National Parks South Australia

Monitoring, Evaluation and Reporting Plan

South Australian Marine Parks

DEWNR Technical report 2017/05

SOUTH AUSTRALIA

Government of South Australia
Department of Environment, Water and Natural Resources

South Australian Marine Parks Monitoring, Evaluation and Reporting Plan

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Department of Environment, Water and Natural Resources

June 2017

DEWNR Technical report 2017/05

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ISBN 978-1-925510-64-5

Preferred way to cite this publication

Bryars, S, Page, B, Waycott, M, Brock, D and Wright, A, 2017, South Australian Marine Parks Monitoring, Evaluation and Reporting Plan, DEWNR Technical report 2017/05, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide

Download this document at: http://www.marineparks.sa.gov.au

Foreword

The Department of Environment, Water and Natural Resources (DEWNR) is responsible for the management of the State's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

High-quality science and effective monitoring provides the foundation for the successful management of our environment and natural resources. This is achieved through undertaking appropriate research, investigations, assessments, monitoring and evaluation.

DEWNR's strong partnerships with educational and research institutions, industries, government agencies, Natural Resources Management Boards and the community ensures that there is continual capacity building across the sector, and that the best skills and expertise are used to inform decision making.

Sandy Pitcher
CHIEF EXECUTIVE
DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES

Acknowledgements

Thanks to the following people for providing valuable input to and feedback on draft versions of the MER Plan:

- staff from the DEWNR Marine Parks Program and the DEWNR Science and Information Group
- Dr Bryan McDonald from Certitude Consulting
- Professor Gavin Begg from SARDI Aquatic Sciences
- Professor Rob Lewis from Science Without Bounds Pty Ltd.

In addition we would like to acknowledge the many people who have contributed to various initiatives over the years that have helped shape the MER Plan, including:

- James Brook from JDiversity Pty Ltd, staff from the University of Tasmania, the Flinders University of SA, the University of Adelaide, the SA Environment Protection Authority, SARDI Aquatic Sciences, and Parks Victoria
- attendees of the habitat asset workshops held by DEWNR during 2012/13
- attendees of the National MER workshop facilitated by the Goyder Institute for Water Research in 2016.

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Summary

The Government of South Australia has developed a network of 19 marine parks as the South Australian component of the National Representative System of Marine Protected Areas. In accordance with the objects of the *Marine Parks Act 2007,* the 19 marine parks across South Australia provide for biodiversity conservation and public appreciation and also allow ecologically sustainable development and use of marine resources. South Australia's marine parks are 'multiple-use' with different zones providing for varying levels of protection and the activities that can occur in each marine park as prescribed in each of the 19 marine park management plans.

The *Marine Parks Act 2007* requires that "the Minister must review a management plan at least once in every 10 years". In response the marine park management plans require the Marine Parks Monitoring, Evaluation and Reporting Program (hereafter 'MER Program') to measure the effectiveness of each management plan in achieving the objects of the *Marine Parks Act 2007* and to inform the ongoing adaptive management of the marine parks.

A critical component of the MER Program is this current document (the MER Plan), which outlines the key information needs to enable the statutory 10-year review of the management plans, and the 'why, what, where, and when' of information to be collected, evaluated and reported. Research is also an integral part of the MER Program and is highlighted within this MER Plan.

The scope of the MER Plan is guided by a number of factors including the regulatory and legislative framework, logistics, available resourcing, community expectations, other monitoring programs already underway, predictions of change due to the marine park management plans, and risk assessment/prioritisation of undertaking selected activities. The ensuing MER Program must be 'fit-for-purpose' and must also be scientifically rigorous, repeatable, and defensible. The MER Program represents a significant undertaking and while DEWNR is the lead agency, collaborations and partnerships outside of DEWNR are integral to its successful delivery, and align with the whole-of-government approach to the marine parks initiative. Existing partners include state and federal Government agencies, research institutions, along with citizen-science and community programs and organisations.

The MER Plan focuses on the relationship between the seven components of: (1) marine park management plans, (2) ecological values, (3) socio-economic values, (4) physical drivers, (5) socio-economic drivers, (6) pressures, and (7) assumptions. A 'multiple-lines-of-evidence' approach using information from the seven components will enable an evaluation of the effectiveness of the 19 marine park management plans in achieving the objects of the *Marine Parks Act 2007*, and in particular whether the marine parks have been effective in protecting and conserving marine biodiversity and habitats. Strategy 12 in the management plans states that outcomes of the MER Program and research outcomes must be made publicly available and inform decision making and periodic review of the management plans. Thus, a number of publicly-available reporting products will be produced by DEWNR prior to the 10-year review (e.g. see Evaluation and Reporting).

This MER Plan should be used to guide ongoing implementation plans for the MER Program and encourage further partnerships and collaborations that enable the MER Program to expand and evolve thereby providing a more comprehensive evaluation of the SA marine parks network.

1 Introduction

1.1 Marine parks in South Australia

The Government of South Australia has developed the South Australian Representative System of Marine Protected Areas (SARSMPA) as part of the National Representative System of Marine Protected Areas (ANZECC TFMPA 1998).

> *The primary goal of the National Representative System of Marine Protected Areas is to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.*

Overarching policies for the SARSMPA include *South Australia's Strategic Plan 2011* (Government of South Australia 2011), the *Living Coast Strategy for South Australia* (DEH 2004a) and the *Blueprint for the South Australian Representative System of Marine Protected Areas* (DEH 2004b). The SARSMPA is comprised of 19 marine parks encompassing the major ecosystems and habitats across the eight designated marine bioregions in South Australian state waters (http://www.environment.sa.gov.au/marineparks, Figure 1).

The marine environment, and associated coasts, have a complex set of many and diverse users, and they provide important and essential ecosystem functions. The coastal/marine environment is important economically to enterprises such as shipping, developers, mining and petroleum industries, seafood producers, researchers and tourism. It is also important socially and culturally for recreational use, spiritual connection, education and enjoyment. Thus, the coastal/marine environment is central to the well-being of many Australians. In recognition of this complexity, the SARSMPA was developed over 10 years and was supported by extensive collaboration with local communities and key stakeholders. This involvement included the contributions of various advisory groups (Marine Park Local Advisory Groups (LAGS), Marine Parks across-Government Steering Committee, Marine Parks Council, and Marine Parks Scientific Working Group), local councils, Aboriginal communities, conservation groups, commercial fishers, recreational fishers, aquaculture operators, scientists, mining and petroleum industry, tourism operators, port and harbor operators, shipping industry and business developers.

In accordance with the objects of the *Marine Parks Act 2007*, marine parks provide for biodiversity conservation and public appreciation, and also allow ecologically sustainable development and use of marine resources. South Australia's marine parks are 'multiple-use' with different zones providing for varying levels of protection and the activities that can occur in each marine park as prescribed in each of the 19 marine park management plans (www.environment.sa.gov.au/marineparks/find-a-park/fleurieu-peninsula/encounter). The zones have differing levels of restrictions; General Managed Use Zone (GMUZ) – lowest level of restriction, through to Habitat Protection Zone (HPZ), Sanctuary Zone (SZ) and Restricted Access Zone (RAZ) – highest level of restriction. Different types of Special Purpose Area (SPA), which allow selected activities (such as shore-based recreational line fishing, transhipment, or harbour activities), are also designated in some of the parks. The marine park network was proclaimed in November 2012 and became fully implemented on 1 October 2014 when fishing restrictions inside SZs came into effect as prescribed by the *Marine Parks (Zoning) Regulations 2012*. Further information on key milestones leading up to 1 October 2014 can be found in Bryars et al. (2016).

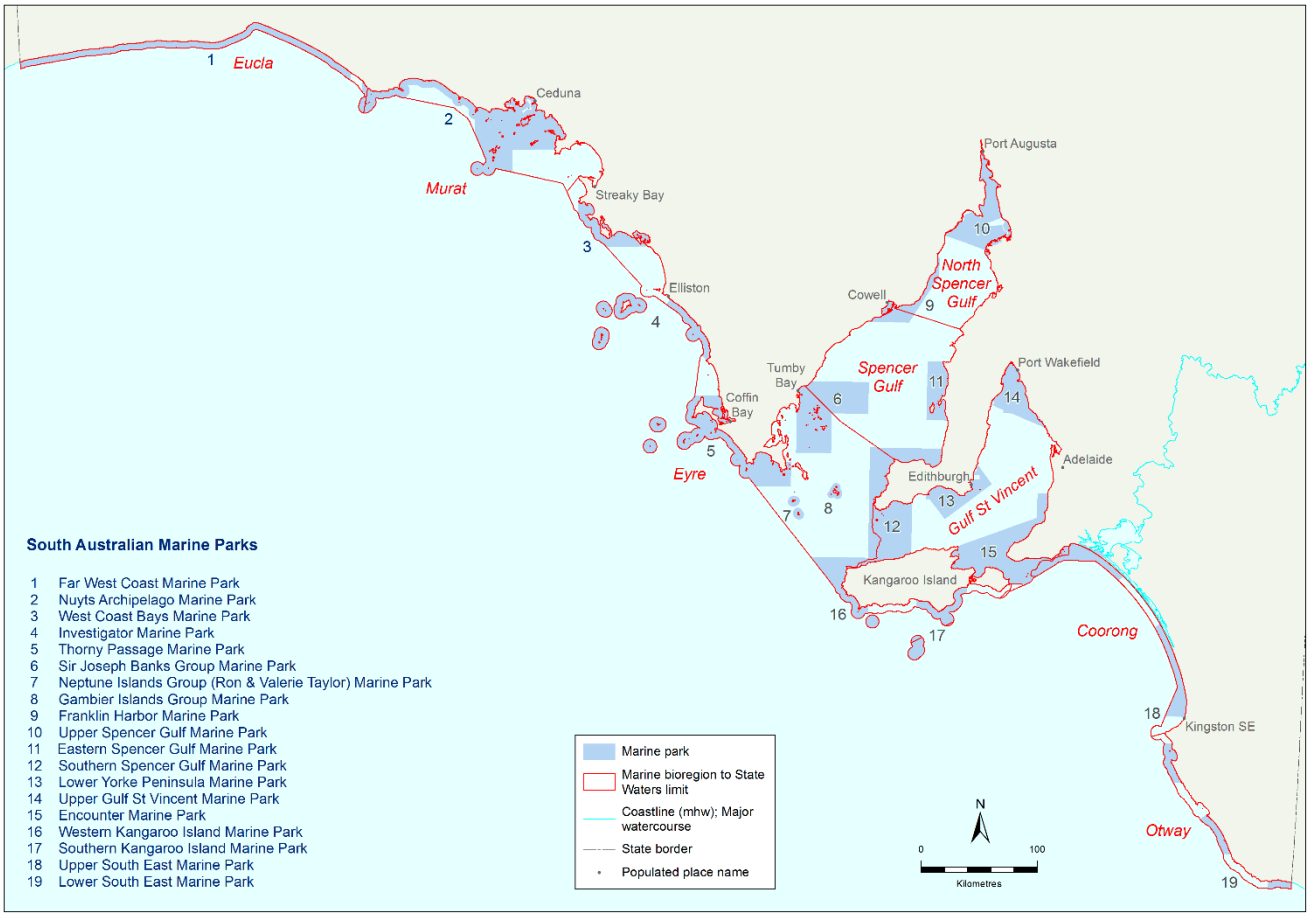


Figure 1. South Australia's network of 19 marine parks showing marine park outer boundaries and 8 marine bioregions 'clipped' to state waters

1.2 Role of the MER Plan

The *Marine Parks Act 2007* requires that "the Minister must review a management plan at least once in every 10 years". In response the marine park management plans require the Marine Parks Monitoring, Evaluation and Reporting Program (hereafter 'MER Program') to measure the effectiveness of each management plan in achieving the objects of the *Marine Parks Act 2007* and to inform the ongoing adaptive management of the marine parks (Figure 2).

The Marine Parks Program is comprised of four sub-programs of Protection, Stewardship, Compliance and Performance who are responsible for implementing the strategies of the management plans and ultimately achieving the objects of the *Marine Parks Act 2007* (Figure 2, see Section 2). The Performance sub-program is responsible for delivering the MER Program. The DEWNR document, '*Monitoring, Evaluation and Reporting Framework – Marine Parks Program*' (Scholz et al. 2017), outlines the key steps required to deliver the MER Program including the need and role of a monitoring, evaluation and reporting Plan (MER Plan). A critical component of the MER Program is the current document (the MER Plan), which outlines the key information needs to inform the statutory 10-year review of the management plans, and the 'why, what, where, and when' of information to be collected, evaluated and reported. Research is also an integral part of the MER Program (Figure 2) and is highlighted within this MER Plan. Effective knowledge management is also critical to delivery of the MER Program (Figure 2) which must align with the state government's 'open data policy'.

The MER Plan has been prepared by DEWNR, who is the lead agency responsible for the implementation and management of marine parks in SA. The MER Plan forms one component of the overall MER Framework for

Marine Parks with preceding components including development of key evaluation questions, a program theory and logic, and baseline reports (see Scholz et al. 2017). The MER Plan provides direction and outlines the steps and components required to develop the MER Program. The MER Plan is not a work plan or an implementation plan; these plans should be generated as required to undertake the activities required to deliver the MER Program.

The target audience for the MER Plan is staff from DEWNR and other Government of South Australia agencies, as well as marine park stakeholders, and monitoring, research and funding partners.

The MER Plan should be revisited following the 10-year review of the management plans.

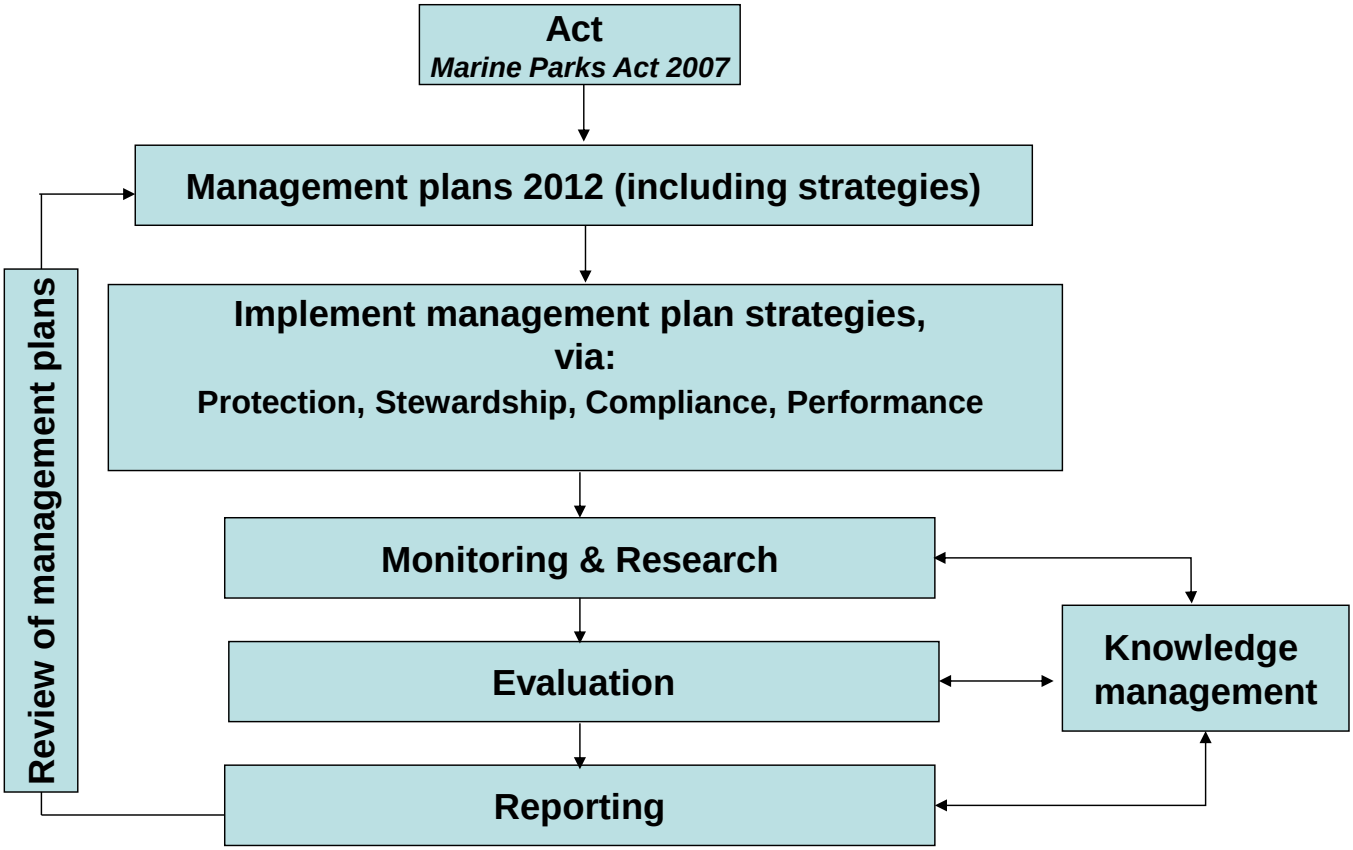


Figure 2. Adaptive management cycle for the marine parks monitoring, evaluation and reporting program

1.3 Scope of the MER Plan

The scope of the MER Plan is guided by a number of factors including the regulatory and legislative framework, logistics, available resourcing, community expectations, other monitoring programs already underway, predictions of change due to the marine park management plans, and risk assessment/prioritisation of undertaking selected activities. These factors are outlined and discussed in detail in Section 2. The ensuing MER Program must be 'fit-for-purpose' and must also be scientifically rigorous, repeatable, and defensible. The MER Program represents a significant challenge and while DEWNR is the lead agency, collaborations and partnerships outside of DEWNR are integral to its successful delivery, and align with the whole-of-government approach to the marine parks initiative.

1.4 How the MER Plan was developed

The MER Plan is the end result of a structured process that has involved input from a series of DEWNR activities, plus some key external activities (Figure 3). By adopting this protracted approach it is anticipated that the finalised MER Plan can deliver on both government responsibilities and external expectations. Readers are directed to the documents shown in Figure 3 for further background information.

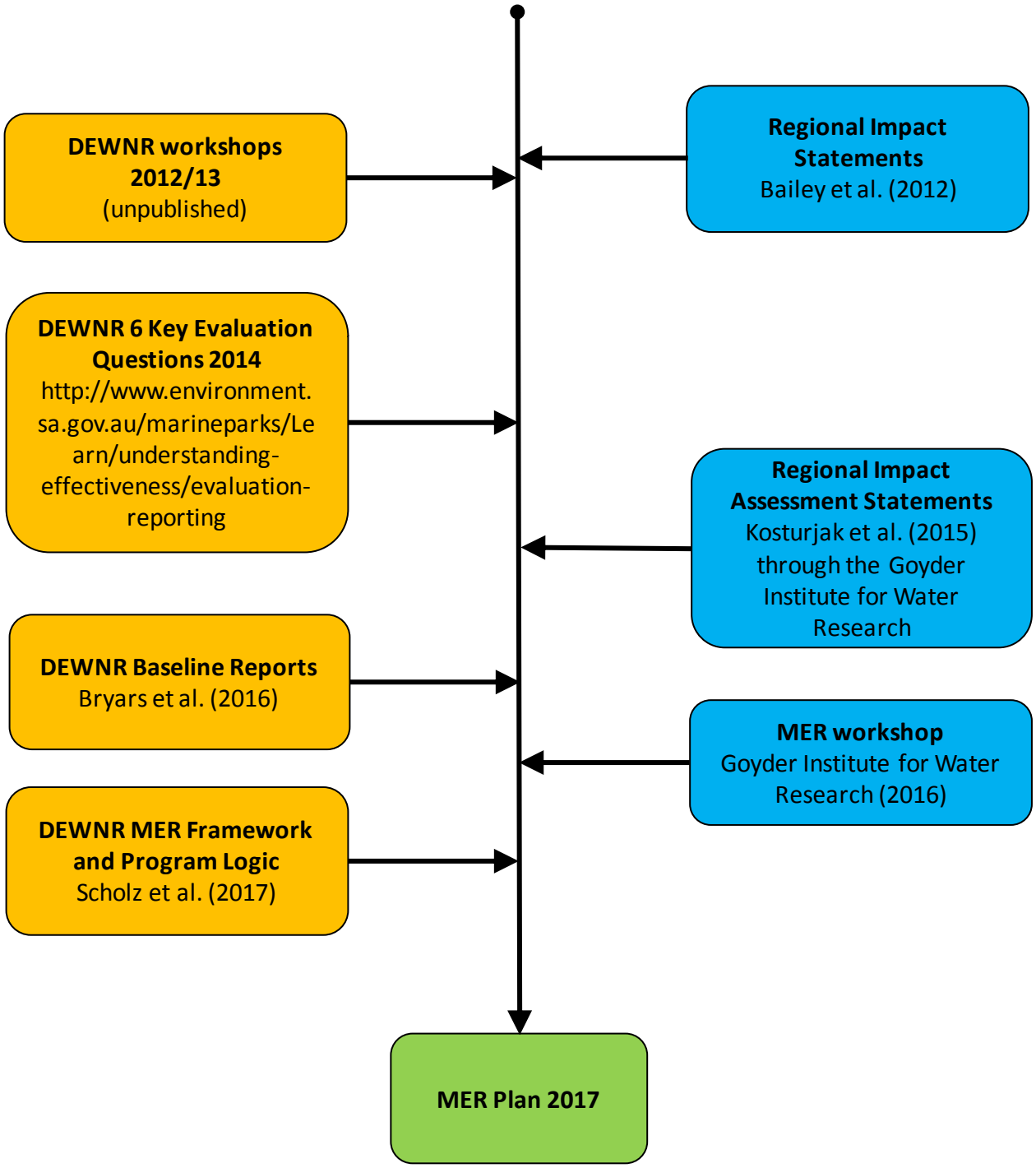


Figure 3. Flow diagram of key DEWNR and external activities that have provided critical input to the MER Plan

2 Setting the scope of marine parks monitoring, evaluation and reporting

2.1 Regulatory and policy framework

2.1.1 *Marine Parks Act 2007* and the management plans for marine parks

The *Marine Parks Act 2007* states that each marine park management plan:

- must be consistent with the objects of the *Marine Parks Act 2007*, set out strategies for achieving those objects and establish the various types of zones for each marine park; and
- may define special purpose areas, direct the day-to-day management of issues associated with marine parks and provide guidelines for the granting of permits for various activities within marine parks.
- must be reviewed at least every 10 years.

The management activities within marine parks must be consistent with, and seek to further the objects of the *Marine Parks Act 2007*:

Part 2, Section 8, Clause (1) of the *Marine Parks Act 2007*

The objects of this Act are -

(a) to protect and conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive, adequate and representative system of marine parks; and

(b) to assist in -

(i) the maintenance of ecological processes in the marine environment; and

(ii) the adaptation to the impacts of climate change in the marine environment; and

(iii) protecting and conserving features of natural or cultural heritage significance; and

(iv) allowing ecologically sustainable development and use of marine environments; and

(v) providing opportunities for public appreciation, education, understanding and enjoyment of marine environments.

The primary objective of the Marine Parks Program is to achieve the object (hereafter referred to as 'Object 1'): "to protect and conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive, adequate and representative system of marine parks" (Scholz et al. 2017).

The *Marine Parks Act 2007* outlines the intent of each type of zone, which is important in scoping and prioritising MER activities based on the primary objective of the *Marine Parks Act 2007* (i.e. achieving Object 1) and the key evaluation questions (see Section 2.1.2.1), particularly in regard to conservation of habitats and biodiversity using sanctuary zones:

- General managed use zone—being a zone primarily established so that an area may be managed to provide protection for habitats and biodiversity within a marine park, while allowing ecologically sustainable development and use;
- Habitat protection zone—being a zone primarily established so that an area may be managed to provide protection for habitats and biodiversity within a marine park, while allowing activities and uses that do not harm habitats or the functioning of ecosystems;
- Sanctuary zone—being a zone primarily established so that an area may be managed to provide protection and conservation for habitats and biodiversity within a marine park, especially by prohibiting the removal or harm of plants, animals or marine products;
- Restricted access zone—being a zone primarily established so that an area may be managed by limiting access to the area.

For the purposes of the MER Program, conservation is defined as "the protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment" (ANZECC TFMPA 1998). Thus it is anticipated that sanctuary zones can facilitate both maintenance of habitats and biodiversity, but also some form of restoration and enhancement from their pre-2014 state in cases where existing pressures were high and where they are now prevented by the zoning. It is expected that both SZs and HPZs will provide for the maintenance of habitats and biodiversity, but that HPZs will not result in restoration and enhancement; although this could potentially occur in areas that were previously trawled (see Bailey et al. 2012). These distinctions become important with regard to predicted change or lack of change in ecological values from the pre-2014 state when evaluating the effectiveness of the management plans (and zoning) in achieving the objects of the *Marine Parks Act 2007*. Thus, maintenance of the pre-2014 status of habitats and biodiversity inside SZs and HPZs should be viewed as a measure of success, with potential enhancement inside some SZs being viewed as an additional benefit.

The management plans for marine parks outline the priorities and 15 strategies under each of the four sub-programs that collectively are designed to achieve the objects of the *Marine Parks Act 2007*. Each of these 15 strategies is outlined below against the relevant sub-program that is responsible for delivering those strategies.

Strategies of each management plan

Protection

1. Manage activities and uses in the marine park in accordance with zoning and special purpose area provisions.
2. Actively influence activities and uses within and adjacent to the marine park to help mitigate threats to marine biodiversity and marine habitats.
3. Consider additional protections and/or temporary restrictions where necessary in circumstances of urgency:
(a) to protect a listed species of plant or animal, or threatened ecological community,
(b) to protect a feature of natural or cultural heritage significance; or
(c) to protect public safety.
4. Introduce a permitting system to provide for the following activities (where not otherwise authorised):
- scientific research in a sanctuary or restricted access zone;
- tourism operations in a sanctuary zone;
- competitions and organised events in a sanctuary zone;
- commercial film-making (including sound recording and photography) in a sanctuary zone; and
- installation of vessel moorings in a sanctuary zone.

Stewardship

5. Provide for public appreciation, understanding and enjoyment of the marine park.
6. Create and promote opportunities for sustainable nature-based tourism in the marine park.
7. Provide education to support the implementation of the marine park.
8. Seek to involve local communities and stakeholders in the day-to-day management and monitoring of the marine park.
9. Work cooperatively with Aboriginal communities to conserve country, plants, animals and culture.

Performance

10. Develop and implement a monitoring, evaluation and reporting (MER) program that measures the effectiveness of this marine park management plan and its contribution to South Australia's marine parks network (2011 baseline), and that:
- is designed to measure the effectiveness of the management plan in delivering the predicted outcomes to inform adaptive management;
- includes linkages to relevant state, national and international monitoring, evaluation and reporting frameworks;
- sets out targets and indicators linked to strategies and outcomes for monitoring, which include ecological, socio-economic, environmental and management elements;
- monitors the delivery of education, research and governance mechanisms; and
- assesses the effectiveness of compliance activities.
11. Foster partnerships to support the implementation of the MER Program incorporating opportunities for community and stakeholder involvement.
12. Ensure outcomes of the MER Program and research outcomes are made publicly available and inform decision making and periodic review of this management plan.
13. Conduct priority research and foster research partnerships to assess the integrity of knowledge frameworks that underpin the predicted outcomes.
14. Encourage Aboriginal people, local communities and stakeholders to preserve traditional and historic knowledge and, where appropriate, share this knowledge with others.

Compliance

15. Develop and implement a compliance strategy for the marine park that:
- is cost-efficient;
- is focussed on sanctuary zones and other conservation priorities;
- complements existing compliance efforts;
- maximises voluntary compliance, and
- includes measures to address serious or repeat non-compliance.

2.1.2 Planning to meet the requirements of the *Marine Parks Act 2007*

The Marine Parks Program has been developed using a program logic model (see Scholz et al. 2017) to identify the program inputs (activities) and subsequent outputs and expected outcomes that would demonstrate achievement of the objects of the *Marine Parks Act 2007*. This logic model will be used to monitor the progress of the Marine Parks Program, and to evaluate the probability of continued success, and to determine the need for management changes. The program logic process documents the assumptions that have been made to link the required outcomes to work that is being implemented. The assumptions can be reviewed and updated when new information is collected.

2.1.2.1 Key evaulation questions

The Marine Parks Program developed six key evaluation questions that are directly related to the objects of the *Marine Parks Act 2007* (see marine parks). The key evaluation questions provide clarity about the priorities for monitoring and guide how the marine parks program should be evaluated to determine whether the marine park management plans achieve the requirements of the *Marine Parks Act 2007*. Each key evaluation question (KEQ) addresses specific outcomes and strategies in the context of effectiveness, impact, appropriateness and efficiency of the Marine Parks Program.

Key evaluation questions

KEQ 1. To what extent has the legislated comprehensive, adequate, and representative (CAR) system protected and conserved marine biological diversity and marine habitats?

KEQ 2. To what extent have marine parks strategies contributed to the maintenance of ecological processes?

KEQ 3. To what extent have marine parks strategies contributed to enabling marine environments to adapt to impacts of climate change?

KEQ 4. To what extent have the marine parks strategies contributed to the ecologically sustainable development and use of the marine environment?

KEQ 5. To what extent have the marine parks strategies contributed to providing opportunities for public appreciation, education, understanding and enjoyment of marine environments?

KEQ 6. To what extent have the marine park strategies contributed to the protection and conservation of features of natural and cultural heritage significance?

As achieving Object 1 of the *Marine Parks Act 2007* is considered to be the primary objective of the MER Program (Scholz et al. 2017), KEQ1 is therefore considered to be the primary question to address. As per the wording of the *Marine Parks Act 2007*, there is an implicit assumption within KEQ1 that the marine parks system is comprehensive, adequate and representative (see Section 4.7, see Design principles document).

2.1.2.2 Desired outcomes

The KEQ document (six evaluation questions) highlighted a number of desired outcomes that are linked to the six KEQs:

- Increased understanding of which components or elements of the existing legislated comprehensive, adequate and representative (CAR) marine park system are successfully contributing to the protection and conservation of marine environments

- Threats to the marine biodiversity and marine habitats are reduced
- Protection and conservation of marine biodiversity and habitats are increased
- Ecosystem status, functions and resilience are enhanced or maintained
- Ecologically sustainable development and management of shipping, mining, aquaculture and fishing industries are appropriately accommodated within marine parks
- Increased opportunities for research and sustainable nature-based tourism within marine parks.
- Increased stewardship of marine parks and marine environments
- Marine Parks are valued by more people
- Traditional Aboriginal knowledge is preserved and shared when appropriate
- Impacts on the significant features of natural and cultural heritage are reduced.

It is important to note that the marine parks program is a long-term state government initiative and that some of the desired outcomes may take many years to be observed.

2.2 Governance

The MER Program represents a significant challenge and robust, transparent governance and technical steerage is required for its successful delivery. DEWNR is the lead agency responsible for managing the whole-of-government marine parks initiative. Ultimate responsibility for the successful delivery of the Marine Parks Program lies with the Minister for Sustainability, Environment and Conservation (Figure 4). Within DEWNR, the Marine Parks Program is responsible for day-to-day delivery of marine parks and is led by a Marine Parks Manager. The four sub-programs of protection, stewardship, compliance and performance are delivered across regional and central parts of the DEWNR agency. The performance sub-program, which is responsible for developing the MER Plan and delivering the MER Program, sits within the Science and Information Group of DEWNR (Figure 4). Strategic decisions within the performance sub-program are informed by a performance program working group comprised of members from the performance sub-program, DEWNR's Science and Information Group, and the University of Adelaide. A DEWNR Program Principal oversees the technical aspects of the MER Program. The Marine Parks Program is overseen by the Marine Parks Coordinators Committee, whom are acting on behalf of the DEWNR Executive, which comprises members of each sub-program and regional coordinators. The Marine Parks Program reports to a DEWNR Marine Parks Executive Committee to ensure that the Marine Parks Program achieves its objectives.

The Marine Parks performance sub-program works in various collaborations and partnerships and seeks additional technical advice/review from colleagues in other government agencies, university academics and external consultants. All technical publications from the Marine Parks performance sub-program adhere to DEWNR peer review and approval guidelines, and may also involve external peer review. The MER Program has previously worked with the Goyder Institute for Water Research to facilitate independent, external advice and feedback on documents and processes (e.g. review of 19 baselines reports, see Bryars et al. 2016; Goyder Institute for Water Research 2016). The MER Program will provide progress updates to the Parks and Wilderness Council, and Marine Innovations Southern Australia (MISA).

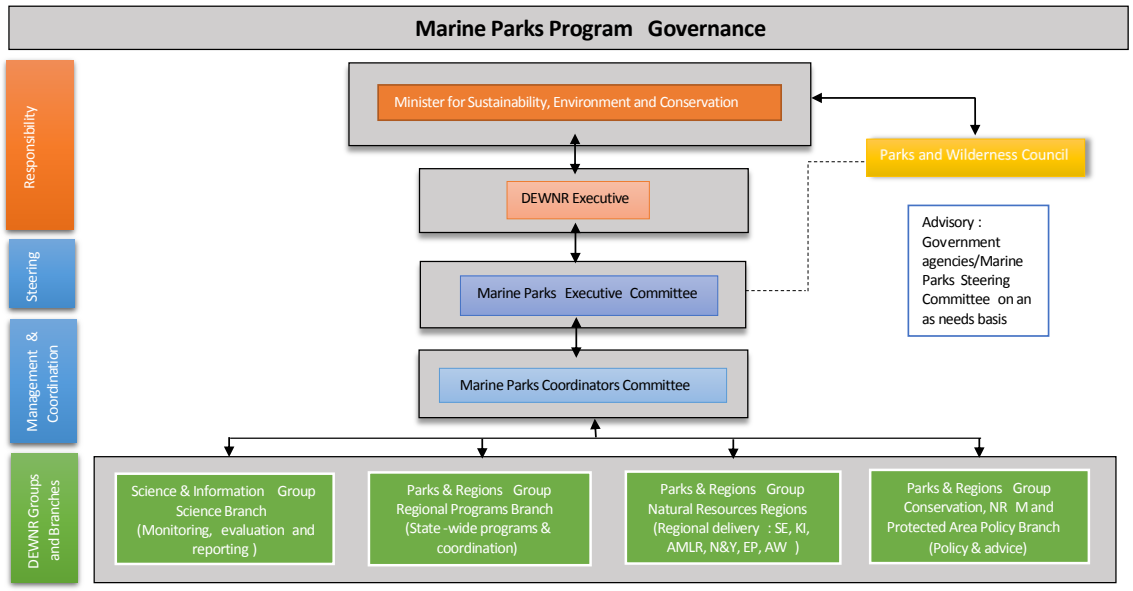


Figure 4. Governance framework for the Marine Parks Program

2.3 Design requirements

2.3.1 Relevance

The first design requirement of the MER Program is that monitoring information is relevant to the KEQs (Section 2.1.2.1) and the specific evaluation questions being asked (see Section 4), i.e. it is 'fit-for-purpose'. The information collected should be scientifically rigorous, repeatable, and defensible.

2.3.2 A hierarchical approach

The second design requirement of the MER Program is that monitoring information can be reported at multiple spatial scales from smallest to largest, including:

- ecosystem components, such as selected habitats and plant/animal assemblages and species
- individual zones, particularly key designated SZs
- 19 marine parks
- various administrative boundaries such as Local Government Areas, ABS regions and NRM regions
- 8 marine bioregions (IMCRA Technical Group, 1998)
- statewide network
- relevant user sector impact/benefit derived from the marine parks.

This hierarchical approach requires that monitoring indicators and other metrics can be aggregated to allow evaluation of the next higher level of the hierarchy. The monitoring information can also contribute to the evaluation of the Australian (ANZECC TFMPA 1998) and global (UNEP 1994) systems of marine protected areas.

2.3.3 A long-term approach

The third design requirement of the MER Program is that, where possible, monitoring information should be collected on multiple occasions to track changes over time and compared against a baseline reference point.

Information should be collected at a temporal scale that is relevant to each indicator; some indicators may need to be measured daily, weekly, monthly, annually or at even longer intervals. A key feature of the MER Program is that monitoring of some indicators will need to extend beyond the 10-year review of the management plans as some ecological changes will likely take decades to occur. Monitoring of other indicators may not need to be continued beyond 10 years if a specific evaluation question has been answered within that time frame. However, the Marine Parks Program and the MER Program must be viewed as long-term initiatives requiring a long-term approach and commitment to data collection.

2.3.4 Efficient design and implementation

The fourth design requirement is that monitoring activities are as efficient and effective as possible, both in their design and in their implementation. The MER Program is guided by the MER framework (Scholz et al. 2017) and the KEQs, and highlights the most important and useful information that will be collected. The priorities for monitoring components and associated indicators are informed by the marine park baseline reports (Bryars et al. 2016) and a number of other processes (Figure 3). This MER Plan further refines those priorities based on a range of factors (see Section 4). Throughout this MER Plan, priority is placed on identifying information that is required to answer the evaluation questions, rather than on identifying all of the information that could be collected, i.e. avoiding 'monitoring for the sake of monitoring'. Sufficient monitoring information should be collected to allow changes to be detected (e.g. it has appropriate statistical power). Integration and collaboration across DEWNR and across other agencies/universities are also important to ensuring efficient design and implementation.

2.3.5 Interpretable and synthesisable information

The fifth design requirement highlights that monitoring information must be synthesizable and interpretable. To be useful to policy makers, resource managers, stakeholders, and others involved in future marine park management decisions, all monitoring information must build on the existing knowledge base and facilitate development of overarching conclusions about the evaluation of the marine park management plans in achieving the objects of the *Marine Parks Act 2007*. Information on the MER Program will be presented in clear and intuitive reports to inform a broad audience. Detailed technical information and scientific reports will also be published to provide additional detail and to support further analyses, review or uses of the data. Evaluation and reporting should be clear, informative and targeted at government decision-makers, commercial and recreational fishers, the community and other stakeholders.

2.3.6 Adaptable design and priorities

The sixth design requirement is that the MER Program should be adaptable (whilst always remaining focused on the six KEQs), such that it can expand and contract to reflect changing priorities and opportunities, and to make the best use of available resources. The MER Program will evolve over time to take advantage of scientific advances, new or improved methods, and other opportunities to increase monitoring accuracy and effectiveness. Accordingly, the MER Plan has been developed as a series of related components that outlines indicators that will be used. Where possible a level of redundancy should be built into the MER Program in which critical ecological components are replicated/duplicated to allow for unexpected disasters (e.g. loss of a sampling site) and to iron out nuance.

A research program has been established since 2012 (*Forging the Links*) that is targeted at improving the effectiveness and efficiency of the MER Program through identifying new methods, prioritising monitoring activities, addressing knowledge gaps, and testing assumptions such as evaluating the CAR principles of the SARSMPA. The MER Program will undertake research in partnership with universities, government agencies, non-government organisations, funding partners, citizen scientists and marine park stakeholders.

The review of the marine park management plans, which is required by 2022, will also include a formal review of the monitoring activities and a subsequent update of the MER Plan if required.

2.4 Scope

A range of factors described above have guided the selection and construction of the monitoring activities. These monitoring activities are outlined below, and are discussed in detail in subsequent chapters.

2.4.1 Monitoring and research components

Monitoring and research activities are aligned to a number of inter-related components to ensure a holistic approach and that the key evaluation questions can be answered (see Section 3). The MER Program will adopt this approach to set the scope of monitoring and research activities.

2.4.2 Spatial scope

The spatial scope of monitoring describes the spatial units of monitoring. Monitoring of marine parks will be based on the information required to answer the key and specific evaluation questions (see Section 4). Different elements of monitoring will be conducted at different spatial scales, depending on the information required, the resources available, and the variability and predicted magnitude of change of that information. Monitoring resolution is discussed further in Section 4. The spatial distribution of monitoring may be refined to reflect changing management needs, or environmental or socio-economic conditions. It should be noted that socio-economic information is often unavailable at a spatial scale that matches the marine park boundaries, and this will present a challenge when interpreting changes in indicators that may be related to the marine park management plans (Bryars et al. 2016, Goyder Institute for Water Research 2016).

Resource and logistical limitations prevent assessments of all species, habitats and ecosystems that are present in all parks and zones. A focused MER Program is required that targets specific parks, zones and ecosystem components based on expected changes and the best available information. In this context, measurements of ecological 'changes' within zones are possible in a number of ways including:

- a positive change from the baseline status inside a zone (most relevant to SZs) relative to no change outside the zone
- maintenance of the baseline status within a zone (most relevant to SZs and HPZs) relative to a negative change outside the zone, in particular declines or degradation, including outside of a marine park
- a positive change from the baseline status inside a zone (most relevant to SZs) relative to a negative change outside the zone, which would exacerbate the observed difference.

In line with the types of changes outlined above and the specific focus on KEQ1, the MER Program will have an ecological focus on SZs and HPZs, but should also incorporate information from GMUZs and areas outside of marine parks for comparison where appropriate.

The MER Program should incorporate multiple spatial scales, inside and outside of individual zones, multiple zones and across broad geographic ranges. This approach will enable the program to:

- assess whether the predicted changes occurred
- incorporate information on ecological and socio-economic trends
- detect changes that were not predicted and/or
- detect changes caused by drivers, which are not influenced by the marine park management plans.

While monitoring of ecological values will be focused at the scale of zones, reporting of ecological values will occur at a range of increasing spatial scales from zones to marine parks to bioregions. South Australia has eight marine bioregions, which are areas that contain distinct combinations of physical and biological features (IMCRA Technical Group, 1998, Figure 1). A bioregional approach to reporting is recognised internationally as providing a basis for reporting biophysical trends. The bioregional approach also allows analyses and interpretation of data at

multiple spatial scales in line with design requirements outlined in Section 2.3 of this MER Plan. Socio-economic values are more readily reported at the State scale or smaller statistical reporting units such as local government areas.

2.4.3 Temporal scope

The temporal scope of monitoring describes the duration and frequency of monitoring. Some monitoring of marine parks should be ongoing. The frequency of monitoring will be based on the information required to answer the evaluation questions (Section 2.1.2.1). Different elements of monitoring will be conducted at different time intervals, depending on the information required and the variability and predicted rate of change of that information. Monitoring frequency is discussed further in Section 4. The temporal distribution of monitoring may be refined to reflect changing management needs, or environmental or socio-economic conditions.

2.4.4 Monitoring (and research) participants and partners

Another factor that influences the scope of this MER Plan is the large number of participants and partners that are already involved and can potentially become involved. There is considerable potential in South Australia for partnership-based monitoring, whereby activities are conducted not only by DEWNR, as the agency with statutory authority for managing marine parks, but also in partnership with:

- other state government agencies
- Australian Government agencies (where there is connection or alignment with the South-west Commonwealth Marine Reserves Network)
- universities and research institutions
- citizen science collaborations
- stakeholders such as commercial and recreational fishers
- community groups and associations.

The MER Plan is adaptable and able to appropriately utilise all available monitoring capacity. For example, citizen scientists will support monitoring components that require less technical rigour. Research programs will continue to provide valuable information that fills knowledge gaps and leads to improved monitoring methods and understanding of the marine parks network. The MER Program will continue to synthesize information from monitoring programs that were established for other purposes, for example:

- recreational fishing surveys (e.g. Jones 2009, Giri and Hall 2015)
- fisheries management (e.g. PIRSA 2014, Flood et al. 2014)
- water quality assessment (e.g. Goonan et al. 2012)
- ocean observing (e.g. Lynch et al. 2014).

These partnerships improve the efficiency of monitoring and the quality of information available for marine park management.

2.4.5 Knowledge management framework

Knowledge management is an integral component of the MER Program (Figure 2). The MER Program will manage environmental knowledge as directed by the MER Framework in accordance with the DEWNR corporate standards and protocols and guided by both the DEWNR Information Management Framework and the Declaration of Open Data (Scholz et al. 2017). Specific details of ecological data management and access are provided in the technical reports by Miller et al. (2017a, b) and Brook et al. (2017).

3 The component-based approach

The marine environment is a complicated space with many users and complex bio-physical systems. In order to break down this complexity into something manageable and to enable predictions of change due to the marine park management plans, Bryars et al. (2016) created a component-based framework which has been adopted for the MER Plan and which is outlined in the sections below.

3.1 Component framework

The marine park baseline reports (e.g. Bryars et al. 2016, Baseline reports) provide the historical and current knowledge for each of the 19 marine parks and present predictions and indicators of change based upon the relationship between six inter-related components: (1) marine park management plans, (2) ecological values, (3) social and economic (socio-economic) values, (4) physical drivers, (5) socio-economic drivers, and (6) human-mediated pressures (Figure 5). The MER Plan has adopted this component-based approach and added a seventh component of assumptions which apply to the links and predicted changes across the whole framework (Figure 5). The MER program will require information on all seven components to answer the six KEQs (see Section 3.2).

At the core of the MER Program are the ecological and socio-economic values of the marine parks, and any predicted changes in these values due to implementation of the management plans (Figure 5). The direction and colour of the arrows in Figure 5 indicates the influence of one component on another component or link. For example, a marine park management plan will directly influence socio-economic values but it will also indirectly influence ecological values by mitigating some (but not all) of the pressures on the ecological values. The assumptions component is shown in isolation in Figure 5 as it encompasses the whole framework. As an example, in order for a predicted change to be observed in an ecological value as a direct result of a management plan (e.g. improved reef condition due to prevention of fishing inside an SZ), it is assumed that (a) an anomalous change in an external physical driver does not influence reef condition (e.g. a catastrophic storm event that destroys the reef), (b) that the management plan zoning scheme is adequate (e.g. the SZ is large enough to encompass the home ranges of various mobile reef species), (c) that the management plan strategies will be effective in reducing the targeted pressure to enable the reef condition to improve (e.g. effective compliance), and (d) that any pressures outside of the influence of the management plan do not impact reef condition (e.g. poor water quality from an adjacent catchment).

For further information on what the management plans can influence and the theory of change that underpins the MER Program, readers are directed to a baseline report (see Bryars et al. 2016).

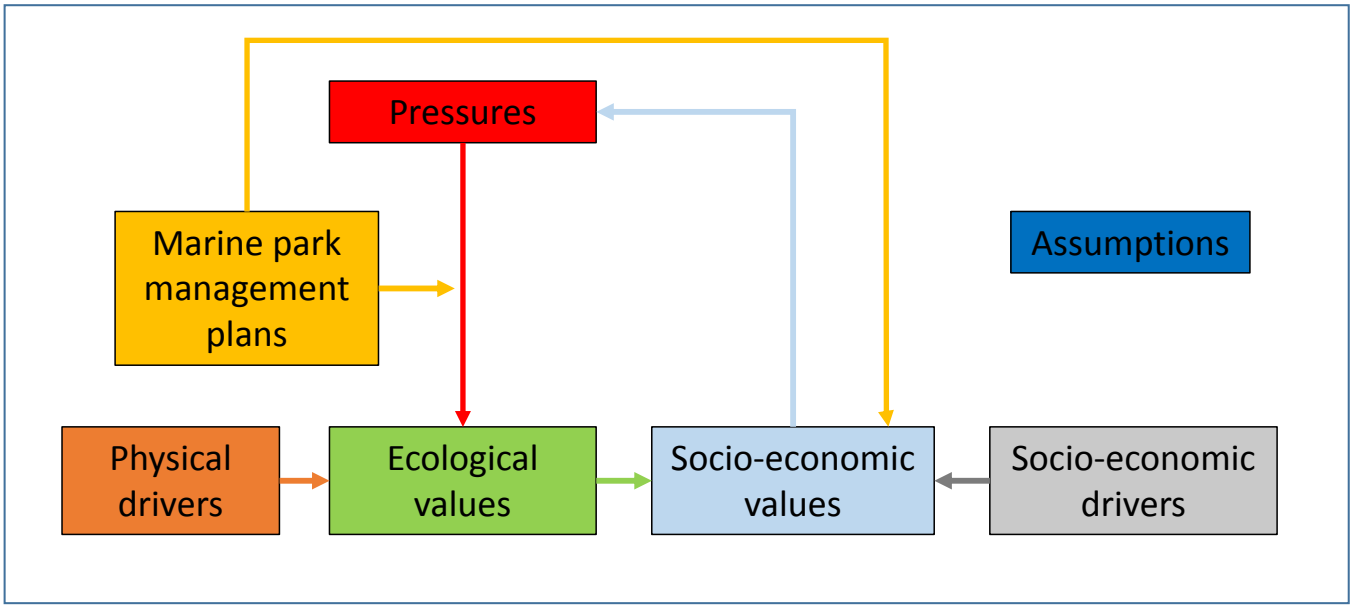


Figure 5. Framework for the seven components of the marine parks monitoring, evaluation and reporting program. See text for further details.

The 19 baseline reports summarised the available information on the values, drivers and pressures, any predicted changes in values, and represented these in conceptual models (Figure 6). Inherent within these models were a number of assumptions. The MER Program is guided by these conceptual models but will continually report new information and review the validity of the conceptual models.

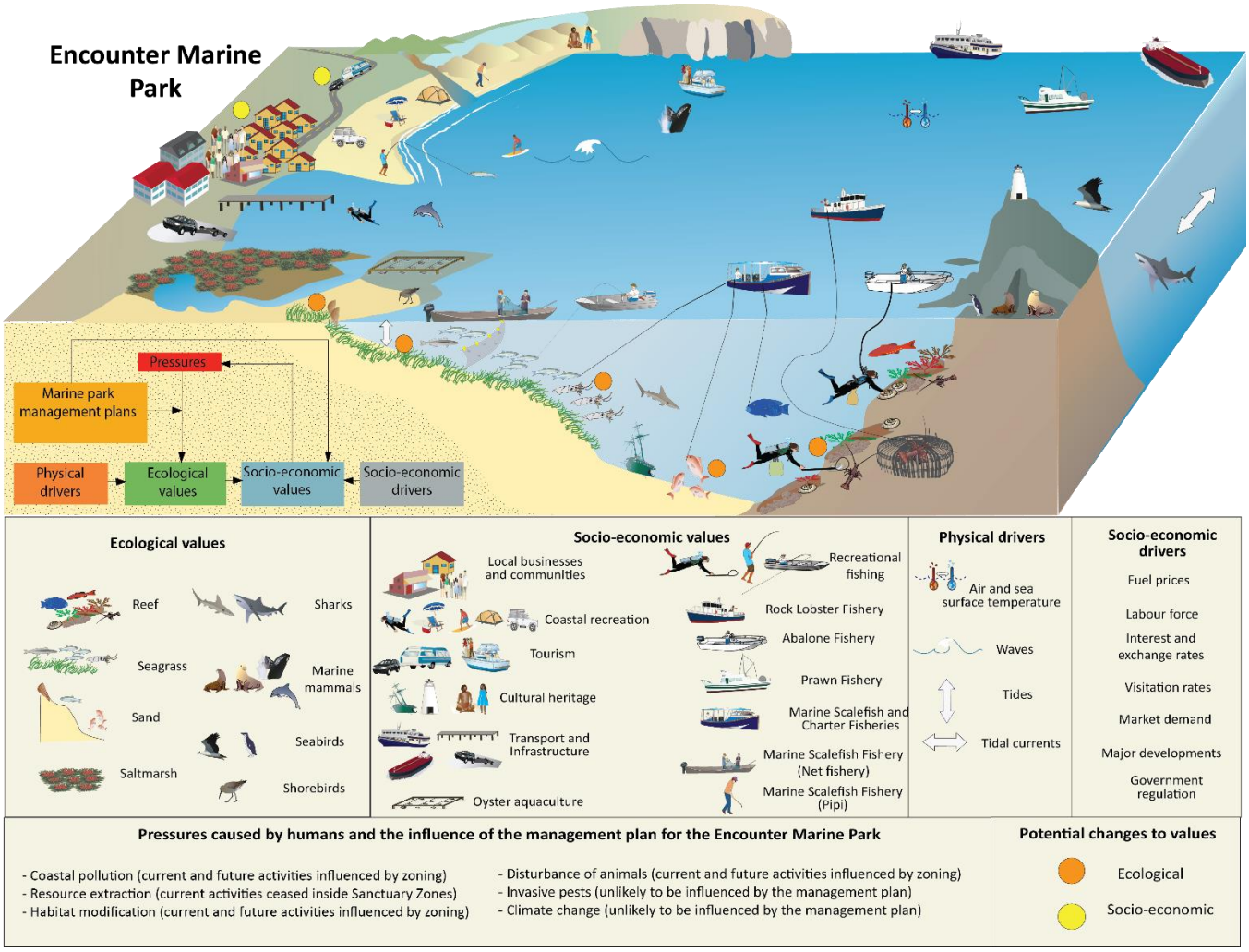
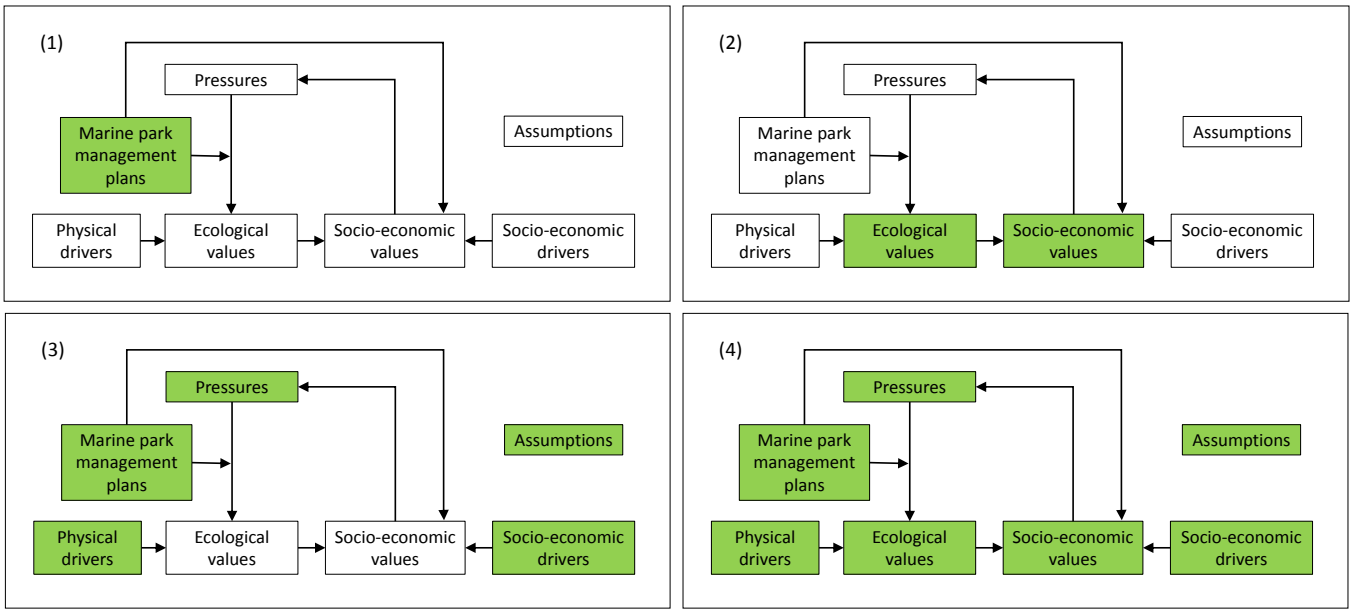


Figure 6. An example of a conceptual model of the ecological and socio-economic values, pressures , drivers and predicted changes taken from the Encounter Marine Park baseline report (Bryars et al. 2016). Note that assumptions are not identified on this conceptual model.

3.2 Utilising the component framework to guide monitoring, research and evaluation

The ultimate aim of the MER Program is to evaluate the effectiveness of the management plans in achieving the objects of the *Marine Parks Act 2007*. Under the component framework of predicted changes, four steps are required to achieve this aim (with the relevant framework components highlighted in a series of diagrams below):



(1) **Have the management plan strategies been implemented?**
To evaluate this question requires appropriate indicators of management activity to be monitored and reported on. This step does not involve an evaluation of whether the activities undertaken have been effective (i.e. indicators of outcomes) – this comes later (Steps 3 and 4).

(2) **Were the predicted changes in ecological and socio-economic values observed?**
To evaluate this question requires appropriate indicators of change in ecological and socio-economic values to be monitored and reported on. Changes in ecological and socio-economic values will be assessed by analysing spatial and temporal trends in the indicators chosen.

(3) **Were the observed changes in ecological and socio-economic values influenced by external drivers, pressures, inadequate marine parks management, and/or incorrect assumptions?**
To evaluate this question requires any observed changes in ecological and socio-economic values to be interpreted using information from the other monitoring components (physical drivers, socio-economic drivers, pressures, assumptions, and management) and research outcomes (assumptions). For examples, an external physical driver such as a storm caused unpredicted changes in the biota of a reef; a predicted ecological change was not observed because the assumption that the SZ was large enough was incorrect; or a predicted ecological change was not observed because a management strategy such as compliance was ineffective in preventing fishing inside an SZ.

(4) **Were the management plans effective in achieving the objects of the *Marine Parks Act 2007*?**
To evaluate this question requires a combination of information from Steps (1) to (3). A 'multiple-lines-of-evidence' approach will be taken to the final evaluation by using all relevant indicators and available information to address each of the six KEQs.

In reality, the monitoring, evaluation and reporting of information to address Steps 1 to 3 must occur concurrently; while Step 4 can only be completed after many years of MER from Steps 1 to 3 (see Section 4.9).

4 Monitoring, Evaluation and Reporting

This chapter outlines the approach to monitoring, evaluation and reporting for each of the seven components of the MER Program: (1) marine parks management, (2) ecological values, (3) socio-economic values, (4) physical drivers, (5) socio-economic drivers, (6) pressures, and (7) assumptions. This chapter also outlines specific evaluation questions (SEQs) under the 6 KEQs, the monitoring indicators and methods to be used for information collection, any prioritization of monitoring activities, how monitoring information will be evaluated, and how monitoring information will be reported. It must be noted here that in order to answer the large number of SEQs, a large range of indicators and methods were initially assessed for potential inclusion in the MER Program, but only a refined suite of indicators/methods have been included in the final MER Plan based upon a range of considerations including the availability of information (noting that many types of information that may potentially be useful are simply unavailable), and the logistics, costs and practicality of information collection. Research to address knowledge gaps, test assumptions and to improve monitoring is an integral part of the MER Program and is included within this section on MER. Monitoring of marine parks represents a significant challenge and the MER Program already involves many partners and collaborations, with further opportunities possible (see Section 4.8).

It is beyond the scope of (or indeed necessary for) the MER Program to collect all of the required information directly and much information can be sourced from other programs that are not focused solely on marine parks. There is, however, some information that must be specifically targeted by the MER Program as it is not currently being collected by these other programs, including ecological data inside and outside SZs, and data on marine parks management. Figure 7 depicts the overlap between non-marine parks programs and the types of information required to address the seven components of the marine parks MER Program.

4.1 Marine parks management

KEQs
1, 2, 3, 4, 5, 6

There are a range of management activities under the sub-programs of Protection, Stewardship, Compliance and Performance that will be undertaken to deliver the strategies of the management plans. Management activities must be monitored across the Marine Parks Program to enable evaluation of the effectiveness of the management plans and to assist with interpretation of monitoring data on ecological and socio-economic values, e.g. a lack of change in a reef community may be due to poor compliance of illegal fishing.

The baseline reports did not present baseline information for marine park management (because there was none prior to 2012) but did, however, present a few possible indicators such as permitting statistics, level of compliance, and numbers and types of educational activities. In order to address the need for new indicators, a series of internal DEWNR workshops were held including input from members of the four marine parks sub-programs to develop a comprehensive suite of appropriate indicators. All indicators are aligned to Step 1 of the evaluation process (i.e. Have the management plan strategies been implemented?), with some indicators also being required for the final Step 4 of the evaluation (i.e. Were the management plans effective in achieving the objects of the *Marine Parks Act 2007*? See Section 3.2). Specific evaluation questions, indicators and measures to be used are detailed in Appendix 1. Information will be collected mainly by the four sub-programs from within the Marine Parks Program but some information will also be sourced from other parts of DEWNR (e.g. Coastal Management Branch) and other government agencies (e.g. PIRSA Fisheries).

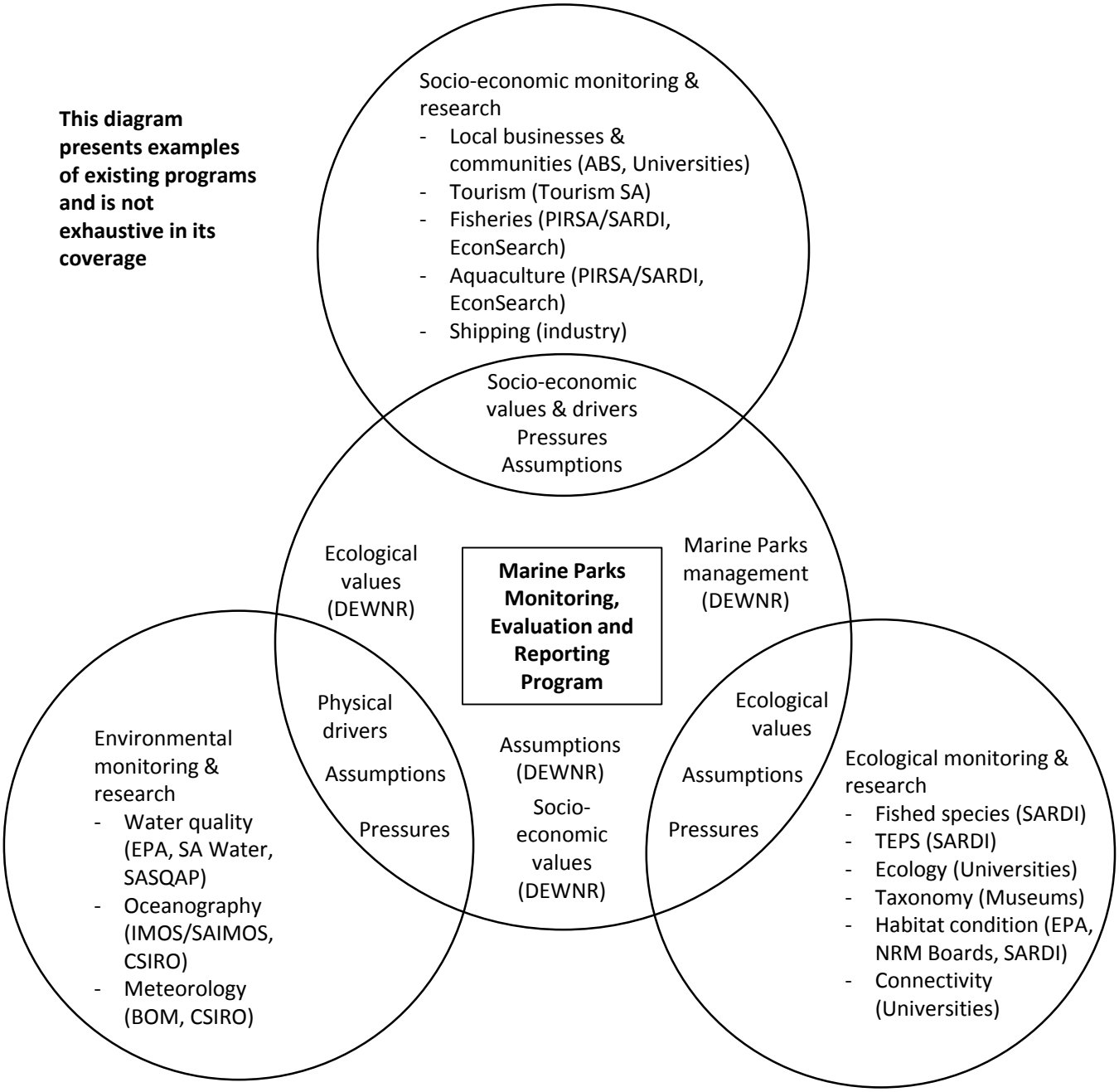


Figure 7. Relationship between the Marine Parks Monitoring, Evaluation and Reporting Program (MER Program) and non-marine parks programs with regard to monitoring and research activities that address the seven components of the MER Program.

4.2 Ecological values

KEQs
1, 2, 3

For the purposes of the MER Program, ecological values are summarised according to five habitat types and four species groups (see Bryars et al. 2016). The habitat types (which are based on seabed/benthic features) are reef, seagrass, sand, mangrove and saltmarsh. The pelagic environment is not considered as a separate habitat to the five benthic habitat types in the MER Program; although this does not necessarily preclude future MER activities specific to this habitat. The four species groups (which include relatively large and mobile species that use a range of habitats) are sharks, marine mammals, seabirds and shorebirds. MER activities will not necessarily be undertaken on all habitat types and species groups.

The marine park baseline reports (e.g. Bryars et al. 2016) and MER workshop report (Goyder Institute for Water Research 2016) identified the ecological values that are likely to change and potential indicators that could be used to monitor changes in those ecological values. This section summarises the background information and outlines the methods that will be used to measure some of those ecological values. Note that some values are predicted to maintain their current status through increased protection, and while not a 'change', prevention of future decline is considered a critical measure of success for South Australia's marine parks network. As the collection of ecological information to address KEQ1 is a particular focus of the MER Program and much of the information collection will be led by the Marine Parks Program, the following section is necessarily larger than other sections in this chapter. Information on ecological change is required for Step 2 of the evaluation (i.e., Were the predicted changes in ecological values observed? See Section 3.2). The Marine Parks Program 'core monitoring' (see Section 4.2.1) will focus on the five habitat groups but not the four species groups which are not predicted to change due to the marine parks management plans (Table 1). A range of other monitoring programs termed 'complementary' (see Section 4.2.2) and 'non-marine parks' (see Section 4.2.3) will provide information on the species groups and additional information for the habitat groups (Table 1). Collectively this information will be used to address KEQs 1 to 3 (Appendix 2).

While the scope of ecological monitoring is currently constrained (Table 1, Appendix 2) it could be expanded spatially and temporally and include other ecological components as methods and resources permit. For example, the addition of intertidal reef monitoring could be complementary to the core subtidal reef monitoring, or the number of reef sites monitored using UVC could be increased in the core program if required.

4.2.1 Marine parks program core monitoring

Ecological data is required for the purpose of assessing condition and trend in ecological values. There are a number of methods available for measuring the indicators associated with the various types of habitats. The most suitable methods for use in a marine parks MER Program are those that are non-destructive, respectful of animal welfare issues, have widespread applicability and capable of recording robust, repeatable and affordable data. A review of existing methods for monitoring SA's Marine Park Network by Bryars (2013) recommended baited remote underwater video systems (BRUVS) and underwater visual census (UVC) as the preferred methods for collecting ecological information to assess the effectiveness of the SA Marine Park Network. Bryars (2013) recommended that these methods be supplemented by others such as towed remote underwater camera video and baited traps. Based on these recommendations, the large extent of the Marine Park network and the existing capabilities of the Marine Parks Program, BRUVS and UVC will be the core monitoring methods utilised by the MER Program for measuring the size, abundance, and/or diversity of plants and animals in reef, seagrass and sand ecosystems. The Marine Parks Program also has a dedicated habitat mapping capability that is aimed at acquiring baseline information, but which can be adapted to monitor change in condition and spatial extent of habitats.

Table 1. List of ecological values showing those components for which monitoring data will be or are currently being collected by the Marine Parks Program (as of mid-2017) and some examples of data that may be available from other non-marine parks monitoring programs. Note that because a component is currently listed as not being monitored, it does not preclude its future inclusion. UVC = Underwater visual census, BRUVS = Baited remote underwater video system.

Ecological value	**Predicted to change due to management plans** (see Bryars et al. 2016)	**Currently included in Marine Parks Program core monitoring for marine parks**	**Included in complementary monitoring for marine parks**	**Included in non-marine parks monitoring programs**
Saltmarsh	No	Yes (Mapping)	No	No
Mangrove	No	Yes (Mapping)	No	No
Reef – intertidal	No	Yes (Mapping)	No	Yes (Reef Watch)
Reef – subtidal	Yes	Yes (UVC, BRUVS, Mapping)	Yes (DEWNR/Reef Life Survey partnership; DEWNR/SARDI/PIRSA/ industry rock lobster project)	Yes (EPA aquatic ecosystem MER program, Reef Watch)
Seagrass – intertidal	Yes	Yes (Mapping)	Yes (DEWNR razorfish project)	No
Seagrass – subtidal	Yes	Yes (UVC, BRUVS, Mapping)	Yes (DEWNR squid egg trial survey using UVC)	Yes (EPA aquatic ecosystem MER program, SARDI)
Sand – intertidal	Yes	Yes (Mapping)	Yes (DEWNR/citizen science pipi project)	No
Sand – subtidal	Yes	Yes (UVC, BRUVS, Mapping)	Yes (DEWNR/industry proposed octopus project)	Yes (Universities)
Sharks	No	No	Yes (DEWNR/FUSA white sharks at Neptune Islands)	Yes (SARDI, universities)
Marine mammals	No	No	Yes (DEWNR/SARDI/ Australian Government Department of Environment & Energy - Australian sea lions at selected locations)	Yes (SARDI, universities – dolphin, southern right whale, Australian sea lion, long-nose fur seal)
Seabirds	No	No	No	Yes (DEWNR/NRM surveys for sea eagle & osprey, Birdlife Australia, SARDI)
Shorebirds	No	No	No	Yes (DEWNR/NRM surveys for hooded plovers; Birdlife Australia, universities)

4.2.1.1 Underwater visual census (UVC)

UVC is a method used to record species assemblages in shallow subtidal habitats by divers using predominantly SCUBA. UVC is a common method for monitoring reefs in Australia (Edgar et al. 2006; Barrett et al. 2007, 2009) and globally (Edgar et al. 2014), but can also be used in seagrass (Steer et al. 2007, Tanner and Thiel 2016). UVC is typically undertaken by two divers, who identify and record the size and abundance of fish, invertebrates and/or algae along transects.

The MER Program has developed guidelines for the use of UVC (Brook et al. 2017). For reef habitats, two methods are used to undertake UVC; the Marine Protected Area method (MPA, Barrett et al. 2007, 2009) and the Reef Life Survey method (RLS, Edgar and Stuart-Smith 2014). Both the MPA and the RLS methods of UVC provide data across all trophic levels (algae, invertebrates and fish) and both methods can be used to detect both predicted and unpredicted changes, because they record both fished and non-fished species. Since 2005, a collaborative project with the University of Tasmania has surveyed more than 250 UVC sites, inside and outside of SZs in South Australia using these methods.

The MER Program currently partners with the University of Tasmania, RLS, the EPA and the AMLR NRM region to deliver UVC monitoring data for the MER Program.

4.2.1.2 Baited remote underwater video systems (BRUVS)

A BRUVS consists of a waterproof video camera that is mounted on a frame with a bag of bait to attract fish and other animals. BRUVS provide a non-destructive, relatively cheap and repeatable method to record the abundance, size and population structure fish and other animals. One of the benefits of BRUVS is that they record species which are shy of divers or UVC and often commercially important (e.g. snapper). BRUVS have been used extensively to evaluate the performance of marine protected areas (Denny et al. 2004; Malcolm et al. 2007; Kleczkowski et al. 2008).

The MER Program has developed guidelines for the use of BRUVS (Miller et al. 2017a). BRUVS are deployed on the seabed for a set amount of time. The video footage is subsequently analysed to determine the size, abundance and diversity of fish and other animals. Stereo BRUVS are used to record the sizes of individuals by determining the position of each individual relative to the camera systems.

In the SA Marine Park Network BRUVS and UVC methods will be used to record the size, abundance and diversity of fish and other animals on reefs. BRUVS will be used as the main method to monitor changes in communities associated with sand and seagrass habitats.

The Marine Parks Program currently partners with the Flinders University of South Australia and the University of Adelaide to deliver additional BRUVS monitoring data for the MER Program.

4.2.1.3 Prioritisation of monitoring sites for BRUVS and UVC

As the Marine Park network extends across the entire state waters it is not feasible to conduct ecological monitoring in all parks and zones. Given the scale of the park network, current resourcing and predicted changes, the ecological monitoring will primarily target SZs and the three habitat types of reef, seagrass and sand.

To ensure the most efficient use of available resources a selection process was undertaken to prioritize SZs for ongoing ecological monitoring. For the monitoring program to effectively achieve the objectives of the Marine Parks program it needs to be scientifically rigorous, representative of the suite of marine biodiversity and habitats contained within the park boundaries while taking into account socio-economic interest and concerns of stakeholders. To prioritize SZs for ecological monitoring, three key criteria were identified:

1. Ecological value
2. Socio-economic importance

3. Predicted change

For the 'ecological value' and 'socio-economic importance' criteria a number of workshops with marine experts and relevant stakeholders were held (Figure 3) and weightings were assigned to each SZ based on these criteria. The criteria, 'predicted change' describes what ecological changes can be expected given protection from extractive activities as outlined in the Marine Park Baseline Reports (see Appendix 2 in Bryars et al. 2016) and Bryars (2013). These three criteria were combined and used to classify each SZ as high, medium or low priority. Twenty five SZs across 12 Marine Parks were identified as high priority (Table 2, Figure 8). These SZs will form the basis of the MER ecological monitoring program.

While these priority SZs will be targeted by the MER Program there are other factors and criteria that will affect which sites are monitored in any given year. Some of the priority SZs may not be feasible to monitor due to logistical constraints or given a certain level of resourcing while other SZs not currently listed as priority may be included to ensure adequate replication or representation of a particular habitat. In addition, there is also the potential to expand the number of SZs if more resources become available in the future. Decisions on annual monitoring priorities will be documented in annual implementation/work plans.

4.2.1.4 Sampling design, frequency and analysis for BRUVS and UVC

The design of the core ecological monitoring program to answer the relevant KEQs uses an approach of Before-After-Control-Impact (BACI) or After-Control-Impact (ACI, if no 'Before' data are available), where SZs represent the 'impact' (whereby impact is expected to be a positive impact) and sites outside SZs are the 'controls'. BACI is more powerful and preferred, however in many cases there are no 'Before' data or it is limited in scale (i.e. only one site or one year's data). This approach applies to both BRUVS and UVC methods and more detail on how these methods are utilised can be found in the relevant technical reports (Brook et al. 2017, Miller et al. 2017a). Sufficient replication of sites and zones will be sampled to provide an adequate level of power to detect change that is linked to the management plans (see Delean 2017).

Although annual monitoring at all priority SZs is desirable, the current program can support only a hybrid model that combines annual monitoring in some areas and less frequent monitoring at others. This approach is supported by modeling of baseline ecological data (Delean 2017).

Annual surveys will be conducted at priority SZs in the Gulf St Vincent (GSV) Bioregion while it is planned to survey the remaining priority SZ where possible every 4 years as part of a rolling program. Reasons for focusing on priority SZ in the GSV region include:

- GSV has the highest number of priority SZs and therefore the best opportunity to assess Marine Park effectiveness at different scales (SZ, Marine Park and Bioregion) as outlined in this plan.
- Compliance effort is highest and field work most cost effective in this bioregion.

Data will be analysed using appropriate statistical models to test for significant differences in spatial and temporal patterns that may be attributed to zoning, e.g. size of fish inside versus outside SZs. It is important to note that positive differences may manifest in different ways; such as an increasing trend inside relative to a stable trend outside, a stable trend inside relative to a decreasing trend outside, and an increasing trend inside relative to a decreasing trend outside which would exacerbate the difference.

Table 2. Priority sanctuary zones identified for ecological monitoring.

Sanctuary Zone (Marine Park)	Sanctuary Zone (Marine Park)
Aldinga Reef (Encounter)	Barlows Beach (Nuyts Archipelago)
Bay of Shoals (Encounter)	Point Bolingbroke (Sir Joseph Banks Group)
Encounter Bay (Encounter)	Salt Creek (Sir Joseph Banks Group)
Rapid Head (Encounter)	Seal Bay (Southern Kangaroo Island)
Sponge Gardens (Encounter)	Chinamans Hat (Southern Spencer Gulf)
The Pages (Encounter)	Kellidie Bay (Thorny Passage)
Carrickalinga Cliffs (Encounter)	Eely Point (Thorny Passage)
Pearson Isles (Investigator)	Clinton Wetlands (Upper Gulf St Vincent)
Top-Gallant Isles (Investigator)	Cape Dombey (Upper South East)
Piccanninnie Ponds (Lower South East)	Cuttlefish Coast (Upper Spencer Gulf)
North Neptune Islands (Neptune Islands Group)	Cape Borda (Western Kangaroo Island)
Isles of St Francis (Nuyts Archipelago)	Cape du Couedic (Western Kangaroo Island)
Nuyts Reef (Nuyts Archipelago)	

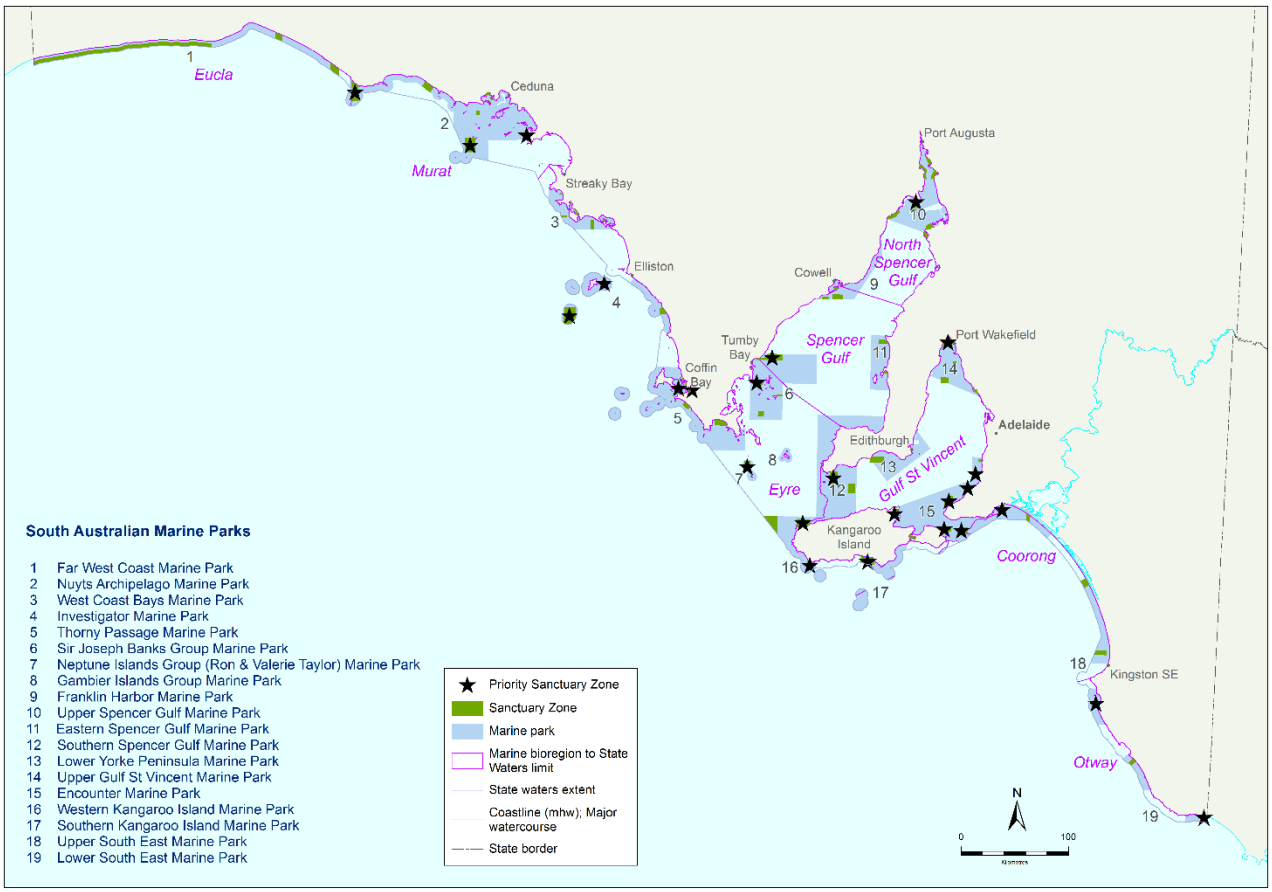


Figure 8. Map of South Australia showing the 19 marine parks, 83 sanctuary zones and the 25 priority sanctuary zones identified for ecological monitoring

4.2.1.5 Habitat mapping

Habitat mapping has been a core component of the Marine Parks Program for many years and has contributed significantly to the current baseline understanding of subtidal habitats across SA (e.g. Miller et al. 2009). The spatial extent of mangrove and saltmarsh habitats have been mapped comprehensively across the marine parks network, while shallow-water seagrass, reef and sand habitats have been partially mapped, with 65% of the parks network unmapped (Bryars et al. 2017 or 19 baseline reports). Of the 83 SZs, 11 were unmapped and 28 partially mapped as of 2012 when the marine parks zoning was finalised.

Mapping of marine habitats is currently undertaken in a number of ways. Mapping the extent of 'terrestrial' and shallow water habitats (mangrove, saltmarsh, and shallow water reef, seagrass and sand) requires data from on-ground surveys, as well as interpretation and modelling of data captured by both airplanes (e.g. Sipe et al. 2009) and satellites (Sulong et al. 2002). One of the benefits of these methods is that they can access archives of aerial images to provide trends in the extent and distribution of habitats. Mapping of deep water reef, seagrass and sand habitats is more difficult but can be undertaken using towed underwater cameras (e.g. Tanner 2005, Stevens and Connelly 2005) and swath sonar (e.g. NSW Marine Parks Authority 2010a,b, Rattray et al. 2009, Di Maida et al. 2011).

Realistically, the entire seabed of the marine parks network cannot be mapped comprehensively using currently available technologies and existing resources. New technologies are emerging that may eventually enable more rapid assessments of the spatial extent of subtidal habitats across the entire network (Durden et al. 2017). In addition, it is unlikely that the current baseline habitat GIS layer (e.g. see Bryars et al. 2016) will be recreated within the foreseeable future. Therefore the aims of the MER Program over the next few years up until the 10-year review will be to target selected areas to monitor for change across a range of zone types and to increase the resolution and extent of habitat information in selected parts of the marine parks network, particularly inside unmapped or partially-mapped SZs. The focus on SZs is due to their relevance to KEQ1 and the specific evaluation question of 'What biodiversity and habitats are included within the marine parks network?' (Appendix 2). New habitat information will also be critical for the MER Program to re-evaluate the CAR design principles of the network of marine parks. For example, the extent of previously unmapped seagrass may increase in some areas and therefore the statistics on the indicators that describe comprehensiveness and representativeness of seagrass habitats may need to be updated.

In the short term (up to 2022) the MER Program will prioritise the following mapping activities:

- A rapid method of improving knowledge of benthic habitats within SZs termed 'inventory mapping'. Inventory mapping will be focused within SZs or sections of SZs that are unmapped. Inventory maps are created using classified footage collected by towed underwater video cameras. The sampling locations are located on predetermined grids and separated by either 500 m or 1 km, depending on the predicted heterogeneity of the benthic habitats and the overall size of the SZ (Miller et al. 2017b).
- Undertake targeted swath sonar mapping to produce bathymetric maps of selected areas of interest to provide information and context for interpreting ecological changes, for assisting in selecting monitoring sites and for stewardship purposes. The high resolution of the swath sonar maps provides information on the rugosity, slope and aspect of habitats which can provide useful covariate data for interpreting changes that are detected in ecological values.
- Explore the possibility of re-mapping the spatial extent of selected areas using existing and new technologies to monitor for temporal change across different zone types, bioregions and adjacent to different land uses and pollutant sources. This type of analysis could provide an indication of the effectiveness of zoning for habitat protection.
- Explore the possibility of repeating existing video drops from the Marine Parks mapping program and other similar data sources (e.g. EPA AECR program) to assess changes in condition/extent of subtidal habitats in selected areas where data coverage is high. This type of analysis could provide an indication of the effectiveness of zoning for habitat protection.
- Explore the possibility of using the DEWNR 'rod-line survey' photo point dataset to assess changes in seagrass habitat at sites around SA. This type of analysis could provide an indication of the effectiveness of zoning for habitat protection.

In the long term the MER Program may explore:

- Producing full cover maps of benthic habitats by combining the data collected by the towed underwater videos in conjunction with swath sonar mapping (e.g NSW Marine Parks Authority 2010a,b). Swath sonar habitat mapping produces bathymetry and backscatter (texture) maps, which have a spatial resolution of about 1 m which when married with adequate ground truthing allow the generation of detailed benthic habitat maps.

4.2.2 Complementary monitoring

In cases where habitats, target species or local pressures are not adequately captured using the Marine Parks Program core monitoring methods, additional 'complementary' methods will be investigated and may be delivered internally or via collaborative partnerships with stakeholders such as other government departments, research agencies or community groups ('Citizen science'). Some examples of current projects are provided below.

Rock lobster pot monitoring project

Research from marine protected areas in Tasmania (Barrett et al. 2009) and New Zealand (Babcock et al. 1999) suggests that DEWNR's subtidal reef monitoring methods will provide robust indicators of changes in the abundance and size of commercially important invertebrate and fishes, including rock lobster and abalone. However, recently a more comprehensive dataset was required on rock lobster populations to assess the recovery of these populations in a previously fished SZ. Bryars (2013) predicted that the Cape du Couedic SZ on Kangaroo Island would show an increase in the abundance and size of rock lobster. Commercial potting to sample lobster abundance (Linnane et al. 2015, Young et al. 2016) was undertaken in the Cape du Couedic SZ during February 2017 in a partnership between DEWNR, SARDI, PIRSA and the fishing industry. Results of the survey were unavailable at the time of publishing the MER Plan.

Calamary egg mass survey

For seagrass habitats, UVC can be used to record the size and abundance of calamary egg masses in *Amphibolis* seagrass habitats, following the methods of Steer et al. (2007) to provide an indicator of adult abundance. This method was trialled by DEWNR in the Rapid Head SZ in December 2015. UVC was undertaken at multiple sites inside and outside of the SZ in 5–10 m water depth. At each site, the size and abundance of egg masses was recorded along 200 m long x 2 m wide belt transects in *Amphibolis* seagrass beds. The survey was timed to coincide with the time when eggs are expected to peak in abundance. Further work is required to utilise this methodology for the MER Program.

Reef Life Survey citizen science monitoring

Reef Life Survey (RLS) is an international citizen science program that trains volunteer divers to assess rocky reef communities to a scientifically rigorous standard (http://reeflifesurvey.com/). This program has been particularly successful and resulted in several peer reviewed publications and awards in the last decade (Edgar et al. 2014, Soler et al. 2015, Stuart-Smith et al. 2015). DEWNR's Marine Parks Program has partnered with RLS to establish a pool of locally-trained volunteer divers who can assist in surveying reefs and eventually help expand the spatial and temporal coverage of the Marine Park subtidal reef monitoring program.

Pipi citizen science monitoring

Pipis (*Donax deltoides*) occur along large areas of the state's South East sandy coastline and are a valued commercial/recreational mollusc species and an important component of beach ecosystems. A citizen science project has been established in partnership with the community and DEWNR South East Natural Resources to compare pipi abundance and size structure inside the Piccaninnie Ponds SZ compared to outside using standardized rapid methods (James & Fairweather 1995).

4.2.3 Non-marine parks programs

While some iconic/mobile species are not a focus of the MER Program, in cases where they are of interest to stakeholders in a particular MP and where robust monitoring data are available from non-marine parks programs, they could be reported on as part of the MER Program (see Table 1). For example, the Australian sea lion is a major tourist attraction at Seal Bay in the Southern KI MP and the giant cuttlefish is a tourist attraction at Point Lowly in the Upper Spencer Gulf MP; both of these iconic species are currently monitored by SARDI for non-marine park purposes (Goldsworthy and Page 2009, Goldsworthy et al. 2014, Steer et al. 2013, Steer 2015, Steer et al. 2016).

In some cases, information on habitats in locations that are not a focus of the MER Program are being monitored by non-DEWNR programs for other purposes. For example, the Environment Protection Authority undertakes monitoring of seagrass habitats to generate their Aquatic Ecosystem Condition Reports (Gaylard et al. 2013, Aquatic ecosystem monitoring, evaluation and reporting). Information on the condition of seagrass is collected by towed remote underwater video cameras as part of the Aquatic Ecosystem Condition Reports, and could also be used for the MER Program.

4.3 Socio-economic values

KEQs

4, 5, 6

Information on socio-economic change is required for Step 2 of the evaluation (i.e., Were the predicted changes in socio-economic values observed? See Section 3.2). The marine park baseline reports (Bryars et al. 2016) and MER workshop report (Goyder Institute for Water Research 2016) identified the indicators that will be used to monitor changes in socio-economic values. For the purposes of the MER Program (see Bryars et al. 2016), socio-economic values are summarised according to eight broad categories: local businesses and communities, coastal recreation, tourism, cultural heritage, transport and infrastructure, aquaculture, recreational fishing, and commercial fishing. These values will be monitored across the marine parks network (Appendix 3), and final evaluation of these data (Step 4) in conjunction with other information will determine whether marine parks contributed to any of the observed changes. It is important to note that some indicators will be measured against specific evaluation questions in cases where no change is predicted to occur but there may be unexpected outcomes, e.g. house prices, commercial fisheries, and fish prices (see Appendix 3). In line with the whole-of-government approach to the RIAS (see Kosturjak et al. 2015) the Marine Parks MER Program will focus on any potential negative impacts at a regional and State scale. It is beyond the scope of the MER Program to monitor for potential socio-economic impacts on individuals; individuals can apply for compensation in accordance with Section 21 of the *Marine Parks Act 2007* and the *Marine Parks (Statutory Authorisation Compensation) Regulations 2015*.

The majority of data will be collated from external sources such as the Australian Bureau of Statistics and SA government agencies, and augmented by data collected by the Marine Parks Program (Appendix 3). The Marine Parks Program currently commissions some broad social surveys (e.g. Square Holes 2015) and this may be expanded in the future to include more targeted surveys on an as needs basis. The frequency of data collection varies for the different indicators depending on how often the agencies report or release information (typically annually or quarterly, Appendix 3). Changes in socio-economic values will be assessed by analyzing spatial and temporal trends in the indicators chosen, and, where appropriate, methodologies used in the RIAS will be adopted.

4.4 Physical drivers

KEQs

1, 2, 3, 4

The marine park baseline reports identified that ecological values can be impacted by a range of external physical drivers, including air and sea surface temperature, upwellings, oceanic currents, waves, and tides (see Bryars et al. 2016). These drivers are not influenced by the marine park management plans. Changes in these drivers could have bigger impacts on ecological and in turn socio-economic values than the marine park management plans. For

example, long-term change in the East Australian Current has warmed coastal waters off eastern Tasmania and resulted in ecosystem shifts from kelp forests to urchin barrens (Ling et al. 2009). To interpret monitoring data on ecological and socio-economic values in the MER Program, it will be necessary to include some information on physical drivers. Information on physical drivers is required for Step 3 of the evaluation (i.e., specific evaluation question: Have there been changes in physical drivers that could have contributed to observed changes in ecological and socio-economic values? See Section 3.2). Indicators and measures are presented in Appendix 4.

Physical drivers will be monitored across the marine parks network wherever relevant data are available from existing programs. Data will be collated from external sources such as IMOS and other SA government agencies (Appendix 4). Data will be analysed for spatial and temporal patterns and anomalies that may have influenced observed changes in ecological values.

4.5 Socio-economic drivers

KEQs

1, 2, 3, 4, 5, 6

The marine park baseline reports identified that socio-economic values can be impacted by a range of external socio-economic drivers, including fuel prices, labour force, interest and exchange rates, visitation rates, market demand, major developments, and non-marine parks government regulations (see Bryars et al. 2016). These drivers are not influenced by the marine park management plans. Changes in these drivers could have a bigger impact than the marine park management plans. For example, the cost of fuel for fishing vessels and changes to spatial management arrangements in fisheries influence the distribution of fishing effort. To interpret monitoring data on socio-economic values (and potentially ecological values where there is a link via pressures, see Figure 5), the MER Program will need to include some information on socio-economic drivers. Information on socio-economic drivers is required for Step 3 of the evaluation (i.e., Specific evaluation question: Have there been changes in socio-economic drivers that could have contributed to observed changes in socio-economic and ecological values? See Section 3.2). Indicators and measures to be used are presented in Appendix 5. Weather has been included as a socio-economic driver because inclement weather can negatively influence commercial and recreational fishing activity, and other recreational activities such as boating and surfing. These could in turn impact on values such as the price of seafood and tourist expenditure (Section 4.3).

Socio-economic drivers will be monitored across the marine parks network wherever relevant data are available. The majority of data will be collated from external sources such as the Australian Bureau of Statistics and other SA government agencies, and augmented by data collected by the Marine Parks Program (Appendix 5). Quantitative data will be analysed for spatial and temporal patterns and anomalies that may have influenced observed changes in socio-economic values. Qualitative information will be assessed for changes from the pre-management plan (November 2012) or pre-SZ (October 2014) status, e.g. for the 2015/16 fishing season of the Northern Zone Rock Lobster Fishery, separate quotas for inshore and offshore regions were introduced which is significantly different to the situation before October 2014; such a change is likely to influence fisher behavior which is independent of marine park management plans.

4.6 Pressures

KEQs

1, 2, 3, 4

The marine park baseline reports identified a number of pressures on the ecological values of the marine parks including coastal pollution, resource extraction, habitat modification, disturbance of animals, pest species, and climate change (see Bryars et al. 2016). Despite the broad spectrum of pressures that are potentially influenced by zoning and the management plans, other than resource extraction, relatively few existing pressures have been lessened by the marine park management plans (see Bailey et al. 2012, Bryars et al. 2016).

Changes in pressures will influence the predicted changes and could have a greater impact than the marine park management plan. For example, if illegal fishing occurs inside an SZ, it may nullify an ecological response to the management plan. Pressures on marine resources that are outside SZs or marine parks may increase and this may

increase the contrast between those areas. For example, coastal development, shipping activity or fishing activity may increase outside an SZ or a marine park. Some of the socio-economic values which are predicted to change due to the management plans may in turn present an increased pressure on the ecological values that they rely upon. For example, increased recreation and tourism activities may cause an increase in disturbance to animals such as marine mammals and seabirds. Multiple pressures may also occur in some areas and understanding the cumulative impact of these on ecological values may present a challenge. Information on pressures is required for Step 3 of the evaluation (i.e., Specific evaluation question: Have there been changes in pressures that could have contributed to observed changes in ecological values? See Section 3.2). The MER Program will monitor indicators that are related to the management plan and a range of existing (and potential future) pressures including, but not restricted to, fishing. The MER Program will analyse information on pressures to assist with the interpretation of data on ecological and socio-economic values, and to assess whether the management plans have reduced or prevented any pressures.

Targeted information on pressures will be collected where it is available and where it may add value to the interpretation of changes in ecological and socio-economic values (i.e. Step 3, see Section 3.2) and to test whether assumptions are true (Section 4.7). The majority of data will need to be collated from external sources such as SA Water (e.g. discharge volumes from wastewater treatment plants) and other SA government agencies, and augmented by data collected by DEWNR (e.g. information on compliance). Much of the required information will likely be qualitative in nature. Bryars et al. (2016) identified a range of potential indicators and information sources will be investigated on a case by case basis as required.

4.7 Assumptions

KEQs

1, 2, 3, 4, 5, 6

There are a numerous assumptions inherent in the program logic, in the theory of change, and in being able to evaluate the effectiveness of the management plans (see Bryars et al. 2016, Scholz et al. 2017). Some of these assumptions will be informed by routine monitoring activities as part of the MER Program but others may be able to be tested with targeted research or monitoring activities. Some assumptions may remain untested. Listed below are some of the key assumptions that underpin the predictions of change in ecological and socio-economic values, along with information on how they can be informed by the MER Program to address the specific evaluation question of 'Are the assumptions correct?':

- The management plans (which include the zoning schemes and strategies) have provided for a comprehensive, adequate and representative system of marine parks. This assumption will be informed by a range of activities including baseline data on habitat statistics that informs comprehensiveness and representativeness (Bryars et al. 2017), collection of routine monitoring data on ecological values from Step 2 that informs adequacy and which could update statistics for comprehensiveness and representativeness (see Section 4.2), and targeted research on adequacy from Step 3 (see Section 4.8).
- The strategies of the management plans are implemented effectively, including:
    - There will be compliance with zoning regulations, particularly inside SZs. This assumption will be informed from collection of routine monitoring data on the performance of the compliance and protection sub-programs of the MER Program (see Section 4.1) and changes in ecological values (see Section 4.2) for Step 2.
    - When marine parks permits are issued, the conditions on the permits are adhered to. Consultation within DEWNR and with other government departments will be required to inform this assumption.
    - When referral advice is given on marine parks, the advice is taken up. Consultation within DEWNR and with other government departments will be required to inform this assumption.
    - While not explicitly an object of the *Marine Parks Act 2007*, it is assumed that by providing opportunities for public appreciation, involvement, education, understanding and enjoyment of the marine

environment, this will lead to increases in those values, and in community ownership and voluntary compliance. This assumption can be informed by collection of additional targeted monitoring or research data. For example, case studies could be conducted whereby people are surveyed to see if their knowledge and appreciation have been increased since the implementation of management plans.

- External factors outside the influence of the management plans do not affect predictions of change, including:
    - External physical drivers (e.g. sea surface temperatures, oceanic currents) will not change from the 2012 baseline trend or status. This assumption will be informed from collection of routine monitoring data on physical drivers for Step 3 (see Section 4.4).
    - External socio-economic drivers (e.g., fuel prices, non-marine park government regulations, major developments) will not change from the 2012 baseline trend or status. This assumption will be informed from collection of routine monitoring information on socio-economic drivers for Step 3 (see Section 4.5).
    - Pressures outside of the control of the management plan will either maintain the 2012 baseline trends or increase under a probable scenario of increasing human population, climate change, coastal development, and resource use (see Bryars et al. 2016). This assumption will be informed from collection of routine and targeted monitoring data on pressures for Step 3 (see Section 4.6).

4.8 Developing further monitoring and research partnerships

This MER Plan aims to facilitate further partnerships to conduct and support monitoring and research activities, and to assist with the overall evaluation of marine parks. Existing partners include state and federal Government agencies, research institutions, along with citizen-science and community programs and organisations. Partnerships assist with conducting marine parks monitoring activities, interpreting monitoring results, and disseminating monitoring information.

DEWNR developed a research prospectus (*Forging the Links*) that encourages collaborations between ecologists, social scientists, economists and marine park management on projects that address the priorities and challenges of the marine parks, and is directly connected to the MER Program. The research prospectus has guided investment and research/monitoring requirements for each park, with a focus on research that integrates ecological (environmental), economic, social and management components. An updated research prospectus will be developed in 2017/18 which reflects the current state of knowledge and research gaps. In particular, the assumption of adequacy (and particularly connectivity) of the marine parks network should be tested with targeted research. Therefore a desktop review will be undertaken in 2017 to: (1) collate available information that is relevant to the marine parks program, (2) document existing research to avoid future duplication, and (3) direct the scope of any research proposals addressing connectivity of the marine parks network. There will be an ongoing review and updating of the research priorities for the MER Program with an aim to deliver strategic research outcomes that lead to improved management of the Marine Parks Network.

4.9 Evaluation of the effectiveness of the management plans in achieving the objects of the *Marine Parks Act 2007*

Prior to 2022 and the review of the management plans, a final evaluation must be conducted by the Marine Parks Program on the effectiveness of the management plans in achieving the objects of the *Marine Parks Act 2007*. This evaluation will utilise a multiple-lines-of-evidence approach that incorporates all available information from the seven components of the MER Program that have been detailed in this chapter (i.e. completion of Step 4, see Section 3.2). This evaluation should be used to inform the legislated 10-year review of the management plans. It is important to note that Strategy 1 of the management plans specifies that activities and uses in each marine park must be managed in accordance with zoning and special purpose area provisions, which are embedded within the

management plans under Section 6 'Zoning Scheme' for each marine park. Therefore the evaluation of the effectiveness of the management plans may include consideration of the zoning scheme. In addition, while there is a requirement to evaluate each management plan individually, a collective evaluation of the 19 management plans is required to effectively evaluate the achievement of Object 1 which articulates the management of a system of marine parks.

If the evaluation is undertaken in 2021, it will be only nine years since implementation of marine parks and just seven years since full implementation of SZs. The marine parks program is a long-term state government initiative that is designed to benefit future generations. While some positive outcomes may be realised within the first 10 years, others will require much longer to be observed. In the case of ecological changes inside SZs, it is important to note that a stable trend inside an SZ after 10 years would still represent a positive outcome because SZs are designed to maintain (i.e. protect) as well as enhance (i.e. conserve) biodiversity. Many species are slow-growing and long-lived, and experience from marine protected areas in temperate locations similar to South Australia is that positive changes are still occurring after several decades of protection. Flow-on socio-economic benefits of marine parks may also take longer to be realized such as increased nature-based tourism that is reliant on SZ protection. In contrast, it is anticipated that seven years will be sufficient time to observe any negative socio-economic impacts, such as increased fish prices, due to marine parks and in particular SZs.

4.10 Reporting schedule

Strategy 12 in the management plans states that outcomes of the MER Program and research outcomes must be made publicly available and inform decision making and periodic review of the management plans. Reporting outcomes will also support broader State and regional reporting of natural resources such as those required under the *Environment Protection and Biodiversity Conservation Act 2009* (e.g., State of the Environment) and the *Natural Resources Management Act 2004* (e.g., trend and condition reporting, natural resource report cards).

A number of publicly-available reporting products will be produced by DEWNR prior to the 10-year review (Table 3, see Evaluation and Reporting). In addition to the products outlined in Table 3, publicly-available technical reports and journal papers may be produced intermittently as desired by the MER Program (e.g. Miller et al. 2017a).

The reporting outlined in Table 3 does not include DEWNR internal reporting mechanisms that are required to document progress against expected outcomes and to direct annual resource allocations. This type of reporting should be part of any implementation and work plans for each sub-program that are outside the scope of this publicly-available MER Plan.

5 Conclusion

This MER Plan sets the foundation for the South Australian Marine Parks MER Program to meet the requirements of the 19 marine park management plans and the *Marine Parks Act 2007*. The MER Program presents a significant undertaking and requires partnerships and collaborations to enable effective delivery. Research is also an important component of the MER Program. The MER Program should focus on the relationship between the seven components of: (1) marine park management plans, (2) ecological values, (3) socio-economic values, (4) physical drivers, (5) socio-economic drivers, (6) pressures, and (7) assumptions. A 'multiple-lines-of-evidence' approach using information from the seven components will enable an evaluation of the effectiveness of the 19 marine park management plans in achieving the objects of the *Marine Parks Act 2007*. This evaluation can then be used to inform the legislated 10-year review of the management plans by 2022.

This MER Plan should be used to guide ongoing implementation plans for the MER Program and encourage further partnerships and collaborations that enable the MER Program to expand and evolve thereby providing a more comprehensive evaluation of the SA marine parks network.

Table 3. Timeline of publicly-available reporting products that will be produced by the MER Program. See Evaluation and Reporting for completed products.

Year	Product	Aim and content
2016	Baseline reports for each of the 19 marine parks	To provide a baseline from which to measure changes into the future. The reports outline predictions of change to ecological and socio-economic values that might occur due to the marine park management plans, and present a range of potential indicators that could be used to track these changes.
2017	MER framework document	To provide direction and outline the steps and components that underpin the MER program. The framework also provides for shorter-term adaptive management of activities and components contributing to implementation of management plans. Two critical components identified in the MER Framework are key evaluation questions and a program logic.
2017	Baseline report for the statewide network of marine parks	As for the individual baseline reports (see above) but across the statewide network of marine parks.
2017	First annual progress summary	To communicate to the general public and stakeholders a snapshot of monitoring activities by the Marine Parks Program with the intent of providing assurance that DEWNR is actively implementing the strategies of the marine parks management plans. Information will be presented for each of the four marine parks sub-programs with specific case studies and highlights up to the end of 2016.
2017	Assessment of implementation report / status report	To assess the progress of the marine parks program after the first five years of implementing the strategies of the management plans since 2012. The outcomes of the assessment will enable DEWNR to identify any issues and adaptively manage the marine parks for effective delivery of the management plans by the 10-year review deadline.
2018	Second annual progress summary	As for the first annual report – with reporting to end of 2017.
2019	Third annual progress summary	As for the first annual report – with reporting to end of 2018.
2020	Fourth annual progress summary	As for the first annual report – with reporting to end of 2019.
2021	Fifth annual progress summary	As for the first annual report – with reporting to end of 2020.
2021	Evaluation of effectiveness of management plans report	Final report to inform review of management plans within 10-year statutory timeframe (by 2022). This will assess Step (4) based upon a final assessment of Steps (1) to (3) at 9 years since management plans were finalized. The assessment will also include an analysis of the marine park network CAR principles for the protection and conservation of biodiversity: comprehensiveness, adequacy and representativeness. In particular, adequacy can be better assessed following the collection of multiple years of data post-October 2014 and through targeted research.

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7 Appendices

Appendix 1. Specific evaluation questions, indicators and measures for management. Note that the specific evaluation questions are adapted directly from the wording of the 15 strategies in the management plans, except for 2b and 5b which were election commitments that have assisted with delivery of Strategies 2 and 5, respectively.

Specific evaluation question	Indicator	Measure
1) Have activities and uses in the marine park been managed in accordance with zoning and special purpose area provisions?	Other government agencies are actively managing their activities in accordance with zoning regulations.	Nature, number and names of agencies and their associated management activities referring to and/or abiding by Marine Parks regulations (e.g. PIRSA aquaculture referrals, development proposals).
	DEWNR Branches are actively managing their responsible activities in accordance with zoning regulations.	Number of breaches to zoning regulations (e.g. jetty/landing installed at Franklin Harbor without regard for zoning regulations).
	Marine Parks permits align with and/or complement the existing DEWNR permitting system.	Qualitative response – What are other DEWNR Branches doing to ensure activities are managed in accordance with zoning regulations?

Specific evaluation question	Indicator	Measure
	Marine Parks permits aligning with/complementing existing DEWNR permitting system.	Permit system integrated with other DEWNR permit systems (e.g. NPWS, Marine Mammals, and Historic Shipwrecks).
	DEWNR policies are developed that address Marine Park management.	Number and nature of policies developed for internal DEWNR use in marine park management, including DEWNR wide policies that address Marine Parks (e.g. fencing, commercial photography).
2a) Have the activities and uses been actively influenced within and adjacent to the marine parks to help mitigate threats to marine biodiversity and marine habitats?	Formal and informal advice on development applications.	Number and nature of informal and formal advice provided on development proposals. Include a measure through number of known cases where development advice was not sought (e.g. jetty/landing installed at Franklin Harbor without seeking advice from DEWNR).
	Advice on referrals given.	Number and nature of (known) referrals for which Marine Parks advice was provided (e.g. carpark expansion at Victor Harbor boat ramp).

Specific evaluation question	Indicator	Measure
	Reduction of land based impacts/threats due to the influence of Management Plans.	Number and nature of projects/activities that reduces threats from land-based impacts on Marine Park biodiversity and habitats (e.g. LGA's; Government Agencies; NRM Boards to reduce threats by diverting stormwater; riparian re-vegetation or wetland creations to reduce turbid run-off).
2b) Was the Government policy framework to adjust commercial fisheries for full implementation of Marine Parks undertaken?	The Commercial Fisheries Voluntary Catch/Effort Reduction Program was implemented as suggested.	Quantum of licences and quota removed versus suggested amount and against GDP.
3) Have any additional protections and/or temporary restrictions been implemented when necessary circumstances: 1) urgency to protect a listed species of plant or animal or threatened ecological community, or 2) a feature of natural and cultural heritage significance, or 3) public safety?	Additional protections and/or temporary restrictions implemented when required.	Number and nature of additional protections and/or temporary restrictions established (e.g. Wave Energy restricted access SPA; Murray Mouth dredging restricted access SPA).

Specific evaluation question	Indicator	Measure
4) Has a permitting system been introduced that allows for activities where they were not otherwise authorised?	Permit System implemented successfully that allows for activities were they are not otherwise authorised.	Permit regulations developed and passed through Parliament.
		A permit application process is accessible to the public.
		Internal assessment process established.
		Number, nature, location and applicant category of permit application requested and subsequent number approved. If possible, include a measure of number of known breaches of permit conditions that lead to expiation or permit cancellation.
5a) Has public appreciation, understanding, and enjoyment of the marine parks been provided for?	Stewardship activities provided for public appreciation, understanding and enjoyment.	Number and nature of products developed to assist in public appreciation, understanding and enjoyment (e.g. interpretive signage installed and number of visitors to that site per year; number of stewardship products produced, printed, and supplied e.g. brochures).
		Number and nature of products developed for 3rd party users.

Specific evaluation question	Indicator	Measure
		Number and nature of 'stewardship' focused citizen science projects supported and number of citizens who participate (e.g. dolphin counts; Hooded Plover).
		Number, nature, and, media platform used for Marine Park media releases (positive and produced or instigated by DEWNR).
		Number of hits on the Marine Parks website.
		Information on SA Marine Parks is available on multiple DEWNR websites (e.g. NRM websites).
		Number; nature; and, forum of presentations or posters given at conferences and/or community events.
		Number of community events supported. How supported resources, such as via people, funding or products (e.g. Experiencing Marine Sanctuaries community group).
		Number and type of community events attended and number of people (potentially/actually reached).

Specific evaluation question	Indicator	Measure
		Nature and topics of social media posts (e.g. posts on FB, Twitter, Blogs, and YouTube).
5b) Were the Government policy commitments to increase opportunities for recreational fishing in and around SA Marine Parks implemented?	Recreational fishing grants scheme implemented.	Dollar amount budgeted for grants project; how project was implemented; amount allocated to grants; grant details - who, where, what?
	Artificial Reef Project implemented.	Budget committed and a qualitative account of what has happened to date (where; what; additional funds leveraged).
	Reservoirs opened for recreational fishing.	Budget committed and a qualitative account of what has happened to date (e.g. number of reservoirs researched for potential to open; budget expended; any open).
6) Have opportunities for sustainable nature-based tourism in marine parks been created and/or promoted?	Nature-based tourism created and/or promoted by the Marine Parks program.	Number and nature of opportunities for sustainable nature based tourism in marine parks created and/or promoted (e.g. information on the Australian Tourism Data Warehouse; collaborative work with Regional Development Australia; collaborative work with South Australian Tourism Commission).
		Nature of 'nature-based tourism' operators promoted on SA Marine Parks website and/or promoting SA Marine Parks website on their pages.

Specific evaluation question	Indicator	Measure
	Established a permitting system to ensure Nature Based Tourism activities within Sanctuary Zones are conducted in a sustainable manner.	Qualitative response on how and why permit system was implemented.
7) Has education on marine parks to support their implementation been provided for?	Marine Park educational material developed and promoted.	Number and nature of Marine Park educational products developed (e.g. beachcombers guide).
		Number and nature of products developed to assist in implementation and user understanding of zone locations and uses.
	Marine Parks introduced into the school education system.	Number and nature of school curriculum activities supported.
8) Have local communities and stakeholders been involved in the day-to-day management and monitoring of the marine parks?	Local communities and stakeholders involved in day-to-day management and monitoring of marine parks.	Number and nature of citizen science (monitoring) projects that involve communities.
		Number and nature of monitoring activities that involve stakeholders.
		Number of compliance incidents reported via community and or community clubs.

Specific evaluation question	Indicator	Measure
9) Have we worked cooperatively with Aboriginal communities to conserve country, plants, animals and culture?	Activities undertaken that work cooperatively with Aboriginal communities to conserve country, plants, animals and culture.	Nature of activities that demonstrate working cooperatively with Aboriginal communities to conserve country, plants, animals and culture.
10) Has a monitoring, evaluation and reporting (MER) program been developed and implemented that measures the effectiveness of this marine park management plan and its contribution to South Australia's marine parks network (2011 baseline), and that: is designed to: measure the effectiveness of the management plan in delivering the predicted outcomes to inform adaptive management; includes linkages to relevant state, national and international monitoring, evaluation and reporting frameworks; sets out targets and indicators linked to strategies and outcomes for monitoring, which include ecological, socio-economic, environmental and management elements; monitors the delivery of education, research and governance mechanisms; and, assesses the effectiveness of compliance activities?	A monitoring, evaluation and reporting (MER) program that measures the effectiveness of this marine park management plan and its contribution to South Australia's marine parks network (2011 baseline), and that: is designed to measure the effectiveness of the management plan in delivering the predicted outcomes to inform adaptive management; includes linkages to relevant state, national and international monitoring, evaluation and reporting frameworks; sets out targets and indicators linked to strategies and outcomes for monitoring, which include ecological, socio-economic, environmental and management elements; – monitors the delivery of education, research and governance mechanisms; and assesses the effectiveness of compliance activities is developed and implemented.	A MER Plan that includes the required specifications is written.

Specific evaluation question	Indicator	Measure
		Amount and nature of monitoring, evaluation and reporting that is being undertaken (e.g. number sites being monitored using BRUVS, number surveys undertaken, reports produced).
11) Have partnerships to support the implementation of the MER Program incorporating opportunities for community and stakeholder involvement been fostered (or established)?	Partnerships to support the implementation of the MER Plan established.	Nature of partnerships established (includes name of partner; type of stakeholder sector, name of project; funding and/or in kind resources contributed).
12) Are outcomes from the MER Program and research publicly available and have the outcomes from the MER Program informed decision-making and periodic review of the management plans?	MER program and research outcomes available to the public	Number, nature (data, reports) and information platform(s) (e.g. web, reports) of MER program and research outcomes made available to public
	MER outcomes informed decision-making (and periodic reviews)	Qualitative – examples/case studies of where MER outcomes have informed decision-making
13) Has research been conducted to assess the integrity of knowledge frameworks that underpin the predicted outcomes?	Research funded that assesses the integrity of knowledge frameworks that underpin the Marine Park predicted outcomes	Number and nature of research projects that have been funded (includes lists of research reports and budget).
14) Have Aboriginal people, local communities and stakeholders been encouraged to preserve, and where appropriate share, traditional knowledge?	Activities where Aboriginal people, local communities and stakeholders have been encouraged to preserve and share traditional knowledge	Case studies including nature and number of activities where Aboriginal people, local communities and stakeholders have preserved and shared traditional knowledge

Specific evaluation question	Indicator	Measure
15) Has a compliance strategy been written and implemented that: is cost-efficient; focussed on sanctuary zones and other conservation priorities; complements existing compliance efforts; maximises voluntary compliance; and, includes measures to address serious or repeat non-compliance?	A compliance strategy is written and implemented that is cost-efficient; focussed on sanctuary zones and other conservation priorities; complements existing compliance efforts; maximises voluntary compliance and includes measures to address serious or repeat non-compliance	A compliance strategy developed that includes required specifications (cost-efficient; focussed on sanctuary zones and other conservation priorities; complements existing compliance efforts; maximises voluntary compliance and includes measures to address serious or repeat non-compliance) is written and being implemented.
		Annual reports / risk assessments and/or additional project plans written are produced as required.
		Number of patrols (and nature e.g. partner patrols with PIRSA and SAPOL)
		Number of vessel owners spoken to (boat ramp outreach)
		Number documents/webpages produced/updated
		Number of "applications" downloads of both the 'myparx' app and the PIRSA developed SA Recreational Fishing Guide APP (PIRSA)
		Number and nature of compliance media releases
		Number of signs installed/replaced/maintained
		Number of DEWNR staff trained for Marine Parks Compliance

Specific evaluation question	Indicator	Measure
		Number of partner agency staff trained for Marine Parks Compliance
		Number reparation orders issued
		Modification to FishWatch 'operator's script and management practice, and the subsequent number of offences reported to DEWNR via FishWatch.
		Number, type and location of offences and incidents reported
		Number of warnings, expiations and prosecutions

Appendix 2. Key evaluation questions (KEQ), specific evaluation questions, indicators and measures for monitoring change in ecological values. Note that not all of the indicators apply to each of the specific evaluation questions but due to the large amount of overlap between them, this presentation style was applied.

KEQ	Specific evaluation question	Indicator	Measure
1	What biodiversity and habitats are included within the marine parks network?	size, abundance and biomass of focal species (e.g. blue groper, lobster)	Lmax, mean length, MaxN, number, weight, size-frequency distribution
1	Have SZs maintained or enhanced biodiversity and habitats?	size, abundance and biomass of focal groups (targeted fish, site attached, fish over 20cm)	Lmax, mean length, MaxN, number, weight, size-frequency distribution
		species richness	total number
1	Have HPZs maintained biodiversity and habitats?	species richness of focal groups (fish, elasmobranches, macro-algae)	total number
		diversity	Shannon Wiener, Functional diversity
2	Have SZs maintained or enhanced ecological processes?	abundance invasive pests	presence/absence
		thermal affinity	community temperature index
3	Have SZs enhanced ecosystem resilience?	community structure	ratio herbivore: carnivores etc./location in ordinal space
		cover of habitat-forming species	% cover
		spatial extent of habitat-forming species	total area, degree of fragmentation

Appendix 3. Key evaluation questions (KEQ), specific evaluation questions, indicators and measures for monitoring change in socio-economic values

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4	Have local businesses and communities changed due to marine park management plans?	Human population	population estimate	Australian Bureau of Statistics (ABS)	Statistical Area Level 2 and Local Government Area	Annually
		Gross regional product	dollar amount of GDP contribution	National Institute of Economic and Industry Research Pty Ltd	Local Government area	Annually
		count of the number of businesses	count of business numbers	ABS	Statistical Area Level 2	Annually
		Number of local jobs	estimated count of local job numbers	National Institute of Economic and Industry Research Pty Ltd	Local Government area	Annually
		Unemployment rate	estimated per cent of unemployment	Australian Government Department of Employment	Statistical Area Level 2 and Local Government Area	Quarterly
		Number of Newstart allowance recipients	count of people on newstart	Australian Government Department of Employment	Local Government area	Annually
		Annual individual salary or wage income	average annual salary	Australian Taxation Office	Postcode	Annually
		Number and value of residential building approvals	count of building approvals	ABS	Statistical Area Level 2 and Local Government Area	Monthly
		House sale prices	average sale price	RP Data Pty Ltd	Local Government area	Annually

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4	Have local businesses and communities changed due to marine park management plans?	Index of socio-economic advantage and disadvantage	index	ABS	Local Government area	Every 5 years
		Community resilience to change	adaptive capacity index	ABS	Local Government area	Every 5 years
		Price of seafood	retail fillet price ($/kg), retail whole price ($/kg)	DEWNR at local fish markets	Adelaide CBD	Weekly since June 2014
			fish and other seafood index	ABS	Adelaide	Quarterly
5	Have local businesses and communities changed due to marine park management plans?	Level of community support for and perceptions on marine parks	per cent of participants	Independent phone surveys (DEWNR commissioned)	Postcode, Local Government Area, State	Annually in most years since 2006
5	Has coastal recreation changed due to marine park management plans?	Participation in coastal recreation	per cent of participants	Independent phone surveys (DEWNR commissioned)	Postcode, Local Government Area, State	Annually in most years since 2006
		Boat registrations/ licences	count of boat registrations and licences	Department of Planning Transport and Infrastructure	State	Annually
4,5	Has tourism changed due to marine park management plans?	Tourist operator numbers	count of tourism businesses	Tourism Research Australia	Marine Park	Annually

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4,5	Has tourism changed due to marine park management plans?	Tourist expenditure	dollar amount of tourism expenditure	Tourism Research Australia	Tourism regions	Annually
6	Have Aboriginal heritage values changed due to marine park management plans?	Level of protection for registered Aboriginal heritage sites	count of protected listed sites	Aboriginal Affairs and Reconciliation Division of the South Australian Department of State Development	Marine Park	As required
		Level of protection for registered Aboriginal heritage sites	protection of listed sites is improved	Qualitative information	Marine Park	As required
		Level of engagement, partnerships, educational activities	count of partnerships and activities	DEWNR	Marine Park	As required
6	Have European heritage values changed due to marine park management plans?	Level of protection for registered heritage sites	count of protected listed sites	DEWNR	Marine Park	As required
		Level of protection for registered heritage sites	protection of listed sites is improved	DEWNR	Marine Park	As required
4	Has shipping changed due to marine park management plans?	Number vessel calls	count of vessels	Flinders Ports	Individual ports	Annually
		Cargo exports/imports	tonnes of exported/imported cargo	Flinders Ports	Individual ports	Annually
4	Has aquaculture changed due to marine park management plans?	Number active licences	count of the number of active licences	PIRSA	Aquaculture zone	Annually

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4	Has aquaculture changed due to marine park management plans?	Direct output	estimated dollar value of aquaculture	Econsearch Pty Ltd	Aquaculture zone	Annually
5	Has recreational fishing changed due to marine park management plans?	Participation rate	estimated number of days fished, estimated number of recreational fishers	PIRSA Independent phone surveys (DEWNR commissioned)	Recreational Fishing Survey Region Post code, State	Every 5 years Annually in most years since 2006
4	Have commercial fisheries changed due to marine park management plans?	Rock Lobster Fishery: Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Marine Fishing Area, Rock Lobster Fishery Zones	Annually
		Abalone Fishery: Catch, catch value and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Spatial Assessment Unit, Abalone Fishery Zones	Annually

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4	Have commercial fisheries changed due to marine park management plans?	Prawn Fishery: Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Fishery Assessment Regions, Prawn Fishery Zones	Annually
		Blue Crab Fishery: Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Marine Fishing Area, Blue Crab Fishery Zones	Annually
		Sardine Fishery: Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	State	Annually

KEQ	Specific evaluation question	Indicator	Measure	Data source	Spatial scale of data availability	Temporal scale of data availability
4	Have commercial fisheries changed due to marine park management plans?	Marine Scalefish Fishery: Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Marine Fishing Area, Statewide	Annually
		Charter Boat Fishery: Catch, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	PIRSA/SARDI	Marine Fishing Area, State	Annually
		C'wealth Southern and Eastern Scalefish and Shark Fishery (Gillnet Hook and Trap Sector): Catch, catch value, catch rate, and fishing behaviour	weight of catch, dollar value of the catch, catch rate, which fishing blocks most of the fishing occurs in and in which fishing blocks most of the catch is taken.	Australian Bureau of Agricultural and Resource Economics and Sciences/AFMA	State	Annually

Appendix 4. Indicators, measures, data sources and spatial units available for monitoring physical drivers

Indicator	**Measure**	**Data source(s)** – see Bryars et al. (2016) for further detail	**Spatial unit available for assessment**	**Temporal unit available for assessment**
Air temperature	Air temperature	Bureau of Meteorology	Specific locations	Variable
Sea surface temperature	Sea surface temperature	Bureau of Meteorology, Geoscience Australia, IMOS, NOAA	Specific locations	Variable
Salinity	Salinity	Various disparate sources	Specific locations	Variable
Upwellings	Index of upwelling	SARDI	Specific locations	Variable
Currents	Index of Leeuwin current	SARDI	Specific locations	Monthly
Tides	Sea level	Bureau of Meteorology	Specific locations	Variable
Waves	Wind direction, wind speed, Waverider^{TM} buoy	Bureau of Meteorology	Specific locations	Variable

Appendix 5. Indicators, measures, data sources and spatial units available for monitoring socio-economic drivers

Indicator	**Measure**	**Source of information** – see Bryars et al. (2016) for further detail	**Spatial unit available for assessment**	**Temporal unit available for assessment**
Interest rates	Monthly cash rate target	Reserve Bank of Australia	National	Monthly
Commodity prices	Monthly commodity price index	Reserve Bank of Australia	National	Monthly
Exchange rates	Australian dollar to US dollar exchange rate ratio	Reserve Bank of Australia	Global	Monthly
	Trade-weighted Index	Reserve Bank of Australia	National	Monthly
Fuel prices	Annual average retail price of diesel and unleaded petrol	Australian Institute of Petroleum	State	Annually
	Transport Index	Australian Bureau of Statistics	State	Quarterly
	Average monthly prices	Australian Automobile Association	Select regional centres in SA	Monthly
Labour force	Wage price index	Australian Bureau of Statistics	National	Quarterly
	Employment and unemployment data	(see socio-economic values table)	(see socio-economic values table)	Quarterly

Indicator	**Measure**	**Source of information** – see Bryars et al. (2016) for further detail	**Spatial unit available for assessment**	**Temporal unit available for assessment**
Visitation rates	Total number of visitors	Tourism Research Australia	Tourism regions in SA	Annually
Market demand	Price of seafood	(see socio-economic values table)	(see socio-economic values table)	(see socio-economic values table)
	Various qualitative measures	DEWNR (see Bryars et al. 2016)	Variable	As required
Major developments	Various qualitative measures	DEWNR (see Bryars et al. 2016)	Variable	As required
Government regulation	Various qualitative measures	DEWNR (see Bryars et al. 2016)	Variable	As required
Weather	Various quantitative measures	See Physical Drivers section	Variable	Variable

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