.
Vessel monitoring systems (VMS) data	Many commercial fisheries including Commonwealth fisheries require vessels to carry and use VMS at all times.	VMS data is unlikely to be made available for marine park reporting purposes.
QLD Social and Economic Long-Term Monitoring Program (SELTMP) data	The SELTMP is conducting on-going surveys with commercial fishers about their use and perceptions of the Great Barrier Reef.	All SELTMP questions relate specifically to the Great Barrier Reef with no questions on the adjacent Coral Sea.
Global fishing watch	Global fishing watch uses machine learning techniques and AIS data to identify fishing activities.	Some vessels are known to turn off their AIS equipment before fishing. Global fishing watch data appears to identify research activities as fishing. Changes in detection capabilities or use of AIS over time may lead to false trends.
SA Commercial fishing industry reports	EconSearch conduct regular assessments of the economic and social state of the major commercial fisheries in SA; e.g. EconSearch (2016).	Data is not disaggregated enough to comment on the impact or use of the AMPs.
Commonwealth commercial fishing industry reports	Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) conduct regular assessments of the economic state of major Commonwealth fisheries; e.g. Bath et al. (2018).	Data is not disaggregated enough to comment on the impact or use of the AMPs.

5.1.1 Recommended measures

Recommended measures for commercial fishers in terms of performance of the AMPs are summarised in Table 11, and measures for understanding the context of commercial fishing use-values of the AMPs are summarised in Table 12. These measure recommendations aim to make maximum use of existing data and do not include any primary data collection. This largely reflects that existing data collection programs are sufficient to generate meaningful measures for commercial fishers.

In terms of performance of the AMPs, a BACI approach is recommended to examine how the implementation of the AMPs has affected commercial fishing catch, revenue and producer surplus. This analysis would attempt to isolate the marine parks effect by using fisheries affected by the AMPs as impacted, and fisheries unaffected by the AMPs as controls. The analysis should also control for confounding effects from changes in catch quota, or changes resulting from Parks Australia's Fisheries Assistance and User Engagement Package. An alternative, and possibly more powerful BACI approach could be used where individual vessel level data is available, using fishers (within a fishery) as impacted, and fishers unaffected by the AMPs as controls. This BACI approach is the only known means of isolating the effect of the AMPs on commercial fisheries.

We also suggest visual examining fisher behaviour where shot-by-shot level data is available to determine whether fishers are fishing-the-line of no-take marine reserves (NTRs). The presence of fishing the line behaviour is a reasonable indicator of whether adult spill-over of fish from the NTR into the fished area is occurring, and that this spill-over is benefiting adjacent fisheries.

Table 12 presents a range of measures that could be used to better understand and track commercial fishing use-values of the AMPs. These measures aim to quantify the level of use of the AMPs, and how this is changing over time. This can be useful for understanding changes in pressures facing ecosystems in the AMPs as well as prioritising management actions. We also suggest several measures for tracking the economic performance of commercial fisheries that use the AMPs.

Table 11. Performance measures for commercial fishers.

Name	Description	Why is it important?	Limitations
Before after control impact (BACI) studies of catch volume, revenue and producer surplus	BACI study of change in key fishery indicators (catch volume, revenue and consumer surplus). Two options are available for this analysis: 1. Data at the fishery level and analysis at the network level using control and impacted fisheries. 2. Data at the fisher level and analysis at the fishery level using fishers that were affected by the AMPs zoning. This will most likely be restricted to the analysis of catch volume. Data should be sourced from state and Commonwealth fisheries agencies as outlined in Table 10.	BACI studies are the most powerful way of detecting the impact of the AMPs on commercial fishers.	It may be difficult to identify appropriate control and impact fisheries and individual fishers. Confounding effects such as changes in catch quota, and changes resulting from Parks Australia's Fisheries Assistance and User Engagement Package should be controlled for in the analysis.
Presence or absence of fishing the line behaviour	Visual plot of shot-by-shot data were available to determine if fishers are fishing the line around each National Park Zone. No effect is expected soon after implementation, and analysis should only be conducted after 8-10 years. Data should be sourced from state and Commonwealth fisheries agencies as outlined in Table 10.	Evidence that fishers are operating along the boundary of a National Park Zone may indicate that adult spill-over is occurring for the National Park Zone.	Indicates only whether adult spill-over is occurring and is benefiting fishers. It does not consider larval spill-over, and costs of lost fishing grounds.

Table 12. Context measures for commercial fishers.

Name	Description	Why is it important?	Limitations
Catch volume	Annual volume of catch by species landed in the AMP area. Data should be sourced from state and Commonwealth fisheries agencies as outlined in Table 10. The spatial extent of catch will depend on existing data availability. For Commonwealth fisheries and others with shot-by-shot data, this should reflect the volume of catch by marine park. Coarser reporting scales will be required for other fisheries.	Catch volume is an important indicator of pressures on the marine environment and is relevant for understanding trends in biological monitoring.	Where data are reported at coarse spatial scales (e.g. 60x60 minute), catch volume is unlikely to accurately indicate pressure in the marine park area and should be treated with caution. False trends may emerge if catch reporting standards improve over time.
Percentage of catch volume in AMPs	Annual time series of percentage of fishery-wide catch for shot-by-shot reporting fisheries caught in the AMP area reported by fishery. Data should be sourced from state and Commonwealth fisheries agencies as	The percentage of fishery-wide catch landed in the AMPs is a reasonable proxy for the importance of the marine park area for each fishery.	Will not provide useful information for fisheries with coarse spatial scales of reporting including the most impacted

Name	Description	Why is it important?	Limitations
	outlined in Table 10. Similar measures could be estimated for fisheries reporting catch in 5x5 minute grids or 10x10minute grids using the methods described in Larcombe and Marton (2018).		fishery, the Western Rock Lobster fishery (Larcombe and Marton, 2018).
Catch volume by zone	Annual time series of catch volume by species landed in each zone of each AMP for shot-by-shot reporting fisheries. Data should be sourced from state and Commonwealth fisheries agencies as outlined in Table 10.	Catch volume is an important indicator of pressures on the marine environment and is relevant for understanding trends in biological monitoring. Finer scale zonal level data will more closely align with biological monitoring.	Not estimable for fisheries with catch reporting by grids.
Producer surplus of fisheries with high overlap with AMPs	Time series of producer surplus for fisheries with a high spatial overlap with the AMPs; e.g. a high percentage of catch volume in the AMPs. Producer surplus is reported in various reports by fisheries agencies and industry groups including (EconSearch, 2016; Bath et al., 2018; Ogier et al., 2018). Where report are not available quota lease prices could be used to infer consumer surplus following Ogier et al. (2018).	Producer surplus is an indicator of the economic value of a commercial fishery that accounts for costs of fishing.	May not be estimable for all relevant fisheries. In some cases, high degrees of latent fishing effort could be used to indicate consumer surplus is zero. Consumer surplus at the fishery scale may be of limited relevance to the AMPs.
Quota market capitalisation of fisheries with high overlap with AMPs	Time series of market capitalisation for fisheries with a high spatial overlap with the AMPs; e.g. a high percentage of catch volume in the AMPs. Market capitalisation is the amount of investment fishers have in quota and licences. Data can be sourced from industry reports (EconSearch, 2016; Bath et al., 2018; Ogier et al., 2018) or directly from state and Commonwealth fisheries agencies.	Market capitalisation is a measure of expected future profits in the fishery. This is a forward-looking measure that captures the optimism of fishers for future profits.	Market capitalisation responds to a wide range of external factors and should not be interpreted as a performance measure. Market capitalisation at the fishery scale may be of limited relevance to the AMPs.
Operating costs of fisheries with high overlap with AMPs	Time series of operating costs for fisheries with a high spatial overlap with the AMPs; e.g. a high percentage of catch volume in the AMPs. Operating costs by fishery are reported for Commonwealth managed fisheries (Bath et al., 2018), and South Australian fisheries (EconSearch, 2016).	One of the main impacts of the AMPs on commercial fishers may be increased operating costs including increased fuel use associated with finding and fishing in alternative sites. Rising operating costs may also by a driver of changes in behaviour and attitudes towards the AMPs.	Operating costs are unlikely to be available for all relevant fisheries. Operating costs at the fishery scale may be of limited relevance to the AMPs.

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Name	Description	Why is it important?	Limitations
Total factor productivity of fisheries with high overlap with AMPs	Time series of total factor productivity for fisheries with a high spatial overlap with the AMPs; e.g. a high percentage of catch volume in the AMPs. Total factor productivity is the ability of fisheries to convert inputs into outputs. It is regularly reported for Commonwealth managed fisheries (Bath et al., 2018).	Zoning in the AMPs may affect fisheries ability to convert inputs to outputs.	Total factor productivity is only available for Commonwealth managed fisheries as far as we are aware. Total factor productivity at the fishery scale may be of limited relevance to the AMPs.

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5.2   Charter operators

Charter operators consists of non-extractive charters (diving, whale watching etc.), and fishing charters. The AMPs imposes relatively few restrictions on non-extractive charter operators; these operators can access all zone types with a permit, except for sanctuary zones located in remote areas of the North-west Network and Macquarie Island Marine Park. Non-extractive charter operators may also benefit from the AMPs if natural values improve over time. Charter fishing operators are excluded from National Park Zones and Sanctuary Zones.

Relatively little is known about the impacts of the AMPs on charter operators, both fishing and non-extractive. Formal assessment of impacts on charter fishers was conducted for the 2013 proposed Commonwealth Marine Reserve Network, including reporting on the number of client trips that would be displaced due to implementation of zoning rules (ABARES, 2012). This analysis used state-reported logbook data and qualitative interviews with some charter fishers to estimate displacement. However, the usefulness of this analysis is limited as the zoning in the AMPs differs from the 2013 proposed Commonwealth Marine Reserve Network. Currently, another National Environmental Sciences Program project is investigating the use of state collected charter fishing data in Western Australia and New South Wales to estimate catch and effort at the marine park scale. The viability of that analysis will likely affect measure recommendations for charter fishers.

As far as we are aware no existing data has been collected on the impacts of the AMPs on non-extractive charter operators.

Available data for charter operators mostly consists of state agency collected data on catch, effort and trip numbers for charter fishers Table 13. This data is reported in grids of varying spatial scale with the smallest grids (5-minute grids) being used in Western Australia and Queensland. Parks Australia have also made it a condition that charter operators entering the AMPs provide activity reports every 3 months; however, it is unclear how complete the data being provided is, with relatively few reports having been returned to date.

Other data sources are likely to be of limited use. The Great Barrier Reef SELTMP program conducts regular surveys with charter operators; however, collected data exclusively focuses on the Great Barrier Reef area. Similarly, charter operators in the Great Barrier Reef report client numbers and trip locations but focussing exclusively on trips to the Great Barrier Reef. Finally, regular economic analysis is conducted for the charter fishing industry in South Australia. However, all data is reported at the state scale and is of limited use for the AMPs.

Table 13. Existing data sources on charter operators. For brevity the following abbreviations are used: Western Australia (WA), South Australia (SA), Tasmania (TAS), Victoria (VIC), New South Wales (NSW), Queensland (QLD), Northern Territory (NT).

Name	Description	Potential uses and limitations
Parks Australia activity reports	Catch, effort, type of activity and number of clients is collected by Parks Australia for charter operators (fishing and non-extractive) that use the Australian Marine Parks (AMPs).	The return rates of this data are currently unknown. Operators are asked to provide exact locational for trips inside the AMPs.
WA, QLD, NT, NSW charter fishing logbook data	WA, QLD, NT, NSW fisheries collect catch and effort data from charter fishers at various spatial scales including 5 and 10-minute grids.	Return rates are unknown. Catch and effort is reported at relatively fine scales which should be suitable for marine park scale reporting. A current National Environmental Sciences Program project is investigating the utility of charter logbook data in NSW and WA for AMP reporting.
SA charter fishing logbook data	SA fisheries collect charter fishing log-book data.	Return rates are unknown. Data is reported at regional scales which are likely to be unsuitable to marine parks scale reporting.
SA charter fishing industry reports	EconSearch conduct regular assessments of the economic and social state of the charter fishing industry in SA.	Information on the total number of clients, number of operators, consumer surplus, costs and revenue are provided for South Australian fisheries. Data is reported at the state-wide scale, limiting use for AMP reporting.
QLD Social and Economic Long-Term Monitoring Program (SELTMP) data	The SELTMP is conducting on-going surveys with charter operators about their use and perceptions of the Great Barrier Reef	All SELTMP questions relate specifically to the Great Barrier Reef with no questions on the adjacent Coral Sea.
Great Barrier Reef Marine Park Authority tourism numbers	Charter operators in the Great Barrier Reef provide data on the number of visitors and locations visited.	Data are not reported for trips outside of the Great Barrier Reef Marine Park.

5.2.1   Recommended measures

Recommended measures for charter operators in terms of performance of the AMPs are summarised in Table 14, and measures for understanding the context of charter fishing use-values of the AMPs are summarised in Table 15. Whilst these measures make maximum use of existing data, some primary data collection is also needed. This reflects that existing data for charter operators are reported at relatively coarse spatial scales by some state agencies (Table 13). Another consideration is that relatively few charter operators are likely to operate in the AMPs and that those that do should be relatively easy to identify. As such, surveying this population is simple and low cost.

Given flaws in existing data, our recommendations for performance measures of the AMPs rely heavily on survey-based measures of awareness, and perceptions (Table 14). This

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includes awareness of zone locations, support for the AMPs, perceived impacts of the AMPs on different aspects of charter businesses, and perceived impacts of the AMPs on the environment. These topics were all identified as a high priority in our review in Chapter 3.

An objective measure of impacts on non-extractive charter operators could also be estimated; the change (and likely increase) in the number of non-extractive charter operator trips using NTR areas. We recommend detecting this trend using a before-after comparison of levels of usage of NTRs. Data sources might include the activity reporting submitted to Parks Australia; however, it is unclear whether this data is complete. Additionally, if reporting rates increase over time this will lead to misleading trends. Instead, we suggest new primary data on use levels be collected for non-extractive charter operators through a recall based survey questions. This measure could be cross-validated with perceptions of increased use of NTRs as has been done by Rees et al. (2015) in Lyme Bay in the United Kingdom.

In Table 15 we also suggest measures to better understand the context of charter operators and their use of the AMPs. These measures include reporting on client numbers, catch volume, and revenue at the marine park level. We also suggest reporting this information at the zonal level on the condition that the return rate of activity reports to Parks Australia is determined and found to be acceptably high (e.g. > 80%).

Table 14. Performance measures for charter operators.

Name	Description	Why is it important?	Limitations
Awareness of zone locations	Survey-based measure of the percentage of charter operators (fishing and non-extractive) that use the AMPs who are aware of current zone locations.	Awareness of the AMPs of zone locations is important for voluntary compliance, and as a key goal under Parks Australia's Communication, education and awareness program.	Requires primary data collection.
Support for AMPs	Survey-based measure of the percentage of charter operators (fishing and non-extractive) that support the AMPs.	Support for the AMPs captures charter operators' overall attitudes towards the AMPs. It provides a measure of whether respondents overall think the benefits of the AMPs outweigh the costs.	Requires primary data collection.
Perceived impacts of the AMPs on businesses	Perceived impacts of the AMPs on key aspects of charter operators' businesses. For fishing charters, this would include impacts on fishing quality, client experiences, the profitability of business, costs and marine user conflicts. For non-extractive charters, this would include impacts on observed wildlife, client experiences, profitability and costs, and marine user conflicts.	Perceptions of impacts of the AMPs on charter operator businesses is a rapid way to identify benefits and costs where they occur. Perceived impacts can also be useful for understanding the overall attitude towards the AMPs.	Requires primary data collection.
Perceived benefits of the AMPs for the environment	Perceived benefits of the AMPs on the marine environment. This would include perceived impacts on fish numbers, sizes and diversity, habitat cover and diversity and resilience of ecosystems.	Charter operators may perceive the AMPs to be worthwhile (or be neutral) even if they negatively impact their business if they perceive environmental benefits.	Requires primary data collection.
Change in level of use of NTRs by non-extractive charter operators	Before-after assessment of the level of use of NTRs by non-extractive charter operators. If activity reports to Parks Australia are thought to be complete than they should be used. Otherwise, primary data should be collected.	Increased use levels of non-extractive charter operators for NTRs would indicate that natural values had improved inside these areas and were, in turn, benefiting non-extractive charter operators.	Ideally, assessment of change in use should include controls. Use levels of other comparable locations in offshore waters may be useful as controls. May require primary data collection.

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Table 15. Context measures for charter operators.

Name	Description	Why is it important?	Limitations
Client numbers, catch volume, and revenue of charter operators in AMPs	Client numbers, catch volume (by species), and revenue of charter operators in the AMP area. The AMP area should be defined based on the smallest spatial scale of data available (e.g. all reporting grids that intersect with the AMPs). Exact locational data reported to Parks Australia could be used; however, it is currently unclear whether this data is complete. For charter fishers, state-based fisheries agency sources as outlined in Table 13 are likely to provide more reliable data.	These key measures of use of the AMPs are important for understanding trends in use-values of the AMPs as well as pressures placed on environments by charter operators.	Where data are reported at coarse spatial scales, catch volume is unlikely to accurately indicate pressure on the AMPs and trends should be treated with caution. False trends may emerge if catch reporting standards improve over time.
Client numbers, catch volume, and revenue of charter operators by zone	Client numbers, catch volume (by species), and revenue of charter operators by zone in the AMPs. This fine level reporting should only be conducted if data collected in Parks Australia's activity reports are found to be reasonably complete and provide precise locational data on charter operators in the AMPs.	These key measures of use of the AMPs are important for understanding trends in use-values of the AMPs.	Requires Parks Australia collected data for the AMPs to be complete.

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5.3   Recreational users

Recreational users consist of non-extractive recreational users (diving, snorkelling, whale watching etc.), and recreational fishers. As the AMPs are offshore, any access by recreational users will be via boat. Non-extractive recreational users are permitted in almost all of the AMP[4], and will potentially benefit from the AMPs due to improvements in the marine environment, and potentially through a reduction in user conflict. Recreational fishers are excluded from fishing inside National Park Zones and Sanctuary Zones.

Relatively little is known about the impacts of the AMPs on recreational fishers and non-extractive users. Impact assessments have shown that the AMPs allow recreational fishers to access 97% of Commonwealth waters within 100 km of the Australian coast (Parks Australia, 2018). While this access will vary considerably for each AMP, Lynch et al. (2019) estimated that between 14,000 and 21,000 recreational fishing boat days are spent each year in the Ningaloo Marine Park (Commonwealth), catching an estimated 29,000 fish. They also show that most recreational fishers have relatively low levels of awareness of the Freycinet Marine Park (Commonwealth).

As far as we are aware no existing data has been collected on the impacts of the AMPs on non-extractive recreational users.

Table 16 summarises available recreational user data for social and economic values of the AMPs. No existing data sources collected on an on-going basis were found for non-extractive recreational users. Lynch et al. (2019) analysed the utility of state-based recreational catch and effort data for reporting at the scale of individual AMPs. They found that Western Australian collected data could support marine park scale reporting, but sample sizes in New South Wales were too low to produce robust estimates. Recreational fishing data in the remaining states is likely to be insufficient to support marine park scale reporting.

Alternative data sources include the development of an Australian Recreational Fishing Foundation (ARFF) app supported by Parks Australia, intended to collect data on recreational fishing use of the AMPs; aerial surveys of boat-based recreational use in Ningaloo; data from spearfishing competitions in New South Wales and Victoria; and data on vessel registrations by residential area. Most of these data sources are likely to be of limited use for AMP reporting as they do not cover the area of the AMPs. It is difficult to determine if data collected through an ARFF app would be useful for marine park reporting; previous research has identified several challenges in collecting reliable data from fishing apps that would have to be overcome for this to be a useful source of information (Venturelli et al., 2017). Data on vessel registrations by areas adjacent to the AMPs may be useful for understanding broad level trends in participation in boat-based recreation.

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[4] Non-extractive recreational users are prohibited from entering Sanctuary zones in the North West Network and Macquarie Island Marine Park.

Table 16. Existing data sources on recreational users. For brevity the following abbreviations are used: Western Australia (WA), South Australia (SA), Tasmania (TAS), Victoria (VIC), New South Wales (NSW), Queensland (QLD), Northern Territory (NT).

Name	Description	Potential uses and limitations
WA state-based recreational fishing data	WA fisheries have conducted regular phone diary surveys with recreational fishers asking about boat-based recreational catch and effort (Ryan et al., 2017).	Lynch et al. (2019) tested the use of this data for Ningaloo Marine Park (Commonwealth). Some limitations exist as data is reported at a 10x10 minute grid. Nevertheless, the data was found to produce robust estimates of effort (boat days) and catch at the marine park scale. Similar estimates could likely be produced for the remaining Western Australian AMPs close to population centres. Errors are likely too large to detect any changes due to zoning at the individual marine park level.
NSW state-based recreational fishing data	NSW fisheries have conducted sporadic phone diary surveys with recreational fishers asking about based recreational catch and effort (West et al., 2015).	Lynch et al. (2019) tested the use of this data for Hunter Marine Park (Commonwealth). The data was found to be inadequate to produce robust estimates of effort (boat days) and catch at the marine park scale.
SA, TAS, VIC, QLD and NT state-based recreational fishing data	Fisheries agencies in SA, TAS, VIC, QLD and NT have at times conducted state-wide surveys of recreational catch and effort.	The data collected in these surveys is less spatially resolved than that collected in WA and NSW and as such is unlikely to help understand the use of the AMPs.
NSW and VIC Spearfishing competition data	Data on total fish weight and numbers in spearfishing competitions in NSW and VIC has been digitised between 1970 and 2011 (Gledhill et al., 2013).	Data is not spatially resolved and may not be made available for marine park monitoring purposes.
Ningaloo aerial surveys	WA Department of Biodiversity Conservation and Attractions conduct 4 aerial surveys annually along a transect of the Ningaloo Coast.	Data does not include use in offshore Commonwealth waters.
Australian Recreational Fishing Foundation citizen science app	Under the Our Marine Parks Grant, Parks Australia has provided funding to develop a citizen science app to support data collection from recreational fishers.	It is unclear what information will be collected. It is also unclear whether the app will overcome the challenges of securing sufficient users and avoiding sample selection biases that have affected previous angler app programs (Venturelli et al., 2017).
Vessel registrations and lengths	Data on vessel registrations for all states except the Northern Territory have been collated by the National Environmental Sciences Program project E4 (Peel et al., 2019).	Registrations of larger vessels may serve as an indicator of the extent of offshore fishing in a region.

5.3.1   Recommended measures

Recommended measures for recreational users in terms of performance of the AMPs are summarised in Table 17, and measures for understanding the context of recreational use-values of the AMPs are summarised in Table 18. Whilst these measures make maximum use of existing data, some primary data collection is also needed. This reflects that existing data sources are limited.

We suggest several measures collected using surveys to measure awareness of the AMPs and perceptions of their benefits and costs in terms of impacts on recreational activities, and effect on the marine environments. To complement these subjective measures we also suggest objective measures of performance for the AMPs. For recreational fishers, one of the only known ways to generate an objective measure of impacts of the AMPs is to use a random utility modelling of site choice and simulate the impacts of zoning on recreational fisher welfare. For non-extractive recreational users, we suggest studying changes in trip patterns over time to determine whether National Park Zones in the AMPs are receiving increased visitation (relative to nearby locations); this may indicate that the state of the environment has improved in these areas and is enhancing non-extractive recreational use-values. The combination of objective and subjective measures of AMP performance allows measures to be cross-validated and provides an opportunity to identify and correct miss-perceptions where they exist.

We also suggest using existing data to understand the context of recreational use values of the AMPs (Table 16). These measures aim to quantify the level of use of the AMPs, and how this is changing over time. This can be useful for understanding changes in pressures facing ecosystems in the AMPs as well as prioritising management actions such as enforcement or education.

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Table 17. Performance measures for recreational users.

Name	Description	Why is it important?	Limitations
Awareness of the difference between state and Commonwealth waters	Survey-based measure of the percentage of recreational users (fishing and non-extractive) that are aware of the difference between state and Commonwealth waters.	A key challenge in communications of the AMPs is conveying that the AMPs are distinct from state implemented marine parks.	Requires primary data collection.
Awareness of the AMPs	Survey-based measure of the percentage of recreational users (fishing and non-extractive) that are aware of the AMP in their location.	Awareness of the AMPs is important for voluntary compliance and is a key goal under Parks Australia's Communication, education and awareness program.	Requires primary data collection.
Support for the AMPs	Survey-based measure of the percentage of recreational users (fishing and non-extractive) that support the AMPs in their location.	Support for the AMPs captures recreational users' overall attitudes towards the AMPs. It provides a measure of whether respondents overall think the benefits of the AMPs outweigh the costs.	Requires primary data collection.
Perceived impacts on activities (fishing/non-extractive)	Survey-based measure of the perceived impacts of the AMPs on recreational fishing and non-extractive recreational activities.	Perceptions of impacts of the AMPs on recreational users' activities is a rapid way to identify benefits and costs where they occur. Perceived impacts can also be useful for understanding the overall attitude towards the AMPs.	Requires primary data collection.
Perceived environmental benefits	Survey-based measure of the perceived benefits of the AMPs for the marine environment.	Recreational users also hold non-use values for marine environments and may support the AMPs even if they negatively impact fishing.	Requires primary data collection.

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Name	Description	Why is it important?	Limitations
Change in consumer surplus	Random utility model-based estimates of the change in consumer surplus of recreational fishers resulting from implementation of the AMPs. This can be estimated using benefit transfer of a random utility model based on state collected catch and effort data.	This is the only known means of gaining an objective measure for the impact of the AMPs on recreational fishers.	Requires a benefit transfer approach with several assumptions.
Before-after assessment of the level of use of NTRs by non-extractive recreational users	Visual plots of patterns in non-extractive recreational users' trips to determine whether the fraction use of National Park Zones has increased over time relative to adjacent locations.	Increased use levels of non-extractive recreational users in NTRs would indicate that natural values had improved inside these areas and were, in turn, benefiting recreational users.	Ideally, assessment of change in use should include controls. Use levels of other comparable locations in offshore waters may be useful as controls.

Requires primary data collection. |

Table 18. Context measures for recreational users.

Name	Description	Why is it important?	Limitations
Boat days and catch in West Australian AMPs	Estimates of boat days and catch volume (by species) as conducted by Lynch et al. (2019). Data should be sourced from West Australian state-based catch and effort surveys Table 16.	Effort and catch volume are important indicators of pressure on the marine environment and relevant for understanding trends in biological monitoring.	insufficient sampling in some locations may prevent estimation for some Western Australian AMPs.
Proportion of trips in the AMPs	Proportion of boat-based fishing trips in key locations that access the AMPs.	Relatively little is currently known about the extent to which recreational users visit each marine park. Knowing this information would help prioritise management efforts.	Requires primary data collection. Relies on recall which can be inaccurate.
Number of registered vessels >5m in length	Count of the number of large (>5m) vessels registered in each network.	The number of large vessels may be a useful proxy for measuring changes in the capacity to access offshore Commonwealth waters of the AMPs.	The relationship between the number of registered large vessels and the use of offshore waters is unclear and may be misleading in some regions.

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5.4   General public

The general public are likely to hold non-use values for the AMPs as they value knowing areas of Australia's marine environments are being protected. These non-use values are most likely substantial and are one of the main justifications for the creation of marine parks. For example, Bennett and Gillespie (2010) estimate that implementation of marine parks in 10% of waters in the south-west of Australia alone would generate $400 million in non-use values.

Whilst it is likely that the AMPs have high levels of non-use values, relatively little is known about these values in the AMPs. Burton et al. (2015) present a choice experiment in the South-east network region showing that the general public holds significant positive values for protection of bioregions, seafloor types, important ecological areas, and areas less than 1500 m depth. The value of the AMPs themselves; however, is not evaluated. They also show that people perceived the reserves to not provide adequate levels of protection. Altogether, relatively little is known about the values that the AMPs provide to the general public.

No on-going sources of data collection relevant to the AMPs were identified.

5.4.1   Recommended measures

Recommended measures for the general public in terms of performance of the AMPs are summarised in Table 19, and measures for understanding the context of recreational use-values of the AMPs are summarised in

Table 20. As no existing data sources useful for constructing measures of the AMPs for the general public are available, primary data collection is required.

These measures include measures of awareness, overall attitudes, and perceptions of benefits of the AMPs. We also suggest tracking knowledge of the ecosystems protected by the AMPs as a measure of Parks Australia's communication, education and awareness program. Level of knowledge will also be helpful in understanding trends in attitudes and perceptions. Some measure of the consumer surplus that the general public hold for the AMPs are also suggested. This could include a choice experiment approach as done by Burton et al. (2015), but with follow-up calculations of the values held for the marine parks in each region. Alternatively, a simpler contingent valuation approach could be used. The results would shed light on the magnitude of benefits that the AMPs provide to the Australian public.

Measures to better understand the context of the general public and its relationship with the AMPs are shown in

Table 20. These include a measure of the proportion of the general public that access each network, the activities they conduct and the frequency, as was done by Burton et al. (2015) in for the South-east network. This will help explain respondents' attitudes towards the AMPs and could be used to track levels of use over time (though sector-specific measures outlined above are likely to be more reliable). Another important context measure is peoples reasoning behind their attitudes towards the AMPs. This will help guide Parks Australia's

communication, education and awareness program where misperceptions are identified and help to understand barriers to social acceptance where they exist.

Table 19. Performance measures for the general public.

Name	Description	Why is it important?	Limitations
Awareness of the difference between state and Commonwealth waters	Survey-based measure of the percentage of the general public that are aware of the difference between state and Commonwealth waters.	A key challenge in communications of the AMPs is conveying that the AMPs are distinct from state implemented marine parks.	Requires primary data collection.
Awareness of the AMPs	Survey-based measure of the percentage of the general public that are aware of the AMP in their location.	Awareness of the AMPs is a key goal under Parks Australia's communication, education and awareness program.	Requires primary data collection.
Support for the AMPs	Survey-based measure of the percentage of the general public that support the AMPs in their location.	Support for the AMPs captures overall attitudes towards the AMPs. It provides a measure of whether respondents overall think the benefits of the AMPs outweigh the costs.	Requires primary data collection.
Perceived environmental benefits	Survey-based measure of the perceived benefits of the AMPs for the marine environment.	For the general public to hold non-use values for the AMPs they must perceive that the environment inside the AMPs will improve.	Requires primary data collection.
Change in consumer surplus	Estimate of the consumer surplus value held for the AMPs measured using either choice experiments or contingent valuation.	Demonstrating the scale of non-use values held by the general public for the AMPs is an important measure of their success.	Requires primary data collection.
Level of knowledge of marine ecosystems in the AMPs	Percentage of respondents stating they know a little bit, or a moderate amount about the marine ecosystems in the AMPs following Burton et al. (2015).	Improving knowledge of the marine ecosystems in the AMPs is a key goal of Parks Australia's communication, education and awareness program.	Requires primary data collection.

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Table 20. Context measures for the general public.

Name	Description	Why is it important?	Limitations
General public use of the AMPs	Use levels and frequency of activity types conducted inside the AMPs by the general public following Burton et al. (2015).	Understanding if respondents are using the AMPs is important for understanding their attitudes.	Requires primary data collection.
Reasons for attitudes about the AMPs	Stated reasons for being opposed, neutral or supportive of the AMPs identifying distinct forms of non-use and use values that may underlie attitudes.	Understanding the reasons behind people's attitude towards the AMPs can help identify misperceptions, and the types of values the general public hold for the AMPs.	Requires primary data collection.

5.5   Aboriginal and Torres Strait Islander peoples

Here we make recommendations for measures to track the delivery of Parks Australia's Indigenous Engagement Program. These suggestions aim to measure success in terms of the extent of engagement, the representativeness of engagement across Aboriginal and Torres Strait Islander groups and the depth of engagement.

5.5.1   Recommended measures

Recommended measures for tracking the performance of Parks Australia's Indigenous Engagement Program are presented in Table 21. The total number of engagement activities is recommended as a coarse measure of the extent of engagement. To test the depth of engagement we suggest reporting the number of person-days supported under different engagement activity types e.g. employment as a ranger or participation in a training program. To capture the extent to which different Aboriginal and Torres Strait Islander groups have been engaged we also suggest reporting the proportion of known groups engaged or invited to be engaged in AMP management in some way.

Finally, we suggest documenting a qualitative description of two forms of deep engagement so that they can act as models for future projects. In particular, we suggest documenting any Aboriginal and Torres Strait Islander business ventures supported by Parks Australia, and any Aboriginal and Torres Strait Islander led marine management programs that have been supported by Parks Australia.

Table 21. Performance measures for Parks Australia's Indigenous Engagement Program.

Name	Description	Why is it important?	Limitations
Total number of engagement activities	A count of the number of individuals involved in engagement activities by network per year.	This is a basic measure of the extent of the engagement program.	Does not capture depth or representativeness of engagement
Total person-days by engagement type	Number of person-days supported for each activity type per year by network. Example engagement types might include ranger positions or training programs.	Expressing the length of engagements, and the type of engagement provides information on engagement depth.	Categories of engagement activities should be identified. These could broadly include employment, training and experiential.
Proportion of known groups engaged or invited to be engaged	Proportion of groups in the network identified by Parks Australia that have been actively engaged in a program or have been approached and asked if they would like to participate in an activity.	Engagement activities must be spread across groups to ensure all have an opportunity to participate.	Does not capture the depth of engagement across groups.
Qualitative description of business supported	A description of the support that the Indigenous Engagement Program has provided to create and sustain Aboriginal and Torres Strait islander run businesses.	Supporting viable businesses is a high level of engagement and should be highlighted.	None
Qualitative description of traditional owner led management	A description of programs supported by Parks Australia in which traditional owners led the program.	Supporting traditional owner led programs is a high level of engagement and should be highlighted.	None

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5.6   Mining and petrochemical industries

The zoning in the AMPs prevents mining activities (including petrochemical) in all areas but Special Purpose Zones and Multiple Use Zones. The area prohibiting mining activities is approximately 69% of the AMP area. However, the actual areas closed to mining have relatively low prospectivity ratings (Totterdell et al., 2014). Some exceptions include the Perth Canyon, Geographe, Bremer and South-west Corner Marine Parks in the South-west Network. Overall, the AMPs are expected to have minimal impacts on mining and petrochemical industries (Parks Australia, 2018).

Existing data on mining and petrochemical industries in the AMPs is presented in Table 22. This data mainly described the use of the AMPs by these industries. It includes the number and locations of exploratory acreage nominations released by the Australian Government each year and the number and locations of petroleum wells.

Table 22. Existing data on mining and petrochemical industries

Name	Description	Potential uses and limitations
Locations of exploratory acreage nominations released	Locations of acreages released for exploration by the Australian Government each year.	The number of exploratory acreages released may indicate the potential for future mining and petrochemical production. Release of acreages does not indicate that a bid will be placed.
Locations of petroleum wells	Spatial data on the locations of petroleum wells.	The number of active wells is useful as an indicator of the importance of petroleum industries in a region.

5.6.1   Recommended measures

Given that the AMPs are expected to have relatively little impact on mining and petrochemical industries, we suggest that monitoring be restricted to existing data. In particular, monitoring the number of exploratory acreages released by marine park, and the number of active wells in each marine park. These two indicators will provide an indication of current and future importance of mining and petrochemical industries in each park.

Table 23. Context measures for mining and petrochemical industries.

Name	Description	Why is it important?	Limitations
Number of exploratory acreages released	Count of the number of exploratory acreages released for exploration by the Australian government in each marine park.	The number of exploratory acreages released in each marine park may indicate areas for future development.	The release of acreages does not indicate that a bid will be placed.
Number of active wells	Count of the number of active wells in each marine park, and change over time.	The number of active wells is useful as an indicator of the importance of petroleum industries in the marine park.	None

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6.   PRIMARY DATA COLLECTION PLAN

In this section, we present primary data collection plans for the recommended social and economic measures in Chapter 5. Our suggested measures require primary data collection on awareness, use, perceptions and economic value from three groups: charter operators, recreational users, and the general public[5].

To collect this data, we propose a four-part integrated survey-approach outlined in Figure 17. The sampling approach involves four survey elements:

1. **Online:** An online panel survey of the general public, but with additional questions for respondents identifying as recreational fishers or non-extractive recreational users.

2. **Ramp:** A boat ramp surveys with recreational fishers and non-extractive recreational users.

3. **Targeted:** An online survey distributed to networks of avid offshore recreational fishers through fishing clubs and non-extractive users through yacht clubs.

4. **Tourism:** Online surveys with tourism operators.

Built into this sampling plan is the recognition that recreational fishers and non-extractive recreational users of the AMPs are a hard to reach population. Our sampling approach; therefore, uses multiple surveys with recreational users to support cross-validation.
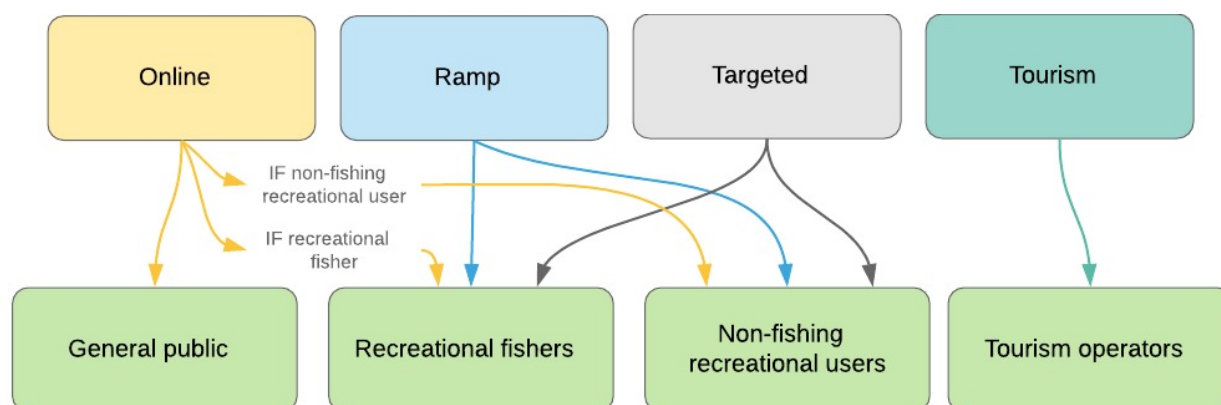
Figure 17. Outline of multi-survey sampling plan.

In the next section, we provide details of each of the surveys.

6.1   Online

Online surveys are increasingly being used by governments as the preferred approach for surveying the general public. Advantages of online surveys include a fast turnaround, enabling respondents to complete the survey at their leisure, cost-effective (compared to for example phone surveys), and no data entry requirements (Ipsos, 2013). A key limitation is

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[5] Primary data collection is also needed for Aboriginal and Torres Strait islander people; however, this involves recording details of engagement activities and should be delivered within Parks Australia's Indigenous Engagement Program

that the survey is administered to a panel of respondents that have agreed to complete online surveys, and therefore may not be representative of the general public. In particular, sample frame bias is likely to be in effect as online panels exclude users who do not have the internet (Pennay et al., 2018). However, online panels allow researchers to set quotas by demographic to achieve a sample that is demographically representative of the population of interest. Some studies have shown comparable results between online panels and more traditional sampling methods (in person, phone etc.) (Windle and Rolfe, 2009).

Online surveys have been widely used in ongoing monitoring of state marine parks including the Great Barrier Reef Marine Park and South Australia and Victoria's marine park networks. We propose also identifying respondents that are recreational fishers and non-extractive recreational users in these online surveys. A similar approach has been used in the monitoring, evaluation and reporting framework in South Australia with several measures reported for both the general public, and the fraction of respondents that are recreational fishers (DEWNR, 2017).

We propose surveying 3,000 respondents. This sample size is larger than that used in the Great Barrier Reef (n=2,002), and South Australia's marine park network (n=1,296); the larger sample size is considered necessary given the national scale of the AMPs, and a considerably larger target population (the Australian population).

Assuming recreational fishing participation rates of 10%, and non-extractive recreational participation of 5%, the fishing subpopulation sample should be n=300, and the non-fishing sub-population sample n=150. These small sample sizes are unlikely to be sufficient to construct measures on their own, but they will act as a cross-validation of the boat ramp and targeted surveys.

6.2   Ramp

The boat ramp survey will be a national survey of recreational fishers and non-fishing recreational users that are using boat ramps adjacent to the AMPs. In an attempt to survey respondents most likely to make use of the AMPs we have deliberately selected boat ramps that are close to the AMPs and population centres. We also propose to maximise survey responses by targeting peak boating times in each region.

6.2.1   Boat ramp selection

Boat ramps planned to be surveyed are shown in Figure 18. These ramps were selected to maximise the likelihood that respondents operated in the AMPs. This was achieved in two steps. First, we identified boat ramps with a high proportion of their adjacent waters (within 30 km) of an AMP; previous research has shown that most fishers operate within 30 km of the boat ramp they launch at (Mitchell et al. 2018). The results of this analysis are shown in Figure 19. These ramps fell into 24 locations. We then ranked (subjectively) the locations in terms of likelihood of observing fishers' operating in the AMP, including both proximity to the AMP and expected sample sizes given nearby population densities. Some weighting was also given to being spatially representative by ensuring at least one boat ramp was surveyed in each state. The subjective ranking resulted in the 12 boat selected boat ramp locations (Figure 18)
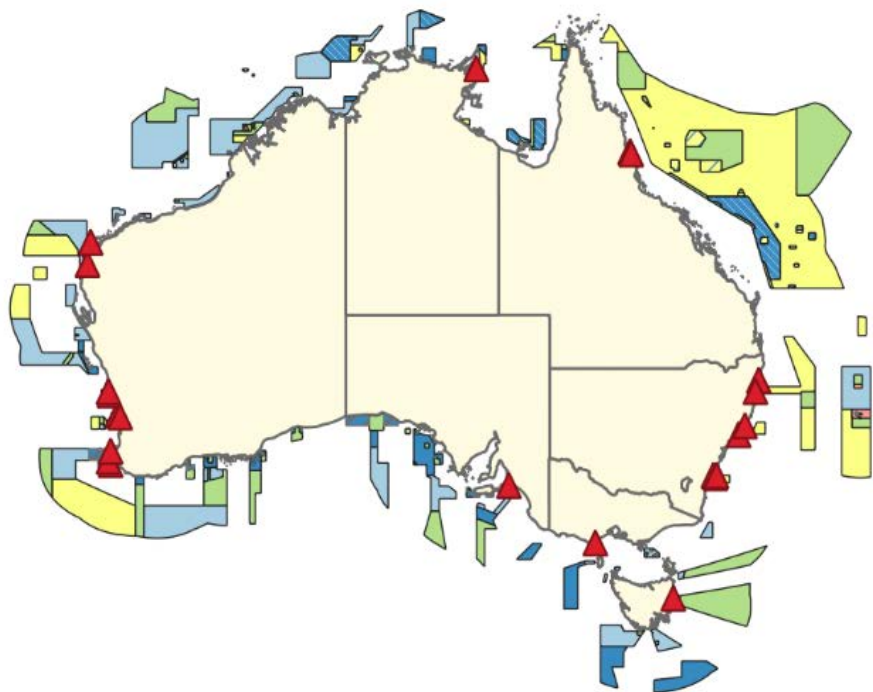
Figure 18. Boat ramp areas selected for AMP boat ramp survey.
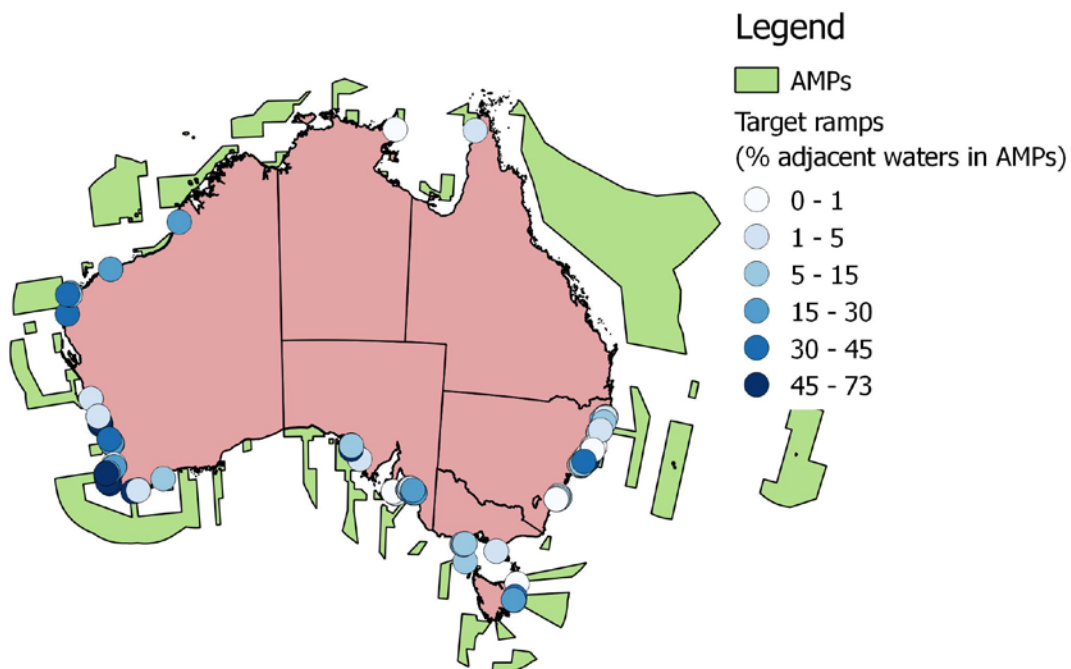
Figure 19. Boat ramp analysis showing the percentage of adjacent waters in AMPs.

6.2.2 Boat ramp survey timing

The timing of boat ramp surveys has not been finalised; however, the timing of each boat ramp survey will reflect seasonality in use levels. Evidence from Western Australia suggests that boat ramps in temperate (Southern) locations exhibit a strong seasonality with peak usage from November to April (Ryan et al., 2017). In contrast boat ramp usage in tropical locations is less seasonal. Other factors that are likely relevant to boat ramp usage include school holidays and long weekends.

6.3 Targeted

The targeted component of the sampling plan aims to focus specifically on recreational fishers and non-extractive recreational users that frequently use the AMPs. This survey will be distributed via an online survey link to recreational fishing clubs and yacht clubs in proximity to the AMPs. The clubs will be asked to distribute the survey link to their constituents. This type of opt-in online survey is unlikely to produce results representative of the wider recreational user community. Instead, the targeted survey complements the boat ramp and online surveys by capturing a more avid sample of recreational users that may be more likely to use AMPs.

6.4 Tourism

The tourism operator survey will be targeted at charter fishing and non-extractive charter operators thought to operate in the AMPs. Parks Australia has a list of charter operators that have sought approval to operate in the AMPs; however, given the AMPs are relatively new, it is unclear whether this list is a true reflection of the operators using the AMPs. Instead, we will use online searches, Parks Australia's network managers, and local contacts (particularly those engaged in regional workshops) to identify operators using the AMPs. The survey will then be distributed to charter operators using an online survey link for charter operators to fill in at their leisure.

7. CONCLUSIONS

This report aims to establish a set of robust and easily understood key measures to capture the change in human experience and value of the marine environment resulting from the implementation and management of the AMPs. To do this we drew on a review of social and economic monitoring of marine parks in Australia and internationally, and a series of regional workshops conducted with relevant staff from state marine park management agencies.

Our review highlights that approaches to social and economic monitoring of marine parks in Australia vary greatly across jurisdictions. Partly this variation reflects differences in management priorities. However, there is a clear opportunity to increase cross-institutional collaborations and ideas exchange as well as the development of standardised, low-cost, approaches to social and economic monitoring that can be readily transferred across marine parks. The national scope of the AMPs provides a unique opportunity to catalyse this collaboration and build towards a nationally consistent approach to social and economic monitoring of marine parks.

Based on the review and workshops we have made recommendations for social and economic measures for six user groups: commercial fishers, charter operators (fishing and non-extractive), recreational users (fishing and non-extractive), the general public, Aboriginal and Torres Strait Islanders, and mining and petrochemical industries. Our recommended measures capture the performance of the AMPs, in terms of impacts of the AMPs on use and non-use values or provide context to inform on-going management of the AMPs.

The suggested measures include assessment of changes in use levels and patterns across the parks, measures of perceptions of costs and benefits, overall attitudes towards the AMPs, levels of awareness of the AMPs and associated zoning, and measures of the economic value of the AMPs in terms of consumer and producer surplus. The measure suggestions build upon previous research and earlier baseline assessments of the AMPs.

The metric recommendations and our review more broadly provides a path forward for Parks Australia to monitor the social and economic dimensions of the AMPs.

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APPENDIX

Table 24. Measures used in social and economic research for state marine parks. For brevity, the following abbreviations are used marine park (MP), full-time equivalent (FTE), gross value product (GVP), gross regional product (GRP).

Measure type	Measure sub-type	Group	Measure	NSW	QLD	SA	VIC	WA
Awareness	Specific MP	General public	Percentage of general public aware of the implementation of a zoning plan.					2
			Percentage of general public that have heard of a specific MP.	1			2	1
		Recreational fishers	Percentage of recreational fishers that have heard of a specific MP.					1
			Percentage of recreational fishers that report being familiar with the zoning in a MP.	1				
	What a MP is	General public	Percentage of general public that correctly identify reasons an area is selected to become a MP.				1	
			Percentage of general public that correctly identify what a MP is.			1	1	
			Percentage of general public that report knowing what a MP is.			1		
	What a MP is for	General public	Percentage of general public that correctly identify what a MP is for.			1		
	Zone locations	General public	Percentage of the general public that report being aware of the locations of sanctuary zones.			1		
		Recreational fishers	Percentage of recreational fishers that can identify the location of their nearest sanctuary zone.					1
	Zone types	General public	Percentage of general public that correctly identify if a MP is in place yet.					1
			Percentage of general public that know diving and					1

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
			snorkelling is permitted inside sanctuary zones.					
			Percentage of general public that know fishing is allowed inside MPs.			1		1
			Percentage of general public that know fishing is not-allowed inside sanctuary zones.			1		1
			Percentage of general public that know MPs have zones.		1			
			Percentage of general public that know what activities are allowed in sanctuary zones.		1			
		Recreational fishers	Percentage of recreational fishers that know fishing is allowed inside MPs.					1
			Percentage of recreational fishers that correctly identify if a MP is in place yet.					1
			Percentage of recreational fishers that know diving and snorkelling is permitted inside sanctuary zones.					1
			Percentage of recreational fishers that know fishing is not-allowed inside sanctuary zones.					1
Economic	Non-market values	Recreational fishers/non-fishers	Total consumer surplus derived from recreation in the marine park.	4				
	Price	Economy	Retail prices of fish in marine park region.			1		
	Regional economic activity	Economy	FTE job loss due to displaced GVP.	2		1		
			FTE jobs injected from marine park related activities.		1			
			GRP in MP region.			1		
			GRP injected from MP related activities.		1			
			GRP loss due to displaced GVP.	1		1		

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
			Income loss due to displaced GVP.	2				
			Number of businesses in MP region.			1		
			Number of jobs in MP region.			1		
			Number of tourism businesses in MP region.			1		
			Property price in MP region.	2		1		
			Unemployment rate in MP region.			1		
			Value of building approvals in MP region.			1		
	Sector based revenue	Charter operators	Average revenue of charter operators in the MP (within sample).		1			
			GVP of affected charter fisheries.	2	1	1		
		Commercial fishers	Average revenue of commercial fishers in the MP.		1			
			GVP across MP.		1			
			GVP of affected commercial fisheries.	2	1	1		
			GVP of commercial fishing catch displaced by zoning.	3		1		
		Recreational fishers	Recreational fishing expenditure in MP region.				1	
		Recreational fishers/non-fishers	Fishing and boating expenditure in MP regions.		1			
		Tourism industry	Accommodation employment in MP region.	2				
			Accommodation expenditure in MP region.	2	1			1
Perceptions	Attitude	Charter operators	Percentage that support the MP.		1			
		Commercial fishers	Percentage that support the MP.		1			
		General public	Percentage that support states MPs.				1	
			Percentage that support the MP.		1	2		3

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
		Recreational fishers	Percentage that think sanctuary zones should be bigger.	1				
			Percentage that support the MP.		1			1
			Percentage that think sanctuary zones should be bigger.		1			
	Governance	Charter operators	Percentage that feel rules place too great a burden on time.		1			
			Percentage that feel the MP area is well managed.		1			
		Commercial fishers	Percentage that feel the MP area is well managed.		1			
		General public	Percentage that feel the MP area is well managed.		3	1		
	Impact on use-value	Charter operators	Percentage that feel optimistic about the future of their business.		1			
			Percentage that think the MP area is an asset for the economy.		1			
			Percentage that think the MP is one-of-the best areas for the activities they conduct.		1			
			Percentage that think they don't have fair access to the MP.		1			
		Commercial fishers	Percentage that feel optimistic about the future of their business.		1			
			Percentage that think the MP area contributes to their quality of life.		1			
			Percentage that think the MP area is an asset for the economy.		1			
			Percentage that think the MP is one-of-the best areas for the activities they conduct.		1			
			Percentage that think they don't have fair access to the MP.		1			

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Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
		General public	Percentage intending to visit the MP again.		1		1	1
			Percentage that think MPs restrict commercial fishing too much.	1				
			Percentage that think the MP area contributes to their quality of life.		1			
			Percentage that think the MP area is an asset for the economy.		1			
			Percentage that think the MP has a large effect on fishers.					3
			Percentage that think the MP has affected local businesses.			1		
			Percentage that think the MP has affected their fishing.					1
			Percentage that think the MP is one-of-the best areas for the activities they conduct.		1			
			Percentage that think the MP will impact the economy.					1
			Percentage that think they don't have fair access to the MP.		1			
			Percentage that would recommend visiting the MP to others.		1		1	
			Satisfaction with recent trip to MP.		3		1	1
		Recreational fishers	Average (within sample) proportion of fishing grounds that was lost to the MP.		1			
			Composite measure of belief that the MP will affect fishing.		1			
			Percentage that identify a regular fishing site that was lost to the MP.		1			
			Percentage that think the MP has a large effect on fishers.					2

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Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
	Impacts on environment		Percentage that think the MP has affected their fishing.		2		1	
			Satisfaction with fishing in MP.		1			
		Recreational fishers/non-fishers	Percentage that think the MP affected the frequency of their activities.			1		
		Charter operators	Percentage that are optimistic about the future of the MP area.		1			
			Satisfaction with the aesthetic beauty of the MP area.		1			
			Satisfaction with the condition of the MP in areas they use.		1			
		Commercial fishers	Percentage that are optimistic about the future of the MP area.		1			
			Satisfaction with the aesthetic beauty of the MP area.		1			
			Satisfaction with the condition of the MP in areas they use.		1			
		General public	Percentage that are optimistic about the future of the MP area.		2			
			Percentage that feel optimistic about the future of their business.		1			
			Percentage that feel the MP helps address pressures.					1
			Percentage that feel the MP will preserve the environment for future generations.					1
			Satisfaction with the aesthetic beauty of the MP area.		1			
			Satisfaction with the condition of the MP in areas they use.		2			
		Recreational fishers	Composite measure of belief that MP will have environmental benefits.		2			

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
Use	Social acceptability	General public	Percentage that feel the MP helps address pressures.					1
			Percentage that feel the MP will preserve the environment for future generations.					1
			Percentage that feel the MP will protect biodiversity.		1			
			Percentage that support MPs in principle.	1		1		
			Percentage that think MPs are necessary.				1	
			Percentage that think MPs shouldn't have sanctuary zones.		1			
			Percentage that think MPs shouldn't restrict recreational fishing.	1				
			Percentage that think there shouldn't be any MPs.	1				
		Recreational fishers	Percentage that think sanctuary zones are a good idea (in general).		1			
	Displaced use	Commercial fishers	Commercial fishing catch displaced by zoning.			1		
		Recreational fishers	Percentage of recreational fishing trips displaced by zoning.	1	1			
	Spatial use patterns within MP	Commercial fishers	Spatial pattern in annual commercial fishing effort across MP.		1			
		General public	Number of visitor days (within sample) to locations across MP.		2			
		Recreational fishers	Percentage of recreational fishing vessels in sanctuary zones.		1			2
		Recreational fishers/non-fishers	Mean (within sample) shore-based recreational fisher density across MP.					1
			Mean (within sample) vessel density across MP.					1
			Percentage of recreational fishing vessels in sanctuary zones.					1

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
	Use of MP	Aboriginal and Torres Strait Islander people	Number of culturally significant sites for Aboriginal and Torres Strait Islander people protected by sanctuary zones in marine park.			1		
		Charter operators	Average (within sample) number of days charter operators in the region fish in the MP per year.		1			
			Number of charter operators in MP region.	2		1		
			Number of charter trips in affected charter fisheries.	1				
			Number of charter trips in MP.	1				1
		Commercial fishers	Average number of days (within sample) commercial fishers in the region fish in the MP.		1			
			Catch in affected commercial fisheries.	2	1			
			Number of commercial fishers in MP region.			6		
		General public	Average number of days (within sample) general public spent in the MP.		1			
			Number of shipwreck sites protected by sanctuary zones in MP.			1		
			Percentage of general public that visited MP.		3		1	
			Total annual number of visitors to state's MP network.				1	
		Recreational fishers	Number of recreational fishing trips observed in MP.	1				
			Percentage of recreational fishers in region that fished in the MP.					1
		Tourism industry	Number of overnight visitors in MP region.			1		1
	Use of state's MP network	Charter operators	Catch in affected charter fisheries.			1		
		Commercial fishers	Catch in affected commercial fisheries.			7		

Measure type	Measure sub-type	Group	Measure	State				
				NSW	QLD	SA	VIC	WA
		General public	Percentage of general public that have visited a MP in the state.	1			2	
		Recreational fishers	Number of recreational fishing days state-wide.			1		
			Number of registered boats state-wide.			1		

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